

10th International Conference on
IT Application & Management

Digitally Networked Global Society

July 11 ~ 20, 2013, Nepal



Hosted by

OPEN
(Organization of
Pokhara University
Educational
Institutions, Nepal)

Co-hosted by

Tribhuvan University
Kathmandu University
Purbanchal University
Pokhara University



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IT Application & Management

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Kathmandu (11 and 12 of July)

Pokhara (15 of July) Nepal

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Shanker Prasad Koirala
Finance Minister

Message

I am delighted to know that the **10th International Conference on IT Applications and Management** has been organized with a theme **Digitally Networked Global Society**. It is also a matter of pride for us that such an international level consortium is taking place for the first time in Nepal. This should be a right forum for sharing national and international experiences and achievements in the field of IT applications and management.

The past few decades have witnessed a revolution in the field of IT and management, and have had a very big impact on every sector of the society. The conference theme **Digitally Networked Global Society** is very much appropriate and relevant in the present context as it can exactly capture and reflect the realization of extensively networked global socio-technical environment and how the advances in field of IT and management have brought the world closer and turned the world into a global village. The proposed symposium should be a milestone for sharing experiences and exchanging information among the scholars and practitioners from around the globe.

I appreciate the sincere joint efforts and initiatives of OPEN, Organization of Pokhara University Educational Institutions, Nepal and all the universities (Tribhuvan University, Pokhara University, Kathmandu University and Purbanchal University) involved for making all this happen.

I believe the conclusions and recommendations drawn from the conference will be able to address IT and management sector challenges ahead and it will provide valuable input to the academia and the government for appropriate policy and guideline.

I wish all the best for the success of the conference.

Shanker Prasad Koirala
Minister
Finance; Industry; and Commerce and Supply



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Ref. No.

Message

It gives me an immense pleasure to know that the **10th International Conference on IT Applications and Management** is taking place in Nepal. I'm even more delighted to know that this is happening with the joint initiatives of OPEN, (Organization of Pokhara University Educational Institutions) and four universities (Tribhuvan University, Pokhara University, Kathmandu University and Purbanchal University) of Nepal and this level of consortium is happening for the first time in the country.

The subject and the theme of the conference **IT Applications and Management: Digitally Networked Global Society** exactly reflects what it stands for and it best suits one of the most emerging needs of the present day world. I believe that this historic gathering and interaction among the internationally renowned researchers, industry experts and professors from the field of IT and Management and sharing of their experiences, achievements and ideas will be a milestone in the process of quest for knowledge.

I hope the conference will come up with concrete conclusions and findings that would be useful for planning and policy making for all the concerned.

I extend my best wishes for the success of the conference.

Prof. Khagendra Bhattarai

Vice Chancellor

Pokhara University



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Message

It is the event of pleasure to be the host of tenth International Conference on Information Technology Application and Management, 2013, organized by Hanyang University, Korean Database Society. This event certainly contributes towards the cooperation among the professors of Universities of Asia Pacific Regions for the development of Information Technology Applications in the different dimension of management. For this we thank Korean Database Society Team and Chairperson of the Team of Korean Database Society for his kind consideration to give this opportunity. Equally we acknowledge all the principals, coordinators, faculties and staffs of different universities and colleges and government and non-government organizations for their support.

This has encouraged us to undertake such conferences in the future to enhance the skill and knowledge in the field of IT and management of different spheres of human life.

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The 10th International Conference on Information Technology Applications and Management

July 14 (Sunday), 2013 at Kathamndu and July 15 (Pokhara)

The Everest Hotel

Kathmandu

[PROGRAM]

Time	Track A Conference Rm #	Track B Conference Rm #	Track C Conference Rm #
07:30 ~ 8.00	Registration		
8.00~9.00	<u>Inauguration Program of 10th ITAM:</u> Requesting to take seat (5 min) [OPEN chair person(1), Chief guest(1), KDBS authority (2), VCs(4)] Welcoming speech: Chair of organizing committee (5 min) Lightening the lamp(2 min) National anthem(3 min) Speech from chief guest(5 min) Speech from VCs KU (KU, PU, PubU,)(15 min) Welcoming Remark from KDBS Hanyang U., Korea (5 min) Closing speech: OPEN Chair person (5 min)		
9.00~10 Common Session	Key note speaker (Poff: Cho. Chairperson Korean Data Base society, Indo-Asian Business Research Centre)		
	A1: Smart IT Applications I	B1: Regional Issues	C1: Social Nurturing
Session 1 10:00 ~ 11:15	Chairperson: Mahabir Pun Nepal) <i>An Android Development for Progressive Secret Image Sharing</i> - C. C. Chen and Y. C. Liu (Tamkang U., Taiwan) <i>Emotion Recognition of Infants from Speech Signals</i> - W. Dai (Fudan U., China) <i>Contextual Elements of Business Application Software Architecture and the Relationships among Them</i> - S. H. Koh (Chungbuk National U., Korea)	Chairperson: Uthai Tanlamai (Chular. U., Thailand) <i>National Context as an Important Variable for the Development of IT-based Strategic Capability</i> - G. M. Kim (Ewha W. U., Korea) <i>Servant Leadership in Indian Organizations</i> - V. Kashyapa and S. Rangnekarb (IIT, India) <i>Organizational Citizenship Behavior in Indian Organization – A Demographic Analysis</i> - M. Yadava and S. Rangnekarb (IIT, India)	Chairperson: Gyeung Min Kim (Ewha W. U., Korea) <i>Analysis of the Motivator of the Use of Social Network Services</i> - N. J. Cho et al (Hanyang U. Korea) <i>IT platform value creation: An inquiry on platform-base IT innovations</i> - B. Patrakosol (Chulalongkorn U., Thailand) <i>Negative Word-of-Mouths Diffusion in Online Community</i> - C. C. Wang and P. H. Wang (National Taipei U., Taiwan)

11:15 ~ 11:30	Coffee break		
	A2 : IT Application II	B2: IT Application III	C2 : Behavioral Analysis I
Session 1 11.30 ~ 12.45	Chairperson: [Arun K. Timalisina, T.U. Nepal] <i>Bridging the Digital Divide: the Case of Nepal Wireless</i> -Mahabir Pun <i>Use of ICT for Betterment of Quality of Life (QOL)</i> - Sailuja Thapa <i>Knowledge Sharing System for Community Learning Centers</i> - K. P. Paudel (Kantipur City College, Nepal)	Chairperson: [Mahabir Pun: Nepal] <i>Structural immunity to change and Technology diffusion in Nepal</i> -Raj Kumar Bhattarai <i>Effect of Nepali Language Features on Nepali News Classification Using Vector Space Model</i> Dinesh Dangola and Arun K. Timalsinab <i>A Study on the Difference in Acceptance of Smart Work according to Tendencies of Leadership Styles</i> -K. H. Park (Hoseo U., Korea)	Chairperson: Santosh Rangnekar, IIT, India) <i>Thai Internet Users' Personality Traits and their Preferred Web Portal's Characteristics</i> - R. Tanya and U. Tanlamai (Chulalongkorn U., Thailand) <i>Why are 3D apparel CADs not used?</i> - S. K. Kim (Chung-Ang U., Korea) and N. Y. Im (Osan U., Korea) <i>Understanding software developers' intentions to adopt secure coding methods</i> -S. K. Kim and J. Y. Kim (Chung-Ang U., Korea)
12:45 ~ 1:30	Lunch		
The 10th International Conference on Information Technology Applications and Management Pokhara Program			
	A3: Data Quality, Security and Privacy	B3: Industry and Policy	C3: Behavioral analysis II
Session 3 12:00~1:15	Chairperson: Chien-Chang Chena (Tamkang U., Taiwan) <i>Big data, how to balance privacy and social values</i> - Joo Seong Hwang^a <i>Cognitive Processing of Text-based versus Visual-based Questions: The Case of Computer-based Training on Deferred Tax Accounting</i> - U. Tanlamai et al. (Chulalongkorn U., Thailand)	Chairperson: Jaehoon Whang (Yonsei U., Korea) <i>A Descriptive Case Study on the Routinization of IT Service Management (ITSM)</i> - K.T. Hwang and Y. J. Choi (Dongguk U., Korea) <i>The Past and Future of Korea's Information Technology Industry</i> - J. Whang et al. (Yonsei U., Korea) <i>Development of Outbound Tourism Forecasting Models in Korea</i> - J. S. Lee et al. (Hoseo U., Korea)	Chair person: N. J. Cho (Hanyang U. Korea) <i>Playing to Win? Gamer Loyalty to Sports Simulation Games</i> - C. Choi (Yonsei U., Korea) and D.B. Seo (Hansung U., Korea) <i>Motives in Purchases of ICT Devices: For Need or Merely for Being A Prestige Agent Calling Status and Esteem?</i> - M. A. Gurol (Turkey) and A. S. Koyuncugil (Capital Markets Board, Turkey) <i>IT based HRIS Practices In Nepal</i> -Sateesh Kumar Ojha^a

An Android Development for Progressive Secret Image Sharing

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Abstract

With the rapid growth of internet, image display quality becomes more and more important. This paper implements an android app developed for supporting different image qualities using progressive secret image sharing strategy. A progressive secret image sharing scheme shares a secret image among shared images and quality of the reconstructed image improves according to the number of shared numbers. Chinese Remainder Theorem is adopted for its high efficiency to share and recover a digital image of executing at android system. Frameworks of the system are clearly described. The developed android application efficiently verify user authentication and provides a useful system for users.

Keywords: Secret image sharing, progressive, Chinese Remainder Theorem, android app, website

Introduction

Conventional (t, n) secret image sharing share one secret image among n participants, and t shared images enable the recovery of the secret image. Secret image sharing methods mathematically calculate the reconstructed image from shared images [6]. Many methods for sharing secret images with various properties like multi-sharing [3], sharing among host images [7, 8], progressive [2], and weighted [1] have been presented.

Among these methods, progressive sharing merits our study for its highly commercial potential. Two kinds of methods, named secret image sharing and

visual cryptography, can be used to share secret image progressively. Visual cryptography uses stacking strategy to reconstruct image and the quality of reconstructed image is poor for visual recognition. Secret image sharing scheme uses mathematical calculation to acquire good image quality and its good for android development. Therefore, this work implements a progressive secret image sharing based application on android system.

Most of secret image sharing scheme used Shamir- Lagrange scheme to share and recover [1-2, 6]. However, the computation load to recover the reconstructed image is high, especially on recovering threshold is large. Therefore, the implemented system adopted Chinese Remainder Theorem [4, 5] to share secret images for its low computation complexity [11] and adopted integer wavelet transform to share progressively. Since two more thresholds are needed in a progressive scheme to reconstructed coarsely and to reconstructed perfectly, thresholds of the implemented system is (s, t, n) . An (s, t, n) secret image sharing scheme shares a secret image among n shared images and s shared images are calculated to recover coarse resolution of the secret image. When collecting t shared images, the secret image can be losslessly recovered. Steps of coarse resolution depend on thresholds s and t . To satisfy the thresholds (s, t, n) used in the Chinese Remainder Theorem, the dealer must first select n prime numbers and calculate a series of two numbers that are products from these s and $s+1$ prime numbers to t and $t+1$ prime numbers. Then the secret numbers acquired from wavelet

subimages, formed from the secret image, have to be adjusted to the range set according to these two products. Therefore, s shared subimages are capable of recovering the above shifted secret number of coarsest subimage. More shared images recover finer resolution subimages for better recovered image quality.

Since android system is popularly installed in mobile phone, this work applies the proposed (s, t, n) secret image sharing scheme to implement an android application for sharing digital images secretly. The application let users select digital images to share progressively. A high quality requested user needs more shared images for obtaining fine resolution images. Gathering fewer shared images acquires coarse resolution image. Number of shared images determine quality of reconstructed image and may also represent the required payment.

The remainder of this paper is organized as follows. Section 2 introduces the method of share a number with (t, n) thresholds. Section 3 illustrates the proposed progressive secret image sharing method. Algorithms for sharing a secret image among shared images and recovering the secret image from shared images are presented in Sections 3.1 and 3.2, respectively. Subimage partition strategy for recovering progressively is introduced in Section 3.3. Section 4 shows framework of the system. Three phases including initial phase, sharing phase, recovering phase are introduced in Section 4.1, 4.2, and 4.3, respectively. Section 5.1 shows experimental results and Section 5.2 provides comparisons between the proposed scheme and other related methods. In Section 6, we draw our conclusions.

2. (t, n) Threshold Chinese Remainder Theorem

This section introduces Chinese Remainder Theorem based (t, n) secret image sharing method. First, n ordered prime numbers q_i ($1 \leq i \leq n$) satisfying $q_1 < q_2 < \dots < q_n$ are required. Then, two thresholds a and β are calculated as products of

prime numbers with $\alpha = \prod_{i=a-t+1}^a q_i$ and $\beta = \prod_{i=1}^t q_i$. Each number from the secret image is shifted between a and β such that gathering t shared numbers enables the recovery of the shifted number. However, collecting fewer than $t-1$ shared numbers will not obtain any number exceeding a ; therefore, no correct numbers can be recovered. Hence, the method satisfies (t, n) thresholds in secret image sharing problem.

3. Proposed (s, t, n) Progressive Secret Image Sharing Scheme

This section introduces the proposed Chinese Remainder Theorem based (s, t, n) progressive secret image sharing scheme. The scheme generates n shared images for each participant, and collects s shared images acquiring coarse resolution of the secret image. Collecting more shared images acquires finer resolution of the secret image and collecting t shared images losslessly recovers the secret image. Sections 3.1 and 3.2 present the sharing and recovery algorithms, respectively. Section 3.3 presents the subimage partition strategy for progressive reconstruction.

3.1 Sharing Algorithm

In an (s, t, n) progressive secret image sharing scheme, n prime numbers q_i ($1 \leq i \leq n$) are required. The secret key of a shared image is the prime number q_i . The sharing algorithm first segments the secret image to subimages by integer wavelet transform. Selections of different subimages determine the progressive property and these selections are determined by threshold parameters s and t and discussed in Section 3.3. The sharing algorithm is as follows.

1. Determine the maximum subimage level L_{max} from thresholds s and t by Eq.(1)
$$L_{max} = \left\lceil \frac{t-s}{3} \right\rceil \quad (1)$$
2. Apply the secret image to integer wavelet transform to acquire subimages LL and $H_{i,j}$ ($1 \leq i \leq L_{max}, 1 \leq j \leq 3$).
3. Partition subimages LL and $H_{i,j}$ to $(t-s+1)$ groups, randomly select n prime numbers q_i

($1 \leq i \leq n$) satisfying $q_1 < q_2 < \dots < q_n$, and apply each group to the following steps.

3.1 For k 's group sharing processing ($1 < k < t-s+1$), calculate two parameters α and β by Eq.(2)

$$\alpha = \prod_{i=n-k-s+3}^n q_i < \prod_{i=1}^{s+k-1} q_i = \beta \quad (2)$$

3.2. Partition subimages in the group's to numbers n_j and calculate g_j using Eq.(3)

$$g_j = n_j + \alpha + \gamma_j \quad (3)$$

where γ_j is a random number.

3.3. Calculate the residue r_j using Eq. (4)

$$g_j \equiv r_j \pmod{q_j} \quad (4)$$

3.4. Combine all r_j to obtain the shared data $s_{j,k}$ from group k for participant j .

4. Combine all $s_{j,k}$ ($1 < k < t-s+1$) and apply them to inverse wavelet transform to acquire the shared image corresponding with participant's secret key q_j for participant j .

Step 3 partitions subimages to $(t-s+1)$ groups for sharing each group with different thresholds. The subimage partition strategy is discussed in Section 3.3. The progressive property is obtained from assigning group k with $(s+k-1)$ different recovering thresholds.

3.2 Recovery Algorithm

The secret image can be progressively recovered from collecting s shared images to collecting t shared images using recovery algorithm. The recovery algorithm is as follows.

1. Collect m ($s \leq m \leq t$) shared images S_i ($1 \leq i \leq m$) with participant secret keys p_i and apply each shared image to integer wavelet transform.
2. Partition wavelet subimage of S_i to $(t-s+1)$ groups according to the subimage partition strategy used in sharing algorithm.
3. Apply each group of coefficients $n_{i,j}$ with secret keys p_i to the following steps
 - 3.1 For recovering k 's ($1 \leq k \leq m-s+1$) group of wavelet subimages, calculate the shifted recovery number rn_j using Eq.(5)

$$n_j = \left(\sum_{i=1}^k n_{i,j} M_i M_i^{-1} \right) \bmod M \quad (5)$$

where $M = \prod_{i=1}^k p_i$, $M_i = \frac{M}{p_i}$, and

$$M_i' = M_i^{-1} \bmod p_i$$

3.2 Subtract the random number γ_j and α from rn_j to obtain the recovery numbers m_j .

$$m_j = rn_j - \gamma_j - \alpha \quad (6)$$

3.3 Collect m_j to acquire one or more pixels in the group k 's recovered wavelet subimage.

4. Collect all pixels that are acquired in Step 3.3 and then apply inverse wavelet transform to obtain the reconstructed image.

The recovering algorithm uses $(k-s+1)$ different thresholds to acquire different quality of the secret image. Collecting s shared image can only recover 1's group of subimages, which shows coarse resolution of the secret image. Collecting $s+1$ shared image can recover 1's and 2's groups of subimages, and collecting t shared image can recover all k 's group of subimage to acquire the losslessly secret image.

3.3 Subimage Partition Strategy

The proposed scheme use integer wavelet transform to partition a secret image to subimages that include one low-frequency subimage LL and several high-frequency subimages $H_{i,j}$ ($1 \leq i \leq L_{\max}$, $1 \leq j \leq 3$), in which $L_{\max}$ determines the maximum subimage level calculated in Eq. (1). Fig. 1 shows a wavelet subimages notation of $L_{\max}=3$.

LL	$H_{3,1}$	$H_{2,1}$	$H_{1,1}$
$H_{3,2}$	$H_{3,3}$		
$H_{2,2}$		$H_{2,3}$	
$H_{1,2}$		$H_{1,3}$	

Figure 1 - Subimages notation under 3-level integer wavelet transform.

A k -level wavelet transform generates $(3 \times k + 1)$ subimages. The progressive step is determined by thresholds s and t , and the resolution steps number is $(t-s+1)$. The subimage partition distributes $3 \times k + 1$ subimages to $t-s+1$ group as follows.

1. 1's group only includes the low-pass subimage LL .
2. The other k 's group includes one subimage $H_{i,j}$ from higher level (for example, $i=3$) to lowest level ($i=1$) and from $j=1$ to $j=3$ orderly.
3. The last $(t-s+1)$'s group includes all non-distributed subimages.

The partition strategy only lets the last $(t-s+1)$'s group have more than one subimage. Other groups consists of only one subimage. Table 1 shows example of partition results under three different (s, t) thresholds. For example, when $s = 2$ and $t = 3$, L_{max} is 1 from Eq.(1) and the partition results are 1's group containing subimage LL , 2's group containing subimages $H_{1,1}$, $H_{1,2}$, $H_{1,3}$. When $s = 2$ and $t = 7$, L_{max} is 2 and the partition results are 1's group containing subimage LL , 6's group containing existing subimages $H_{1,2}$, $H_{1,3}$, and other group containing only one subimage.

Table 1 - Example of subimage partition

(s, t) threshold	L_{max}	Partition results
(2, 3)	1	1's: LL , 2's: $H_{1,1}, H_{1,2}, H_{1,3}$
(2, 7)	2	1's: LL , 2's: $H_{2,1}$, 3's: $H_{2,2}$, 4's: $H_{2,3}$, 5's: $H_{1,1}$, 6's: $H_{1,2}, H_{1,3}$
(2, 10)	3	1's: LL , 2's: $H_{3,1}$, 3's: $H_{3,2}$, 4's: $H_{3,3}$, 5's: $H_{2,1}$, 6's: $H_{2,2}$, 7's: $H_{2,3}$, 8's: $H_{1,1}$, 9's: $H_{1,2}, H_{1,3}$

4. Proposed Methodology

The proposed android application is introduced in this section. The application includes three phases, named initial phase, sharing phase, recovering phase, and they are introduced in Section 4.1, 4.2, and 4.3, respectively. Figure 2 shows the system structure of the developed android application.

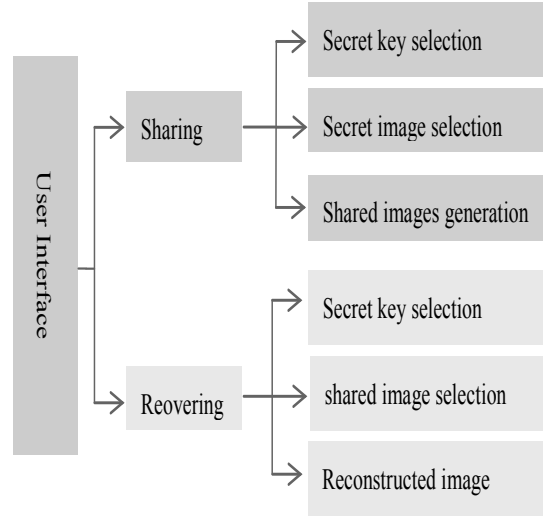


Figure 2 - Structure of the system

4.1 Initial phase

The initial phase let users determine their secret keys. From results in Quisquater et. al. [4], the best secret keys selection in Chinese Remainder Theorem is continuous prime numbers. Therefore, the application first randomly suggest continuous prime numbers as secret keys for users. There are two ways to acquire the secret keys. First, the secret keys can be acquired from system suggestion. Second, the system asks user to input a number and then the system calculated secret keys as prime number nearing the user number. The secret key for user should be secretly kept and each user possesses different secret key. After each user selecting his secret key, he can use sharing or recovering phases to share or recover secret image.

4.2 Sharing phase

The developed application calculate and share a secret image in sharing phase. Users first select the secret image and then apply the sharing algorithm illustrated in section 2.1 to share the secret image among shared images corresponding with different secret keys. Each user has to store their secret key and shared image secretly and use them to recover the secret image in recovering phase.

4.3 Recovering phase

The secret image can be progressively recovered in the recovering phase. Since the application can recover the secret image progressively, any collection of more than s shared images can acquire coarse secret image. Collecting more shared images acquires finer secret image. When collecting t shared images, the secret image can be perfectly recovered. Thus, the developed application designs the user interface for the recovering phase and the experimental results are provided in Section 5.1.

5. Experimental Results and Discussion

5.1 Experimental Results

This section presents the experimental results obtained from the proposed method. Programs were coded and run on an android system. The first image was LENA, 512×512 pixels, with thresholds determined as (2, 3, 4). This threshold assignment partitions the secret image among four shared images and two different quality's recovered secret images can be acquired. The Haar integer wavelet transform is calculated for transforming the secret image to wavelet subimages.

Figure 3 shows the experimental results on the grey image LENA. Figure 3(a) shows the selected secret keys and Figure 3.(b) show the secret image. Figure 3(c) shows four shared images with secret keys of 19, 23, 29, and 31, respectively. These shared images are then possessed by participants with their secret key. Recovering results are demonstrated in Figure 4. Figure 4.(a) show the selection of two secret keys and shared images. The corresponding reconstructed image is depicted in Figure 4.(b). Figure 4.(c) show the selection of three secret keys and shared images. The corresponding reconstructed image is depicted in Figure 4.(d). Figure 4.(e) show the selection of four secret keys and shared images. The corresponding reconstructed image is depicted in Figure 4.(f). Since the thresholds are (2, 3, 4), therefore, reconstructed image from three or four shared images has the same perfect quality.

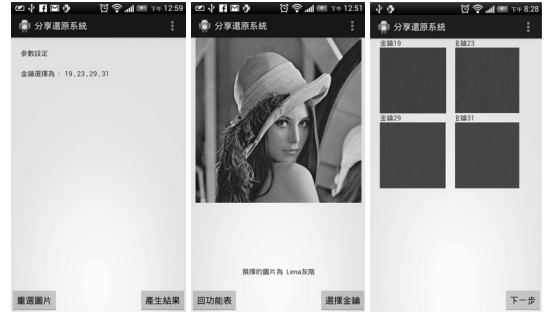


Figure 3 - examples for sharing a secret image (a) secret key selection (b) secret image selection (c) shared image generation.

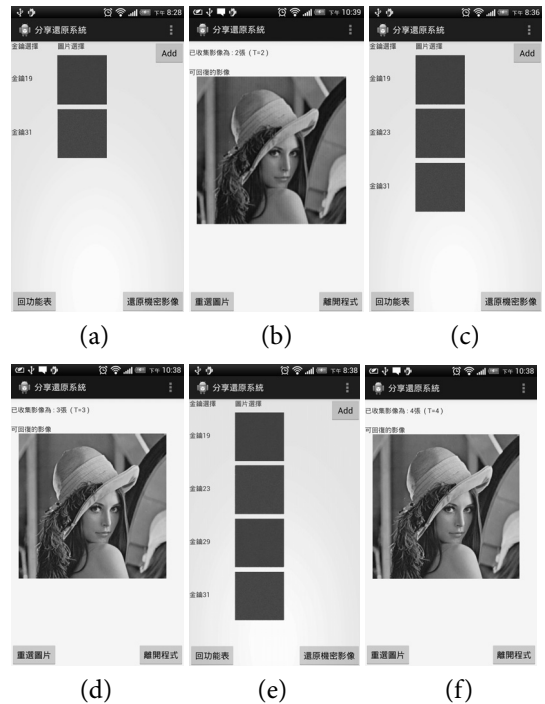


Figure 4 – examples for recovering the secret image (a) 2 secret keys and shared images selection (b) reconstructed image by 2 shared images (c) 3 secret keys and shared images selection (d) reconstructed image by 3 shared images (e) 4 secret keys and shared images selection (f) reconstructed image by 4 shared images.

Figure 5 and 6 show another example of sharing a color image. The thresholds are also the same as previous example defined by (2, 3, 4). Figure 5(a) list the selected secret keys and Figure 5(b)

shows the color secret image. Figure 5(c) shows four shared images, in which each shared image is a noised color image. The reconstructed images are demonstrated in Figure 6. Figure 6.(b) shows the reconstructed image from two shared images listed in Figure 6.(a). Figure 6.(d) shows the reconstructed image from three shared images listed in Figure 6.(c). Figure 6.(f) shows the reconstructed image from four shared images listed in Figure 6.(e). As previous example, reconstructed image from three or four shared images has the same perfect quality because of the thresholds being (2, 3, 4).



Figure 5 – examples for sharing a secret image (a) secret key selection (b) secret image selection (c) shared image generation.

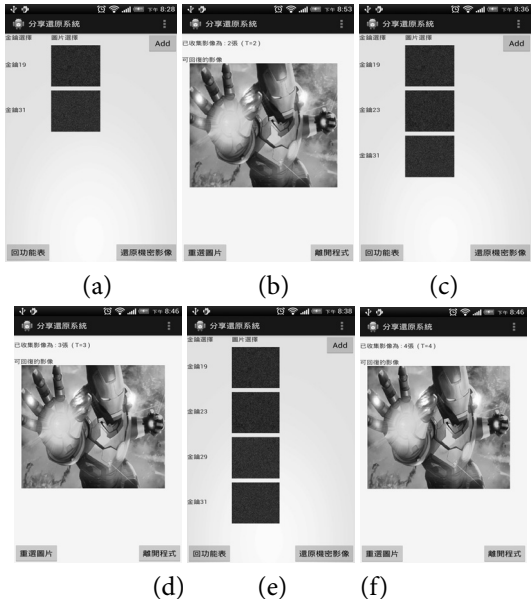


Figure 6 – examples for recovering a color secret

image (a) 2 secret keys and shared images selection (b) reconstructed image by 2 shared images (c) 3 secret keys and shared images selection (d) reconstructed image by 3 shared images (e) 4 secret keys and shared images selection (f) reconstructed image by 4 shared images.

5.2 Comparisons

This section compares the sharing properties of the proposed scheme and one related work [2]. The compared features, as shown in Table 2, are explained as follows.

- 1) Kernel method: Main techniques in sharing and recovery procedures are noted as kernel methods. Sharing and recovery using Secret Image Sharing strategy requires mathematical schemes like the Shamir-Lagrange [2] or Chinese Remainder Theorem.
- 2) Lossless recovery: Sharing and recovery using secret image sharing can acquire lossless recovery [2] and so is the proposed scheme.
- 3) Progressive strategy: Different sharing strategies are compared in progressive strategy. The related work [2] uses image transform to segment coarse or fine resolution from secret image. Both the related work and the proposed scheme is applied under wavelet transform.

Table 2 - Comparisons between the proposed scheme and one related scheme [2]

Schemes	Kernel method	Lossless recovery	Progressive strategy
Huang et al. [2]	Shamir-Lagrange	Yes	wavelet SPIHT
The proposed scheme	Chinese Remainder Theorem	Yes	wavelet subimages

Complexity in the proposed scheme, as shown in Table 3, is $O(K \log M)$, where K is the computation loop and M is the largest possessing key. On the other hand, Shamir-Lagrange based method has time complexity $O(N \log N)$, where N is the size

of image. The Shamir-Lagrange based scheme is known of perfect zero-knowledge scheme that any collection of less than t shared images give no information about secret image. However, the proposed scheme is conditional perfect zero-knowledge scheme, which is perfect zero-knowledge scheme when the secret keys are consecutive prime numbers [2].

Table 3 - *Computation time comparison between Shamir-Lagrange and Chinese Remainder Theorem*

Schemes	Computation complexity	Security
Shamir-Lagrange based method	$O(N \log N)$	perfect zero-knowledge
The proposed method	$O(K \log M)$	conditional perfect zero-knowledge

Comparison results in Table 2 and 3 demonstrate that the proposed CRT-based scheme performs more efficient than other Shamir-based schemes with regard to computation complexity. The easy way to share a secret image progressively demonstrates the efficiency of the proposed scheme. Efficient key selection also preserves good security property on the proposed scheme.

6. Conclusions

This study presents a novel (s, t, n) progressive secret image sharing method based on the Chinese Remainder Theorem and integer wavelet transform. The proposed method selects Chinese Remainder Theorem for the highly efficiency and adopts integer wavelet transform to partition the secret image to subimages. Subimages under different scales preserve properties from course to fine resolutions. Therefore, all subimages partitioned to groups with different thresholds satisfying the progressive requirement. The proposed scheme is implemented on an android system. Experimental results and comparisons indicate that the proposed scheme is efficient on sharing and recovering the secret image

progressively. Merging other function to the proposed scheme merits our further study.

References

- [1] C. C. Chen, C. C. Chen, Y. C. Lin, "A Weighted Modulated Secret Image Sharing Method", **Journal of Electronic Imaging**, Vol. 18, No.4, 2009, 043011.
- [2] C. P. Huang, C. H. Hsieh, P. S. Huang, "Progressive sharing for a secret image", **Journal of Systems and Software**, Vol. 83, No. 3, 2010, pp. 517–527.
- [3] S. J. Lin, S. K. Chen, J. C. Lin, "Flip visual cryptography (FVC) with perfect security, conditionally-optimal contrast, and no expansion", **Journal of Visual Communication and Image Research**, Vol. 21, No. 8, 2010, pp. 900–916.
- [4] M Quisquater, B Preneel, J. Vandewalla, "On the Security of the Threshold Scheme Based on the Chinese Remainder Theorem", in **5th International Workshop on Practice and Theory in Public Key Cryptosystems**, 2002, pp.199–210.
- [5] S. J. Shyu and Y. R. Chen, "Threshold Secret Image Sharing by Chinese Remainder Theorem", in **IEEE Asia-Pacific Services Computing Conference**, 2008, pp. 1332–1337.
- [6] C. C. Thien and J. C. Lin, "Secret image sharing", **Computers & Graphics**, Vol. 26, No. 5, 2002, pp. 765–770.
- [7] M. Ulutas, G. Ulutas, V. Nabiyeu, "Invertible secret image sharing for gray level and dithered cover images", **The Journal of Systems and Software**, Vol. 86, No. 2, 2013, pp. 485–500.
- [8] X. Wu, D. Ou, Q. Liang, W. Sun, "A user-friendly secret image sharing scheme with reversible steganography based on cellular automata", **The Journal of Systems and Software**, Vol. 85, No. 8, 2012, pp. 1852–1863.

Playing to Win? Gamer Loyalty to Sports Simulation Games

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Abstract

Different game genres have different impact on game designs as well as player activities. However, most IS researchers are focused on 3D virtual community and online Role-Playing Games (RPG). In spite of such growth of sport-related games and interests on them, the academic discussion regarding factors inducing flow experience to sports simulation games, is relatively limited. Cheating is prevalent in current gameplay but not well understood. The purpose of this research is to identify and examine the influencing factors including cheating for flow experience to football management games. To meet this goal, we take qualitative interview analysis as well as quantitative questionnaire analysis. This study will yield important implications for the developing and operating sports simulation games; furthermore, the understanding of the cheating behavior of gamers and its relationship with loyalty can contribute in the study of flow experience.

Keywords:

Flow, Game cheating, Gamer loyalty, Perceived reality

Introduction

As a digital game market grows up, many academic studies have identified factors that increase flow experience and retain gamer loyalty in online network games. Not surprisingly, researchers and practitioners are concerned with people's retentions

in playing Massively Multiplayer Online Role-Playing Games (MMORPGs), since the online game genre is closely related to game item consumption. However, there are various game genres such as Action, Adventure, Role-Playing, Strategy, Simulation, and Sports [15]. Moreover, people have played with not only multi-player games but also single player games.

Different game genres or player modes have different impacts on game design features as well as gamer activities. In other words, a sport-related gamer may have a different motivation than other MMORPG gamers. In spite of such growth of sport-related games and interests on it, the academic discussion regarding factors inducing gamer loyalty to sports simulation games, is relatively lacked. Moreover, most of these sports simulation games are about that games participate in a sport tournament as a player. For instance, a gamer playing FIFA online or Winning Eleven series takes a role of a football player. Meanwhile, in the football management simulation games such as FIFA Manager and Football Manager (FM) series, a gamer plays out the career of a soccer manager, for example, taking control of possible teams and managing their tactics to success in leading his or her team [5].

The purpose of this research is to identify and examine the influencing factors for the gamer loyalty of football management games. To meet this goal, we take a multidisciplinary approach.

Concentrating on football simulation gamer flow experience, we will examine how the perceived control and the act of ‘cheating’ game influence the flow experience and the sports gamer loyalty. In addition, we are going to study how various gamers select different types of game play modes that have different effects in gaming. At this point in time, we have conducted a Focus Group Interview (FGI) and a pilot test to develop a research model. The next section explains the conceptual framework of FM gamer loyalty.

Theoretical Framework and Research Model

Flow Experience and Gamer Loyalty

According to Csikszentmihalyi [4], flow is “the holistic sensation that people feel when they act with total involvement”. When people are in flow, they shift into a common mode of experience when they become absorbed in their activity [3]. Flow is too broad and ill defined because of the numerous ways it has been operationalized, tested, and applied [14]. Some researchers (e.g. [1, 7]) treat flow as a multi-dimensional construct. Dimensions of flow include focused attention, heightened enjoyment, curiosity, a sense of being in control, and a transformation of time [1, 4]. On the other hand, Hoffman and Novak [8] describe flow as an uni-dimensional central component in a complex network of relationships in others.

Meanwhile, in marketing research area, many researchers have interests in customer loyalty, because loyal customers are willing to pay more for the success of companies [14]. Gamer loyalty for an online game is defined as gamers’ intention to play the game repeatedly based on their prior experiences and expectations of the future [2]. To be truly loyal, a gamer must hold flow state toward a game. We therefore expect:

Hypothesis 1: Flow experience in gaming is positively related to gamer loyalty.

Predicting the Flow Experience

Many studies suggest that the challenges presented

by an activity are the key predictors of flow (e.g., [4, 7, 8]). Likewise, FM gamers are also optimally challenged in soccer tournaments. As a football manager, the gamer devises a strategy to win a competition. In addition, flow occurs when the gamer perceives a balance between the challenge of the activity and his or her own skill [4]. As Figure 1 [3, 10] shows, flow can occur when both challenges and skills are high. High challenges but low skills with high challenges result in anxiety, the reverse situation results in boredom [9]. Therefore, flow requires sufficient expertise with corresponding difficulty of the task. Drawing upon this literature we test:

Hypothesis 2: The level of challenges is positively related to flow experience.

Hypothesis 3: The level of skills is positively related to flow experience.

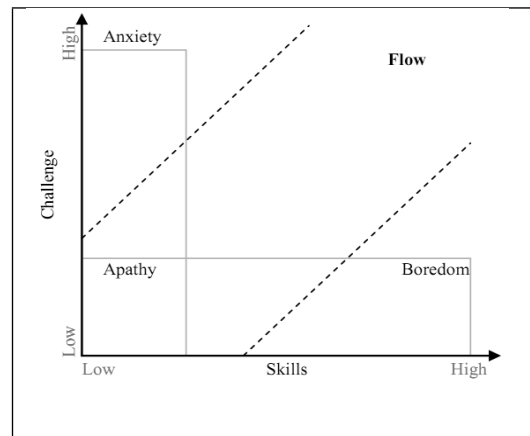


Figure 1- Reformulated Model of Flow

People tend to experience flow when they perceive themselves as being in control of actions [4]. According to Koufaris [14], perceived control is the level of one’s power over environment and actions. In general, control is closely related to game characters, units or user interface. For example, when a gamer has a feeling of control over her/his own avatar, s/he is more likely to experience flow state in sports simulation games. Hence, we test:

Hypothesis 4: The perceived control is positively related to flow experience.

When a gamer overly uses this control function, it becomes so called ‘modding’ or ‘adapting’ in playing games [5]. For example, some gamers produce merely these game adaptations and add-on functions for their own use but they distribute through friendship networks or via the Internet. Some security researchers call this control form as a ‘cheating’ in online games. Although many gamers have been familiar with a cheating, it has not been well studied because it is a rising topic for information systems (IS) researchers and a complicated phenomenon. Yan and Choi [16] redefine a cheating as “any behavior which player uses to gain an advantage over his peer players or achieve a target in an online game s/he is not supposed to have achieved.” Yan and Randell [17] summarize the various known methods of cheatings in games. They have also found that a cheating in online games is largely due to various security failures. However, the aspects of security should not be overstated because they are insufficient to explain a cheating and its consequences. For online games, a cheating is more based on an achievement motive [6]. Most of gamers tend to fear failure and want to achieve their goals, so some gamers use a cheating tool such as Real Time Editor or Data Editor which they can edit the game database. Therefore, we test:

Hypothesis 5: The level of challenges is an important factor of a game cheating.

Hypothesis 6: The level of skills is an important factor of a game cheating.

Hypothesis 7: A game cheating is negatively related to flow experience.

Mixed Reality and Gamer Loyalty

Mixed reality is the experience of a blended virtual and real world. As Kirkley and Kirkley [13] state, it includes a broad range of applications in which some elements of the real world (e.g., physical space, real objects, and environmental conditions)

can be blended with digital objects. The virtual game worlds and the real (actual) world can intersect with and impact one another. Lantz [11] calls this concept the ‘porous border’. Most simulation games provide interesting ways to access and interact with the real environment. For example, sports simulation games have evolved to keep pace with reality as well as to simulate the various rules and regulations that define sports worldwide. Likewise, the perceived ‘realism’ has continued to be a main focus in FM [5].

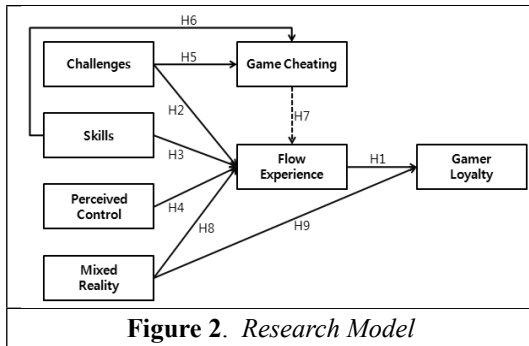
According to our face-to-face interview, one of FM gamers states:

“I’m very surprised at a lot of data of real-life leagues and clubs in FM...I often change the position of football players by managing the Roman team...I’m in flow when I make tactics with Francesco Totti, my favorite football player!!!”

As game graphics quality improves, the feeling of reality may increase, but a loading time decreases. Since massive database of FM game provides a wealth of information to support players and teams from the real-life football world, the loading time is a major issue. Most of game developers try to improve the graphic quality; however, the graphic quality should not be exaggerated in simulation games. Although FM series are primarily text based and involved in limited graphical content, it is the most popular football management game. An undergraduate participant in our FGI says, “I’ve played FM series since I was a high-school student. The simulated reality is fantastic, so I feel like I’m a real manager in a real team...I will download the newest patch to experience the most up-to-date version of FM 2011.” Therefore, we hypothesize:

Hypothesis 8: Mixed reality is positively related to flow experience.

Hypothesis 9: Mixed reality is positively related to gamer loyalty.



Research Methodology

In this study, two methodologies are employed, that is, qualitative interview analysis and quantitative questionnaire analysis to develop and to test our hypotheses. First of all, we begin each FGI by asking participants what makes them experience flow in FM series. Each interview is approximately 20 to 30 minutes in duration. Participant responses are recorded using an audio digital recorder. Most research samples consist of a group of FM gamers, who are identified through a FM community bulletin board for FM series.

In addition to solidifying our hypotheses into FGI, we expect that qualitative studies can also complement the quantitative data because interview data may provide additional perspectives as to what leads to flow state in FM series. Questionnaire items are either adapted from existing scales or developed for this research as in *Survey Items*. To develop new scales for intention to cheat and mixed reality, we have conducted literature reviews and exploratory interviews with 6 students. Answer options are based on a 7-point Likert scale, ranging from strongly disagree to strongly agree. To ensure that questionnaire items are clearly articulated, we have conducted a pilot test of the survey instrument using 27 FM gamers. We have then modified our survey questions based on the comments and suggestions obtained from the pilot test participants. The survey instrument is listed below.

Survey Items

Challenges (adapted from [8])

1. Playing FM series challenge me to perform the best tactic.
2. Securing my job with a better club provide a good test of my strategy.

Skills (based on [6])

1. I feel just the right amount of skill.
2. Managing my tactics to success in leading my team stretch my capabilities to the limits.

Flow Experience (adapted from [6, 8])

1. I am totally absorbed in when I am playing FM series.
2. I don't notice time passing while I am playing FM series.
3. I identify myself with the soccer manager when I am playing FM series.

Gamer Loyalty (based on [1])

1. I prefer FM series to other football management games.
2. I will say positive things about FM series to other people.
3. After playing FM series, I am very satisfied.
4. I intend to continue playing FM series, even though the graphic quality is not fancy.

Perceived Control (modified to [14])

1. I know how to control the position on my football team efficiently.
2. In general, I have enough control my game characters and user interface.
3. I feel in total control of my skills to make tactics securing a new job with a better club.

Game Cheating (developed by authors 2011)

1. I intend to use Real Time Editor or Data Editor for leading my team to success.
2. I frequently cheat to scout my favorite football players or staffs.

Mixed Reality (developed by authors 2011)

1. I am fascinated to see that FM series reflect the real-life football leagues and clubs.

2. I feel like I am playing in the actual world as well as in the virtual world in FM series.
3. I sometimes hope that a real soccer manager refers to my tactics of FM series.

Next steps for this study are online surveys and data analysis. The samples will consist of FM gamers who have played FM series repeatedly. Some of them may have experienced a cheating in FM series to support his or her favorite Premier League club as a promising soccer coach. Based on the result of the interview and the questionnaire survey, statistical analysis using SPSS and PLS will be conducted.

Implications

This paper has investigated the effects of perceived challenges-skills, control, and mixed reality with flow experience on gamer loyalty. Additionally, this study has increased our understanding of why people cheat in football management gaming. In conclusion, the overarching goal in this study is to yield important implications for the developing and operating sports simulation games. Since this research is in progress, it has to be developed more; however, we hope that this study will stimulate others to expand flow research. Moreover, we expect that IS researchers have interested in various game genres besides MMORPGs.

References

- [1] Agarwal, R. and Karahanna, E. "Time Files When You're Having Fun: Cognitive Absorption and Beliefs about Information Technology Usage," **MIS Quarterly** (24:4), 2000, pp. 665-694.
- [2] Choi, D. and Kim J. "Why People Continue to Play Online Games: In Search of Critical Design Factors to Increase Customer Loyalty to Online Contents," **CyberPsychology and Behavior** (7:1), 2004, pp. 11-24.
- [3] Csikszentmihalyi, M. and Csikszentmihalyi, I. *Optimal Experience: Psychological Studies of Flow in Consciousness*, 1988.
- [4] Csikszentmihalyi, M. **Flow: The Psychology of Optimal Experience**, New York: HarperPerennial, 1991.
- [5] Crawford, G. "The Cult of Champ Man: The Culture and Pleasures of Championship Manager/Football Manager Gamers," **Information, Communication & Society** (9:4), 2006, pp. 496-514.
- [6] Engeser, S. and Rheinberg, F. "Flow, Performance and Moderators of Challenge-Skill Balance," **Motivation and Emotion** (32:3), 2008, pp. 158-172.
- [7] Ghani, J. A. and Deshpande, S. P. "Task Characteristics and the Experience of Optimal Flow in Human-Computer Interaction," **The Journal of Psychology** (128:4), 1994, pp. 381-391.
- [8] Hoffman, D. L. and Novak, T. P. Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations, **Journal of Marketing** (60:3), 1996, pp. 60-78.
- [9] Kivikangas, J. M. *Psychophysiology of Flow Experience: An Explorative Study*. University of Helsinki, Helsinki, Finland, 2006.
- [10] Nacke, L. and Lindley, C. A. "Flow and Immersion in First-Person Shooters: Measuring the Player's Gameplay Experience," in **Proceedings of the 2008 Conference on Future Play: Research, Play, Share**. Toronto, Ontario, Canada: ACM, 2008, pp. 81-88.
- [11] Lantz, F. "Big Games and the Porous Border between the Real and the Mediated", **Receiver Magazine** (16), 2006.
- [12] Kerr, A., Brereton, P. Kucklich, J., and Flynn, R. **New Media: New Media Pleasures?**, STEM Working Paper: Final Research Report of a Pilot Research Project, 2004.
- [13] Kirkley, S. and Kirkley, J. "Creating Next Generation Blended Learning Environments Using Mixed Reality, Video Games and Simulations," **TechTrends** (49:3), 2004, pp. 42-53.
- [14] Koufaris, M. "Applying the Technology Acceptance Model and Flow Theory to Online Consumer Behavior," **Information Systems Reviews** (13:2), 2002, pp. 205-223.
- [15] Rapeepisarn, K., Wong, K. W., Fung, C. C., and Khine, M. S. The Relationship between Game Genres, Learning Techniques and Learning Styles in Educational Computer Games, Technologies for E-Learning and Digital Entertainment, Lecture Notes in Computer Science (5093), 2008, pp. 497-508.
- [16] Yan, J. and Choi, H.J. "Security Issues in Online Games," in **Proceedings of International Conference on Application and Development of Computer Games. Hong Kong**, 2001.
- [17] Yan, J. and Randell, B. "A Systematic Classification of Cheating in Online Games," in **Proceedings of 4th ACM SIGCOMM Workshop on Network and System Support for Games**. Hawthorne, NY: ACM, 2005, pp. 1-9.

IT Based HRIS Practices in Nepal

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Abstract

This study aims to examine the applications of IT while collecting information for the purpose of operating human resource management (HRM) in organizations of Nepal. Primary data based on 75 respondents from different types of organizations were analyzed. The study covers HR processes like acquiring human resource (recruitment and selection), rewarding human resource (compensation and benefits), developing human resource, (training and development, career management), protecting human resource (health and safety), retaining human resources, (retention strategies, work life balance). The study revealed some impacts and differences in the organizations due to the applications of technology in the organizations. Only few organizations were found to apply IT of sophisticated nature. The authorities of the organizations have positive attitude towards applications of IT, but in reality very few organizations were found using software designed specifically for HR. Even though authorities are in the opinion that IT has many organizational benefits, but the implementations of IT in the organizations is very low. This study is the preliminary study of IT based HRIS applications. The preliminary finding regarding managers behaviors towards IT based HRIS is that managers in the public sector organizations get challenged against their discretionary power from being flexible in decision making and planning so they resist to implement IT application to those levels which affect them..

Keywords, Human resource information system, HRM, Information technology(IT), sophisticated HRIS and HRIT.

1. Introduction

Information technology (IT) is the application of

computers and telecommunications equipment to store, retrieve, transmit and manipulate data. Researchers have observed that the field of human resource management (HRM) is encountered with frequent and numerous innovations in technology [18]. Some others examine the possible influence of IT on the roles and effectiveness of the HR function [10]. Some have argued that [2, 12] that the HRIT allows HR professionals to manage large amount of information with high speed and accuracy, which leads to more efficient information management. Some of the IT related terms used by HRM are: human resource information system (HRIS), electronic human resource management (e-HRM) and virtual human resource management (VHRM) [22]

The term human resource information system (HRIS) is defined as one which is used to acquire, store, manipulate, analyze, retrieve, and distribute information about an organization's human resource [27]. Some defined HRIS as the composite of databases, computer applications, and hardware and software necessary to collect/record, store, manage, deliver, present, and manipulate data for human resources[5]. Personnel management used the term HRIS during 1960s in the form of employee record management for benefit administrations [5, 19]. When many software characterized by low cost, generic, flexible, easy to install and easily customizable window based products appeared in the market then many firms become attracted to use these software. This helped software houses in writing affordable, easily customizable, modular HRISs with better customizable capability and to the rise of computers and net based technologies. In 1990s, the HR expectations were how HRIS can contribute in organization's HR strategic activities and help in business planning. With the inception of com-

puter based HRIS management felt that it can offer the real solution for retention of critical human resource and its development because of its unbiased nature and treatment towards the employees. There is a belief in the well developed society that the proper information collection and their proper use help the managers to treat all employees equally. With an HRIS, the human resource department can effortlessly manage employee data, whenever required supplementing it with computer and web-based technology, allowing them to reallocate their energies towards more important HR activities like implementing policies to achieve organization goals [17].

HRIS is normally used for two different purposes [19]. One for simple automation like payroll and benefits administration and keeping the employee records electronically for administrative purpose to reduce costs and time. The other use of HRIS is for analytical decision making [15]. Interest No one really knows what lies ahead for business in the 21st century; futurists say one thing is certain human resource executives will play a vital role in helping companies compete.

2. Review of literature

There has been completely absence of research about IT based HRIS practices in the country. The studies conducted elsewhere have been reviewed here.

HRIS applications in human resource (HR) helped in achieving primarily three objectives: (a) cost reduction/efficiency gains, (b) client service improvement/facilitating management and (c) employees and improving the strategic orientation of HRM/innovation [5]. Fourth dimension added to it is allowing integration of HR functions [24]. During the period of 90s some studies undertaken on HRIS have focused on the type of applications that predominate in HRIS [5, 8], the contexts necessary for the successful implementation of HRIS [29] as well as the conditions that support successful HRIS [11]. HRIS was viewed sophisticated and unsophisticated use. The use of HRIS for administrative purpose, like employee record-keeping, payroll, payroll benefits etc. was

viewed as “unsophisticated” [19]. The use of HRIS in training and development, recruitment and selection, HR planning and performance appraisal was viewed as “sophisticated” [19].

HRM can increase service efficiencies through the introduction of automation process of information receiving and providing, streamlining administrative tasks, and deleting the repetitive activities. These activities help HRIS to achieve basic purpose of cost and time reduction in performing the jobs [1, 3, 19, 22, 24].

HRIS allows HR professionals to help employees design their career plan, training and development etc. Integration of HRIS with other information systems along with applications of HRIS in implementing HR policies and practices that support business strategy of organization makes use of HRIS strategic [20]. Kossek and her colleagues have also argued that a corporate human resource information system can practically and symbolically transform human resources into a strategic business partner [14]. Ruël and colleague found that an organization with global presence or multi-plant company requires integration [24]. Many studies on HRIS have been carried out to know the extent of the various applications of HRIS [3, 6, 7, 14, 18, 28, and 26].

Review of the literature on HRIS give differing results in different countries, like Taiwan, UK, Hongkong and US. A study in Taiwan found that HRIS is most extensively utilized at the Electronics Data Possessing (EDP) level, followed by the Management Information system (MIS) and Decision Support System (DSS) levels [19]. Studies done within UK have reflected varying degree of HRIS use. The investigations done in UK depicted that in UK companies the most frequent uses of HRIS were in operational areas of employee records (72%), payroll (66%), pensions (57%) and employment contract administration (48%) [14] whereas another study found that employee record-keeping (96.8%), payroll (90.5%) and benefits management (57.1%) [28]. In a survey in UK found that current employee details and organizational salary details were the most frequently ap-

plied areas [3]. The study of Hongkong done found the two major applications of HRIS are providing general information (86.4%) and payroll services (84.7%)[19]. Recruitment and selection (11.1%) and succession planning (7.9%) were least used HRIS applications [28]. A researches of Ngai and Wat also showed that corporate communication (20%) and recruitment and selection (26.9% and 19.1%, respectively) were least used HRIS applications[22]. These studies show that HRIS is more commonly used for administrative purposes like employee record-keeping and payroll rather than for strategic purposes [9, 15]. In the later days companies have shown interest to start using sophisticated HRIS like training and development, performance management, compensation management and corporate communication [6, 7, and 26]. In the case of US companies, the applications of HRIS seem to be used in a broadened way. This is reflected in HCM Surveys on US companies[6]. Along with the use of Administrative HRIS as the most popular application (62%), companies found to increase in the use of strategic applications like talent acquisition services (61%), performance management (52%), or compensation management (49%) [6]. DeAlwis did his study on Srilankan Industries and found that HRIS is most commonly used in training and development, recruitment and selection and performance appraisal[7]. Studies done on Indian Companies found the major applications of HRIS as recruitment and selection (67.2% and 71.9%, respectively), pay roll service (67.2%), providing general information (67.2%), compensation (67.2%), performance appraisal (62.5%) , job analysis and design (62.5%) and in corporate communication (48.2%) [26]. Studies have indicated that HRIS would have future applications in training and development (72.5%), career development (60.8%) and performance appraisal/management (58.8%) [28], which means a shift towards strategic applications of HRIS from day to day record keeping of pay and benefits.

3. Objectives of the Study

The main objective of the study is to explore the applications of IT based HRIS in the organiza-

tions of Nepal. To fulfill the main objective, study attempts to seek the answers to the following questions:

1. To study the state of IT based of HRIS application in Nepal.
2. To assess the barriers of applications of IT based HRIS in different organizations.
3. To study the benefits perceived by HR departments in the IT based HRIS in different organizations.

4. Research Methodology

The study is based on primary data. For data collection, a structured questionnaire was developed by including the variables used in various studies [1, 3, 14, 19, 22, 23, and 28]. Different variables included were like: HR planning, job analysis and design, training and development, disciplining procedure, performance appraisal and review, employment reward, compensation management, pay roll, current employees' information, and employment leave[1]; recruitment, pay roll benefit, self-service web portal and internal and external communication [22]; corporate communication [23]; historical record of employees [3] and strategic management [23]. The queries were assessed on Likert's 5-point scale ranging from strongly disagree to strongly agree i.e. strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4) and strongly agree (5). In order to make the result understandable no complicated tools of statistics have been used. In the preliminary study of first phase of the study a total of 75 responses were received from different organizations operating in Nepal. The organizations for the study includes university service commission, public service commission, Ministry of General Administrations, constructions industry, hotel, manufacturing, pharmaceutical, commercial banks, development banks, finance companies, cooperatives, colleges running under Purbahncal university, Pokhara university, Tribhuvan University, and Kathmandu university.

The instruments used to furnish information had four parts which were supposed to take four types of information.

1. General information: This section was previously used in the research of Altarawneh and Al-Shqairat[1]. In this section included general questions about the surveyed organizations, participant's profile, and the profiles HRIS usage. It included questions related to the organizations name; size; participant' job title; academic qualification; work experiences; and age. It also asked whether the organization has a particular department for HRM; whether the organization has adopted HRIS yet, if yes, for how long, and. whether HRIS have a particular budget or not.

2. HRIS applications: this scale contained 15 HRIS applications and asked participants to indicate the extent to which do their organizations apply HRIS on different activities of HR, like planning, acquiring, developing, rewarding , etc. Responses ranged from 1= to a large extent to 4= not applied or used at all.

3. HRIS barriers: Items used to measure HRIS barriers were adapted from Ngai and Wat[21] to fit the study context, and were used elsewhere. In total, eleven barriers were measured on a five points Likert scale where responses ranged from 5= strongly disagree to 1= strongly agree. Each item asked the participants to indicate their agreement about the existence of the measured HRIS barriers in their universities.

4. HRIS benefits: this scale included 24 items under two headings as designed by Calandra[4]. Thirteen items were headed as hard money saving items and twelve were related to soft money saving benefits. Respondents were asked to rank from one to thirteen for hard money saving and one to twelve for soft money saving. Each item asked participants to indicate their agreement about the measured HRIS benefits from their point of views.

5. Delimitations

The study is conducted taking a sample of

5 key personnel of each organization. This research cannot be treated as extensive research so generalizations done may not have wider applications unless verified again with extensive a study which is on the process.

6. Result and Discussion

The majority of the participants indicated that their organization had separate HR Department\ division that employed more than 5 members of staff.

On the questions what should be the objectives of HRIS almost all respondents have 'agreed and strongly agreed' on the objectives of hard money saving and soft money saving as Calandra[4]. Under hard money saving some listed objectives mentioned by the respondents in order of importance were:

- Reduce incorrect or missed payroll payments to new hires.
- Reduce penalties, due to late tax deposits.
- Decrease time to recruit the right talent, using an automated recruiting process (resume scanning, searching, etc.).
- Reduce turnover, which would reduce recruiting, training and lost production costs.
- Reduce OSHA penalties for not maintaining an OSHA
- Reduce excess insurance premium payments due to late or inaccurate notification of employee terminations.
- Reduce payroll overpayments due to late or inaccurate notification of employee terminations.
- Reduce overpayments for vacation and sick time, with an ability to accurately accrue and track time off.
- Reduce retroactive changes in payroll with automated benefits enrollment.
- Reduce penalties for late notification of voluntary or involuntary job loss, reduction in the hours worked, transition between jobs, death, for terminating employees.
- Reduce lost time and Worker's Comp premiums, by analyzing lost time due to injury

and implementing preventive measures.

- Reduce FTE through consolidation of HR processes into a single integrated HRIS operating and centralized service center environment.
- Reduce cost of forms.
- Under soft money saving some listed objectives were:
- Increase manager effectiveness.
- Increase employee productivity.
- Increase payroll accuracy.
- Increase HR process efficiencies.
- Strengthen labor relations.
- Improve employee morale.
- Increase quality.
- Increase of information availability to managers
- Decrease the time it takes to read resume
- Realign some HR staff from administrative tasks to strategic tasks.
- Decrease cycle times

Though their interest to use IT based HRIS are similar in difference types of the organizations, but IT is not being applied in the equal manner. So the respondent were asked to state their barriers of using IT based HRIS.

In the questions the order they mentioned about the barriers regarding using IT based HRIS were: 1) lack of top management support and commitment, 2) the lack of information technology support, 3) lack of sufficient capital and skills, 4) lack of HR knowledge by system designers, 5) a lack of cooperation with other departments, 6) cost of setting up and maintaining HRIS, 7) lack of money, 8) the lack of applications for HR users, 9) lack of qualified HRIS staff; lack of a HRIS budget

The observations of various HR related performance and advertisements, selections practices, training and development practices the researcher found the input of IT related instruments used by the sample organizations in varying degree.

Organizations	E practice for HRIS	Missing parts of HRIS
University service commission	Advertisement, result, interview	Recording system was very poor; same records are asked again and again to submit from the single applicant.
University Personnel department	No	updated data base of the faculties of constituents and affiliated colleges
Government public service commission	Advertisement, result, interview	Updated database are absent
Commercial banks	Advertisement, result, interview	Sometime through back door entry About 50% bank fulfills vacancies without using IT based advertisement
Hotel industry	No	IT based advertisement for wide area recruitment
Construction industry	No	IT based advertisement for wide area recruitment
Pharmaceutical industry	No	IT based advertisement for wide area recruitment
Manufacturing industry	No	IT based advertisement for wide area recruitment
Colleges under different universities	Partially. Everywhere,	Not committed totally

An analysis was done to see what can be found into some organizations, though they were limited, but where IT was used. Some commercial banks based on kathmandu were found to apply IT based HRIS system. The result is summarized in the table given under.

Differences between IT based on less IT based HRIS system were observed as follows?

HR planning

Traditional HR (less IT based)	IT based HRIS
Manual processes for estimating future demand and supply of HRs Use of paper works(filling different forms) from department to department and sections	Use of MIS, electronics data processing system and use of software for analyzing current HR inventory

Acquiring human resource

Traditional HR	IT based HRIS
Paper resumes and paper posting Positions filled in month Limited by geographical barriers Costs directed at attractions Manual review of resumes Lengthy, time consuming and costly File Transfer process	Electronics resumes and internet posting Positions filled in week or days Unlimited access to global applicants Costs directed at selections Electronics review of resumes Some distance interviewing

Rewarding human resource

Traditional HR	IT based HRIS
Supervisor evaluations Face to face application Time spent on paperwork Emphasis on salary and bonuses Naïve employees Emphasis on internal equity Changes made by HR	360 degree evaluation Appraisal software (on line and hardcopy) Emphasis on ownership and quality of life Knowledgeable employees Emphasis on external equity Changes made by employees on line

Developing human resource

Traditional HR	IT based HRIS
Standardized classroom training Development process is HR driven HR lays out career path for employees Reactive decision Personal networking (Local area only)	Flexible online training Development process is employee driven Employees manage their career with HR Proactive planning with technology Electronic and personal networking

Protecting human resource health and safety

Traditional HR	IT based HRIS
Building and equipment safety Physical fatigue Mostly reactive program Limited to job related stressors Focus on employee management relations Stronger union presence Equal employment opportunity Sexual harrashment/ discrimination Task performance monitoring	Ergonomic consideration Mental fatigues and wellness Proactive program to reduce stress Personal and job related stressors Focus on employee relations Weaker union presence Intellectual data security Inappropriate uses of technology use of technology monitoring/ big brother

Retaining human resources

Traditional HR	IT based HRIS
Not a focal point	The critical HR activity Online employee opinion surveys Cultivating an effective company culture Mundane task done by technology, freeing time for more interesting work

Week family balance

Traditional HR	IT based HRIS
Not a major focal point	Developing and monitoring a program Providing children and eldercare Erosion of work home boundaries

Conclusions

1. There is duplication of works mostly in universities, and other organizations of public nature. Responsible authorities appointed there is mostly generalists and from the political agenda. The advertisement for these which other universities of the world have started and practiced was not found here. Many universities and organizations of foreign countries use the advertisement and selections based on some well defined selection criteria based on a system. Instead of preparing oneself for better fit in the organizations positions and contribute to the society, they (incumbent) like to assess the strength of political party and enter into the line and get recommendations to receive stronger value. Human resource information system does not work in such situations. Every respondents have shown interest towards IT by mouth but by conduct they don't want to use IT based HRIS system
2. About 50 percent of the organizations sampled use attendance register. But when rewarding the employee, the authorities use their own discretionary power without using the HRIS (attendance register and performance register) Many instances were found that even employees laws have been violated and even court cases were seen against such practices in many organizations.
3. In the analysis of couple of advertisements of human resource managers the knowledge of IT required for HR is not listed as job description. Some trainings of employees was observed and analyses where skill parts of IT and attitude towards IT have not got significant considerations and has less than 10 percent weight.
4. The IT supported programs and system of the organizations get hampered time to time because proper backup system is not maintained. The reason for it is given to load shading imposed by the electricity authority. No proper alternative supply of electricity through solar system is provisioned in most of the organizations.
5. Mostly applications software, like spreadsheet were found to be used rather than database software like Microsoft Access and specific user targeted customized software. Whatever software were used about 95 % were found to be pirated even in the big organizations.
6. Almost all the managers from each type of organizations show their concern towards IT positively but their involvement seems very weak; this can be exemplified from the fact that most of the organizational chief have the desktop and laptop on the desk but the applications they use is not database system but word process system and social networking system. Rarely can they access to the field activities, which is supposed by the MIS system.
7. The use of CCTV is found around forty percent of the organizations, especially at the critical places like banks counter, and classes of some colleges though may not necessary, central libraries, traffic license, etc. they are trying to use them properly.
8. There are much more software developed and sold to keep track of specifically for human resource system from the holistic or integrated perspective but these are not found to be used by any organizations, sampled in this preliminary studies.
9. Application of IT and HRIS encourages transparency in decision making regarding promotions, transfer, selections, and career

development but in the case of Nepal rarely these are found to be used properly so that court cases from the unsatisfied decisions are increasing day by day in the government sectors and university sectors to go against the organizations by employees is increasing, which shows demotivating factors for the employees.

Reference

- [1] I. Altarawneh and Z. Al-Shqairat, "Human Resource Information Systems in Jordanian Universities". **International Journal of Business and Management**, 2010, 5(10), 113-127.
- [2] S. Ashbaugh, & R. Miranda, (). Technology for Human Resources Management: Seven Questions and Answers. **Public Personnel Management**, 2002, 31(1), 7-20.
- [3] K. S. Ball, "The Use of Human Resource Information Systems: A Survey". **Personnel Review**, 2001, 30(6), 677-693.
- [4] B. Calandra, "Looking Ahead", **Human Resource Executive**, 2000, March 16,
- [5] R. Broderick, and J. W. Boudreau, 'Human Resource Management, Information Technology and the Competitive Edge', **Academy of Management Executive**, 1992, 6(2), 7-17.
- [6] C. Crestone, 'Workforce Technologies and Service Delivery Approaches Survey,' **9th annual ed. CedarCrestone**. 2006
- [7] A. C. De Alwis, 'The Impact of Electronic Human Resource Management on the Role of Human Resource Managers' **E + M Ekonomie A Management**, 2010, 4, 47-60.
- [8] G. DeSanctis, 'Human Resource Information Systems: A Current Assessment'. **MIS Quarterly**, 1986, 10(1), 15-26.
- [9] G. M., Groe, W. Pyle, , & J. J. Jamrog, "Information Technology and HR", **Human Resource Planning**, 1996, 19(1), 56-61
- [10] V. Y. Haines, & G. Lafleur, "Information Technology Usage and Human Resource Roles and Effectiveness" **Human Resource Management**, 2008, 47(3), 525-540. http://www.ekonomiemanagement.cz/download/1331826738_3ec7/04_alwis.pdf(June 10, 2012).
- [11] V. Y. Haines and A. Petit, "Conditions for Successful Human Resource Information Systems" **Human Resource Management**, 1997, 36(2), 261-275.
- [12] Z. Hussain, , J. Wallace, & N. E. Cornelius, "The Use and Impact of Human Resource Information Systems on Human Resource Management Professionals". **Information & Management**, 2007, 44(1), 74-89
- [13] N. J., Kinnie, and A. J. Arthurs, (1996). "Personnel Specialists' Advanced Use of Information Technology". **Personnel Review**, 25(3), 3-19.
- [14] E. E., Kossek, W. Young, D. C Gash, and V. Nichol, "Waiting for Innovation in the Human Resources Department: Godot Implements a Human Resource Information System" **Human Resource Management**, 1994, 33(1), 135-159.
- [15] K. A., Kovach, and C. E Cathcart, Jr. "Human Resource Information Systems (HRIS): Providing Business with Rapid Data Access, Information Exchange and Strategic Advantage" **Public Personnel Management**, 1999, 28(2), 275-281.
- [16] C. Kundu, D., Malhan, & P. Kumar, "Human Resource Management Practices in Shipping Companies Human Resource", **Delhi Business Review**, 2007, 8, No. 1 (January – June).
- [17] S.C. Kundu, and R. Kadian, " Applications of HRIS in Human Resource Management in India: A Study". **European Journal of Business and Management** 2012, Vol 4, No.21,
- [18] C. Y. Lin, "Human Resource Information Systems: Implementation in Taiwan", **Research and Practice in Human Resource Management**, 1997, 5(1), 57-72
- [19] M. G. Martinsons, "Benchmarking Human Resource Information Systems in Canada and Hong Kong", **Information & Management**, 1994, 26(6), 305-316.
- [20] J. H. Marler, "Making Human Resources Strategic by Going to the Net: Reality or

- Myth". **The International Journal of Human Resource Management**, 2009, 20(3), 515-527.
- [21] E. W. T. Ngai, and F. K. T. Wat, "Human Resource Information Systems: A Review and Emperical Analysis", **Personnel Review**, 2006, 35(3), 297-314.
- [22] E. W. T. Ngai, C. C. H. Law, and F. K. T. Wat, "Importance of the Internet to Human Resource Practitioners in Hong Kong", **Personnel Review**, 2008, 37(1), 66-84.
- [23] H. J. M. Ruël, T. V., Bondarouk, and M. V. Velde, "The Contribution of E-HRM to HRM Effectiveness: Results from a Quantitative Study in a Dutch Ministry" , **Employee Relation**, 2007, 29(3), 280-291.
- [24] H. J. M., Ruël, T. Bondarouk, , and J. C. Looise, **E-HRM: Innovation or Irritation: An Exploration of Web-based Human Resource Management in Large Companies**, 2004, Lemma Publishers, Utrecht, Netherlands
- [25] S.C.Kundu and R. Kadian. "Applications of HRIS in Human Resource Management in India: A Study". **European Journal of Business and Management** 2012,ol 4, No.21, 2012
- [26] T. Saharan, and S. Jafri, "Valuation of HRIS Status an Insight of Indian Companies ' Perspectives", in S.C. Kundu, B.K. Punia, K.P. Narwal, and D. Singh, (Eds), **Business Management: Key Research Issues**, Excel Books, New Delhi, 2012, pp. 113-27.
- [27] S. I. Tannennbaum, "HRIS: User Group Implications" **Journal of System management**, 199041(1), 27-32.
- [28] T. S. H. Teo, L. G Soon, and S. A. Fedric, "Adoption and Impact of Human Resource Information Systems (HRIS)" **Research and Practice in Human Resource Management**, 2001, 9(1), 101-117.
- [29] C. Y. Yeh, "Human Resource Information Systems: Implementation in Taiwan. **Research and Practice in Human Resource Management**, 1997, 5(1), 57-72.

Contextual Elements of Business Application Software Architecture and the Relationships among Them

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Abstract

Software architecture is the blueprint for a software system and should provide consistent guidelines for design, implementation, and maintenance throughout the entire lifecycle of the system. Components, interactions among the components, well-formed structure, reasons, and various perspectives reflecting various stakeholders' concerns changing through the phases of software lifecycle are the key elements of software architecture. The architect identifies and engages the stakeholders, understands and captures the stakeholder's concerns including those regarding life cycle, and lets the concerns reflected in the architecture. To do so, architect should take into consideration various contextual elements regarding the system too. We make an extended list of the elements, especially those of business application software architecture, that the architect should take into consideration and construct a model of the relationships among the elements.

Keywords:

Software Architecture, Software Life Cycle, Software Evolution, Software Architecture Degeneration, Software Project

Introduction

Architecture is indispensable for a successful software project, from the start of the project [1, 2]. According to Abrahamsson et al. [1], however, the extent of architectural activity that a project will need usually fluctuates depending

on the project's context. By context, they mean the project's environment such as: the organization, the domain, and so on as well as specific factors such as age of system, size, criticality, business model, stable architecture, team distribution, governance, rate of change.

Various stakeholders are engaged in a software project and, according to Boehm et al [3], each stage of software project should begin by identifying key stakeholders engaged in the stage and their win conditions for the system.

Literature Survey

Definitions of Software Architecture

Various definitions of software architecture exist. For an example, on May 1, 2012, 257 definitions of software were listed in the website of SEI/CMU. There is no universally accepted definition, however, and this often leads to confusion [5]. Koh [8] classified the keywords of 27 'formal' definitions listed in the website of SEI/CMU as follows:

- **Component:** components, elements, modules, parts,
- **Interaction:** interaction, relation, relationship, inter-relationships, connectors, connecting elements, inter-connection, interface, collaboration, shared data, shared information,
- **Well-formed Structure:** structure, organization, well-chosen forms, well-formedness constraints, particular forms, architectural style, layer,

- **Reason**
 - ✓ **Knowledge:** knowledge, strategies, principles, guidelines, rules, methods, protocols, patterns, best practice,
 - ✓ **Constraint:** constraints, requirements, stakeholders needs, properties, performance, parameters,
 - ✓ **Rationale:** rationale,
- **Various Perspectives:** life-cycle, evolution, (requirements, design, implementation), (technical architecture, operational architecture, systems architecture), (abstract architecture, concrete architecture), (structural model, framework model, dynamic model, process model), (conceptual architecture, module interconnection architecture, execution architecture, code architecture).

Software literature about software aging, architecture erosion, architecture degeneration, architecture drift, d architecture decay and so on addresses the issue of lifecycle of software. From the perspective of architecture erosion, there are two types of architecture [5, 4]:

- **Intended Architecture:** the outcome of the architecture design process. It is also called planned, as-designed, ideal, or conceptual architecture.
- **Implemented Architecture:** the model that has been realized or built-in within low level design construct and the **source code**. It is also called **actual, as-is, as-built, or concrete architecture**.
- **Eroded Architecture:** the implemented architecture which diverged from its intended architecture.

Rozanski and Woods [12] argue “Every system has an architecture, whether or not it is documented and understood.” By architecture, they actually mean the implemented architecture. More precisely speaking, every system composed of mutually interacting components has an implemented architecture. In this respect, the minimal element of architecture is mutually interacting components (refer to Figure 1). A structure, whether it is

well-formed or not, will emerge among the components and interactions anyway.

On the other hand, every system does not have an intended architecture. Advocates of agile approaches, for example, believe that architectural design has little value and that the architecture should emerge gradually iteration after iteration [1]. The system developed so may not have an intended architecture.

The process of extracting the description of the implemented architecture from an existing system is known as architecture recovery, which is a subset of reverse engineering [5]. Architecture recovery seeks to recover information through static and dynamic analysis of a legacy system and some architecture recovery tools can identify components, function call dependencies, and even design structures which commonly occur in source code [5]. Architecture recovery is a step of life-long architecture process (refer to Figure 2).

The reasons behind the architectural decisions, however, cannot be identified by such tools. The reason behind an architectural decision can be elicited from and explained by only the one who made the decision. The reasons can be documented only for the intended architecture. A good description of intended architecture includes the architectural knowledge applied to the intended architecture, constraints applied to and rationales of architectural decisions made. A good architecture has well-formed structure and reflects various perspectives.

Architectural Context: Rozanski and Woods [12]

Rozanski and Woods [12] define the following terms as:

- **Computer System:** the software elements that you need to specify and/or design in order to meet a particular set of requirements and the hardware that you need to run those software elements on.
- **Architecture:** the set of fundamental concepts or properties of a system in its environment,

embodied in its elements, relationships, and the principles of its design and evolution.

- **Architectural Elements:** a fundamental piece from which a system can be considered to be constructed.
- **Concern:** a requirement, an objective, a constraint, an intention, or an aspiration of a stakeholder has for that architecture.
- **Architectural Description:** a set of products that documents an architecture in a way its stakeholders can understand and demonstrates that the architecture has met their concerns.
- **Architectural Style:** a fundamental structural organization schema for software systems. It provides a set of predefined element type, specifies their responsibilities, and includes rules and guidelines for organizing the relationships between them.

They also identify three key architectural concepts: stakeholders, viewpoints (views, along with), and perspectives. Their definitions of the concepts and the components of the concepts are as follows:

- **Stakeholders:** individuals, group, organizations, or entity with an interest in or concerns about the realization of the system.¹
 - ✓ **Acquirers:** oversee the procurement of the system or product.
 - ✓ **Assessors:** oversee the system's conformance to standards and legal regulation.
 - ✓ **Communicators:** explain the system to other stakeholders via its documentation and training materials.
 - ✓ **Architect:** responsible for designing, documenting, and leading the construction of a system that meets the needs of all its stakeholders.²
 - **Product Architect:** responsible for the delivery of one or releases of a software product to external customers (and typically would stay associated with the product over a

number of release cycles).

- **Domain Architect:** a specialization of the general architectural function, focusing on a particular domain of interest, such as the business architecture, data architecture, network architecture, and so on.
- **Infrastructure Architect:** owns the provision of hardware and software infrastructure to systems and often performs this activity at a company-wide level.
- **Solution Architect:** specifically takes a broad, high-level view of the entire solution, focusing on wider issues than just technology, such as business process change, procurement, staffing, and so forth.
- **Enterprise Architect:** has responsibility for the cross-system information systems architecture of the whole enterprise, including sales and marketing, client-facing systems, product and services, purchasing and accounts, the supply chain, human resources, and so forth.
- ✓ **Business Analysts:** responsible for capturing and documenting detailed business requirements, typically focusing on stakeholders from the user community, and ensuring that these are correct, complete, and consistent.
- ✓ **Project Managers:** responsible for ensuring delivery of the product or system and meeting commercial priorities for resources, costs, and timescales.
- ✓ **Design Authorities/Technical Design Authority/Technical Lead:** take overall responsibility for quality of the internal element designs for the system. *The design authority takes the architectural views as her input and acts as guide and leader to the software developers who design, build, test, and integrate the product or system.*
- ✓ **Technology Specialists:** provide detailed

¹ Rozanski and Woods[2012], pp.73- 75, 131-138.

² Rozanski and Woods[2012], pp.68-73.

- expertise in one specific area.
- ✓ **Developers:** construct and deploy the system from specifications (or lead the teams that do this).
- ✓ **Maintainers:** manage the evolution of the system once it is operational.
- ✓ **Production Engineers:** design, deploy, and manage the hardware and software environments in which the system will be built, tested, and run.
- ✓ **Suppliers:** build and/or supply the hardware, software, or infrastructure on which the system will run.
- ✓ **Support staff:** provide support to users for the product or system when it is running.
- ✓ **System Administrators:** run the system once it has been deployed.
- ✓ **Testers:** test the system to ensure that it is suitable for use.
- ✓ **Users:** define the system's functionality and ultimately make use of it.
- **Views:** *the representations of one or more structural aspects of an architecture that illustrates how the architecture addresses one or more concerns held by one or more of its stakeholders.*
- **Viewpoints:** *the collections of patterns, templates, and conventions for constructing one type of view. It defines the stakeholders whose concerns are reflected in the viewpoint and the guidelines, principles, and template models for constructing its views.*
 - ✓ **Context:** describes the relationships, dependencies, and interactions between the system and its environment (the people, systems, and external entities with which it interacts). *Many architecture descriptions focus on views that model the system's internal structures, data elements, interactions, and operation. Architects tend to assume that the "outward-facing" information — the system's runtime context, its scope and requirements, and so forth — is clearly and unambiguously defined elsewhere. However, you often need to include a definition of the system's context as part of your architectural description.*
- ✓ **Functional:** describes the system's functional elements, their responsibilities, interfaces, and primary interactions. A Functional view is the cornerstone of most ADs and is often the first part of the description that stakeholders try to read. It drives the shape of other system structures such as the information structure, concurrency structure, deployment structure, and so on. It also has a significant impact on the system's quality properties such as its ability to change, its ability to be secured, and its runtime performance.
- ✓ **Information:** describes the way that the architecture stores, manipulates, manages, and distributes information. The ultimate purpose of virtually any computer system is to manipulate information in some form, and this viewpoint develops a complete but high-level view of static data structure and information flow. The objective of this analysis is to answer the big questions around content, structure, ownership, latency, references, and data migration.
- ✓ **Concurrency:** describes the concurrency structure of the system and maps functional elements to concurrency units to clearly identify the parts of the system that can execute concurrently and how this is coordinated and controlled. This entails the creation of models that show the process and thread structures that the system will use and the inter-process communication mechanisms used to coordinate their operation.
- ✓ **Development:** describes the architecture that supports the software development process. Development views communicate the aspects of the architecture of interest to those stakeholders involved in building, testing, maintaining, and enhancing the system.
- ✓ **Deployment:** describes the environment

into which the system will be deployed, including capturing the dependencies the system has on its runtime environment. This view captures the hardware environment that your system needs (primarily the processing nodes, network interconnections, and disk storage facilities required), the technical environment requirements for each element, and the mapping of the software elements to the runtime environment that will execute them.

- ✓ **Operational:** describes how the system will be operated, administered, and supported when it is running in its production environment. For all but the simplest systems, installing, managing, and operating the system is a significant task that must be considered and planned at design time. The aim of the Operational viewpoint is to identify system-wide strategies for addressing the operational concerns of the system's stakeholders and to identify solutions that address these.
- **Architectural Perspectives:** the collections of activities, tactics, and guidelines that are used to ensure that a system exhibits a particular set of related quality properties that require consideration across a number of the system's architectural views.
 - ✓ **Accessibility:** the ability of the system to be used by people with disabilities.
 - ✓ **Availability and Resilience:** the ability of the system to be fully or partly operational as and when required and to effectively handle failures that could affect system availability.
 - ✓ **Development Resource:** the ability of the system to be designed, built, deployed, and operated within known constraints around people, budget, time, and materials.
 - ✓ **Evolution:** the ability of the system to be flexible in the face of the inevitable change that all systems experience after deployment, balanced against the costs of providing such flexibility.

- ✓ **Internationalization:** the ability of the system to be independent from any particular language, country, or cultural group.
- ✓ **Location:** the ability of the system to overcome problems brought about by the absolute location of its elements and the distances between them.
- ✓ **Performance and Scalability:** the ability of the system to predictably execute within its mandated performance profile and to handle increased processing volumes.
- ✓ **Regulation:** the ability of the system to conform to local and international laws, quasi-legal regulations, company policies, and other rules and standards.
- ✓ **Security:** the ability of the system to reliably control, monitor, and audit who can perform what actions on what resources and to detect and recover from failures in security mechanisms.

Project & Program Management: PMI

Software is usually produced and maintained by projects. PMI [10, 11] defines projects, programs, and portfolios as follows:

- **Project:** a temporary endeavor undertaken to create a unique product, service, or result.
- **Program:** a group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually.
- **Portfolio:** a collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives.

PMI [10, 11] defines stakeholders of a project and its subcategories as follows:

- **Stakeholders:** persons or organizations who are actively involved in the projects or whose interests may be positively or negatively affected by the performance or completion of the project.

- ✓ **Users:** persons who directly use the project's product or service or result.
- ✓ **Customers:** the entity acquiring the project's product or service or result.
- ✓ **Sponsor:** a person or group that provides the financial resources, in cash or in kind, for the projects. *He/She champions the project.*
- ✓ **Portfolio Managers:** persons who are responsible for the high level governance of a collection of projects or programs, which may or may not be independent.
- ✓ **Portfolio Review Board:** committees (usually made up of the organization's executives) that act as a project selection panel. *They review each project for its return on investment, the value of the project, risks associated with taking on the project, and other attributes of the project.*
- ✓ **Program Managers:** persons who are responsible for managing related projects in a coordinated way to obtain benefits and control not available from managing them individually. *They interact with each project manager to provide support and guidance on individual project.*
- ✓ **Project Management Office:** an organizational body or entity assigned various responsibilities related to the centralized and coordinated management of those projects under its domain. *It provides project management support functions and/or directly manages a project.*
- ✓ **Project Managers:** persons who are assigned by the performing organization to achieve the project objectives. *They are the lead persons responsible for communicating with all stakeholders, particularly the project sponsor, project team, and other key stakeholders.*
- ✓ **Project Team:** the team comprised of the project managers, project management team, and other team members who carry out the work but who are not necessarily involved with management of the project.

They carry out of the work of the project.

- ✓ **Functional Managers:** key individuals who play a management role within an administrative or functional area of the business, such as human resources, finance, accounting, or procurement. *They provide subject matter expertise or their function provides services to the project.*
- ✓ **Operations Managers:** individuals who have a management role in a core business area, such as research and development, design, manufacturing, provisioning, testing, or maintenance. *They incorporate the handed off project into normal operations and provide the long term support.*
- ✓ **Sellers/Vendors/Suppliers/Contractors:** external companies that enter into a contractual agreement to provide components or services necessary for the project.
- ✓ **Business Partners:** external companies that have special relationship with the enterprise, sometimes attained through a certain process. *They provide specialized expertise or fill a specified role such as installation, customization, training, or support.*

OMG's BMM

The motivations of the organizations participating in a software project are the major elements of architectural concerns. OMG [9] published the BMM (business motivation model) whose ingredients are as follows:

- **Ends:** about what an enterprise wants to be, about changing what the enterprise is (e.g., developing new lines of business, moving into new markets), or about maintaining its current position relative its market and competition.
 - ✓ **Vision:** an overall image of what the organization wants to be or become.
 - ✓ **Desired Results:** a state or target that the enterprise intends to maintain or sustain
 - **Goal:** a statement about a state or

condition of the enterprise to be brought about or sustained through appropriate Means.

- **Objective:** a statement of an attainable, time-targeted, and measurable target that the enterprise seeks to meet in order to achieve its Goals.
- **Means:** any device, capability, regime, technique, restriction, agency, instrument, or method that may be called upon, activated, or enforced to achieve Ends.
 - ✓ **Mission:** the ongoing operational activity of the enterprise.
 - ✓ **Course of Action:** an approach or plan for configuring some aspect of the enterprise involving things, processes, locations, people, timing, or motivation undertaken to achieve Desired Results.
 - **Strategies:** the essential Course of Action to achieve Ends (Goals in particular).
 - **Tactics:** Course of Action that represents part of the detailing of Strategies.
 - ✓ **Directives:** indicate how the Courses of Action should, or should not, be carried out (in other words, they *govern* Courses of Action).
 - **Business Policies:** define what can be done and what must not be done, and may indicate how, or set limits on how, it should be done.
 - **Business Rules:** actionable Directives defined as such, and managed for consistency and completeness.
- **Influencer:** something that can cause changes that affect the enterprise in its employment of its Means or achievement of its Ends.
 - **Internal** (from within the enterprise): Assumption, Corporate Value (Explicit Value, Implicit Value), Habit, Infrastructure, Issue (a point in question or a matter that is in dispute as between contending partners), Management Prerogative, Resource.
 - **External** (from outside the enterprise

boundary): Competitor, Customer, Environment, Partner, Regulation, Supplier, Technology.

- **Assessment:** the judgment about the influence on the enterprise's ability to employ its Means or achieve its Ends.

The software, the result of the software projects supports business processes, which realize the courses of action and, ultimately, the ends of customer organization. The architect should capture and assess those concerns associated with the business processes the resulting software will support.

For an enterprise-level software project, for example, such as ERP system, the whole business motivation system of customer corporation should come into the picture.

The word stakeholder is typically used to denote a person or group of persons. Influencer expands the concept of stakeholder, denoting anything that can cause changes that affect the enterprise in its employment of its means or achievement of its ends [9]. In context of software project of program, an influencer can be defined to be something that can cause changes that affect the project or program in its employment of its means or achievement of its ends. At the beginning of each stage of lifecycle of a system, key influencers of that stage should be identified. The architect should assess their influences to the project, as well as the influences of the project to them.

Contextual Model of Software Architecture

Jones [6] classifies software or software projects into system software (used to control physical devices), commercial software (leased or marketed to external clients), information systems software (software for business information, outsourced software (software developed under contract), military software (software adhering to the Department of Defense standards), and end-user software (private software for personal use), and defines as:

- **Management Information Systems:** the type of applications that enterprises produce in support of their own business and administrative operations,
- **Outsourced Software:** software projects that are built under contract by an external company for a client organization.

Figure 4 illustrates the life cycle issues regarding architecture. The architectural process increases the cost of the current project. The cost of architectural process is obvious. The result of the architectural process, that is, good-formed architecture and its documentation reduces the cost of the current project and, especially, that of future projects. The problem is, however, that the value of architecture is hard to grasp, because it remains invisible [1].

In the MIS environment, however, the whole phenomena occur in the boundary of an enterprise and the feedback information from the projects is accumulated in the architectural knowledge base of the enterprise. So, there exists the pressure to minimize the life cycle cost of the software.

In the outsourcing environment, however, the phenomena occur dispersed in the boundaries of many organizations, and the architectural process is partitioned into pieces which various organizations perform separately. So, the benefit of coordinated architectural process is never fully realized. Moreover, the long-term benefit of good architecture does not accrue to the developer organization. Users, however, will evaluate the performance and usability of the application software exactly sooner or later. So, the developer organization who wants to minimize the cost of the project focuses on performance and usability and restrains the architectural process. As the result, the low engineering quality increases the cost of succeeding maintenance projects. The increased cost of succeeding maintenance projects, however, passes to the customer organization ultimately, not to the maintenance organizations, increasing the life cycle cost. The customer organization cannot break this vicious cycle because of lack of architectural knowledge. Figure 5 depicts this situation.

Figure 6 shows a contextual model illustrating the relationships between the elements listed above in the environment of outsourcing. The contextual model places the system clearly in its environment and relates it to the external entities with it interacts, via explicit relationships that represent the interfaces to and from it, and summarize the roles and responsibilities of the participants in these interactions [12]. The architect identifies and engages the stakeholders, understands and captures the stakeholder's concerns including those regarding life cycle, creates and takes ownership of the definition of an architecture that addresses these concerns, takes a leading role in the realization of the architecture into a physical product or system, and often fills the design authority's role as the project move into the design phase [12]. Figure 5 expands Figure 3 and includes the elements discussed above.

Conclusions

The issues regarding lifecycle are at the core of software architecture. That is, architecture should address the issues that are anticipated to be important in the future as well as the current issues. One of such issues is the cost of future maintenance projects.

In the context of outsourcing, the current project team is not guaranteed to be the performer of next projects in the lifecycle of the system. So, the current project team tends to focus on the short term issues, for example, such as performance or usability, against long term interests of customer organization. So, the long term concern should be enforced to be addressed in the architecture. The expanded contextual model in this paper provides a framework

References

- [1] Abrahamsson, P., Babar, M.A., and Kruchten, P., "Agility and Architecture: Can They Coexist?" IEEE Software, March/April 2010, pp.16-22.
- [2] Blair, S. and Watt, R., "Responsibility-Driven Architecture," IEEE Software,

- March/April, 2010, pp.26-32.
- [3] Boehm, B., A. Egyed, J. Kwan, D. Port, A. Shah, R. Madachy, "Using the WinWin Spiral Model: A Case Study," IEEE Computer, Vol.31, No.7, July 1998, pp.33-44.
- [4] de Silva, L., and D. Balasubramaniam, "Controlling Software Architecture Erosion: A Survey," **J. of Systems and Software**, Vol. 85, 2012, pp.132-152.
- [5] Hochstein, S. and M. Lindvall, "Combating Architectural Degeneration: A Survey," Information and Software Technology, Vol. 47, 2005, pp.643-646.
- [6] Jones, C., Software, Assessments, Benchmarks, and Best Practices, Addison Wesley Longman, Inc., 2000.
- [7] Koh, Seokha, "A Software Architecture Life Cycle Model Based on the Program Management Perspective: The Expanded Spiral Model," to be appeared in *J. of Information Technology Applications and Management*, Vol.20, No.2, 2013.
- [8] Koh, Seokha, "An Extensive Model on Essential Elements of Software," **J. of Information Technology Applications and Management**, Vol.19, No.2, 2012, pp.135-147.
- [9] OMG (Object Management Group), Business Motivation Model, ver. 1.1, OMG, 2010.
- [10] PMI (Project Management Institute), A Guide to the Project Management Body of Knowledge (4th edition), PMI, 2008a.
- [11] PMI, The Standard for Program Management (2nd edition), PMI, 2008b.
- [12] Rozanski, N. and E. Woods, Software Systems Architecture (2nd ed.), Pearson Education, Inc., 2012, pp.68-255.

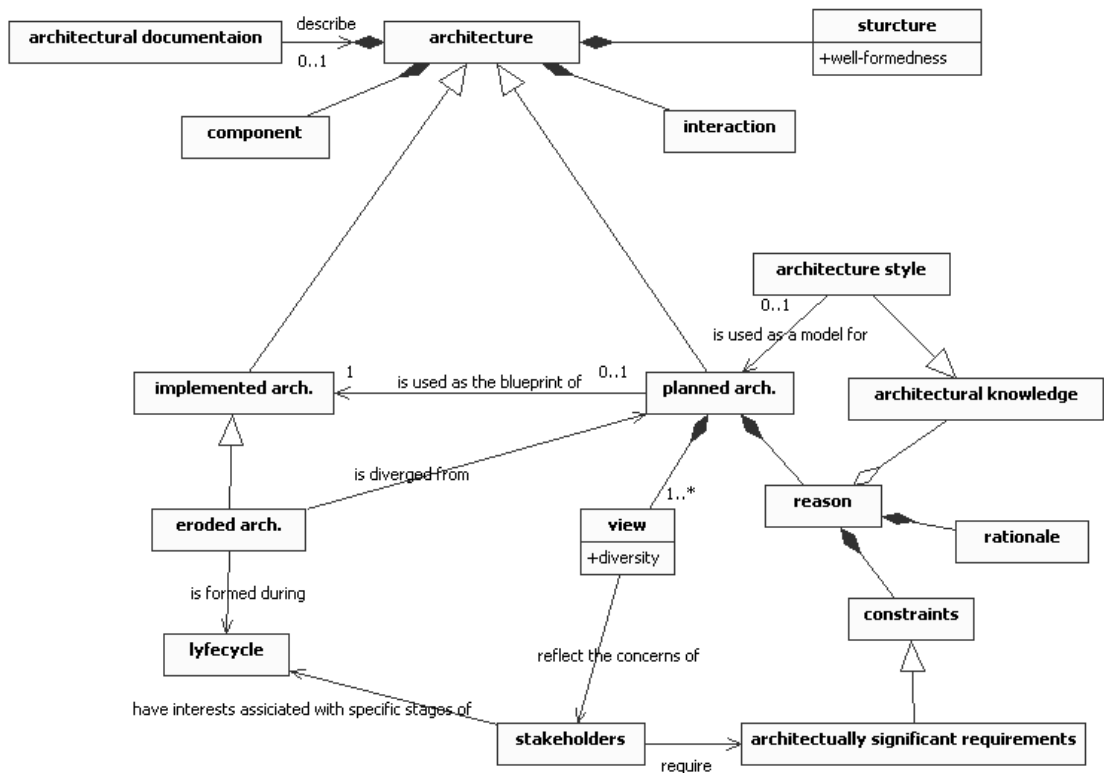


Figure 1: Elements of Architecture by Types
 Legend: arrow denotes the direction of reading, not that of navigation.

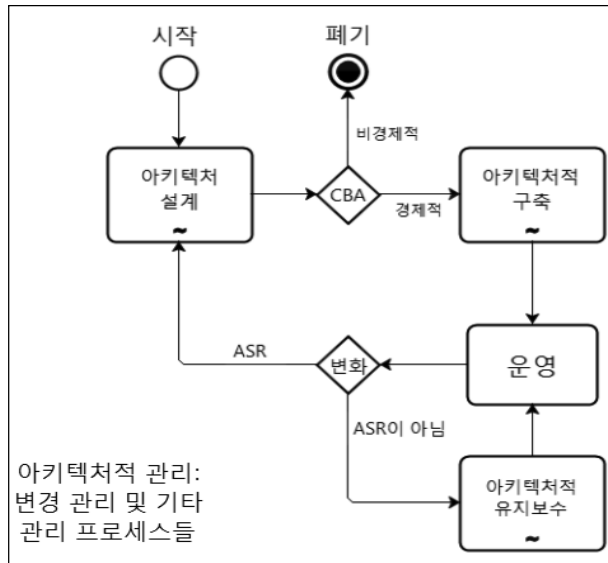


Figure 2: The Expanded Spiral Model
Source: Koh [2013].

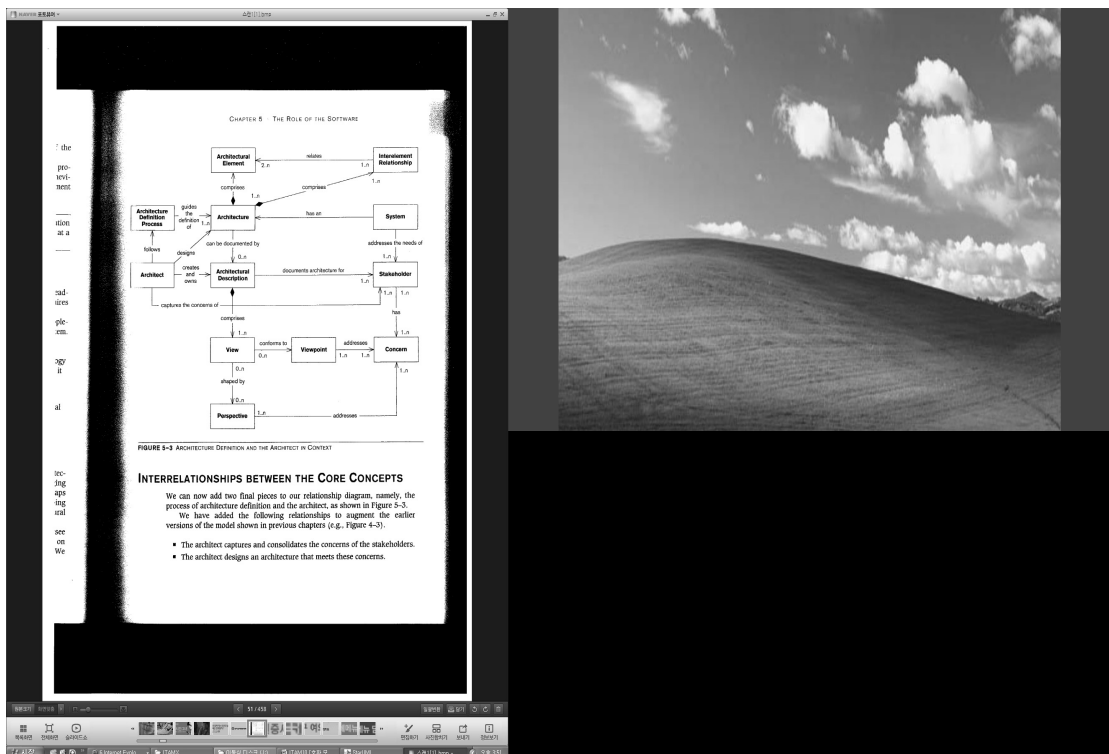


Figure 3: Architecture Definition and the Architect in Context
Source: Rozanski and Woods [2012] p.71 (Figure 5-3).

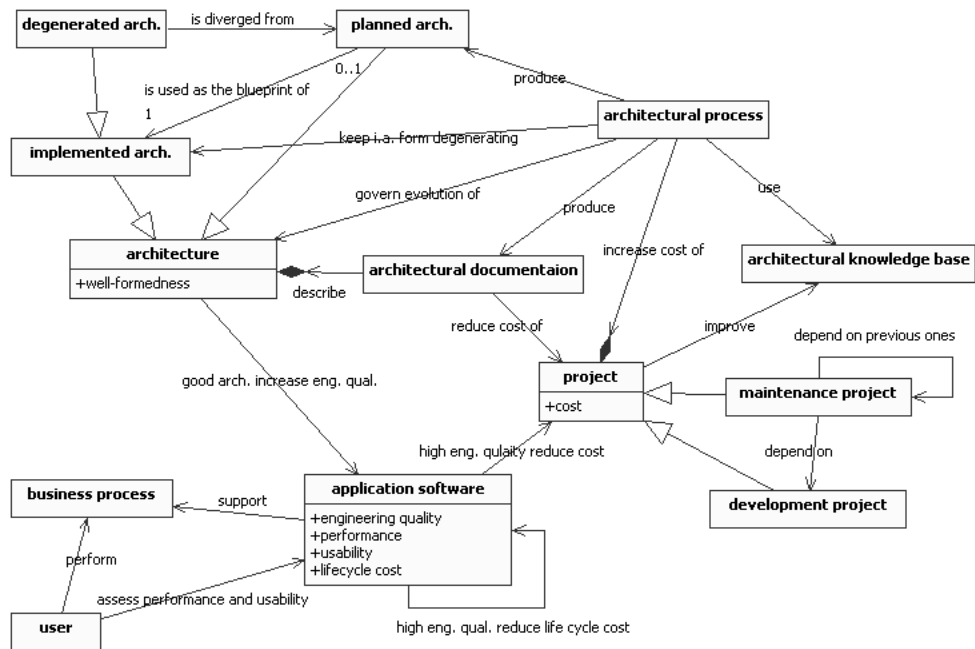


Figure 4: The Life Cycle Issues regarding Software Architecture

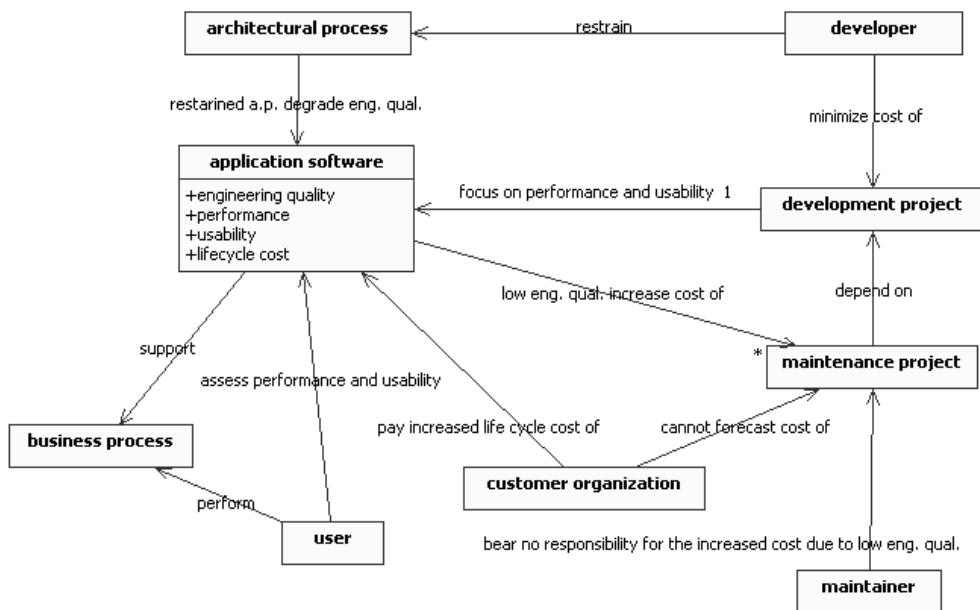


Figure 5: Life Cycle Issues in the Outsourcing Environment

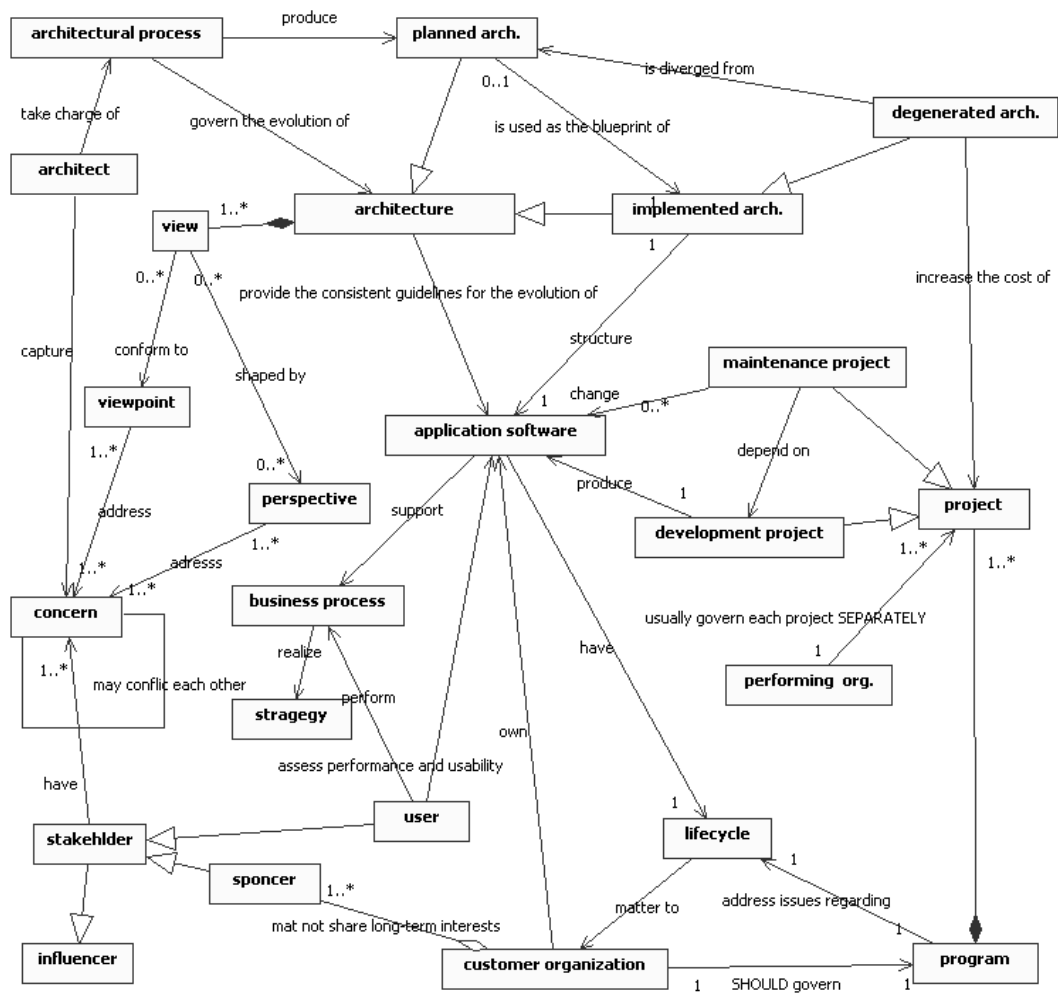


Figure 6: The Extended Contextual Model with Lifecycle Program Management

Bridging the Digital Divide: the Case of Nepal Wireless

Mahabir Pun

EXECUTIVE SUMMARY

Information and Communication Technology (ICT) has become a vital instrument for delivering a number of services such as education, healthcare and public services. Community wireless networks are community-centric telecommunication infrastructure developed to provide affordable communication for those who live in remote areas. This chapter discusses the role of Nepal Wireless in achieving socio economic development of rural communities by facilitating affordable Internet access. We analyze the challenges Nepal Wireless faced and articulate on the approaches it took to address those challenges such as lack of technical skills, appropriate technology and funding, difficult geographical terrains, unstable political situation, and expensive devices. In addition, we address the success and failure factors of this community-based ICT4D approach in order to guide similar endeavors. We conclude the chapter by some suggestions for policy makers, community developers, and academicians.

Keywords: *ICT4D, Wireless networks, Wi-Fi, VoIP, Digital divide*

BACKGROUND

Governments and individuals in developing countries usually give higher priority to fundamentals of living such as healthcare, education, agriculture, clean water, roads, and other public infrastructures. It is greatly overshadowing the concept of the development of information and communication technologies (ICTs) in remote areas where majority of the population of developing countries live [1]. As a result, IT services are available mostly for the people living in big cities and their peripheries. In other words, access to information and online resources in most

of rural areas in developing countries is difficult [9]. This is one of the reasons why there is a huge digital divide between people living in rural and urban areas in developing countries.

Nepal is a small country located between China and India. It has about thirty million people. It is mostly a mountainous country with majority of the highest mountains of the worlds. Politically, Nepal is the youngest republics of the world, which is officially called the Federal Democratic Republic of Nepal.

A brief overview of IT and telecommunication services that are presently available in Nepal has been given in order to make the readers understand clearly the reason behind the evolution of Nepal Wireless in 2001. Even if the mobile penetration rate has increased significantly in recent years in Nepal, many people in rural areas are still deprived from communication services including the Internet. As shown in Table 1, the MIS report of June 14, 2011 of Nepal Telecommunication Authority, which is the telecommunications regulatory body of Nepal shows the percentage of the people of Nepal using telephone and Internet services [15]. The figures in the table show that about 55% of Nepali people do not have telephone services and almost 90% of them have no access to the Internet.

Table 1. Percentage of people using telephone and Internet services

Voice Services being provided by different operators	Users	Penetration Rate %
Fixed	837,705	2.93
Mobile	11,299,735	39.53
Others (LM, GMPCS)	695,893	2.43
Total	12,833,333	44.90

Note: Projected population for 2010 was 28,584,975 (Source: cbs.gov.np)

However, the statistics of the telephone and Internet users in October/November 2003 (NTA, 2003) and June 2011 (see Table 2) can help readers to guess how the situation was like in 2001, when Nepal Wireless was born informally to connect some of the mountain villages of Nepal using wireless technology.

Table 2. Telephone and Internet Users in 2003 and 2011

Telephone and Internet Users	2003	2011
Fixed Telephone Services	379,235	837,705
Mobile Telephone Services	88,551	11,299,735
Others Voice Services (LM, GMPCS)	5470	695,893
Email Subscribers and Internet Users	180,000	2,940,623

Setting the Stage

Prior to the initiation of the IT project in the mountain villages by Nepal Wireless in 2001, no villager had any idea as what an Internet was or what a computer looked like. There was no telephone or electricity in the villages. The villagers had to walk five to eight hours to the nearest city just to make a telephone call. As a social worker, the author of this chapter was involved since 1993 with several community development projects such as building schools, starting income producing programs, building health clinics in the villages, and being involved in nature conservation projects. Some of the income producing projects that were started then and still running successfully is yak farming, cheese making, yak and cow crossbreeding farm, fishery, paper making, camping and lodging facilities for trekkers, jam making, and mushroom farming, etc. In the absence of modern communication and transportation means, villagers had to use human messengers to send messages from one village to another, which is the oldest form of communication used in remote corners of the world. Nangi was using the same age-old communication means until 2001.

Thus Nepal Wireless was born with the desperate need of a modern communication system for local use to help villagers communicate and run community development projects in different villages effectively and successfully. However, the political situation at that time was not favorable. Wi-Fi equipment had to be smuggled with the help of international volunteers. Different kinds of antennas had to be built by team members and tested at different ranges. Because of lack of knowledge and lack of funding the project had to adopt cheaper solutions using donated Wi-Fi equipment, normal hubs and homebuilt antennas including large recycled television satellite dishes. As for the power needed at the repeater stations, solar panels and wind generators were used to charge the storage batteries.

For the first year of the project Internet connectivity was provided through a dial-up proxy server based in the city of Pokhara. Five villages shared the dial-up Internet link. In 2004, the Internet link was upgraded from dial-up to 64/64 kbps dedicated wireless link from the Internet service provider based in Pokhara. Now Nepal Wireless subscribes to a 5 Mbps Internet link from the Internet Service Provider to its base stations in Pokhara and Kathmandu. The base stations are running a web server, a proxy server, a network management server, an Internet bandwidth management server and an audio/video streaming server.

Step by step, IT services through different applications such as e-learning, tele-medicine, tele-teaching, tele-training and e-commerce were introduced. Moreover, Nepal Wireless is working with different research groups for monitoring glacial lakes, weather and climate change in the Himalayas. It is also working on developing a surveillance system based on IP cameras at Chitwan National Park to monitor poachers and to help save endangered animals like tigers, leopards, and rhinos

DESCRIPTION OF NEPAL WIRELESS

The idea of using wireless networks to provide affordable local communication services to some

mountain villages evolved few years before the real start of Nepal Wireless. In particular, community developers informally implemented testing phase of the wireless network in Nangi village of Nepal in 2001. Nangi is a small mountain village of 800 inhabitants. It is located in the foothills of the Annapurna and Dhaulagiri Himalayas of western Nepal at 7,300 feet elevation. It takes pedestrians about 7 hours to climb the mountain from the nearest highway to Nangi. The low population and harsh geography of Nangi make it less attractive for telecommunication companies to invest in it. In addition, Nangi is an isolated and remote village that lack infrastructures and economic opportunities other than farming. More specifically, its residents are subsistence farmers who use primitive farming tools such as wooden plows, iron spades, axes, and sickles etc. There are no roads in the area. Therefore, villagers carry all kinds of loads such as supplies, fire wood, building materials, composts and others on their back, which they have been doing for centuries.

Currently, Nangi has a robust wireless network and a community computer lab. This lab serves as the main hub for the wireless networks that connects more than 120 villages in the 13 districts of Nepal. Several reporters from around the world such as BBC [3], ABC News [8], PC Magazines[7], and The Sydney Morning Herald [11] and many more have written about the role of Nepal Wireless in connecting and improving the economic conditions of such rural communities. Several academic research articles have been published about the project, for detail read references [19, 20, 21].

In 2001, when the plan was made to connect Nangi village to Pokhara city to bring the Internet through

Wi-Fi, the responses from several communication engineers and experts in the communication field were negative. Their main concern was the lack of proper equipment and the long distance the radio signals from simple Wi-Fi equipment had to cover. In spite of the negative feedback, the team members of Nepal Wireless had decided to go ahead for doing field experiments to find if a long range wireless link can be made using simple Wi-Fi radios and homebuilt antennas. The experiment was successful to the surprise of many technical experts who had been skeptical of the project. As a result, Nepal Wireless has now expanded its network to more than one hundred twenty villages in thirteen districts of Nepal. It is expanding its network to more districts of Nepal in coming years. A brief description of network design, technology used, and server setup has been given below to explain the technical part of the network.

The telecommunication infrastructure

Nepal Wireless network was built step by step and expanded to many villages over a time span of about ten years and it is still growing. The villages that are connected to the network get Internet and intranet services via a server in Kathmandu or in Pokhara. The servers in Kathmandu and Pokhara are linked through a leased optical fiber line. A series of mountaintop repeater stations relay the signal from Kathmandu and Pokhara up into the mountain villages. There are also access points at the mountaintop relay stations to distribute Internet to end users in the neighboring villages. Villages are connected to the access points using point-to-point wireless links or by connecting to a wireless access point that serves many villages at once. The table below shows the progression of users through 2011.

Progress of Nepal Wireless Networking Project - From 2002 to 2011										
Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
No. of Villages	1	2	5	13	22	35	60	82	102	122
No. of Rural Schools	1	2	5	8	19	24	40	58	74	80
No. of Rural Clinics	0	0	0	2	3	5	5	6	8	10
No. of Individual Users	0	0	0	0	0	0	0	15	40	65

The high-speed backhaul radios at the relay stations operate on a dedicated core local-area network (LAN) that reaches from the base stations (Pokhara and Kathmandu) to different districts through relay stations. The longest point to point link the project has made is 42 km from a mountain top to another mountaintop. The distance of the villages from the Access Points ranges from 2 km to 18 km. The districts that are connected to the network are divided into different subnets in order to manage the network smoothly. Thus the villages in each of the network's coverage areas from the relay stations operate on separate local LANs through VLAN switches. Routers at each of the relay stations provide DHCP services to the end users and interface between the backbone LAN and the local distribution LANs.

Objectives of the Project

The goals and objectives of the project have evolved over time. At the initial stage of the project, the goal was to connect just a few neighboring villages of Nangi and provide communication services such as IP telephony and email communication. The founders of the project did not know what other purposes the wireless technology could be used for. New objectives and services have emerged after several years of experience and collaboration and interactions with similar community wireless networks. For example, it was found that the minimum intranet bandwidth in local wireless network was around 2Mbps, which was enough to run simple video conferencing application for teaching and training purpose. Therefore the current objective is not to bring only the Internet and computers in the rural areas but to maximize the benefits of wireless and information technology for the rural population in remote areas. Nepal Wireless is trying its best by introducing useful applications and services in the field of education, health, communication, e-commerce activities and climate change monitoring activities. The project is even working on helping national parks of Nepal to set up IP based surveillance system to monitor the movements of poachers in that park. Using the wireless technology, we hope to make

the life of rural people easier and bring some socio-economic transformation. Besides, the long-term goal of Nepal Wireless is to become one of the biggest rural Internet Service Providers in Nepal to help bridge digital gap narrower. The digital gap in this context expand beyond physical access and agree with the reconceptualization of digital gap by Warschauer [25] as social, political, and economical gap. According to the final report of APT ICT J3 project in Nepal presented to Asia Pacific Tele-community, Nepal Wireless specifically aims to achieve the following goals, divided into six main areas (E-Networking Research and Development, 2009 (pp. 10-11).

1. **Education:** Increase better educational opportunities in the rural communities by creating tele-teaching and tele- training program, and by making e-learning materials in local language available to students, teachers and villagers through e-libraries.
2. **Health:** Connect rural health clinics and health workers to city hospitals in order to provide quality medical assistance through a tele-medicine program and make available highly needed healthcare in rural communities by virtually bringing medical doctors to villages.
3. **Communication:** Increase communication facilities in rural areas by providing telephone services through Internet phone system (VoIP), make Internet available for email communication, and help villagers to discuss by using Nepali language bulletin boards for community discussion.
4. **Local e-commerce:** Help villagers to buy and sell their products in the local market and international market through local intranet and Internet.
5. **Job creation:** Create jobs in the rural areas for younger generation through ICT related services such as communication centers, VoIP phone services, remittance services, and virtual ATM machine.
6. **Research and Field Testing:** Help researchers of climate change monitoring projects to collect data remotely and provide real time weather information about air

routes in the Himalayan valleys during bad weather and the monsoon season for airlines. Moreover, provide technical support to the Department of National Park of Nepal to install surveillance system at the parks to monitor the movement of the poachers to save the endangered species in the park.

Funding resources

After the successful completion of testing phase of the long range Wi-Fi link in May 2002, Nepal Wireless Networking Project started getting modest financial and some in-kind support from individual supporters and donor organizations from around the world. Some organizations supported the wireless project directly and some did it through Himanchal Education Foundation in Nebraska, USA. The donors who helped the project at the initial years are International Center for Applied Studies in Information Technology (ICASIT) in Virginia, Huguenin Rallapalli Foundation in California, and Poverty Alleviation Fund Nepal. Moreover, International Telecommunication Union (ITU), AMD, and Asia Pacific Tele-community (APT) also provided financial support for buying some more equipment in order to expand the network to reach more villages and for doing a pilot project for tele-medicine. Even while the project was still in its learning phase, the team leader of the project, Mahabir Pun, was awarded one of the most prestigious awards in Asia, the Ramon Magsaysay Award for Community Leadership, in 2007 from the Philippines for connecting Nangi and its neighboring villages to the global village through the Internet.

International recognition for the team leader of Nepal Wireless helped to get some more support for the project from more individuals and organizations. Used computers and wireless networking and communication gear and accessories were received from several individuals and international companies like KDDI Japan, Cisco USA, National University of Singapore, Polycom Australia, and Swiss Re, Switzerland. In 2009, the project got financial support from ISIF

Asia for building its human capacity. The project got financial support from Juniper Foundation, USA to provide training for the wireless networking operators and computer teachers. Most recently, Asia Pacific Tele-community provided a research grant for developing an open-source multi-destination audio/video conferencing system for tele-teaching, tele-medicine and tele-training purposes. Nepal Wireless is working with E-Networking Research and Development for developing the video conferencing software and testing it in twenty five high schools in seven districts of Nepal.

Rather than being dependent upon external support, Nepal Wireless encourages local stakeholders such as community members, local schools, not-for-profit organizations and local governments to donate money to build wireless networks in rural areas and to bring ICT services for the benefit of rural population. As a result, the district governments of Myagdi, Makawanpur, and Mustang invested significant amounts of money to build wireless network in those districts. Similarly, several other local governments are contributing funds every year to buy computers for schools and wireless equipment to connect villages to the wireless network.

The received financial support was not enough to build a wireless network across the entire country. Therefore, Nepal Wireless started a campaign in July 2008 called “Donate One Dollar a Month to Help Build Wireless Broadband Information Highway in Nepal” with the help of some Non-Resident Nepalese (NRNs) residing the USA. The project has received more than US\$50,000 so far as contribution from countries like the US, the UK, Japan, Hong Kong, and Malaysia donated by NRNs.

One of the reasons the NRNs want to contribute to the project is that the wireless broadband information highway can open opportunities for them to connect to relatives or family members in their home villages in Nepal using low-cost VoIP phone services, and live audio/video conferencing systems such as Skype or Google chat. Therefore,

it is a good investment for the NRNs as well. Because of such interest of NRNs living in different parts of the world, Nepal Wireless has helped NRNs to connect more than fifteen villages to the wireless network and build computer labs in the schools.

Business partners

Nepal Wireless was started entirely with the help of technical volunteers from abroad. It still does not have all the expertise it needs, or adequate human resources to fully implement the goals of the project. Therefore, Nepal Wireless works with partners that have different expertise. Now Nepal Wireless is working with several partner organizations and institutions to implement the projects and to provide IT services to the rural people. The names of its partner organizations are given below to make clear how Nepal Wireless is providing services to rural people.

1. E-Networking Research and Development: This organization has been helping as a technical partner since 2006 to build wireless networks in rural areas and to provide training for local wireless technicians, network operators and computer teachers. It is helping the tele-teaching and tele-training program to rural areas through audio/video conferencing (<http://www.enrd.org>).
2. Open Learning Exchange – Nepal: it develops contents in Nepali language for the elementary level student and makes the contents accessible online for the students in community schools. It has also developed e-library contents in Nepali language for the students and villagers. Nepal Wireless is working with this organization to connect the schools and make the contents available (<http://olenepal.org>) in the rural areas.
3. Nepal Research and Education Network: it uses the network as a platform for research and development (R&D) and is supporting for technical issues like network designing, equipment testing, routing, server building and maintenance (<http://nren.net.np>).
4. Kathmandu Model Hospital: Doctors in this

hospital uses the network as an electronic facility for delivering tele-medicine services and tele-training programs for rural health workers (<http://www.phectnepal.org>).

5. Thamel.com: This entity has created a virtual ATM system for implementing credit card transaction services for the trekkers in trekking routes of Annapurna region (<http://www.thamel.com>).
6. Kathmandu University: engineering and computer science students volunteer to develop applications needed for the project such as local e-commerce and phpBB applications, and customizing them in Nepali. The students are also helping to develop video conferencing software for tele-teaching and tele-training using open source.
7. Japan International ICT Association (JIIA): it is providing technical support by frequently sending their experts to Nepal. JIIA is also providing support to collect used computers and networking gears for the project (<http://www.jiiasec.com>).

Moreover, Nepal Wireless is continuously getting technical support from many national and international volunteers, who either come to Nepal for a short stay to provide technical support or provide online support from abroad for managing the wireless network, and for developing applications that the project needs.

Technology Used

At the beginning stage, Nepal Wireless did not have any funding to buy high end equipment for building wireless network. It had to use mostly used equipment including wireless radios, switches, power sources and computers donated by individual donors. Now, the network has grown bigger and better equipment and applications have been added as mentioned below.

Transport Technology

A considerable amount of resources have been dedicated over time to the network infrastructure and management. This includes wireless devices, network servers and associated software, and

power generation systems at the relay stations. The transport devices that are being used in the network are high speed and long range backhaul radios, access points and cheaper client radios that are available in the market, directional and Omni directional antennas with different capacities, routers, manageable switches, normal switches and IP phones. Some of the Omni directional antennas were built by volunteers and staff. Thus the wireless network has used a variety of wireless devices to maintain connectivity between the nodes. Conceptually, the network has been divided into two parts, as follows:

1. Network backbone, which connects base stations in Pokhara or Kathmandu to a series of mountaintop repeater stations
2. Client connections that connect villages to the relay stations. In some cases, a connected village has also acted as a relay station.

Proprietary devices made by Alvarion and Motorola Canopy at 5.8 GHz bands were used for the backbone connection due to their high reliability, robustness, and to avoid signal interference. However, several brands of 802.11b/g radios such as smartBridges, EnGenius, Ubiquity, Deliberant, Mikrotik and TP Link were used for the last mile connections due to their lower cost and the compatibility between manufacturers. All the wireless equipment including backhaul radios, access points, client radios and wireless routers installed by Nepal Wireless use de-licensed frequencies of 5.8 GHz and 2.4 GHz.

Access Technology

Before the wireless network was built for Internet connection, most of the “computers at the schools were assembled in wooden boxes” [2] using used computers parts brought by volunteers coming to Nepal. Now access to the IT services is provided through desktop computers and laptops. With the addition of an Internet telephony system, the project added a number of network telephones in the villages. The addition of Internet telephony equipment has enabled phone users to make international phone calls at cheaper rates.

Network Servers

Several servers such as web server, sip server, proxy server, network management server, Internet bandwidth management server and video conferencing server have been set up for different purposes. For example, the network server in Pokhara facilitates network monitoring and management. The video conferencing server is dedicated for tele-teaching, tele-medicine and tele-training purposes only. All of the server computers are branded computers. The servers run Ubuntu with additional third party software and are configured for maximum redundancy to guard against failure. Ubuntu was chosen for a multitude of reasons, primarily due to the large abundance of high quality Open Source software included with the standard distributions and easily available online. It is well tested and proven in production environments and thus made a perfect choice for the server.

Currently, the servers provide the following services:

1. Voice over IP Phone system for local use through SIP server and Internet telephony.
2. Community (Nepali) bulletin board service and locally hosted home pages for the villages through the Intranet.
3. File sharing service through the server as the central point of coordination for sharing teaching materials and network maintenance software for the network
4. Database for additional projects on the network, like the Haat Bazaar trading forum, which is hosted on the server.
5. Network name and route monitoring through which the system can resolve IP addresses to names and also maintains a table of availability for each host on the network.
6. Video conferencing for tele-teaching and tele-medicine

The server also contains dozens of custom scripts to tie all the functionality together in a usable interface. Administering such complex functionality, even from a GUI interface like WebMin, is too difficult for the average users.

Thus custom scripts written in Perl and PHP have been implemented to provide a user friendly server management system.

Delivered Services

Nepal Wireless delivers a wide range of services. The following section discusses the most important ones:

E-Learning

Nepal Wireless is providing e-learning content produced by Open Learning Exchange Nepal (OLE-Nepal) in the schools connected to the wireless network. The students of grade two through six are using the interactive learning materials based on their textbook. So far OLE-Nepal has developed content for English, Math, Science and Nepali. Moreover, OLE-Nepal has also created an e-library (<http://www.pushtakalaya.org>) with contents in Nepali and English for the students and villagers as well. Nepal Wireless is teaching villagers how to use those contents. Teachers and students now can have access to the contents through intranet. Nepal Wireless has also created a Wiki in Nepali language for the villagers with more than four hundred useful articles on health, education, agriculture and technology. The villagers can access the materials through the intranet. This opportunity creates a new paradigm in the education system of Nepal as there is always the problem of accessibility of printed content and qualified teachers in rural areas. In addition, an audio/video conferencing application is under development using open source for tele-teaching purposes. Once the software is complete, Nepal Wireless is planning to teach live through the network to fulfill the shortage of qualified teachers in the rural schools.

Tele-medicine

In order to address the absence of clinics and doctors in rural areas, Nepal Wireless has found that connecting a rural health worker to a doctor in city hospital using audio-video conferencing through an intranet can be very useful to provide some medical assistance to the rural people, who

have never visited hospitals. By connecting one clinic in a village to a hospital in Pokhara in 2006, so far Nepal Wireless has connected eight rural clinics to a hospital in Kathmandu for tele-medicine purpose. The health workers in the villages can consult with medical specialists at a city hospital whenever they need help to treat patients. With this service, Nepal Wireless has assured a virtual presence in remote areas of doctors who otherwise would never have made it physically. Moreover, it has been realized that it is a much cheaper and faster way to deliver basic health services in the remote rural areas than building clinics and hospitals, which takes several years.

E- Commerce

With the emergence of Internet in remote villages, people are also using it to communicate with other villagers to tell about products they have to sell. Villagers are doing this through an application called Haatbazar where they can put information about the produce and products with pictures. It is actually a virtual marketplace, accessible in the network through intranet. With the connection of Internet, villagers have also been able to promote their local areas for tourism. Nepal Wireless has helped villagers to develop a room booking system for lodges built by the communities along the trekking trails. The rural connection established by Nepal Wireless has helped people to establish money transfer stations in some of the villages. Moreover, Nepal Wireless is providing virtual ATM service to trekkers with the help of Thamel.com so that trekkers can get cash in the villages or pay their bill using their credit card.

Technical Training

Human resources development is also highly needed for technical sustainability. Nepal Wireless frequently runs training programs to provide training in the design, setup, running and maintenance of a WISP (Wireless Internet Service Provider). The training package includes setting up access points and clients, managing bandwidth, IP sub-netting, line of sight calculation, link budget calculation, firewall control, etc. It also runs

basic and intermediate level computer training for villagers, teachers and communication center operators from the villages.

Research and Field Testing

Nepal Wireless is helping some researchers on climate change to access the weather and climatic data online by connecting sensors and field servers set up in remote mountain sites to the Internet. It has installed three weather stations to date in the remote Himalayan Mountains. It is also working with Wild Land Security (<http://wildlandsecurity.org>) in the US to set up an IP based surveillance system developed by them for monitoring the movement of poachers in one of the national parks of Nepal to help protect endangered animals. The researchers of Nepal Wireless are also developing a cheaper Electro Cardio Graph (ECG) machine in its laboratory. Once it is developed, the machines will be put in rural clinics and will be used for telemedicine.

Project Management

Until 2009, the school management committee of Himanchal High School managed the Nepal Wireless Networking Project because the wireless network was limited to few villages and not many services were provided. Himanchal High School had not obtained a license to become an Internet Service Provider. While Himanchal High School helped to build the network with the technical support from E-Networking Research and Development and managed it, it did not provide services directly to the end-users of the villages. The services to the end-users were provided through village communication centers. Each of the centers was managed differently and independent from the others. The project did not collect revenues directly from end users, but instead billed communication centers to cover the operating cost of the network. Common caretaker organizations included mother's groups, social clubs, school management committees, and communication center management committees formed by the villagers. By running the communication centers, the respective caretaker organizations also gained an opportunity to

share in the revenue produced by usage fees. Additionally, the telephone users were charged a surcharge on telephone calls (Approx. \$0.01 per minute more than is billed by Nepal Telecom), resulting in an additional profit for paying the operating costs of the network.

In order to comply with the rules and regulations of the Nepal Government and to become a legal rural Internet service provider, Nepal Wireless was registered as a not-for-profit sharing company on July, 2009 from the Office of Company Registrar. The company consists of a board with five board members. As a nonprofit sharing company, it can provide IT services, technical support to build wireless networks and training for bringing IT related services to users in rural Nepal.

Until it became a nonprofit sharing company, Nepal Wireless provided connectivity only to rural schools, health clinics, and community communication centers. However, now it is providing services to individual home users in the villages if they can afford to have it. Still, villagers who can't afford to have computers and Internet connection at home can get IT services through communication centers in each village or school. Nepal Wireless charges a monthly connectivity fee directly to the schools, rural communication centers, and local service providers to cover the operating and maintenance cost of the network, such as monthly costs for the Internet bandwidth, rent for the server rooms, electricity bills, and salaries for the repeater station manager and fulltime technical staff.

In addition, Nepal Wireless also works with local internet service providers to provide internet connectivity to home users. A group of individuals or schools or organizations can form a committee to become a local ISP. Local representatives from the villages have been put in the management committee so that they can come up with their own ideas and make their own plan on how to use and maintain the wireless network.

Thus an organizational structure has been developed in which public and private partners

have taken responsibility to manage the local network and provide IT services with the technical support of Nepal Wireless as a partner. The reason to make public partners involved in the management of the network is to develop Nepal Wireless as a business enterprise with public and private stakeholders. Now there are many community stakeholders involved including local schools, local governments and individual partners. This allows an avenue for democratic participation as well as risk and profit sharing.

Status of Nepal Wireless

Unwin, T. [23] describes that there must be seven key elements for the ICT4D partnership to operate in a successful manner. They are as follows:

1. Trust
2. Focus
3. Champions/ Leaders
4. Sustainability
5. Balance between demand and supply
6. Networking
7. Transparency and sound ethical basis (pp.64-67)

This project has achieved most of the components of Tim Unwin's explanation about an ideal ICT4D partnership. It is entirely focused on providing IT services to rural communities and is driven by local champions. Working with the local partners, it has built network in more than 120 remote mountain villages of Nepal and is expanding the network to more districts. With its constant progress and nonprofit structure of operation it has gained huge trust from the rural people as well. Moreover, Nepal Wireless has created 6 full time and several part time jobs for rural people. Because of these reasons, Nepal Wireless has become one of the most reputed projects in Nepal. Thapa and Sein [22], transcribes an interview with a villager at Nangi while they were making a research on Nepal Wireless. The villager says that "Mahabir has done entire thing. He is the one who brings computer and internet in village. All the credit goes to him, as long as Mahabir is with us, there is no fear" (pp. 18).

With a long experience in the field of ICT4D, Nepal Wireless has overcome several challenges such as legal, technical, financial etc, and is progressing steadily with a hope to narrow the digital divide to some extent in Nepal. There are defined goals and objectives, and the operation of the organization is according to those defined goals. Organizational transparency is another positive part of Nepal Wireless. That is why Nepal Wireless has been able to establish its network in more than thirteen districts of Nepal. Nepal Wireless is focused and determined to extend rural networks with public and private participation as much as it is possible.

CURRENT CHALLENGES

Thus we can argue that Nepal Wireless is really contributing to the socioeconomic development of Nepal through ICTs and online resources. With Tim Unwin's model of successful partnership, Nepal Wireless lacks some components such as full sustainability, and balance between supply and demand. Nepal Wireless is aware of those shortages and it is trying to address them step by step as it progresses. Over a decade of efforts to connect the mountain villages with wireless and bring IT services, Nepal Wireless has faced the following challenges:

1. Lack of technical expertise: It was decided to build a wireless network with the desperate need of creating local communication system between the villages to run community development projects without the team leader and team members having much technical know-how. Therefore, lack of technical knowledge and expertise was certainly the first challenge.
2. Lack of appropriate technology: Wi-Fi was just an emerging technology in 2001 and it was primarily built for indoor use. Therefore many of the communication engineers with whom the author had communicated did not believe that it would be possible to build long range wireless network using the indoor Wi-Fi equipment available in the market. The Wi-

Fi equipment that was donated to the project to build the first 40 km long wireless link with a 3,300m tall mountain between Nangi village and the city had just 60 mW transmit power without any amplifier and long range antennas.

3. Difficult geographical terrains: Geographical barriers created by the high mountains also made it look impossible to accomplish the project. Many of the villages were not in Line of Sight (LOS) because of the high mountain ranges in between. Moreover, the repeater stations that had to be created on the mountain tops were far from the villages with no human settlements. Therefore powering the equipment and ensuring the security of the equipment was a big challenge for the project.
4. Unfavorable political situation: The wireless networking project was started at the peak time of political instability in Nepal. The conflict in rural Nepal made the wireless networking work extremely difficult hence the project had to be implemented while constantly facing threats of closure. The villagers were often reluctant to participate due to fears of violence from the government soldiers and the Maoist rebels.
5. Legal issues: The autocratic regime of the king had severely restricted import and use of wireless networking equipment. The restrictive laws requiring a license to import and use any kind of wireless gear made acquiring equipment from abroad almost impossible. Also, the requirement to get a license from the government to become an Internet Service Provider by paying expensive license fee seemed impossible to overcome for a grassroots project like Nepal Wireless.
6. Expensive Internet cost: The monthly connectivity fee during the early days of the project was at the range of USD 2,500 per month for a 1 Mbps link. Therefore the project had to use a dial-up link at the beginning. Even though the Internet bandwidth cost has come down to approximately USD 500 per Mbps per month in 2011, it is still expensive.

The 5 Mbps of Internet bandwidth Nepal Wireless has subscribed to provide to more than 120 villages is too little for the villagers. Therefore Internet bandwidth is still the main bottleneck for the project to provide IT services smoothly in an affordable and cost-effective way in the villages.

7. Sustainability of funding resources: This is the major challenge many of the organizations like Nepal Wireless have been facing in Nepal and in other developing countries. The challenge is not only to make a project financially sustainable but also to make it technically sustainable.

Looking at the numerous challenges and problems mentioned above, it is clear that the idea of building a long range wireless network in 2001 was a crazy idea then. Despite that, the team members could overcome most of the challenges and problems with persistence. The credit for making the project successful at the initial years goes to the international volunteers.

Seeing that it was almost impossible to get import and user license from the government, the project decided to take the risk to import the equipment and use them illegally. The international volunteers helped to smuggle the wireless equipment in their backpacks to Nepal and carried them to the villages through many strict security check points along the highway. The team built different types of antennas and tested them at different ranges in the mountain villages. The mountain barriers were overcome by building relay stations on tall trees at mountain tops. Solar power and wind power were used to power the equipment up.

Recalling the risky situation of that time, one can imagine that anything could have happened to the team members. They could have been arrested or shot dead by the rebels or the government forces had any of the team members had been found carrying wireless equipment or using them to build a local communication system. Luckily, no such incident happened and the wireless networking project kept expanding slowly to more villages. Thus the dream to build long range wireless network and to

connect the villages was fulfilled. In short, Nepal Wireless Networking Project could not have come into existence without the courageous support of the international volunteers.

After the restoration of democracy in 2006, a hard lobbying was done by the Nepal Wireless team along with the members of the Association of Internet Service Providers in Nepal demanding the government to de-license 2.4 GHz and 5.8 GHz frequencies on ISM band. The team leader of Nepal Wireless gave two presentations to the Members of Parliament and Members of Development Committee of the Parliament on how Nepal Wireless had been set up and how the rural communities were benefiting. As a result Nepal Government de-licensed those frequencies in September 2006. Now the wireless equipment at those de-licensed bands can be easily imported and used.

Another regulatory obstacle to bring IT services in the rural areas was also overcome. That was the requirement of license by paying high license fee to become Internet Service Provider, which was almost \$4,000 a year [13]. As a result no investor was motivated to become a rural Internet Service Provider because there was almost no chance of the return on the investment. Nepal Wireless lobbied with the regulatory body of the government to reduce the license fee and Nepal Telecommunication Authority (NTA) brought a new law making the licensing procedure simple and bringing down the license fee to become rural Internet Service Provider to Nepali Rupee 100 (Approx. USD 1.50) a year. As a result Nepal Wireless has now received a license and it can legally provide Internet and IT services in the rural areas.

Similarly, financial and technical sustainability of Nepal Wireless itself is a challenge. From the interview transcription of Thapa and Sein [20] with a villager, he expresses his worries on the sustainability of the project, “until Mahabir is here, it will function properly, however in his absence, we need another person like him for the sustainability of this project” (pp. 18).

The issue of the balance between demand and supply is still a big challenge for Nepal Wireless. Nepal Wireless receives requests from many enthusiastic villagers and local governments from around the country for help to connect their villages to the Internet. They are also able and willing to raise some funds for connectivity. At present, Nepal Wireless can't support all of them in funding even if it can definitely provide technical assistance. Thus there is huge demand and Nepal Wireless is unable to balance between supply and demand of IT services in rural Nepal.

RECOMMENDATIONS

The main issue that has been discussed in this chapter with Nepal Wireless as an example is the issue of finding ways to make IT services accessible to the majority of rural people in developing countries in sustainable manner and to bridge the most publicized issue of digital gap as far as it is possible. The way Nepal Wireless has been trying to address the issue in Nepal might or might not be applicable in other countries. It is mainly because Nepal Wireless was started on the grassroots level by local champions of a specific area in Nepal. Nepal Wireless can't provide solutions for others, but it can propose some recommendations.

The important point that should be noticed here is that Nepal Wireless is inspired more by the social cause to help bridge digital gap in its capacity than as a business venture for financial gain. No commercial Internet Service Provider has gone to the rural areas where Nepal Wireless Networking Project has been working. The long term goal is not only to help bridge the digital gap but to bring about socio-economic transformation of rural areas in Nepal by optimum use of information and communication technology. Therefore Nepal Wireless is helping to connect rural side of Nepal to urban areas so that the transfer of technologies from urban to rural area would be possible through Internet and intranet. Nepal Wireless has been an “unusual” case for the following reasons [18].

There are several aspects which make

the Nangi case unusual. First of all, it was not initiated through government, NGO or multilateral interventions. Second, it was managed entirely by Nepalese local leaders, with assistance provided through skillful selection of outside helpers, mostly volunteers, from developed nations. There was no role of the USAID, UNDP or World Bank in the project. Third, the hardware used was top-of-the-line, and not a compromise among cheap or aging technologies. Fourth, the cost of the project was relatively modest, since there were no “middle-man” charges and because several equipment suppliers were so impressed with the Nangi concept that they gave large price concessions. Perhaps the most unusual aspect of the case is that the entire effort was not driven by an application, like licensing, taxation or finance. Instead, the idea for Nangi was, “if you build it they will come”, like the theme from the film “Field of Dreams”.

The cases of Nangi and Nepal Wireless case is unusual in some senses because it has been able to bridge some digital divide successfully under difficult circumstances by connecting more than 120 villages with Wi-Fi technology and by bringing IT services in the remote mountain villages, where the people did not know what an Internet is. It is the persistence of the team members for about a decade that made it possible. The team members are still working in their full capacity with a hope to connect many more villages. Based upon its accomplishment so far, Nepal Wireless case can be taken as one of the examples for bridging the digital divide in remote rural areas. However, it should not be taken as the best solutions to meet the huge need of Nepal.

Over time, the project has learned an important lesson to make IT projects like Nepal Wireless self-sustained. The lesson learned is to make local stake holders such as local private partners, local community organizations and local governments

involved as operating partners as much as possible for the long term sustainability of rural IT projects in rural Nepal. This lesson has become a guideline for Nepal Wireless to help bridge the digital divide more effectively especially in the rural areas. Without community involvement, an ICT4D project will survive for the project period only, and then may flounder.

The issue of technical sustainability has been solved by hiring some full time and part time staff after Nepal Wireless was established as a nonprofit sharing company in 2009. Still the number of full-time technical staff is not adequate. Therefore there are quite a number of people volunteering or doing internship in the project, and Nepal Wireless seems it depends more on the support of the volunteers.

The issue of financial sustainability has been addressed to some extent through community participation. Each user, whether it is an individual, a school, a business, or a clinic or an office, has to pay the installation cost and monthly Internet connectivity cost. The monthly connectivity fee is based upon the Internet bandwidth used by a user, which is from USD 15 to USD 30 a month. The contribution received from outside donors is spent to build the backbone of the network and to install back up power systems at the relay stations. Support from local government and district government also goes to build local networks and backup power systems. Nepal Wireless also provides ongoing trainings to teachers, administrators and local people to manage and use the network effectively. Since the community members have also invested money for the installation cost, there is a feeling of ownership towards the network. While support from donor organizations are helpful, Nepal Wireless always believes in the maximum level of local participation for achieving its goal.

After looking at the decade long efforts of Nepal Wireless, it has been realized that it is very difficult to bridge the digital gap of the whole country with the efforts of a single organization like Nepal Wireless no matter how hard one tries.

An organization or some organizations like Nepal Wireless can help to develop a model or system and connect only a few hundred or so villages for bridging the digital gap if it works in its full capacity. However, there are over 6,000 villages in Nepal and many organizations like Nepal Wireless will be needed to bring IT services to the Nepalese society at large. A majority of the 80% people living in the rural areas of Nepal will not get fast broadband services from ISPs without government subsidy.

Therefore the government must take initiative to build broadband information highway in rural areas using wireless technology or it must provide financial support to grass root level organizations or companies like Nepal Wireless. This is important to make IT services available throughout the rural areas and to bridge digital gap. One of the reasons government intervention is recommended is that it is less likely for commercial companies to invest in the remote rural areas. It is unwise for commercial operators to invest huge amounts of money to build infrastructure to bring broadband information highway and to provide Internet services in sparsely populated and scattered rural areas of Nepal because there is a slim chance for them to get a return. In addition, the low income of rural residents and the mountainous nature of the area decrease the viability of any telecommunication infrastructures.

Based upon the experience Nepal Wireless has gained, it is recommended that the government intervention for bridging the huge digital gap in developing countries must come both in the form of open policies and favorable spectrum regulations for the expansion of wireless or optical fiber networks, whichever is feasible, in the rural areas. In addition, governments should also subsidize the service or provide financial support to rural operators that are interested to bring Internet and IT services in the remote rural areas for which it is recommended to provide subsidized financial support for building infrastructure and for paying the cost of the Internet access. Governments can use the Universal Service Obligation Fund (USOF), which the commercial operators pay to

the government.

Most of the countries require the incumbent operators to pay a part of their net earnings to provide information and communication services to rural population, which is called Universal Service Obligation Fund in India. Chile has the Telecommunications Development Fund (FDT). Pakistan has the Universal Service Fund Company, and Taiwan has the Universal Service Fund (Wikipedia, Free Encyclopedia 2012). It is called Rural Telecommunication Development Fund in Nepal and Nepal government is planning to use the fund for connecting all the 75 district headquarters through optical fiber link and then the villages through wireless link. The amount of money collected for Universal Service Obligation Fund in each country is quite a large amount. Therefore it will be good resource for bridging digital divide in developing as well as in developed countries. According to the National Broadband Plan of America, approximately 100 million Americans do not have broadband at their home. Therefore the US government has set up "Create the Connect America Fund (CAF) to support the provision of affordable broadband and voice with at least 4 Mbps actual download speeds and shift up to \$15.5 billion over the next decade from the existing Universal Service Fund (USF) program to support broadband" (Connecting America, The National Broadband Plan pp. xiii).

Another recommendation for helping to bridge digital divide is by providing ICT in education programs in all the schools supported by government. The initiative taken by Nepal Government can be an example. As part of the ICT in education program, the Ministry of Education of Nepal Government recently "has started an initiative for introducing information and communication technology (ICT) in education with UNESCO's support. It aims at harnessing the power of ICT for teaching and learning. This initiative is part of an ongoing major education initiative in the country such as the School Sector Reform Plan, the Education for All campaign and teachers education projects" [24].

Even the government of a developed country like the United Kingdom feels that they are obliged to do more for ICT in education. That is why the “rural areas in England and Scotland have been allocated nearly £363m to improve their broadband connections”. In addition, the British government has brought forth a scheme to give “free laptops to 270,000 pupils from poor backgrounds in England” [5]. In order to target digital divide, “low-cost computers are to be offered as part of a government scheme to encourage millions of people in the UK to get online for the first time” [4].

One example of government intervention for bridging digital divide is through the “One laptop Per Child Program”. Under this program, “over 1.7 million children and teachers in Latin America are currently part of an OLPC project, with another 400,000 in Africa and the rest of the world” [16]. Similar projects have been started by governments in Gaza, Afghanistan, Haiti, Ethiopia, and Mongolia. There is no doubt that such programs will be able to bridge not only the digital divide but make people connected to each other, to the world and create new opportunities to the people of remote communities [20]. Open Learning Exchange Nepal has successfully done “One Laptop Per Child Program” as a pilot project with the Department of Education in five districts of Nepal. The pilot program was done in two phases and it distributed more than 2,500 laptops to the students and teachers [17].

Finally, the time is not that far when a person will require IT in every step for one's living as one of the basic human needs such as food, shelter, and clothes etc. However, there are billions of people deprived of such opportunity. Therefore, getting an opportunity to learn IT in education should be included by all the responsible governments of the world as one of the fundamental rights of a child under the right to get a basic education. Without such a provision, many children still will stand across the digital divide from opportunities of the modern world.

Conclusion

In this chapter we discussed the importance of ICT in promoting education, healthcare and public services particularly in the remote communities. Examples include how the Nepal Wireless Networking Project created the socioeconomic opportunities to the mountain villages by facilitating affordable Internet access. The chapter also demonstrated how the project turned challenges into opportunities. The founder of the project – Mahabir Pun - was awarded an Honorary Doctorate of Humane Letters by University of Nebraska, USA for his outstanding work. Furthermore, the chapter addressed the factors that may influence the success and failure of community-based ICT4D approaches. Finally, the chapter suggested some practical implications for policy makers, community developers, and academicians.

REFERENCES

- [1] Aitkin, H. (2009). Bridging the Mountainous Divide: A Case for ICTs for Mountain Women. *Mountain Research and Development*, 22(3), 225-229. doi: 10.1659/0276-4741(2002)022[0225:btmdac]2.0.co;2
- [2] BBC. (2001). Village in the clouds embraces computers. Retrieved July 22, 2011, from <http://news.bbc.co.uk/2/hi/science/nature/1606580.stm>
- [3] BBC.(2004).Wi-Fi lifeline for Nepal Farmers. Retrieved July 28, 2011, from <http://news.bbc.co.uk/2/hi/technology/3744075.stm>
- [4] BBC. (2010). Poorer pupils to be given free laptops. Retrieved July 25, 2011, from <http://news.bbc.co.uk/2/hi/8449485.stm>
- [5] BBC. (2011). £98 PCs target UK digital divide. Retrieved July 22, 2011, <http://www.bbc.co.uk/news/technology-12205412>
- [6] E-Networking Research and Development (2009). *Final Report of APT ICT J3 Project in Nepal*. Report presented to Asia Pacific Telecommunity, Bangkok, Thailand.
- [7] Harsany, J. (2003). Taking Wifi to New Heights. Retrieved July 25, 2011, from <http://www.pcmag.com/article2/0,2817,1365140,00.asp>
- [8] Harsany, J.(2004). Wireless networks open up Nepal. Retrieved July 25, 2011, from <http://abcnews.go.com/Technology/ZDM/story?id=99622&page=1>
- [9] Heeks, R., & Kanashiro, L. (2009). Telecentres

- in mountain regions - A Peruvian case study of the impact of information and communication technologies on remoteness and exclusion. *Journal of Mountain Science*, 6(4), 320 - 330.
- [10] ITU. (2000). The Internet from the Top of the World: Nepal Case Study. <http://www.itu.int/ITU-D/ict/cs/nepal/material/nepal.pdf>.
- [11] Levett, C. (2004). Himalayan village joins wireless road. Retrieved July 23, 2011, from <http://www.smh.com.au/news/World/Himalayan-village-joins-wireless-world/2004/12/26/1103996439623.html?oneclick=true>
- [12] NTA (2003). Management Information System. 1st Issue 1 Year. Retrieved July 25, 2011, from http://www.nta.gov.np/articleimages/file/NTA_MIS_1.pdf
- [13] NTA (2010). License Fee. Retrieved July 23, 2011, from <http://www.nta.gov.np/en/content/index.php?task=articles&option=view&id=46>
- [14] NTA. (2010). *Ten Year Master Plan (2011 - 2020 AD): For the development of Telecommunication Sector in Nepal*.
- [15] NTA (2011). Management Information System. X Year Issue 31st Vol. 79. Retrieved July 27, 2011 from http://www.nta.gov.np/articleimages/file/NTA_MIS_51.PDF
- [16] OLPC (2011). Over 2 million children and teachers in 42 countries are learning with XO laptops today. *About the project/ countries*. Retrieved July 24, 2011, from <http://one.laptop.org/about/countries>
- [17] OLE Nepal (2011). Our Projects. *OLPC Project*. Retrieved July 29, 2011 from http://www.olenepal.org/olpc_project.html
- [18] Ruth, S. & Schwere, R. (2008, October). Pursuing Truly Successful e-Government Projects: Mission Impossible? *Information Technology in Developing Countries*, Volume 18, No. 3, October 2008. Retrieved July 25, 2011 from <http://www.iimahd.ernet.in/egov/ifip/oct2008/stephen-ruth.htm>
- [19] Thapa, D. (2011). The Role of ICT Actors and Networks in Development: The Case Study of a Wireless Project in Nepal. *The Electronic Journal of Information Systems in Developing Countries*, 49(1), 1-16.
- [20] Thapa, D., Sein, M. K., & Sæbø, Ø. (2012). Building Collective Capabilities through ICT in a Mountain Region of Nepal: Where Social Capital leads to Collective Action. *Information Technology for Development*, 18(1), 5-22.
- [21] Thapa, D., & Sæbø, Ø. (2011). *Demystifying the Possibilities of ICT4D in the Mountain Regions of Nepal*. Paper presented at the 44th Hawaii International Conference on System Sciences (HICSS-44), CD-ROM, pp 1-10, IEEE Computer Society, Kuai, Hawaii.
- [22] Thapa, D., & Sein, M. K. (2010, December). *ICT, SOCIAL CAPITAL AND DEVELOPMENT: THE CASE OF A MOUNTAIN REGION IN NEPAL*. Paper presented at third annual SIG GlobDev workshop, Saint Louis, USA.
- [23] Unwin, T. (2005). *Partnerships in Development Practice: Evidence from multi-stakeholder ICT4D partnership practice in Africa*. Paris, place de Fontenoy: UNESCO
- [24] UNESCO. (2010). Nepal en route for introducing ICT in education. *Communication and Information Sector's news service*. Retrieved July 21, 2011, from http://portal.unesco.org/ci/en/ev.php-URL_ID=30622&URL_DO=DO_TOPIC&URL_SECTION=201.html
- [25] Warschauer, M. (2003). *Technology and social inclusion : rethinking the digital divide*. Cambridge, Mass. [u.a.]: MIT Press.
- [26] Wikipedia Free Encyclopedia. *Universal Service*. Retrieved March 12, 2012 from http://en.wikipedia.org/wiki/Universal_service
- [27] Connecting America, The National Broadband Plan. *Download the Plan*. Retrieved March 26, 2012 from <http://www.broadband.gov/download-plan>

KEY TERMS & DEFINITIONS

ICT4D: The full form of the abbreviation is Information and communication Technology for Development. It is usually used when information communication networks are used for the sake of development through e- services like e-learning, e-commerce, tele-medicine, e- governance etc. to raise socio economic standard of life.

Wireless networks: Interconnection between different networks of computer at different places without wired connection.

Wi-Fi: Wireless Fidelity

VoIP: Voice over internet protocol gives a platform for voice communication with the use of internet as a medium.

Digital Gap/Digital divide: There is a huge difference between the people with the access of information and without access of information. In case of developing countries the gap is more. This gap is defined by digital divide or digital gap.

Thai Internet Users' Personality Traits and their Preferred Web Portal's Characteristics

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Abstract

The objective of this research is to identify a web portal's specific functions and layouts that are aligned with personality trait of an individual internet user. This is the first stage of the overall research project that intends to check whether the research instrument, namely the NEO Five Factors Inventory (NEO-FFI), is applicable to assess the personality traits of Thai internet users. Data were collected from an online survey of 207 Thai internet users. The functions/ layouts of a web portal that individuals with different personality traits would like to have were identified. Example pages of a web portal with predefined functions and layouts were mocked up for internet users to rate their preferences. Results from these ratings were used to triangulate with the respondent's designated functions/layouts. The topical contents of the mocked-up web portal are confined only to tourism destinations in Thailand.

Keywords:

Thai internet users, Personality Traits, NEO Five Factors Inventory, Web portal's characteristics

Introduction

How to mesmerize a website user has always been a challenge to system developing community. One of the perhaps most sought after schemes is to attract users to use, reuse, stay longer on the viewing page and so on. An effective website is

the one that asks for minimal data from a user but it is able to display the information that user finds most relevant and useful. However, different users need different information. The challenge is to come up with what a user wants to see. This is true especially when a single web portal is developed to address the needs and behaviors of many different users.

In analyzing web search behaviors, search engine specialists found that web users are less likely to search information only from many complex, popular websites because searching activities are quite time consuming. Rather, these users would prefer to get right to a particular page that has the content that they want. Thus, they tend to spend time screening and reading through blocks or using probable keywords to search from the search engine website, such as Google. Then most users would rely on the networks of links found relevant by the search engine's algorithm to retrieve their needed information.

However, even though search engine usage has become a habit by today's internet users, it is questionable whether this search behavior is really effective, if so, why users often switch from one website to another. From such phenomena, it reckons that the search result from such web search is not satisfactory enough to fulfill users' expectation. There is a chance that users may have personal preference that might subject to their

individual personality traits. Therefore, a good design strategy for website attributes is to have appealing display together with well structure layout. These factors can influence users' satisfaction with their website experiences. We then propose that if the website can be constructed to best suit with an individual user's personality trait, it would increase the level of satisfaction during their information searching and selecting activities.

The web search activity can be categorized into two groups: searching and browsing. When users browse and find that the content does not match with their expectation, they usually leave those pages immediately. Therefore, the effective website shall forecast what users' expectation are. Consequently, website identity is crucial in order to solve such problem [11].

Can a website have personality?

If websites could have different personality traits, individual users would have different experiences with the website accordingly. Since a different design can stimulate different emotion in a person, therefore, during a website interface design, consideration shall be made toward other dimensions as well, such as various degrees of appealing appearance and emotion [9]. This research aims to create the web portal to serve individuals by considering the tool that is able to evaluate personality trait prior to actual use. The success of a website is subjected to how to identify pattern of users and able to respond appropriately. However, there might be some differences in message display and graphic user inference in each web page [13].

Where personality comes from?

Personality is an individual identity inherited from birth and influenced by socialization [8]. The development of personality is an accumulation of life activities. The accumulated activity leads to individual personality. Trait Theory portrays habitual patterns of a person's behavior, thought, and emotion. Personality traits are relatively stable over time, differ across individuals and

influence behaviors. Overt behavior reflects a person's inner self or one's personality trait when he or she responds to external stimuli [4]. Thus, personality trait defines a person's behaviors and differentiates one individual from another [1]. There are two types of personality traits: Common Traits which are common to people who are from the same culture, same tribe, same value systems; Personal Disposition Traits which are individual characteristics influencing ones' behaviors.

The Five-Factor Personality Trait

The five factor personality trait theory indicates that pattern of behavior is related to individual because inner forces push emotion to play role over actions and feeling [2]. The five-factor personality trait has been studied over 50 years in five dimensions. D.W. Fiske (1949) is the first pioneer in this field. The five-factor personality trait has been studied by several researches (Norman, 1967; Smith, 1967; Goldberg, 1981; McCrae & Costa, 1987). Eksi and Otrar (2001) studied trait from the pattern of thinking behavior. [6][5] McCrae and Costa's theory (1992) became a landmark study in personality evaluation [10]. They classified people according to dimension, which were neuroticism, extraversion, openness, agreeableness, and conscientiousness.

The categorization of trait can be conducted through observations. The more people do things regularly, they tend to have those trait. Gordon Allport (1975) suggested that trait might be changed when the perception changes [1]. Therefore, the assessment of personality trait is active, dynamic and unsuitable for monitoring. The factor analytic theory (Raymond B Kettle, 1950) classified trait into 16 groups. Myers-Briggs Type Indicator (MBTI)'s theory believes that trait is subject to the personal interest and motivation. Table 1 illustrates the comparison of four personality trait theories by Raymond Bernard Cattell (1950), Hans Jurgen Eysenck (1947), MBTI (1962) and Five-factor Personality Trait (1992). [4] [7] [12]

Table 1: Comparison of Personality Trait Theories

Type of Trait	Factor Analytic Theory (Raymond Bernard Cattell (1950))	Three Dimensions of Personality (Hans Jurgen Eysenck (1947))	Myers-Briggs Type Indicator (MBTI, 1962)	Five-factor Personality trait (1992)
1	(Emotional)	Neuroticism	X	(Neuroticism) High sensitive/nervous
	(Apprehensive)			
	(Tense)			
2	(Stable)	Emotional Stability	X	(Neuroticism) Low secure/confident
	(Placid)			
	(Relaxed)			
3	(Outgoing)	/Extroversion	Extroverts (E)	(Extraversion) High outgoing/energetic
	(Assertive)			
	(Happy-go-lucky)			
	(Venturesome)			
	(Group-dependency)			
4	(Reserved)	/Introversion	Introverts (I)	(Extraversion) Low solitary/reserved
	(Humble)			
	(Sober)			
	(Shy)			
	(Self-sufficient)			
5	(Imaginative)	X	Intuitive (N)	(Openness) High inventive/curious
	(Experiment ion)			
6	(Practical)	X	Sensor (S)	(Openness) Low consistent/cautious
	(Conservative)			
7	(Tough-minded)	X	Thinker (T)	(Agreeableness) High friendly/ compassionate
	(Trusting)			
	(Forthright)			
8	(Tender-minded)	X	Feeler (F)	(Agreeableness) Low cold/unkind
	(Suspicious)			
	(Shrewd)			
9	(Conscientious)	X	Judger (J)	(Conscientiousness) High efficient/ organized
	(Controlled)			
10	(Expedient)	X	Perceiver (P)	(Conscientiousness) Low easy-going/ careless
	(Indiscipline Self-conflict)			
11	(Intelligent)	X	X	X
12	X	(Psychoticism)	X	X

Methodology

The present study is part of a larger research inquiry to investigate and develop an innovative web portal with personality trait. This is the first stage of the overall research project that intends to check whether the research instrument, namely the NEO Five Factors Inventory (NEO-FFI), is applicable to assess the personality traits of Thai internet users. The present study also attempts to identify the functions/ layouts of a web portal that individuals with different personality traits would like to have. Example pages of a web portal with predefined functions and layouts were mocked up for internet users to rate their preferences. Results from these ratings were used to triangulate with the respondent's designated functions/layouts. The topical contents of the mocked-up web portal are confined only to tourism destinations in Thailand.

The sampling frame of this study comprises internet-users with the age ranging from 12-90 years old. The data were collected through snowballing technique. The sample size of 150 persons serves as the subjects in this study. The traits were classified by five factors with positive and negative polar making a total of 10 personality traits as shown in Table 2.

Table 2: Classification of Personality Traits

Personality Trait	Positive Trait	Negative Trait
Neuroticism (N)	N+ (Sensitive/Stable)	N- (Secure/Confident)
Extraversion (E)	E+ (Outgoing/Social Accretive)	E- (Private/Reserved)
Openness (O)	O+ (Inventive/Novelty)	O- (Traditional/Unchanged)
Agreeableness (A)	A+ (Friendly/Compassionate)	A- (Self-Centered/Impartial)
Conscientiousness (C)	C+ (Efficient/Organized)	C- (Easy going/Careless)

Data collection Tool

In order to examine the functions and layouts of a web portal that a person with different personality trait would prefer, an online survey instrument was developed. The questionnaire comprises three parts:

Part 1 is to assess a person's personality trait using the "NEO Five-Factors Inventory (NEO FFI)" which was developed based on the Five-Factor Personality trait originated by Fiske (1949). Later, the NEO™ Inventories: NEO™ Personality Inventory-3 (NEO™-PI-3) was developed and commercialized by Costa & McCrae (2004). This inventory comprises 60 personality trait assessment items. The inventory had been translated into Thai and was used by in a few studies by some Thai scholars (Smithikrai, 1999; Arpapronkul, 2004). Using the Revised NEO Personality Inventory method, T-score were calculated in order to classify individuals into different personality traits.

Before applying these inventory items to the Thai internet users, a pilot study with 52 internet users (29 males and 23 females) was conducted using the original 0-4 points Likert scale measure (0=Totally Disagree to 4=Strongly Agree). Based on the standard T-scores, the Neuroticism+ personality trait represented the highest number of respondents (15.38%) and Extraversion+ and Conscientiousness+ equally lowest (5.77%). All ten-personality traits were found in the pilot study, confirming the applicability of the instrument for Thai internet users, the setting of the present research.

Part 2 of the online questionnaire includes asking respondents to identify the functions and layouts that they would want or prefer to have in a web portal. User interface design principles are used to identify functions and layouts of a web portal. Also, existing web portal's functions and layouts were pinpointed, i.e., social media and social con-

nectedness, automatic grouping and sequencing of contents, user's evaluation, wiki look alike content contribution, extraneous widget/icon presentation (horoscopes, IQ games, advertisements) and so on. These functions were included for the respondents to choose.

Also in this part, example pages designed for a web portal of tourist destination in Thailand were developed based on assorted behavioral implications of individuals with different personality traits. Respondents were also asked to rate the pages using Likert scale 1-5 where 1 is the least favorable and 5 the most favorable. To make sure the numbers of example pages were manageable, only simple and clear layout will be used with varying functions. Results from these favorably rated functions were triangulated with the scores received from the respondent's chosen functions. It is expected to find the type of functions and layouts that would fit to the personality trait of a given internet user.

Part 3 are demographic data, including gender, age, occupation, and the average number of hours per week as well as the number of times per week of respondent's using internet.

Results

A total of 207 internet users responded to the on-line survey. Table 3 outlines the subject's characteristics. On the average the participants are 24 years old (77.78%), the maximum age is 60 and the minimum is 12. A little more than half are male participants (54%). In terms of occupation, the majority works in private companies (44.44%) and many indicated that they are still studying (31.88%). The largest number of participants received a bachelor degree (86.47%). In terms of the regularity of internet's and web portal's usages, over one third of the subjects, 37.68% and 34.30% respectively, had more than 40 hours per week on the internet and more than 30 times per week on web portals.

Thai Internet Users' Personality Traits

For each participant, his/her personality trait scores were calculated and classified according to

the Five Factors Theory. Table 4 shows the percentage of personality traits as manifested in Thai Internet users. Among all ten traits scoring as individual "Prime" trait, the highest percentage of respondents (16.91%) was found to be N-(Secure/Confident) and the lowest percentage (3.86%) to be A+ (Friendly/Compassionate). However, taking the same ten traits, 16.43% of respondents were found to be O- (Traditional/Unchanged) and 6.28% to be E- (Private/Reserved). For those who see themselves as being N-, the most dominating combined-pair trait is someone who is secure, confident, efficient and organized (N-C+). Likewise, for those with an O- minor trait, the most dominating mixed traits for them are traditional, unchanged, secure, and confident (O-N-).

Table 3: Subject's Characteristics (N=207)

Characteristics	Dimension	Subjects (%)
Age (Years)	< 20	4.35%
	20 - 25	77.78%
	> 25	17.87%
Gender	Male	54.00%
	Female	46.00%
Occupation	Student	31.88%
	Government Officer	2.90%
	Private Company	44.44%
	Others	20.77%
Education	Below undergraduate	5.31%
	Undergraduate degree	86.47%
	Master degree	7.25%
	Beyond Master degree	0.97%
Experience – Average number of hours per week on Internet (Hours)	< 10	12.08%
	10 - 20	18.84%
	21 - 30	17.87%
	31 - 40	13.53%
	> 40	37.68%
Weekly Usage of Web Portals (Number of time)	<5	12.56%
	5 - 10	17.87%
	11 - 20	23.67%
	21 - 30	11.59%
	> 30	34.30%

Table 4: Percentages of Personality Traits for Thai Internet Users

Personality Trait	Respondents with “Prime” trait (%)	Respondents with “Minor” trait (%)	Dominating Mixed Traits
(1) Neuroticism +	23 (11.11%)	22 (10.63%)	N+O- (Sensitive/Stable; Traditional/Unchanged)
(2) Neuroticism -	35 (16.91%)	18 (8.70%)	N-C+ (Secure/Confident; Efficient/Organized)
(3) Extraversion +	20 (9.66%)	16 (7.73%)	E+O+ (Outgoing/Social Accretive; Inventive/Novelty)
(4) Extraversion -	16 (7.73%)	13 (6.28%)	E-A- (Private/Reserved; Self-centered/Impartial)
(5) Openness +	19 (9.18%)	25 (12.08%)	O+C+ (Inventive/Novelty; Efficient/Organized)
(6) Openness -	20 (9.66%)	34 (16.43%)	O-N- (Traditional/Unchanged; Secure/Confident)
(7) Agreeableness +	8 (3.86%)	20 (9.66%)	A+E+ (Friendly/Compassionate; Outgoing/Social Accretive)
(8) Agreeableness -	27 (13.04%)	17 (8.21%)	A-O- (Self-centered/Impartial; Traditional/Unchanged)
(9) Conscientiousness +	22 (10.63%)	27 (13.04%)	C+E- (Efficient/Organized; Private/Reserved)
(10) Conscientiousness -	17 (8.21%)	15 (7.25%)	C-A- (Easy going/Careless; Self-centered/Impartial)
Total	207 (100%)	207 (100%)	

Preferred Web Portal’s Characteristics

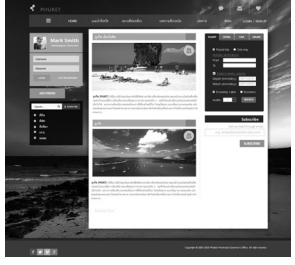
In an attempt to come up with personality traits of a web portal, its characteristics that coincide with the nature of user’s personality traits was identified and tested by first using the “text-based description” of a hypothetical design for a web portal’s layout and function and then using the “graphic-based illustration.” As shown in Table 5, about half and over number of respondents whose “Prime” personality trait are E+, O+, and A+ chose by ranking the hypothetical design of web portal’s layout and function from its corresponding “text-based description,” 60%, 58%, and

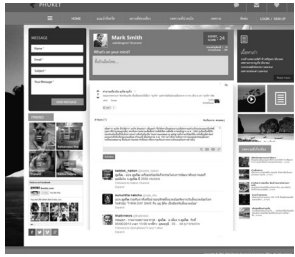
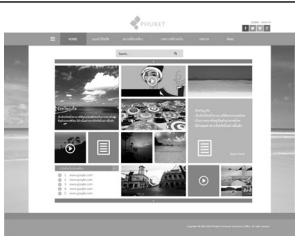
50% respectively. For A- individuals, only 22% of them rank the text-based description of corresponding layout and function to be the highest.

Graphic-based illustration received a totally different ranking preference. As shown below, the layout and function of graphic corresponding to N+ personality trait received almost 70% of top rank rating. It is possible that this is the first graphic being seen on the online questionnaire of this section, so it was chosen first by everyone. Also, it might be the static nature of the picture that make no different for participants after the ranking.

Table 5: Percentage of Respondents with the Highest Ranking on the Hypothetical Design for the Web Portal’s Layout and Function Correspondingly to Individual Personality Trait

Personality Trait	“Text-based Description”	%	“Graphic-based Illustration”	%
(1) Neuroticism +	Automatic classification of contents by display only the predefined topics	39.13%		69.57%

Personality Trait	“Text-based Description”	%	“Graphic-based Illustration”	%
(2) Neuroticism -	Display variety of contents that allow users to rearrange the layout and encompass social network links with recommendation system	42.86%		17.14%
(3) Extraversion +	Emphasize links to social networks with friends and outsiders blog management and recommendation systems	60.00%		25.00%
(4) Extraversion -	Draw search content with keywords by topic; Display variety of information with online reservation support	43.75%		37.50%
(5) Openness +	Having assessment systems that summarize critiques and with rank ordering of related contents with links to outside sources of data	57.89%		31.58%
(6) Openness -	Diary and personalized web management capability with history tracking and in-depth and complete, relevant data display	45.00%		20.00%

Personality Trait	“Text-based Description”	%	“Graphic-based Illustration”	%
(7) Agreeableness +	Wiki-like capability for content sharing and recommendation system with variation and continual changes in the content and presentation formats	50.00%		37.50%
(8) Agreeableness -	Compare and assess needed contents from various sources with previously retrieved data	22.22%		14.81%
(9) Conscientiousness +	Flexible and independent content management with fixed layout based on the type of content	36.36%		18.18%
(10) Conscientiousness -	Randomly display variety of contents from the recommendation system by topic only and mainly using picture and video at the starting point	35.29%		29.41%

To further analyze the difference between female and male participants, Table 6 shows that female participants ranked the text-based description that is more consistent with their personality traits than the male counterparts. However, no gender difference was found with respect to graphic-based illustrations.

Table 6: Gender Difference and Consistency Ranking

Personality Trait	Text-based Description		Graphic-based Illustration	
	Female	Male	Female	Male
(1) Neuroticism +	1	4	1	1
(2) Neuroticism -	2	3	1	1
(3) Extraversion +	3	3	1	1
(4) Extraversion -	4	1	1	4
(5) Openness +	5	5	1	1
(6) Openness -	6	6	1	1
(7) Agreeableness +	5	3	7	1
(8) Agreeableness -	2	4	1	1
(9) Conscientiousness +	9	1	1	4
(10) Conscientiousness -	10	10	10	1

Discussion and Conclusion

The result shows that the Five Factor Personality Traits theory is applicable to this setting since all ten traits were spread out across the Thai Internet users in this study [10]. Many of these users saw themselves as being Secure/Confident (N-). The finding can perhaps explained by the respondents' demographic – their average age is 24 years old. Very few see themselves as being Friendly/Compassionate (A+). Avid internet users might just really be “couch-potato” at their young age. Not too surprising that traditional/unchanged (O-) was found to be the minor trait maintained by quite a few respondents. The hypothetical design of web portal's layout and function by using text-based description shows more consistent to personality trait than by graphic-based illustration. This is perhaps caused by the static nature of the mock-up web page. The authors plan to develop an interactive version of the web portal that dynamically varies by the personality trait of a particular user.

References

1. Allport Gordon W Letters from Jenny, New York: Harcourt, Brace & World, Inc. ., 1956.
2. Bacanlı, H., İlhan, T. ve Aslan, S, Beş faktör kuramına dayalı bir kişilik ölçeğinin geliştirilmesi: sıfatlara dayalı kişilik testi (SDKT). Türk Eğitim Bilimleri Dergisi, 7 (2), . 2009, pp. 261-279. Quoted in DENİZ M. Engin, (2011) “An Investigation of Decision Making Styles and the Five-Factor Personality Traits with Respect to Attachment Styles,” Kuram ve Uygulamada Eğitim Bilimleri, Educational Sciences: Theory & Practice , 11(1) Winter, pp. 105-113.
3. Cattell, Raymond B., Personality and Motivation Structure and Measurement, World Book, New York,1957.
4. Cattell, Raymond B., Personality a Systematic Theoretical and Factual Study, New York, McGraw Hill, 1950.
5. Costa, Paul T., Jr., McCrae, Robert R., **Revised NEO Personality Inventory, PAR Publishers** 2004.
6. DENİZ M. Engin, “An Investigation of Decision Making Styles and the Five-Factor Personality Traits with Respect to Attachment Styles” in Kuram ve Uygulamada Eğitim Bilimleri, Educational Sciences: Theory & Practice - 11(1) Winter, 2011, pp. 105-113.
7. Eysenck, Hans Jurgen, Dimensions of Personality, **Transection Publishers**, New Brunswick, New Jersey, 1947.
8. Hamarta Erdal, Selçuk University, Social Sciences Institute, Konya. Quoted in DENİZ M. Engin, (2011) “An Investigation of Decision Making Styles and the Five-Factor Personality Traits with Respect to Attachment Styles” in Kuram ve Uygulamada Eğitim Bilimleri, Educational Sciences: Theory & Practice - 11(1) Winter, 2004, pp. 105-113.
9. Hekkert, P. and Schifferstein, H. N. J., "Introducing product experience," in Product Experience, N. J. S. Hendrik and H. Paul, Eds San Diego: Elsevier, 2008, pp. 1-8.
10. McCrae, R.R., & Costa, P.T. “Personality trait structure as a human universal,” American Psychologist, 52, 1997, pp. 509-516.
11. Minxiao Lei; Fan, L., "A web personalization system based on users' interested domains," Cognitive Informatics, Proceeding of the 7th IEEE International Conference, 14-16 Aug. 2008, pp.153, 159 (doi: 10.1109/ COGINF. 2008, 4639163).
12. Myers, Isabel Briggs and Peter B. Myers, Gifts Differing: Understanding Personality Type, Mountain View, CA: Davies-Black Publishing (1980, 1995).
13. Vila Natalia, Kuster Ine ' s, “Consumer feelings and behaviors towards well designed websites,” Information & Management, Vol. 48, No. 4 (May), 2011 pp.166-177.

Use of ICT for Betterment of Quality of Life (QOL)

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Abstract

In today's world, information is considered as power. ICT is extensively used by individuals and organizations in their business through storage and manipulation or translation of digital data. Data management is a part of knowledge management system that prevents reinventing the wheel. Time is money if managed properly. ICT is a proven tool for time management in any business model. The productive use of ICT is widely acknowledged as an important catalyst in this process. Use of ICT provides more time to concentrate on the other aspects of one's business. In line with these stylized facts, this paper has analyzed the use of IT in achieving efficiency in personal management. Efficiency in personal management is further analyzed in relation to quality of life. This paper has highlighted the contribution of ICT in improving personal management leading to improved quality of life.

Keywords:

Information, Communication, Knowledge, Management, Business

Introduction

The term quality of life (QOL) refers to the general well-being of individuals and societies. The term is used in wide range of contexts, including the fields of international development, health-care, and policies. However QOL should not be confused with standard of living, which is primarily based on income. Instead, standard indicators of the quality of life, include not only wealth and employment, but also the built environment, physical and mental health, education, recreational and leisure time, and social belonging. ICTs

are becoming increasingly vital in our day-to-day living, but societies in general are never short of population segments which need additional encouragement and awareness to integrate ICTs in their lives. Information communication technology has advanced rapidly from past to the present time. The quality of life has been uplifted with this enhancement in technology. The way works are done has changed rapidly.

Today's ICT offers different and greater opportunities in this respect than it did in developments in the 1980s. It is the "communication" in the element in the ICT, which through allowing access to and manipulation of the same data and information by multiple workers and organizations, across space and time, which enhances organizational trends: blurring boundaries of working time and work location, growing importance of relationships with clients and partners, increasing role of communication skills in workers' profiles, new production rhythms in industry and services, networking and outsourcing.

Over the past few decades, advancements in Information and Communication Technology (ICT) have ushered in rapid transformations in various sectors such as health, agriculture, communication, entertainment, transportation, manufacturing, infrastructure development, etc. [1].

According to a Policy paper by Prof. Dinesh p. Chapagain [2], in Nepal, real progress in the IT arena took-off only from 1995 onwards after a large number of offices went for automation and universities and colleges started offering courses on computer science and computer engineering. Liberation of the communication sector facilitates the rapid

growth in IT business with the dominant participation of the private sector. Moreover rapid growth took place in the telecommunication services. The distribution of telephone lines increased from about 65,000 in 1992 to over 422,000 at the end of 2004. The tele-density of 1.4% (2003) is expected to increase to 15% by 2017. Half of the country's VDCs have telephone connectivity. In addition, there are more than 70,686 post-paid mobile subscribers and 172,894 prepaid mobile subscribers. A number of ICT enabled services have developed during the decade and being implemented with the strong role of the private sector.

Some of the notable ICT enabled services in use in Nepal are call centers (international enquiry routing), medical transcription (for hospitals in US), digitization (of geographical maps), e-commerce (on-line mail orders), e-publications (local broad-sheet dailies, newsletters), cyber-cafes (in urban cities), audio-visual broadcasting (radio, television), e-education (distance learning), tele-medicine (used by some NGOs), e-library (libraries of Tribhuvan University and Kathmandu University linked up with oxford University library) and e-registration (college/training applications/registration).

Some statistics provided by ITU on the use of ICT is shown below in the table.

	Year 2013 (Per 100 Inhabitant)
Fixed telephone subscription	
Developed	41.6
Developing	11.1
World	16.5
Mobile – cellular subscriptions	
Developed	128.2
Developing	89.4
World	96.2
	Year 2013 (%)
Households with internet access at home	
Developed	77.7
Developing	28.0
World	41.3

Individuals using the internet	
Developed	76.8
Developing	30.7
World	38.8
*Source: ITU World Telecommunication/ICT Indicators database	

Table 1 – Key ICT indicators for developed, developing and world

These enhancement and use of ICT in many sectors has certainly enhanced the quality of life. Regarding the changed quality of life this paper has discussed on the following areas..

- How the advancement in ICT has improved the business?
- How ICT is used in education?
- How ICT is used for management?

ICT in business

Information communication and technology has become a vital part of today's business. ICT is used more and more in decision making. It allows the member of the business to gather information from variety of sources. It has also helped in presentation and processing of the data or the information, it is now possible to easily present statistics to the peers that one has gathered and processed. It has also allowed instant worldwide communication. Multi-national companies can easily have conference meeting or share information among its branches very easily.

Use of ICT in business brings flexibility of work. ICT is also used in the production as it can be used for both design and to create goods. The use of ICT brings about a general reduction in errors and wastage of a company's resources. Computer aided Manufacturing (CAM) helps with the manufacturing processes, this may be through computer aided robots building cars, printing, sewing or robots to take materials to certain destinations.

To the question why business use ICT the simple answers are to reduce cost or to reduce price or both. Low price mean that there may be an increase in the sales leading to increased revenue and profit.

And low cost mean more competitive and increase in profit. Using IT, staff records or the customer records can be maintained easily and effectively with a quicker access when the data or information is to be fetched. With the increase in the advancement of ICT the online business like online shopping has been impressing customers, as it can fulfill their needs on a mouse click. Now-a-days almost anything can be bought with if internet access is available. This form of buying and selling has certainly helped the business personal and the customers. This development has helped uplift the quality of life.

ICT in education

Education is regarded as a key factor for a quality of life. There is a common misconception that ICT based education is about teaching students computer skills. ICT- based education is about using computers and technology as tools to enrich learning in various subjects such as English, Science and Mathematics.

Key Benefits of ICT-based Education according to OLE:

- Promotes learning by doing approach
- Enables self-placed learning
- Provides access to wide range of up-to-date learning materials
- Enriches learning through a combination of audio, video, images, text and animation
- Enhances learning through interaction and collaboration
- Provides a platform that engages students

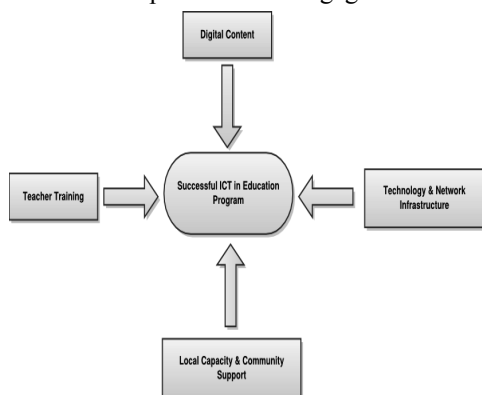


Figure 1 – The use of ICT in learning process

ICT can play a vital role in shaping policies for education.

The growing use of ICT in further and higher education brings clear benefits of administrative efficiently and increased effectiveness in teaching, learning and researches. Some examples are:

- E-learning, and especially versions with media content, are increasing the storage and processing of information within data centers, which are very useful
- Since lot of research papers and other information available can help enhance knowledge of students. Also the email facility has increased the interaction with professors
- The increasing adoption of ICT in universities and colleges has improved teaching and learning environment

ICT applications: benefits in all aspects of life

ICT applications can support sustainable development, in the field of public administration, business, education and training, health, employment, environment, agriculture and science within the framework of national e-strategies. This would include actions within the following sectors [3]:

1. E-health

- Promote collaborative efforts of governments, planners, health professionals, and other agencies along with the participation of international organizations for creating a reliable, timely, high quality and affordable health care and health information systems and for promoting continuous medical training, education, and research through the use of ICTs, while respecting and protecting citizens' right to privacy.
- Facilities access to the world's medical knowledge and locally-relevant content resources for strengthening public health research and prevention programmes and promoting women's and men's health, such as content on sexual and reproductive health and sexually transmitted infections, and for diseases that attract full attention of the world including HIV/AIDS, malaria, and

tuberculosis.

- Alert, monitor and control the spread of communicable diseases, through the improvement of common information systems.
- Promote the development of international standards for the exchange of health data, taking due account of privacy concerns.
- Encourage the adoption of ICTs to improve and extend health care and health information systems to remote and underserved areas and vulnerable populations, recognizing women's roles as health providers in their families and communities.
- Strengthen and expand ICT-based initiatives for providing medical and humanitarian assistance in disasters and emergencies.

2. E-employment

- Encourage the development of best practices for e-workers and e-employers built, at the national level, on principles of fairness and gender equality, respecting all relevant international norms.
- Promote new ways of organizing work and business with the aim of raising productivity, growth and well-being through investment in ICTs and human resources.
- Promote teleworking to allow citizen, particularly in the developing countries, LCDs, and small economics, to live in their societies and work anywhere, and to increase employment opportunities for women, and for those with disabilities. In promoting telenetworking, special attention should be given to strategies promoting job creation and the retention of the skilled working force.
- Promote early intervention programmes in science and technology that should target young girls to increase the number of women in ICT carries.

3. E-environment

- Governments, in cooperation with other stakeholders are encouraged to use and promote ICTs as an instrument for environmental protection and the sustainable use of natural resources.
- Government, civil society and the private sector are encouraged to initiate actions and implement projects and programmes for sustainable production and consumption and the environmentally safe disposal

and recycling of discarded hardware and components used in ICTs.

- Establish monitoring systems, using ICTs, to forecast and monitor the impact of natural and man-made disasters, particularly in developing countries, and small economics.
- Monitoring forest area, forest fire landslides and flashfloods is also successfully done by using ICT.

4. E-agriculture

- Ensure the systematic dissemination of information using ICTs on agriculture, animal husbandry, fisheries, forestry and food, in order to provide ready access to comprehensive, up-to-date and detailed knowledge and information, particularly in rural areas.
- Public or private partnerships should seek to maximize the use of ICTs as an instrument to improve production (quantity and quality).
- Forecasting disease epidemic irrigation control, and technology transfer are the successful uses of ICT in agriculture.

5. E-science

- Promote affordable and reliable high-speed Internet connection for all universities and research institutions to support their critical role in information and knowledge production, education and training, and to support the establishment of partnerships, cooperation and networking between these institutions.
- Promote electronic publishing, differential pricing and open access initiatives to make scientific information affordable and accessible in all countries on an equitable basis.
- Promote the use of peer-to-peer technology to share scientific knowledge and pre-prints and reprints written by scientific authors who have waived their right to payment.
- Promote the long-term systematic and efficient collection, dissemination and preservation of essential scientific digital data, for example, population and meteorological data in all countries.
- Promote principles and metadata standards to facilitate cooperation and effective use of collected scientific information and data as appropriate to conduct scientific research.

Analysis of the Motivator of the Use of Social Network Services

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Abstract

With a focus on Facebook, the most popular social network service(SNS), this research tried to find out which type of motivation makes users to spend more time on the SNS and in the same vein, which type of motivation makes users to believe that they will continue to use the SNS. The result shows that the need for play (entertaining) and image as social reputation affect the current amount of use, while the needs for information search, building relationship, and entertainment would make them continue to use.

Key words:

Social Network Services (SNS), motivator, amount of use, intention for repeated use.

1. Social Network Service

Social Network Service (SNS) is a service to support or facilitate an on-line extension of off-line network among people by helping them to share personal profile [3]. SNS help users to conveniently post pictures, texts, or other contents so that members can share them easily. People use SNS as a window of communication to share personal opinion, experience, and situation as well as a tool develop and maintain the link with others. There are different types of SNS:

community-based SNS, mini-homepage type SNS, blog, micro-blog, profile-based services. Depending of the type of SNS, the behavior of user tends to differ.

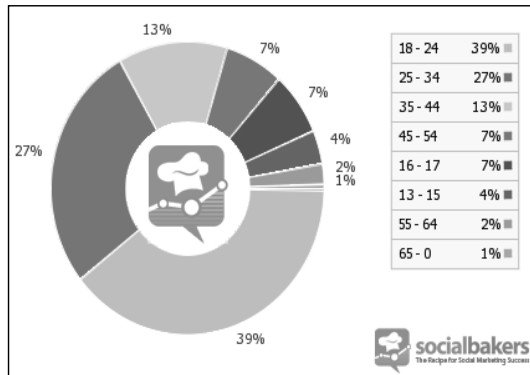
Companies try to use SNS for marketing purpose as SNS can be used to understand the behavior of consumers and to convey advertising information. The influence of SNS sometimes extended beyond social and economic arena into political activities.

This research aims to examine the relationship between the use of SNS and various types of psychological and social motivations to use such services. This research specifically focused on the use of Facebook, the most popular SNS in Korea and also in most countries.

According to Socialbakers.com, which collects and announces statistics on the use of SNS, the largest number of users of Facebook resides in the USA; 154,760,400 or 49.89% of the whole population and 64.69% of Internet users (as of 2012. 3. 31) In Korea, the number of Facebook users is 6,697,900; 13.77% of the whole population and 16.98% of Internet users (as of 2012. 3. 31).

In the case of Korea, 58% of the users of Facebook are male. 39% of the users fall in the age group between 18 and 24, and 27% of the users fall in the age group between 25 and 34 ([Figure 1]).

Figure 1- Use of Facebook in Korea by age



(source: Socialbakers.com)

2. Media Usage Motivation

Analysis of the usage motivation of media is considered useful in understanding the patterns of the behavior of media users [6]. Armstrong and Hagel [1] suggested interest, fantasy, relationship as the typical motivation to participate in on-line communities. The use of SNS should be related to both personal and social motivation.

1) Personal Motivators

According to Wang and Fesenmaier's (2004) framework motivation to use SNS includes the functional motivation to acquire information, entertaining motivation to pursue enjoyment, and the desire to express one's self. It is worth to note that Wellman [16] pointed out that people have an intrinsic desire to share and exchange information. On the other hand, in a research on the behavior of on-line word-of-mouth Hennig Thureau et al., [7] identified such motivators as altruistic motivation to help other consumers, self-expression motivation, and motivation to develop social relationship.

This research includes the needs for information acquisition, self-representation, relationship development, altruism and entertainment as personal motivator variables.

2) Social Motivators

Social influence is an important factor in the use of media. Social influence is the degree of

influence the social expectation or peer pressure exerts on one's behavior within the context of the social community where one belongs [13]. The expected evaluation of personal community affects one's behavior especially when one decides on the use of new and innovative media. Specifically the desired or expected image from peers or neighbors and subject norm affects the adoption of innovation [14].

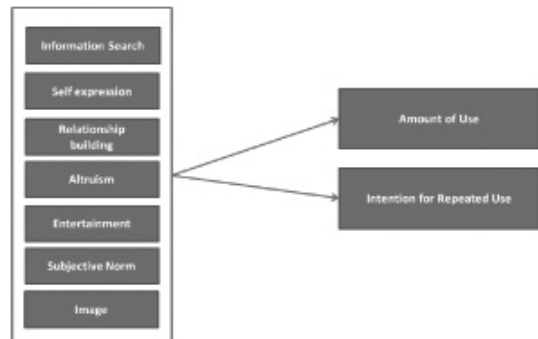
According to Ajzen and Fishbein [5] subjective norm means the personal perception of others' opinion which is expected to form the referent criteria of the peer group or important individuals. Image implies the degree by which one's social reputation and communal status improve by the adoption and use of innovation [8]. Venkatesh and Davis [14] emphasized that information technology users tend to improve their social image within the reference group. Image is also related to one's subjective norm.

This research includes the subjective norm and image as social motivator variables.

3. Research Model and Method

The seven personal and social motivators are hypothesized to affect the use of SNS. In designing the use of SNS, we included both the current and future uses of SNS. Current use of SNS is the amount of time they spend to use SNS, which the future use is considered to be reflected to respondents' intention to continue to use the SNS repeatedly. For this reason, the research model include 7 independent variables and 2 dependant variables.

Figure 2 - Research Model



- H1. Personal and social needs are positively related to the amount of the use of Social Network Services.
- H2. Personal and social needs are positively related to the Intention for continued use of Social Network Services repeatedly.

<Table 1> and <Table 2> summarizes the operational definitions of the independent and

Table 1 - Operational Definition of Independent Variables

	Variable	Definition
1	Information search	Need to acquire information and solve problem
2	Self expression	Motivation to use SNS to represent one's self
3	Relationship building	Motivation to use SNS as a tool to develop and maintain social relationship
4	Altruism	Motivation to use SNS to help others
5	Enter-tainment	Motivation to use SNS as a tool to pursuit entertainment and enjoyment
6	Subjective Norm	One's perception of the influence of the thought of important people around one about dos and don'ts
7	Image	One's perception of the improvement of social status within one's community by adopting a new technology or innovation

Table 2 - Operational Definition of Dependent Variables

	Variable	Definition
1	Amount of Use	Average amount of the time one spend to use SNS
2	Intension for Repeated Use	One's intention to continue to use the SNS

dependant variables respectively.

A questionnaire survey was administered to test

the research model. The Data were collected from Facebook users in Korea using both Facebook itself and off-line contact. Total 350 responses were collected. As many of the responses included missing items, only 284 questionnaire responses were used for model test.

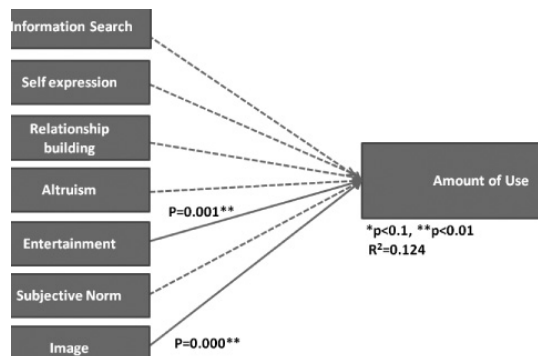
4. Research Results

Analysis of the demographic nature of the sample shows that 56.3% of the respondents were male and 84.9% of the respondents were in their 20s.

As shown in <Appendix>test of the validity of research variables using factor analysis showed the same factor structure as suggested by the research model.

Reliability test using Cronbach's α showed that reliability of all the variables fell within acceptable level (0.718 ~ 0.855) except two variables; information search and relationship building. Although the reliability of these two variables was below 0.6, these two variables were maintained for the purpose of the research intention.

The research model was tested using multiple regression analysis. The results of the test are summarized in [Figure 3] and [Figure 4]. [Figure 3] is the regression result on the dependent variable of the amount of the use of SNS. Only two independent variables (entertainment and image) were found to significantly affect the amount of use. [Figure 4] shows the result of regression result on the intention to continue to use the SNS. Two variables (relationship building and entertainment) were found to significantly affect the intention for continued use, while the motivation for information



search showed a minor influence.

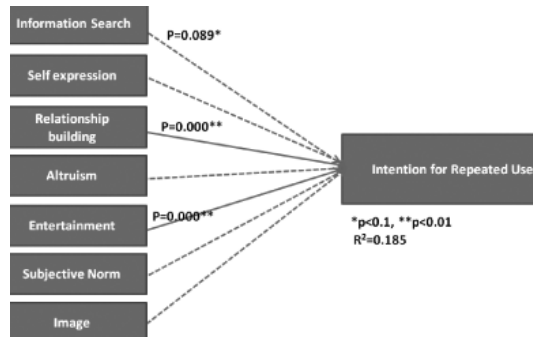


Figure 3 - Regression Result on the Amount of Use

Figure 4 - Regression Result on the Intention for Repeated Use

5. Conclusion

This research attempted to examine the effect of various personal and social motivation on the use of Social Network Service with a focus on the use of Facebook in Korea.

The research showed that the level of the needs for entertainment and social image development within the community affected the amount of the use of SNS. The result implies both certain aspect of personal and social motivation serve as the determinant of the amount of the use of SNS.

The research also showed that the level of the needs for entertainment and social image development within the community affected the amount of the use of SNS. Interestingly, personal aspects of motivation dominate in determining the level of intention for repeated use of SNS.

Entertaining motivation is a factor that consistently affects both current use and future intention to use SNS. As the influence of other aspects was not consistent across current use and future intention to use, future research should focus on the reason for this difference and the diminishing effect of social motivation.

References

- [1] Armstrong, A. and Hagel, J., "The real value of on-line communities," **Harvard Business Review**, 74, 3, 1996, pp.134-141.
- [2] Arulchelvan S. and D. Viswanathan, "Pattern of usage of various electronic media by higher education students", *International Journal of Education and Development using Information and Communication Technology*, Vol.2, No.4, 2006
- [3] Boyd, D. M. and Ellison, N. B. "Social Network Sites : Definition, History, and Scholarship," **Journal of Computer-Mediated Communication**, Vol. 13, 2007, pp. 210-230.
- [4] Brandtzaeg, P. B. and Heim, J. "Why People Use Social Networking Sites," **Online Communities**, Vol. 56, No. 21, 2009, pp. 143-152.
- [5] Fishbein, M., & Ajzen, I., "Belief, attitude, intention, and behavior: An introduction to theory and research," **Reading, MA: Addison-Wesley**, 1975.
- [6] Flanagin, A. J. and Metzger, M. J., "Internet use in the contemporary media environment," **Human Communication Research**, Vol.27, 2001, No.1, pp.153-182.
- [7] Hennig-Thurau T., Gwinner K.P., Walsh G., Gremler D.D. (2004), "Electronic Word-of-Mouth via Consumer-Opinion Platforms: What Motivates Consumers to Articulate Themselves on the Internet?," **Journal of Interactive Marketing**, Vol.18, No.1, 2004, pp.38-52.
- [8] Moore, G.C. & Benbasat, I., "Development of an Instrument to Measure Perceptions of Adopting an Information Technology Innovation," **Information Systems Research**, Vol.2, 1991, No.3, pp.192-222.
- [9] Richter, M. Koch (2008), "Functions of Social Networking Services. In: Proc. 8TH International," Conference on the Design of Cooperative Systems.
- [10] chaefer, Cora (2008), "Motivations and

- Usage Patterns on Social Network Sites,” ECIS 2008 Proceedings. Paper 143.
- [11] Shanyang Zhao (2008), Sherri Grasmuck and Jason Martin, "Identity Construction on Facebook: Digital Empowerment in Anchored relationships", *Computers in Human Behavior*, Vol. 24, Issue 5, pp.1816-1836.
- [12] Shih, C. F.; Venkatesh, A.,(2004), “Beyond adoption: development and application of a use-diffusion model,” *Journal of Marketing*, Vol.68, pp.59-72.
- [13] Venkatesh, V. and Brown, S “A longitudinal investigation of personal computers in homes: Adoption determinants and emerging challenges,” **MIS Quarterly**, Vol.25, No.1, 2001, pp. 71-102.
- [14] Venkatesh, Viswanath. and Davis, Fred., “A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies,” **Management Science**. Vol. 46, No. 2, 2000, pp. 186-204.
- [15] Wang, Y., and Fesenmaier, D. R. (2004), “Towards understanding members’ general participation in and active contribution to an online travel community,” *Tourism Management*, Vol. 25, No.6, pp. 709–722.
- [16] Wellman, B. “Are personal communities local? A dumptarian reconsideration,”**Social Networks**, 18, 1996, pp.347-354.

Appendix - Result of Factor Analysis

	Factor							
	Intension for Repeated Use	Altruism	Enter-tainment	Image	Subjective Norm	Self expression	Information search	Relationship building
Int2	.837	.098	.249	-.065	-.049	.120	.011	.014
Int3	.820	-.077	-.033	.060	-.026	-.021	.050	.064
Int1	.804	.133	.204	.079	.077	-.049	.097	.085
Mo_8	.125	.854	.082	.149	.048	.099	-.035	.052
Mo_7	-.036	.745	.072	.156	.114	.179	.090	.260
Mo_10	.101	-.006	.890	.051	.043	.047	.124	-.082
Mo_9	.223	.098	.853	.017	-.063	-.005	.069	.150
Mo_13	.053	.211	.060	.842	.244	.153	.023	.098
Mo_14	.031	.157	-.003	.840	.291	.154	.017	.026
Mo_11	-.050	.071	.021	.162	.906	.074	.012	-.001
Mo_12	.054	.074	-.021	.343	.817	.067	.061	.082
Mo_4	.080	.072	.069	.126	.168	.886	-.092	.118
Mo_3	-.063	.343	-.022	.183	-.028	.779	.194	.100
Mo_1	.112	.015	.214	-.016	.058	-.024	.867	.168
Mo_2	.091	.563	-.078	.118	.033	.226	.569	-.099
Mo_5	.099	.167	.007	.163	.024	.190	.189	.857
Mo_6	.315	.221	.410	-.250	.191	.044	-.265	.471

Motives in Purchases of ICT Devices: For Need or Merely for Being a Prestige Agent Calling Status and Esteem?

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Abstract

This is a quantitative study intended to investigate certain drives/needs of people such as pleasure, status and esteem in purchasing ICT devices other than use and functionality not considering these to be what they 'have to have'. In awareness of that engineering and marketing departments of companies in consumer electronics market show to follow strategies and policies to meet such needs/intentions of people through designs not merely focusing on functional properties of the devices. A survey is conducted in order to picture the effect of these variables on the sales of ICT devices where findings reached through a group of undergraduate and graduate students verify the idea.

Keywords: Status & Esteem needs, hedonic tendencies, ITC devices sale.

1. Introduction

“The global electrical and electronics sector is highly fragmented, comprising of various auxiliary sectors namely electronic components, computer and office equipment, telecommunications, consumer appliances and industrial electronics.” Split in many small and medium size companies it is in a rising trend for primary reasons such as “increased productivity and higher value added electrical and electronics products” resulting from

“rising and continuous investments in research and development”, raised foreign investments triggering electronic production and exports, extending support to a large number of global industries in medical, telecommunications, automotive [and other] sectors, higher “demand of electronics especially consumer electronics products in the world” as a consequence of the “rising incomes and living standards” and claims “for newer and faster products and applications [3]. As a part of this industry it is “The global consumer electronics [part of] the industry [that] involves [with] the manufacture, distribution and sale of communications and entertainment devices such as digital and video cameras, telephones, stereos, MP3 players, DVDs, VCRs, calculators and televisions [15].

The purchases in global ICT devices do not merely originate from people's needs aimed at their use and functionality where the motives leading such groups of customers could rely on different drives. Human personality is complex and hard to reach for many of these drives affecting the thinking, acting, behaving of a person is based in subconscious. Thus, customers in consumer electronics market could purchase an electronic item simply for its appearance and attractiveness beyond or other than their use and functionality, a preference that could be related to their hedonic

tendencies calling pleasure finally triggering their wants. Accordingly electronic companies in a highly competitive market for profitability and sustainability purposes are also stressing on that stimulus when designing and marketing these groups of devices.

In literature there are a vast number of theories aiming to explain this sophisticated makeup of personality with stressing over principal characteristics of human nature. Concerning with their needs and wants people show not to be all conscious and rational for many times acting in an illogical and irrational way guided/ dominated through powers dominated by subconscious. Consequently, it will be necessary to make a distinction between an individual's needs and wants one being different from the other. While a need is a sort of thing that one has to have, a want is another thing that makes an individual enjoy and to be pleased these meeting his/her other types of essentials such like status and esteem. Pleasure, while being "An emotional experience that many regard as fundamentally undefinable" [14] is commonly being an issue relating to happiness people feel when their wants are satisfied through gaining what they wish to have. Thus in the market while money is spend for needs, similarly it could also be used up to buy something that is liked, enjoyable and additionally being a status symbol that possibly maintains a higher position within the group the person stands. Naturally identical drives count for the buyer in consumer electronic market leading to a number of purchases that are not necessarily a need yet a want. The high number of buys of the black model of the Ipad placed to the market in 2005 following the white model with poor sales after the release of the black one while there is no difference between the two in price and technical qualifications is a good example of that. Apple getting the right lesson [an indication of the possibility that consumer electronics companies not always being aware of the effect of wants in buys beyond needs] through this experience high priced the black model of the Macbook for high demand to be originating mainly by the color of the device [5].

Consequently being equally mentioned by Meadows as cited in [18], Working Paper RES-154-25-005, n.d.) what people really need to have is "identity, community, challenge, acknowledgement, love, [and] joy." The way to satisfy those needs is to fill them with material things through "set[ting] up an unquenchable appetite for false solutions to real and never-satisfied problems." However it is still possible for a society to "admit and articulate its nonmaterial needs and find nonmaterial ways to satisfy them would require much lower material and energy throughputs and would provide much higher levels of human fulfilment."

2. Literature Review

What lies in roots of consumerism in common are the needs and wants of individuals strongly tied to their hedonic tendencies leading them to reach pleasure whether consciously or unconsciously.

Hedonism is commonly defined as seeking pleasure (what is an equivalent of good) and keeping away from pain (what is an equivalent of bad) as argued by Socrates. However, in reality tending to reach pleasure most people are not aware of things making him/her happy [17]. The idea formulated and flourished in the Hellenistic period through the Stoic school (310 BC) is a reaction to the understanding articulating pleasure as the only good while pain is always bad admitting that nothing can make an individual happy or unhappy against his/her own will. The origin of the word pleasure basically rests in the human physical desires and needs that the individuals urge to fulfill [11]. While Epicurus "believed that the true life of pleasure consisted in an attitude of imperturbable emotional calm which needed only simple pleasures, a healthy diet, a prudent moral life (based on contractual agreement), and good friends", today "Epicureanism" is understood in a different manner indicating "a sensuous, profligate life style or gourmet tastes." [13]. There are a number of theories on hedonism. While 'psychological hedonism' claims that

“people are motivated solely by the desire for the maximum degree of pleasure, and invariably act on the stronger of conflicting desires”, for ‘ethical hedonism’ pleasure is the only ultimate good where individuals should not be after [solely] for their own sake. Additionally, ‘rational hedonism’ is one “arguing that the true philosopher should study to separate his soul from his body by cultivating wisdom and weaning himself from physical pleasures.” [1]

The idea that most people being not aware of things making them happy or unhappy is also stated by Freud arguing that people not to have a control over their own selves where this makes them incapable to take decisions or to have dominance over their wants and desires based in unconscious [16] stressing the role of “unconscious processes as motivators of behavior” [14]. To Freud “unconscious is the notion that when the subject’s loss of authority with respect to his own mental states is due to a process... called ‘repression’; [where] these states are subject to transformations which render them unrecognizable by the subject and may have pathological consequences” (Honderich, 1995). Dijksterhuis and Nordgren[4] presenting the Unconscious-Thought Theory on human thought distinguish among unconscious and conscious as two different modes of thought having different characteristics each mode being preferable depending on the situation. “Contrary to popular belief, decisions about simple issues can be better tackled by conscious thought, whereas decisions about complex matters can be better approached with unconscious thought.” Ruled by the capacity principle while “conscious thought is constrained by the low capacity of consciousness” the other mode “Unconscious thought does not have this constraint” for having a capacity considerably higher than the conscious one. “Conscious thought by necessity often takes into account only a subset of the information it should take into account.”

Maslow similarly “viewed human potential

as vastly underestimated and an unexplained territory” [9]. In his ‘hierarchy of needs theory’ human needs are categorized in five levels starting from physiological [basic survival] needs to self-actualizing needs where within steps of the ladder the individual hopes to become a member of a group [belongingness and love needs] and further desires to be recognized, have a high status beyond increased responsibilities in the group as a result of his/her esteem needs [2]. While ‘belongingness and love needs’ is a manifestation of the need of affiliation that “is the need to interact with and be psychologically close to others” [12], esteem needs relates the tendencies of individuals “to feel adequacy, strength, achievement, confidence, independence, and freedom; also, to obtain attention, reputation, prestige, recognition, importance, and appreciation from others” [10].

Consumption of certain goods and services what really are not needs but ‘wants’ similarly plays a role in the group as a way of messaging their higher status to the ‘other’. As stated by Giddens [6] “Consumption refers to the goods, services, energy and resources that are used up by people, institutions and societies... also [being] a way of thinking, a mentality or even an ideology.” While consumers consume goods “simply because consumer goods have ‘use-value’ for people... luxury items fit [ting] this explanation less well” for these “show another side to modern consumerism; its role on the social status competition within society.” Modern consumerism is also demarcated with “its pleasurable aspect” whereas argued by some sociologists “the pleasure of consumerism does not lie in the *use* of products but in the *anticipation* of purchasing them... [this] is the most pleasurable part of the process; the wanting, the longing after, the seeking out and desiring of products, not the use of them. It is a ‘romantic ethic’ of consumption based on desire and longing.”

Subject to his “Sensible Model” stressing on that “human instincts for trying unconsciously

to display certain desirable personal traits”, an alternative to previously stated based on “consumerism as natural” and “consumerism as cultural oppression” models [10] has the sense that consumer capitalism makes us to “buy things because we think we’ll enjoy owning and using them.” He believes that “Biology offers an answer” to the question of why people still have to be in a [vicious circle of] working, buying and aspiring as such pleasures resulting from acquisition that are “usually short lived at best”. To his idea “Humans evolved in small social groups in which image and status were all-important, not only for survival, but for attracting mates, impressing friends and rearing children.” The aim in “ornamenting ourselves with goods and services” is more than to “enjoy owning a chunk of matter” where that is really being directed to “make an impression on other people’s minds.” “Many products are signals first and material objects second. Our vast social-primate brains evolved to pursue one central social goal: to look good in the eyes of others. Buying impressive products in a money-based economy is just the most recent way to fulfill that goal.” For Miller [10] the luxury goods are fitness indicators “advertising fundamental biological traits such as good genes, good health, and good social intelligence” that have a function as to “attract mates, intimidate rivals, deter predators, and solicit help from parents and kins.”

To Solomon (2003) it is a time mirroring the kingdom of customers where today they are much more aware about their choices and buys. However, he also mentions that beyond being manipulated through mass media tools there are “large-scale efforts... often with impressive success... to channel our thinking habits, our purchasing decisions, and our thought processes by the use of insights gleaned from psychiatry and social sciences.”

Depending all theories/assumptions mentioned in above paragraphs hedonic demands under unconscious influences show to guide the

tendencies of individuals in purchasing certain goods and services that always not showing to be ‘needs’ but happening to be ‘wants’ servicing their needs in having a superior status in the group, consumers of ITC products being one.

3. Research Method

3.1. Operationalization of research variables

A study is conducted through the measurement of survey questions on each study variable through a 5-point Likert scale (1. Strongly Disagree, 2. Disagree, 3. Neutral, 4. Agree, 5. Strongly Agree). In order to prevent the respondents’ hesitation when filling the paper other than the higher reliability of the survey a note is included in the questionnaire explaining the term electronic device mentioning that to mean ICT devices (consumer electronics) such as cellular phones, personal computers, MP3’s, digital cameras, digital televisions, and DVDs. Respondents are also asked to state their sex and age beyond whether they happen to be a undergraduate or graduate student details given below.

3.2. Data collection procedure and Respondent’s profile

The study is conducted between October-December, 2012 over a group of distant education undergraduate and graduate students where out of the 200 questionnaires 128 are returned in adequate form. Of the 128 students 75 were male and 53 are female age average being 34, age range differing in 24-48. The breakdown of the total number of students returning the questionnaires according to undergraduate and graduate groups are consequently 70 (44 male, 26 female) and 48 (31 male, 17 female).

4. Research Results

The content of the questionnaire and replies of the respondents based on a 5-Digit Likert Scale in percentage basis are given in Table 1.

Table 1 - List of questions and respondents' replies depending on a 5-Digit Likert Scale (%)

	Questions	Not Agreed	Poorly-Agreed	Neutral	Much Agreed	Fully Agreed
1	Electronic devices are purchased merely for their functionality.	3,87	8,53	2,33	47,29	37,98
2	Attractive design of an electronic device is a factor in its purchase.	2,36	13,39	3,15	61,42	19,68
3	In electronics market price is an indication of quality.	3,94	14,96	14,17	53,54	13,39
4	An appealing model electronic device used is an indication of the status of an individual in the group.	27,78	25,40	12,7	29,36	4,76
5	Electronic devices are designed in an attractive form beyond their functionality to have higher market share.	4,69	7,81	7,03	55,47	25,00
6	Type and quality of an electronic device is a factor upgrading the status of a person having that.	28,35	31,50	10,24	22,83	7,08
7	Individuals spending higher and providing more of the electronic devices are those of a higher status in society.	43,85	32,31	12,31	11,53	0,00
8	Sale of a multi-purpose and high quality electronic device is poor if not have a sales appeal.	9,09	22,73	25,76	37,12	5,30
9	Use of an appealing model and high price electronic device is a factor fostering the person's self-respect and confidence.	12,31	26,92	14,62	37,69	8,46
10	High-priced electronic devices are more functional than lower priced ones.	7,03	28,91	21,09	37,50	5,47
11	Electronic devices designed and marketed merely based on their functionality disregarding attractiveness.	29,03	41,94	16,13	11,29	1,61
12	In consumer electronics market attractiveness is a more significant factor compared to functionality in sales.	7,81	32,03	17,19	36,72	6,25
13	Brand and model of an electronic device used is a factor indicating the status of the individual within the group.	19,84	31,75	17,46	26,19	4,76
14	Purchase of electronic devices merely for their attractivity of the design, brand and model is a common trend.	3,15	4,72	9,45	55,91	26,77

In analyses of the survey with 5-digit Likert scale Reliability & Item Analysis is used where Cronbach's Alpha results of 0,985 is obtained providing proof for the high reliability of the questions. In other words, questions included

in survey are satisfactory enough to explain the subject.

Basic statistics obtained for each question are given in Table-2 below.

Table 2 - Item statistics

	Mean	Std. Deviation	N
Q1	4,01	1,057	120
Q2	3,77	,968	120
Q3	3,51	1,012	120
Q4	2,48	1,236	120
Q5	3,82	1,021	120
Q6	2,36	1,222	120
Q7	1,87	,961	120
Q8	2,95	1,044	120
Q9	2,90	1,170	120
Q10	2,95	1,028	120
Q11	2,10	,999	120
Q12	2,90	1,056	120
Q13	2,54	1,137	120
QS14	3,93	,909	120

The Item-Total Statistics table directed to the entirety of the survey given below (Table-3) presents the Cronbach's Alpha in case item Deleted in the final column of the table.

Table 3 - Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Q1	38,06	161,484	,878	,985
Q2	38,30	164,212	,849	,985
Q3	38,56	161,946	,901	,984
Q4	39,59	155,975	,929	,984
Q5	38,25	162,391	,875	,985
Q6	39,71	156,578	,920	,984
Q7	40,20	164,262	,853	,985
Q8	39,12	159,969	,952	,984
Q9	39,17	157,165	,943	,984
Q10	39,12	160,625	,941	,984
Q11	39,97	162,537	,890	,985
Q12	39,17	160,056	,936	,984
Q13	39,52	157,831	,948	,984
Q14	38,14	165,148	,866	,985

'Cronbach's Alpha if Item Deleted statistics' when examined indicates that there is no question which needs not to be included in the

questionnaire. Accordingly, all questions included in the questionnaire are practically of the equal significance. However, based on the 'Corrected Item-Total Correlation' statistics the highest correlation meaning the peak related value (0,952) contingent with the purpose of the survey happens to be the statement in question 8 wording "Sale of a multi-purpose and high quality electronic device is poor if not have a sales appeal." In contrary, lowest correlation value (0,849) shows to be the Question 2 uttering that "Attractive design of an electronic device is a factor in its purchase."

6. Conclusion and Comments

The purpose of the research is to see whether ICT devices are to be purchased for the needs or wants of the purchaser that are really two different things. As commented by Huffstetler [8] while a need is something that one have to have for survival purposes, a want is something that one like to have. As long as "life is meant to be lived, not to be survived" people could throw some money for their wants in case they can afford it.

Accordingly, customers in buying ITC devices sometimes could merely act according to their wants, not needs. Reasons for such a "want" is tied to the need of an individual to have a place in the group where beyond that to have a status within that to meet his esteem needs as stated in the 'hierarchy of needs' approach of Maslow where at that point a need turns to be a want. Wishing to have an appealing model, high-price consumer electronic device that the person do not really need not to have seems to be a tendency reflecting the status and esteem desires of the individual.

The results of the survey have clues verifying the idea. When ranked depending on the strength of correlation values (Table-3) from highest to lowest (Q8, Q13, Q9, Q10, Q12, Q4, Q6, Q3, Q11, Q1, Q5, Q14, Q7 and Q 2) images relating to ICT goods are as follows:

- Low sales if no sales appeal (Q8).
- Appealing brand and model indicating status (Q13).
- Appealing model and high price fostering

self-respect and confidence (Q9).

- High-price meaning higher functionality (Q10).
- Attractiveness significant than functionality (Q12).
- Appealing model an indication of status (Q4).
- Appealing model upgrading status (Q6).
- Price an indication of quality (Q3).
- Design and marketing merely for functionality (Q11).
- Purchases merely for functionality (Q1).
- Design in attractive form for higher market share (Q5).
- Purchases merely for attractiveness of the design, brand and model being a common trend (Q14).
- Higher spending and provision an indication of higher status (Q7).
- Attractive design a factor in purchase (Q2).

While depending on the ranking, respondents confirming the assumptions mentioned, some of the respondents such as Q5, Q14, Q7 and Q2 (according to their order of significance) have lower correlation values poorly proving outcomes reached above. That of the Q5 (ITC devices to be designed in an attractive form beyond their functionality to have higher market share) possibly results from the lack of knowledge of the respondents for this happens to be a reality as in the case of the Macbook mentioned in paragraphs above. Relating to Q14 and Q7 (wording attractiveness/status symbol characteristics of the purchases) these survey questions are intentionally designed in a way stressing the 'definite importance' of these determinants to see the comebacks of the respondents resultantly showing to be unimpressed from the idea. Q2 indicating the 'Attractive design of an electronic device is a factor in its purchase' being the one with lowest correlation value signifies a valuation contradicting the general opinion needing some interpretation.

Thus the results of the survey ordinarily reveal the significance of certain determinants on the purchases of the ICT devices. Likewise these also verify the importance of such factors in designing

the status and self-esteem of the people owning these. Producers of these goods being aware of the weaknesses of the individuals to be originating from their hedonic tendencies calling pleasure and self-gratification and the dominant role of the subconscious suppressing the will value the appeal, form, so design and attraction of a product beyond its functionality when marketing.

However, the study has limitations for being conducted on a limited group attached to a certain socio-cultural background that believed to guide the respondents. When based on a rather larger group of respondents tied to different social and cultural backgrounds the results could be somewhat dissimilar and even be contradicting with findings of the that one.

References

- [1]. Blakemore, Colin & Jennett, Sheila, *The Oxford Companion to the Body*, **Oxford University Press**, 2001, <http://www.encyclopedia.com/topic/hedonism.aspx> (Jan 11, 2013)
- [2]. Daft, Richard L., **Management. Fourth Edition. The Dryden Press**, 1997
- [3]. Digitivity, *Electrical and Electronic Industry Overview*. (n.d.), <http://www.digitivity.com/industry-overview.html> (April 27, 2013)
- [4]. Dijksterhuis, Ap and Loran F. Nordgren, *A Theory of Unconscious Thought. Perspectives on Psychological Science*, Vol. 1, No. 2, 2006, pp. 95-109 <http://www.alice.id.tue.nl/references/dijksterhuis-nordgren-2006.pdf> (May 05, 2013)
- [5]. Frank, Robert H., *The Economic Naturalist: Why Economists Explain Almost Everything*, Basic Books, 2007. Giddens, Anthony, *Sociology*, **Polity Press**, 2009
- [6]. Hall, Calvin, S. & Lindzey, Gardner, *Introduction to Theories of Personality*, John Wiley & Sons, 1985
- [7]. Huffstetler, Erin, *Wants vs. Needs. How to Distinguish Between the Two*, About.com Frugal Living. (n.d.), <http://frugalliving.com>

- about.com/od/frugalliving101/qt/Wants_vs_Needs.htm (09.06.2013)
- [8]. Maslow, Abraham H., Stephens, D.C. & Heil, G., Maslow on Management, John Wiley & Sons, 1998
 - [9]. Miller, Geoffrey, Spent. Sex, Evolution and Consumer Behavior, Viking, 2009 http://www.amazon.com/Spent-Sex-Evolution-Consumer-Behavior/dp/0143117238#reader_B0023SDQFI (May 05, 2013).
 - [10]. Miner, John, B., Industrial-Organizational Psychology. Psychology Series, McGraw-Hill, 1992.
 - [11]. Mitchell, T. R. & Larson, J. R. Jr., People in Organizations. An Introduction to Organizational Behavior, McGraw-Hill, 1987.
 - [12]. Pojman, Louis, P., Classics of Philosophy, **Oxford University Press**, 1998.
 - [13]. Reber, Arthur S., The Penguin Dictionary of Psychology, **Penguin Books**, 1985.
 - [14]. ReportLinker, Consumer Electronics Industry: Market Research Reports, Statistics and Analysis, n.d., <http://www.reportlinker.com/ci02060/Consumer-Electronics.html> (April 29, 2013)
 - [15]. Russ, Jacqueline, L'aventure de la Pensée Européenne. Une histoire des Idées Occidentales, Université-philosophie, Armand Colin, 1995.
 - [16]. Soccio, Douglas, J., Archetypes of Wisdom: An introduction to Philosophy, **Wadsworth Publishing**, 2006.
 - [17]. Soper, Kate and Thomas, Lyn, 'Alternative Hedonism' and the Critique of 'Consumerism', CC Programme Working Paper. RES-154-25-005. 'Cultures of Consumption' Phase Two, Working Papers, n.d.. http://www.londonmet.ac.uk/library/g71374_24.doc (May 11, 2013).

A Descriptive Case Study on the Routinization of IT Service Management (ITSM)

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Abstract

In order to realize the benefits of ITSM, it is necessary to institutionalize ITSM into the organizational culture. Currently, efforts to routinize ITSM lack in practice, and research in this area is also lacking.

This study identifies the factors affecting the routinization of ITSM through literature review and interviews with experts, selects a company that has successfully routinized ITSM, and analyses the activities, methods, and procedures employed by the company on the factors in detail. The specific factors analyzed in the study include fulfillment of the customer requirements, top management support, communication, change management, training and education, quality of the ITSM system, and capability of the personnel.

Important points verified in this study is that in order to realize organizational performance from ITSM, just the adoption of ITSM is not enough, but the routinization of ITSM through continuous and systematic management and improvement with the support of top management are required.

Since this study is a descriptive case study, results of the study cannot be generalized. However, the study will provide practical information that can be referenced by the organizations attempting to routinize ITSM. In addition, results of the study will provide a basis of future research in ITSM.

Keywords:

IT Service Management (ITSM), ITSM Routinization, Descriptive Case Study

Introduction

With the recent advent and growth of the new technology and services, such as cloud computing, social network service, and smart phone, attention to and importance of IT management in business are increasing as well. While traditional IT management focused on IT infrastructure and was technology-oriented, the recent focus of IT management is on business and is customer-oriented. In this respect, businesses are striving to provide the higher quality of services to customers, and adopting and utilizing IT Service Management (ITSM). The ultimate goal of ITSM is to provide customer-oriented services at a reasonable cost.

In Korea, the concept of ITSM was introduced around mid 2000. In the initial period, large IT service providers and banks dominated the adoption of ITSM, but recently, the adoption is being diffused to mid-sized companies. According to a study [14], the domestic ITSM market in 2011 is expected to grow more than 5% from the previous year, and the sector shows a steady growing trend. Now, ITSM is not an option taken by a few advanced companies, but it has become an indispensable system for all organizations.

However, of the organizations that have adopted ITSM, there are few that actively perform the activities to routinize their ITSM. A major reason for adopting ITSM is to provide customers with value by supplying low cost, high quality, and customer-oriented services [17]. This goal cannot be achieved by just establishing ITSM processes and implementing the system. In order

to realize the benefits of ITSM, it is necessary to institutionalize ITSM into the organizational culture. Currently, efforts to routinize ITSM lack in practice, and research in this area is also lacking, even though some research has been performed on the aspects of adoption and implementation of ITSM.

The goal of this study is to identify and analyze the factors affecting the successful routinization of ITSM. To achieve the research goal, this study first identifies the factors affecting the routinization of ITSM through literature review and interviews with experts. Then it selects a company that has successfully routinized ITSM, and analyses the activities, methods, and procedures employed by the company on the factors in detail.

This study belongs to a descriptive case study, and suggests the idiographic results that can be applied to a specific situation rather than nomothetic statement that can be generalized to any organizations. Therefore, even though results of the study cannot be generalized, the study will provide practical information that can be referenced by the organizations attempting to routinize ITSM. In addition, results of the study will provide a basis of future research in ITSM.

This paper is organized as follows: In Chapter 2, the existing literature on the concept of ITSM, concept of routinization, and the factors affecting the routinization of ITSM is reviewed. In Chapter 3, the factors affecting the routinization of ITSM are identified, and the detail items to be analyzed are described. Chapter 4 explains an overview of the case company and results of the analyses. Finally, Chapter 5 summarizes the implications and limitations of the study and future research directions.

Literature review

Concept of ITSM

ITSM is defined in various ways. itSMF (IT Service Management Forum), which is a global forum formed to advance the ITSM practices,

defines ITSM as 'collection of all activities related to overall IT life cycle to develop and operate high quality IT services' [18]. Garter defines it as 'a collection of process, organizational capability, and technology necessary to provide the reasonable and expectable IT service' [7]. In another study [13], the objective of ITSM is 'to maximize business value of IT service portfolio to achieve required performance in a given cost structure'.

A common definition of ITSM does not exist. However, taking all the definitions into consideration, ITSM, in a narrow sense, means the approach to manage operations of IT systematically based on business, enterprise, and service perspectives beyond traditional technology focused perspective. In a broad sense, the scope of ITSM includes not only operations of IS, but all aspects of IT such as planning, development and monitoring of IT [9].

Concept of routinization

Since ITSM can be regarded as an innovation adopted by organizations, the concept of routinization can be referenced by technology innovation theory. Kwon and Zumd [15], which is one of the most referenced theories, proposes six stages of technology adoption: initiation, adoption, adaptation, acceptance, routinization, and infusion. Initiation is a process in which organizational problems/opportunities are scanned, and information are collected and evaluated. Adoption is a process of negotiations to obtain organizational support and resource commitment for IT implementation. Adaptation is a process in which IT application is developed and installed; both the organizational procedures and IT are modified to achieve a better fit. Acceptance is a process of encouraging employees to commit to using the IT application. Routinization is a process of routinized usage of the IT application. Lastly, infusion is a process of integrating the IT application into the organization's work processes to fully utilize its potentials. A later study, Wang, et.al, [25] simplified the process into three stages: initiation, adoption/ adaptation, and acceptance/

routinization/infusion. In this study routinization is the third stage of Lee & Wang's model and means the stage that involves operating ITSM and inducing employees to use the system as a part of their work process.

Factors affecting the routinization of ITSM

Since the topic of routinization of ITSM has been studied very rarely, studies on the adoption and implementation of ITSM are reviewed, and the factors affecting the adoption and implementation of ITSM are identified.

The identified factors can be classified into external, organizational, managerial, technical, and individual categories, and summarized in Table 1.

Table 1 - Factors affecting the adoption and Implementation of ITSM

Category	Factors	reference
External	integration of customer and market; relationship with vendor/consultant; fulfilment of customer requirements	[26], [23], [10]
Organizational	integration of strategy and goal; top management support; organizational role and responsibility; communication; evaluation and compensation	[13], [4], [27], [22], [21], [10], [20]
Managerial	management process standardization; process management; change management; training and education	[13], [4], [19], [5], [8], [12], [3], [1], [11], [2], [10]
Technical	IT resource monitoring; strategic dashboard; interoperability with existing systems; system quality	[13], [8], [1], [27], [20], [24]
Individual	belt level and capability; productivity	[4], [11], [6], [21]

Research method and the case company

Research method

This study adopts a case study strategy, and the reasons for selecting the strategy is as follows: Currently, the number of organizations that have adopted ITSM is less than 100, and the research on the routinization of ITSM has been performed scarcely [16]. In these circumstances, therefore, the research topic is not mature enough to perform an explanatory study through hypothesis testing,

and even if hypothesis testing is attempted, the sample size is not enough [26]. Accordingly, it is decided to perform a case study, which is easier to understand the phenomena in detail rather than a hypothetical-deductive analysis.

In this context, this study reviews and analyzes the deliverables, reports, and other related documents that have been produced by the case company in the process of implementing ITSM, and performs a series of in-depth interview to ensure triangulation of evidence. Interview with an ITSM expert of the case company is performed three times during a 2-month period. In the first interview, the factors and detail items identified through literature review are verified from the practical point of view and final factors and items are determined through the advice of

an expert. In the second interview, the relevant documents related to the factors are collected and the additional questions are asked. In the final interview, the contents summarized by the research team are presented and the contents are modified if necessary.

The case company

This study selects a company that is regarded as successfully routinized ITSM as a case. The

case company is one of the largest Korean SI companies, and shows successful performance after continuous routinization efforts since the adoption of ITSM in 2004. One of the special reasons for choosing the company as a case is that one of the authors of this paper has worked for the company in the ITSM area, and consequently, data accessibility is high. From this perspective, this study has an element of an action research.

The case company is an IT solution firm providing the integrated IT services ranging from development of IS to operations of IS. Major business areas of the company include outsourcing, solution based business, solution distribution, and systems integration.

Progress made by the company on the implementation of ITSM is summarized in Figure 1. Firstly, the company made a decision to adopt ITSM in 2004, and completed the development and implementation of ITSM in 2007. Since then, the company has performed various efforts to routinize ITSM by attempting to improve the operational level of ITSM through 6 Sigma technique. During the process, the company has successfully obtained the international certifications such as ISO/IEC 20000 and CMMI Level 5. In addition, the ITSM system developed in-house obtained the Korean national quality certification (Good Software). Since 2011, the company continues to improve ITSM to deliver more business value from IT services.

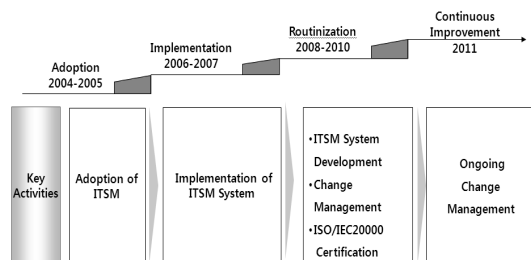


Figure 1 - progress made by the case company on the implementation of ITSM

One indicator showing that the company has

succeeded in the routinization of ITSM is the level of ITSM operations. The company has been assessing the level of ITSM operations annually. As can be seen in Figure 2, the score for internal ITSM operations had increased by 15 points from 73.3 in 2006 to 88 in 2010. The ITSM operations score for external customers increased dramatically (from 27 in 2008 to 80 in 2010).

Taking the progress made and the level of operations into consideration, there seem to be enough evidence to regard the company as a success case that has routinized ITSM.

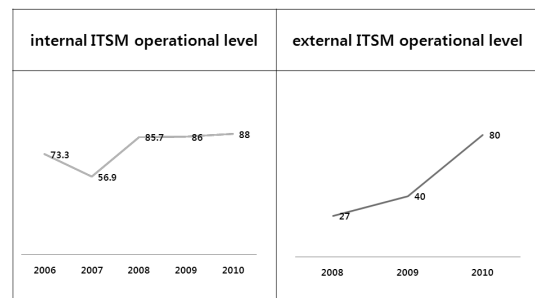


Figure 2 - ITSM operations score of company A

Factors and detail items to be analyzed

Of the factors identified through literature review, 7 factors are selected to be analyzed in the study after combining the overlapping and similar factors and consultation with the expert. The specific factors to be analyzed include fulfillment of the customer requirements, top management support, communication, change management, training and education, quality of the ITSM system, and capability of the personnel.

Table 2 summarizes the factors to be analyzed, definition of the factor, and detail items to be analyzed.

Table 2 - factors to be analyzed in the study

Factor		Definition	Detail Items
External	fulfillment of the customer requirements	satisfaction of the customer needs and reflection of the feedback (complaints)	- customer requirements management scheme - types of customer requirements - methods of receiving and responding to the customer requirements - time to receive and process the customer requirements
Organizational	top management support	support activities performed by the top management to routinize ITSM	support activities performed by the top management
	communication	interest and involvement of the employees in the routinization of ITSM	- major means of communication - key communication activities
Managerial	change management	activities and performance of change management for the routinization of ITSM	- key change management activities - degree of improvement achieved through change management
	training and education	ITSM related training and education for the IT personnel	- training and education program - training and education results
Technical	quality of the ITSM system	quality of the ITSM system and improvement efforts	- quality of the ITSM system - activities performed to improve the quality of ITSM system
Individual	capability of the personnel	level and capability of the ITSM personnel	6 sigma belt level of the ITSM personnel - productivity of the ITSM personnel

Results of the analyses

Fulfillment of the customer requirements

Customer requirements management scheme

The company operates an independent VOC (Voice of Customer) unit and a consolidated service desk to systematically manage the customer requirements. The customer requirements are handed over to the VOC unit directly without any intermediate processes to respond quickly. VOCs are managed to reflect customers' complaint, feedback and opinions through the customer interview, questionnaire, and happy call system.

Interviews with the customers are conducted every quarter to understand the needs of customers. Survey is performed every year, and complaints and opinions of the customers collected by the

survey are acted upon. Happy calls are made after the completion of the customer requirements to understand proactively whether the customer is satisfied with the measures taken. The following questions are asked to the customers: Do the requests have been processed well?, Is there any inconvenience the service staff has caused?, Do the requests have been handled at the wanted time, and Are there anything to be improved in the future?

Contents of the call with the customers are collected, collated and communicated to the Operations Team, and the root cause analyses are performed to find the improvement options and opportunities.

Types of the customer requirements

The company classifies the customer requirements received in the Service Desk by categories, manages the frequency and trends of the requirements systematically, and attempts to respond to the recurring requirements proactively rather than reactively. Categories of the customer requirements include business system, infrastructure, and PC. Table 3 shows the detailed requirements for each type of customer requests.

Methods of receiving and responding to the customer requirements

The company receives and responds to the customer requirements via the consolidated Service Desk. The customers may send the requirements in various ways, including telephone call, ITSM system, and mail/messenger system. The ways to respond to the customer requests by the type of reception are summarized in Table 4.

Table 3 - Types of the Customer Requests

Category	Type	Detail requirement
Business System	Business System of the Customer Company	program change
		program Development
		data entry, revision, and deletion
		simple inquiry and request
		document and report
		password/ID/IP/right/firewall
		data inquiry/request
		training/meeting/on-site support
Infrastructure	Network	infrastructure change
	Server	service open request
	Others	document inquiry and request
		password/ID/IP/right/firewall
		data inquiry/request
		training/meeting/on-site support
PC	PC	PC incident
	Printer	S/W installation
	Scanner	virus and malware resolution
	Other	network setting
		PC replacement
		inquiry on use of PC
		other

Table 4 - Ways to receive and respond to the customer requests

Method	Response
Telephone Call	① telephone call → ② respond by automatic introduction message → ③ validate and record basic information → ④ validate and record requests → ⑤ confirm whether the request has been resolved → ⑥ register resolution results → ⑦ verify degree of satisfaction → ⑧ report results
Request by ITSM System	① request by ITSM system → ② receive the request on the ITSM system → ③ validate and record basic information → ④ validate and record requests → ⑤ confirm whether the request has been resolved → ⑥ register resolution results → ⑦ verify degree of satisfaction → ⑧ report results
Request by mail/messenger	① request by mail/messenger → register the contents of the request on the ITSM system → ③ validate and record basic information → ④ validate and record requests → ⑤ confirm whether the request has been resolved → ⑥ register resolution results → ⑦ verify degree of satisfaction → ⑧ report results

Time to receive and process the customer requirements

The company has established a consolidated Service Desk and reduced the times to receive and process the customer requests dramatically (see Table 5). Before operating the Service Desk, the average time taken to receive the customer request was 14.3 hours and the average time to process the request after receiving it was 14.2 hours. However, the times have been reduced to 0.3 hours and 3.8 hours, respectively, and the improvement rates show 98% and 73%, respectively. The total time to receive and process the customer requests has been decreased from 28.5 hours to 4.15 hours (improvement rate of 85%) by employing the customer request management system.

Table 5 - Performance comparison before/after the establishment of the Service Desk

	Before establishing the Service Desk		After establishing the Service Desk
average time to receive the customer requests	14.3 hour	→	0.3 hour
average time to process the customer requests	14.2 hour	→	3.8 hour
total time	28.5 hour	→	4.15 hour

Top management support

The CEO of the company has provided considerable interest and support for the routinization of ITSM in the following aspects:

First, since the adoption of ITSM, the CEO receives the report on the utilization of ITSM system on a weekly basis. In addition, the CEO reviews the results of the assessment of the levels

of ITSM operations which is performed 4 times a year. These supervision and directions given by the CEO have played a major role in encouraging the organization units and employees to utilize ITSM actively.

Second, the CEO has paid much attention to and provided support for the human resource development, which is an indispensable element in the routinization of ITSM. In order to develop and retain the ITSM experts, for example, the CEO has mandated all employees to receive the ITSM related training and to obtain the related professional certificate. Furthermore, the results of training and certification are integrated into human resource management system to be considered in determining the promotion and evaluation of the employees. All these efforts seem to play a major role in improving capability of the personnel, which is one of the most important aspect in the routinization of ITSM

Third, it is necessary to satisfy the customers' opinions and resolve complaints of the customers to facilitate routinizing ITSM. In this respect, the CEO has made the newly established VOC unit directly report to him so that he can listen the voice of the field directly.

Communication

Major means of communication

The company is utilizing a groupware to pursue smooth communications among employees. However, the most important communication means related to ITSM is the 'ITSM operations committee'. To facilitate the integrated communications related to ITSM, the company uses not only the technology based communications, such as a groupware, but also a committee composed of the ITSM related personnel and users is established and operated. The objective of the committee is to achieve the best level of ITSM operations in the industry. In order to achieve the goal, the committee meets once a month to collect process improvement requests and other operational issues, and to improve them continuously.

Key communication activities

In the company, key communication activities are performed through the 'ITSM operations committee'. The committee performs the following key activities: First, it shares the assessment results of ITSM operational level, and requests necessary improvement through ITSM operational level management. Second, it contributes to enhancing the level of ITSM operations by collecting and disseminating the best practices of each operational unit. Finally, it provides a forum to discuss issues occurring between the data center and the operation teams.

Change Management

Key change management activities

The company has adopted the 6 Sigma technique as a key mechanism for effective change management. Under the 6 Sigma scheme, the company has performed continuous efforts to find the root causes of IT service incidents, to define them as 6 Sigma projects, and to improve them. Through these efforts, the problem management capability has been improved, and it has been able to eliminate the recurring incidents and/or unknown errors

In addition, the company has developed a tool to diagnose the ITSM operational level and systematically manages the level of ITSM operations. Using the diagnostic tool, the self assessment and expert review are performed 4 times a year to check the degree of ITSM process conformance. Each operation unit measures and evaluates the current status of each diagnosed item quantitatively, and performs the necessary improvement activities.

The company has worked to convert the knowledge on ITSM operations into the formal job manuals. All employees are required to prepare and manage the job manuals, are encouraged to use them, and are provided with incentives based on the extent of contribution in preparation of the manuals. Since the job manuals are prepared by the personnel who actually performs the work, and verified on the enterprise wise basis, the

manuals are prepared in a practical and usable form, and the degree of utilization and ease of use have increased significantly. And through the job manual management system, all personnel can retrieve and utilize the manuals easily, and the internal knowledge on ITSM operations can be systematically accumulated and shared, which have contributed to the effective and systematic provision of IT services. Furthermore, thanks to the systematic management of knowledge and manuals, the problem of personnel turnover, which is often encountered in IT service organizations, can be responded effectively.

Degree of improvement achieved through change management

The areas improved by the change management are diverse. However, in this section, the four areas, including problem management, incident management, job manual management, and customer satisfaction, will be reviewed.

Firstly, in case of the problem and incident management, while the number of problems managed has increased significantly, the number of enterprise level incident has decreased (see, Table 6). As explained earlier, the reduction of errors is mainly due to the improvement of problem management capability through 6 Sigma.

Secondly, the number of job manuals produced has been increased significantly. As explained above, by institutionalizing the job manual management, not only the quantity of manuals has been increased, but many other benefits are also realized. That is, more usable manuals are produced, internal knowledge is effectively accumulated and easily shared, and it becomes possible to respond effectively to the employee turnover.

Finally, customer satisfaction has been improved, too. Thanks to the various change management efforts, including Happy Call, and regular survey and interviews, the service quality has been enhanced by resolving the customers complaints and reflecting customer feedback actively, and as a result the customer satisfaction has been increased.

Table 6 - performance comparison before/after the routinization

	Before Routinization		After Routinization
Number of Problems Managed	3	→	28
Number of Enterprise level incidents	42		30
Number of Job Manuals	87		389
Customer Satisfaction	76.8 points		83.3 points

Training and Education

Training and education program

The company has established and operated a training and education program designed for all personnel involved in IT outsourcing business to familiarize and fully understand the concepts and practices of ITSM.

The training program is divided into the basic training program and the advanced program (Table 7). The basic training program targets new employees, and consists of 5-day course (2-day foundation course and 3-day exam preparation course). On completion of the program, the trainees should take the ITIL Foundation Exam (Exam fee is supported by the company). The advanced education program targets the process managers, and the duration of the program is one week, covering overall ITSM process and detail content related to the operations of ITSM. Similarly, the trainees should take the ITIL Exam and receive merits at the promotion if he/she passes the exam.

Table 7 - training and education program of company A

	Basic Training	Advanced Training
Goal of the program	Increase awareness on ITSM	Develop ITSM process manager
Target Trainee	All ITO related personnel and new employees	process managers
Contents of program	Foundation training on all ITSM process	Detail training on specific process
Duration of the program	foundation 2 days exam preparation 3 days	1 week

Training and education results

The company has been continuously exerting efforts to improve capabilities of the employees by stressing the importance of education and training through leadership of top management. As a result, by 2009, 585 employees completed

the basic training program and 1,084 did the advanced program. In addition, 83% of all employees involved in IT service outsourcing area obtained ITIL certificates.

Quality of ITSM System

Quality of ITSM system

The company adopted an ITSM package developed by a vendor in 2004 when they first adopted ITSM. Many first generation ITSM organizations that have adopted the vendor's package have found themselves encountered with such problems as not being able to respond flexibly to the various business environmental change and customer requests [13]. The company has encountered and identified the similar problems:

Firstly, the utilization rate of ITSM system by customers and operators was quite low. One problem is that low information linkage and unnecessary duplicate inputs have caused delay of work. Additional problem include too many not so useful menu and input items, too many work steps to complete a process, and incorrect data in report, etc.

Secondly, since the ITSM package has applied the global best practices in terms of ITSM process literally, activities to perform are so complex and there are so many work steps that the work efficiency becomes reduced and the conformance of ITSM process and system utilization are negatively affected.

In order to resolve these problems, the company made a decision to develop an ITSM system in-house in 2007. The project began in mid 2008 and completed at the end of the year, and the company was able to secure a quality ITSM system. Recently, part of the ITIL V3 processes was incorporated into the system, and the company is not only using it internally, but also selling it outside. So far, the company has sold to more than 20 organizations in Korea.

In sum, the quality of ITSM system in the initial stage was not excellent. After the significant improvement efforts, the quality of the current

system seems to be satisfactory.

Activities performed to improve quality of ITSM system

As explained before, the company decided to develop an ITSM system in-house to resolve the problems of the existing system. About 30 internal staff and experts have participated in the project, and a system that satisfies requirements of customers and operators was completed at the end of 2008.

Improvements made by the resulting system are summarized in Table 8.

Table 8 - quality of ITSM systemElement

	Improvement results
Satisfaction of requirements of users and operators	requirements and complaints of customers and operators are reflected in the system by the systematic collection and management of them
Ease of use, Flexibility and Linkage with other systems	- user input system is simple - procedures can be modified according to the customers request - users can receive SMS and monitor status of service real time - redundant activities are eliminated, sign off and work procedures are simplified - input time is reduced by minimizing management items - useful reports can be downloaded and utilized on a real time basis - time required to prepared reports is dramatically reduced
Other	reflect requirements of ISO/IEC 20000 standard to ITSM system to obtain the certification

Level and capability of ITSM personnel

6 sigma belt level of ITSM personnel

In order for 6 Sigma technique that has been adopted by the company as a major means of change management to be successful, the employees of the company should be well equipped with the technique. The degree of employee readiness can be measured by the number of employees possessing the 6 Sigma belts.

In the company, the ratio of employees with 6 Sigma belts is quite high. Of all about the 900 employees in the company, 90% of them possess the Green Belt, and 70% have the Black Belt. The high ratios are attributed to the active support of top management, and the policy requiring the Black Belt as a condition in promoting to the manager position.

Productivity of ITSM personnel

Productivity of the ITSM personnel, in terms of the first call resolution rate (FCRR) and the number of service requests processed by an employee, is reviewed below.

FCRR had improved about 10% in 2009 compared with the previous year (Figure 3). The number of service requests processed by an employee has been also improved (Figure 4). As such, productivity of the ITSM personnel in the company shows an increasing trend year by year.

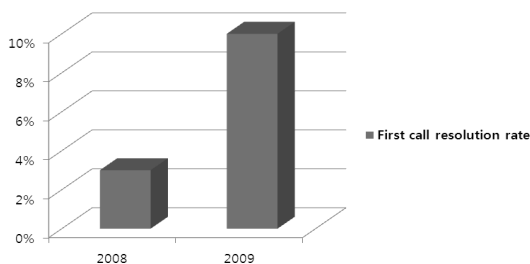


Figure 3 - improvement of first call resolution rate

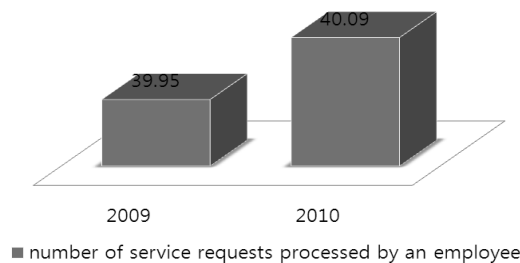


Figure 4 - number of service requests processed by an employee

Conclusions

This study selected the factors affecting the routinization of ITSM through literature review and consultation with the expert, and analyzed the activities, techniques, procedures, and contents conducted by the company, which can be regarded as a successful case, for each factor in detail. Major factors analyzed include fulfillment of the customer requirements, top management support, communication, change management, training and education, quality of the ITSM system, and

capability of the personnel. The results of the analyses show that the company has successfully routinized ITSM by performing various activities on the factors, and by introducing a variety of policies and systems.

Important points verified again in this study is that in order to realize organizational performance from ITSM, just the adoption of ITSM is not enough, but the routinization of ITSM through continuous and systematic management and improvement with the support of top management are required. The examples of activities and techniques for the routinization of ITSM suggested in this study are expected to provide useful information that can be utilized by organizations pursuing the routinization of ITSM. However, since the study is a descriptive case study, the results cannot be generalized to all organizations. Therefore, it would be necessary for the organizations attempting to utilize the information to choose carefully the contents appropriate and applicable to their organization.

Future research topics in this area may include a research that provides systematic and objective measurements of the variables analyzed in the study (routinization, and affecting factors), and the quantitative survey study to provide the research results that can be generalized.

Reference

- [1]. An, J.M., S. Lee, and H. Kim, "The Impact of IT Service Process Maturity on IT Outsourcing Performance", **Information Systems Review**, Vol. 9, No. 2, 2007, pp. 189-207.
- [2]. An, J. M., Y. Hahm and H. Kim, "An Exploratory Case Study on the Implementation of IT Infrastructure Library(ITIL) Service Management System", **Journal of Information Technology Applications & Management**, Vol. 15, No. 4, 2008, pp. 1-20.
- [3]. Cater-steele, A. & N. McBride, "IT service management improvement—An actor network perspective." **Proceedings of European Conference of Information Systems**, St Gallen, Switzerland, June 2007, pp. 7-9.
- [4]. Cater-steele, A. & W.G. Tan, "Implementation of IT Infrastructure Library (ITIL) in Australia: Progress and Success Factors", **Proceedings of**

- the IT Governance International Conference.** Auckland, New Zealand, November 2005, pp. 14(16).
- [5]. Cater-steele, A., M. Toleman, & W. Tan, "Transforming IT Service Management - the ITIL Impact", **Proceedings of the 17th Australasian Conference on Information Systems**, 2006.
 - [6]. Galup, S. D., R. Dattero, & J.J. Quan & S. Conger, "An overview of IT service management." **Communications of the ACM - Security in the Browser**, Vol. 52, No. 5, 2009, pp. 124-127.
 - [7]. Gartner Group, Data Center and IT Service Management Best Practices, **Gartner Group Research**, 2002.
 - [8]. Gu, C., and K. Nam, "An Empirical Study of the Determinants of Service Level Management and its Performance", **The Journal of Information Systems**, Vol. 16, No. 3, 2007, pp.69-90.
 - [9]. Hwang, K.T., Evaluation of the Maturity Level of IT Service Management, National IT Industry Promotion Agency, 2006.,
 - [10]. Im, S.B., and K.T. Hwang, "A Comparative Case Study on Improvement of ITSM using 6 Sigma Technique", **Information System Review**, Vol. 12, No. 2, 2010, pp. 121-144.
 - [11]. itSMF Australia 2007 Conference, "Summary of ITSM Standards and Frameworks Survey Responses", USQ & itSMF Australia, 2007.
 - [12]. Johnson, M. W., A. Hatley, B.A. Miller, & R. Orr, "Evolving standards for IT service management", **IBM Systems Journal**, Vol. 46, No. 3, 2007, pp. 583-597.
 - [13]. Kim, D.O., H. Han, and J. Hwang, (2005). "A Study on the Development of Customer Oriented ITSM Model", **Entrue Journal of Information Technology**, Vol. 4, No. 1, 2005, pp. 51-65.
 - [14]. Kim, H.S., "A case study on realization of ITSM performance applying the change management framework of ITSM", **Korea Society of IT Services Journal**, Vol. 10, No. 3, 2011, pp. 251-264.
 - [15]. Kwon, T. H. & R.W. Zmud, "Unifying the fragmented models of Information Systems Implementation.", **Critical Issues in Information Systems Research**, 1987, pp. 227-251.
 - [16]. Lee, J.O., S.H. Shin, H.K. Kim & K.T. Hwang, "A Study on Research Framework and Reserarch Trend in IT Service Management (ITSM) Area", **Information Policy**, Vol. 19, No. 1, 2012, pp. 25-46.
 - [17]. Lee, S.E., A Study on the Improvement of ITSM Implementation Performance, National IT Industry Promotion Agency, 2008.
 - [18]. Loews. A., "Stability in a Changing World: Why We Need Services Management" ,itSMF, 2002.
 - [19]. Nam, K., and J. Kim, "A Study of SLA's Maturity Level on Performance", **Journal of Information Technology Applications & Management**, Vol. 14, No. 1, 2007, pp. 1-20.
 - [20]. Oh, H., and C. Cho, "A Study on IT Service Management Based on ITIL with Consideration of IT Governance Structures : Focused on A Case Study of Manufacturing Company", **Journal of the Korea Safety Management & Science**, Vol. 12, No. 1, 2010, pp.149-159.
 - [21]. Park, K. & K.T. Hwang, "A Study on the Implementation of ITSM using 6 Sigma Technique: A Descriptive Case Study", **Journal of Information Technology Applications & Management**, Vol. 16, No. 2, 2009, pp. 121-133.
 - [22]. Pollard, C. & A. Cater-steele, "Justifications, strategies and critical success factors in successful ITIL implemetations in U.S. and Australian companies: Exploratory study." **Information Systems Management**, Vol. 26, No. 2, 2009, pp. 164-175.
 - [23]. Tan, W. G., A. Cater-steele & M. Toleman, "Implementing IT service management: a case study focussing on critical success factors." **Journal of Computer Information Systems**, Vol. 50, No. 2, 2009, pp. 1-12.
 - [24]. Wan, J. & D. Wan, "Analysis on the Mindbugs in Information Technology Service Management Project Implementation." **Technology and Investment**, Vol. 2, 2011, pp. 184-192.
 - [25]. Wang, M.W., O. Lee, & K.H. Lim "Knowledge Management Systems Diffusion in Chinese Enterprises: A Multi-Stage Approach with the Technology-Organization- Environment Framework". **Journal of Global Information Management**, Vol. 17 Issue 1, Jan-Mar. 2009, pp.70-84.
 - [26]. Yoon, K.S., and K.T. Hwang, " Case Study on Implementation of ITSM using 6 Sigma Technique: Focused on Service Desk", **Journal of Information Technology Applications & Management**, Vol. 14, No. 3, 2007, pp. 1-14.
 - [27]. Zhen, W. & Z. Xin-yu, "An ITIL-based IT Service Management Model for Chinese Universities." **Proceedings of the Fifth International Conference on Software Engineering Research, Management and Applications**, 2007, pp. 493-497

National Context as an Important Variable for the Development of IT-based Strategic Capability

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Abstract

For multi-national businesses, the environmental differences such as cultural differences among countries require that businesses vary its strategy country by country. In Korea, the Confucian Ethics is penetrated in every aspect of people's life. An important aspect of the Confucian Ethics is women's role and responsibility in society. Then, the businesses need to understand Korean women's preferences as consumers; and develop business strategies accordingly. A stream of the research shows that with the lack of alignment between firm's IS strategy and business strategy, business opportunities can be missed and performance is not improved. From the IS point of view, this study emphasizes that understanding Korean women are important for multi-national firms in developing IT-based strategic capabilities to gain competitive advantages in Korean market. Using a case, this study shows how a firm developed IT-based strategic capabilities through alignment of IS strategy with business strategy according to a national context; and gained competitive advantages.

Keywords:

IS strategy, Business strategy, Strategic Alignment, Multi-national business, Strategic Capability

Introduction

Chandler's [3] seminal work on strategy [26] explains the relationships between environments, strategy, and structure and business performance. He asserts that the organization's environment

shapes strategy; and the firms whose structure matches their strategy become more effective than mismatched firms. Chandler [3] emphasizes the importance of designing and implementing strategies according to distinct contexts to gain competitive advantages. For multi-national businesses, the environmental differences come from disparities in cultures, political systems, economical systems, legal systems and the level of economic development [11]. Such differences among countries require that businesses vary its strategy country by country.

While Chandler [3] focused on the fit between firm's environments and strategy, resource-based view (RBV) focused on firm's strategic resource and capability as the source of competitive advantages. Among firm's capabilities, the capability that distinguishes a company from its competitors in the eyes of customers is defined as strategic capability [26]. An example could be Wal-Mart's Inventory Replenishment Capability. RBV considers that capabilities are grounded in the organizational practices, business processes and information systems; thus focuses on the infrastructure that supports capabilities [26]. Viewing that strategy should fit to national contexts, this study investigates how a firm develops IT-based strategic capability according to national context and gains competitive advantages. According to Konsynski and Karimi [15], firm's global IS strategy need not only address coordination needs of global enterprise but also address country issues. However, many

CIOs find it difficult to fully understand their international operations and fail to develop appropriate IS strategy. This justifies the need for this study. This study in particular addresses the following questions:

- what national conditions become important to look into to develop the strategic capability?
- what has been performed in relation to the setting and coordinating of IT, business processes and other organizational resources to develop the strategic capability?

This is a revelatory, single case with a historical perspective. A revelatory case in a single-case format is appropriate for researching the complexity of the phenomena, where little or no previous research exists [30]. Since IT-based strategic capability is a product of the environment, the agent's (e.g. CEO/CIO) decisions and technological choices made in the past [7, 14], the process of developing such a capability can best be understood by taking historical approach. Further, the effects of strategic capability on value-creation can best be understood from the historical and interpretive analyses of events and actions taken by one or more agents operating within socio-economic environments [18, 31]. History in general provides high valued knowledge to decision makers, which can be used effectively by decision makers in different times [20]. Results of this study provide the senior management with guidelines and a framework for designing an IT-based strategic capability according to given country condition.

According to Eisenhardt [5], a priori specification of constructs based on extant literature assists in designing case research and to link the collected data to the questions of a study [5]. Based on previous research on strategic alignment, international business and organizational theory, the organizational and environmental elements that must be considered and aligned with the corporate strategy in global environment were identified. Using the identified elements, a case study on the E-Mart is performed. The case is chosen based on theoretical sampling [6, 10, 16].

The case involved major development of firm's capability using technological implementation, which matches with the objective of this study. The case data were collected from various sources including interviews, corporation publications, autobiographies of CEO, project documents and various trade publications. For the future study, using a single historical case, general propositions will be generated inductively. The following table demonstrates the design for this study, comparing it to the recommendations by Eisenhardt [5].

Table1 Research Design

Eisenhardt's step [5]	Study design of this research
1. Definition of research question	Two research questions were defined
2. A priori specification of constructs.	Potentially important constructs were identified from organizational theory and strategic alignment. These constructs were explicitly measured during interviews and review of documents.
3. Selection of cases	Selected a case from an initial pool of 3 cases.
4. Multiple data collection methods.	Interviews, corporation publications, project documents and various trade publications are used to provide richness of the data and different perspectives.
5. Analyses of Data	Similar to approach taken by Quin, a teaching case for the E-MART was developed as a prelude to this theoretical study. This gives researcher a familiarity to the case being analyzed.
6. Generating propositions or hypotheses.	General propositions are generated from the case.
7. Enfolding literature	Compared our theory with other management and IS literature

Although case research has disadvantage of bringing systematic rigor, this research used several tactics to improve methodological rigor. To improve construct validity, potentially important constructs were identified from organizational theory and strategic alignment; and multiple sources of evidence were used to build construct measures [5, 30]. To improve reliability, efforts were made to elicit detailed research steps and to document research process [30].

IS Strategy in Global Environment

The use of IS (Information Systems) is considered to directly influence firm's competitive position. The most effective way to achieve strategic benefits from IS is to focus on businesses by analyzing current business problems and environmental change and considering IS as one aspect of the solution [4]. Consequently, IS strategies must be developed within the context of the business strategy formulation and implementation processes. Aligning business and IS strategy means that the firm allocates finite resources in a coherent manner to achievable strategies and plans that collectively will deliver benefits to the firm.

With the lack of alignment between IS strategy and business strategy, business opportunities can be missed and thus business performance is not improved. A major factor for misalignments between business and IS is the mind gap between strategists and technologists [22]. In the Spring 2002 issue of Sloan Management Review, Sauer and Willcocks [24] argued that "many companies wrongly assumed that strategists and technologists would talk to one another or that one side, typically IT, would address the alignment of business needs and technology support (p. 42)." Still, how well IT is aligned with business goals remains one of the top issues in IT management [13, 17]. According to Teo and Ang [27], problems with the IS strategy process include (1) ignoring business objectives, (2) failing to translate business objectives and strategies into action plan, and (3) relying exclusively on user's wish list for application ideas.

For multi-national businesses, business strategy could vary country by country according to cultures, political systems, economical systems, legal systems and the level of economic development [11]. The description of the environmental factors can be found in the international management literature. Such differences require that IS strategy vary country by country. According to Ward and Peppard [p. 144, 29]:

"IS strategy deals with what to do with information, systems and technology, and how to manage the applications from a business point of view. It focuses on the close alignment of information and systems in support of business needs and on identifying and exploiting competitive opportunities for IS/IT. IT strategy designates how technology it to be applied in delivering information and how the technology resources are managed to meet the range of business needs."

Some of the challenges that must be considered in developing global IS/IT strategy are listed in Table 2 below. The differences between countries raise many problems and challenges that the businesses in a domestic environment never confront.

Table 2 - Challenges of Global IT Management
(Adapted from [20])

Type	Challenges
Cultural challenges	• Cultural interests • Religions • Customs • Political philosophies
Political challenges	• Many countries regulate or prohibit the transfer of data across their national boundaries • Others severely restrict, tax, or prohibit imports of hardware and software • Some have local content laws that specify the portion of the value of a product that must be added in that country if it is to be sold there • Others require a business to spend part of the revenue they earn in a country in that nation's economy

Geoeconomic challenges	• Physical distances are still a major problem • It may take too long to fly in specialists • It is difficult to communicate in real time across 24 time zones • Many countries do not have good telephone and telecommunications services • It may be hard to find skilled local workers • There can be great differences in the cost of living and labor costs between countries
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Strategic Capability

Resource-based view (RBV) argue that longer-term success would result from a realignment of the organization's resources and capabilities to match the demands of the environment. In RBV, inimitable and non-substitutable resources and capabilities are believed to drive value creation and sustainability. The skills and knowledge of the human resource along with other resources like IT and organizational processes are linked together to form an organizational capability such as Information Services and Research and Development (R&D) [1, 2]. Firms then can possibly be viewed as a collection of such capabilities [8].

Strategic management literature labels the process of forming capabilities through arrangement of an existing skill sets as 'bundling' [26]. Capability can also be formed through the reconfiguration of a current resource bundle such as acquiring (recruiting) and developing (training) new resources; and divesting less valued resources [24, 30]. New capabilities are also formed through the coordination of existing capabilities; or acquisition of new capabilities [11]. Thus, skills and capabilities can be viewed as organizational elements linked to form a large-scale organizational structure such as functional groups (e.g. marketing) and technical areas (e.g. printed circuit board assemble) [9].

Among firm's capabilities, the capability that distinguishes a company from its competitors in the

eyes of customers is defined as strategic capability [27]. Stalk et al. [27] calls this conception of corporate strategy as 'capability-based competition'. Capability-based competition emphasizes the organizational practices and business processes in which capabilities are rooted. Therefore managerial attention on the infrastructure that supports capabilities is called for. In capability-based competition, business processes have critical roles to play. The business processes are considered as the building blocks of corporate strategy and a capability is viewed as a set of business processes strategically understood. In this study, strategic capability is defined as a set of business processes and supporting resources such as Information systems and human resources that deliver value to the customer.

Case of the E-MART

Company Overview

Established in Seoul in 1930, the Shinsegae Department Store, the mother company of the E-MART started as the Mitsukoshi Department Store (Mitsukoshi hereinafter) of Japan. Since then, Shinsegae Department Store had quite long experiences in running luxurious department stores and accumulated expertise and know-how. On the first of May, 1984, the Yeoungdeungpo branch of the Shinsegae Department store (Shinsegae hereinafter) opened. It was determined that the very first POS (Point of the Sales Systems) be installed in the Yeoungdeungpo branch. The Mitsukoshi had already operated POS system. Store development team of the Mitsukoshi helped the opening of the Yeoungdeungpo branch. In the Shinsegae, there was no IT expert who can lead the implementation of the POS system.

In November, 1983, KWON was scouted from the Samsung Semiconductor by the Shinsegae as the IS Director of the IS department. For the successful implementation of the very first POS system in Shinsegae, KWON diligently studied both success and failure cases of the POS system. When it came to the selection of the POS, Shinsegae chose a Japanese POS brand, TEC over American brands such as IBM and NCR. To be close to the CIOs of Top 5 Japanese department store brands

(Mitsukoshi, Takashimaya, Isetan, Hankyu and Tokyu), KOWN went to Japan 2 times per month on average. He maintained a close relationship with them and learned a lot about their POS systems. He learned that the POS system would fail if the employees do not utilize the system. Once the POS was installed in the Shinsegae, he tried hard to let the employees in the business side utilize the system. He extracted top five important data sets from the POS system and let the Yeoungdeungpo branch use up to the top three data sets.

When the POS system was first introduced, the accounting department in the Shinsegae was panicked in relation to tax evasion. The accounting department was reluctant to give the data to the business team to perform the sales contribution analyses for each product for the merchandising. The supplier was also panicked for being known about what products were supplied for what amount. KOWN tried to resolve the problems by institutionalizing the use of the POS system by the retail stores through the tax benefits. First, in-store bar code was implemented and the supplier was asked to attach the in-store bar code. Then, in 1987, before 1988 Olympics, EAN 880 code (European code) consisting of the supplier code and the product code was chosen for a national standard after the meeting with a manager BAK in the Ministry of Commerce. The Shinsegae implemented the POS systems in the Shinsegae's other branches, Main Store, Dongbang Plaza and Miari branches.

In 1993, the first store of the E-Mart was opened with one store in Changdong, Seoul. With a help of consultants from TEC and the benchmarking outcome of the Japanese discount stores, the POS system for the E-Mart was developed on the top of the Shinsegae's POS system. To develop the POS system, EAN based KAM bar code was developed. The E-Mart was opened with KAM center established in the Chamber of the Commerce where code assignments were made. At that time, 50-60% of the products had the bar codes attached. The E-Mart had policy that the supplier with the bar codes attached be preferred. The suppliers without the bar code was assigned

with in-store markings. Even the IS employees in the Shinsegae were helping the E-Mart to scan the products while finding and resolve problems with the POS systems. The E-Mart did not have clear ideas about how to run their first discount store and had to struggle in the early days of their operation.

Before Uruguay Round became effective in 1996, the management in the Shinsegae had benchmarked Taiwan, Malaysia, Indonesia and Singapore; and had observed that Wal-Mart, Carrefour and Marco ranked as the number one or two retailers in those countries. They realized that to compete with the foreign retailers, information systems are important. They learned that the POS system is important for the merchandising. In 1995 when KWON became the Director of the Strategic Planning Team in the Shinsegae Corporation (Conglomerate), he was pressured to be better than KIM's Club, another discount store in Korea. To learn the discount store's operation in advanced countries, the E-Mart wished to have strategic alliances with a company that did not have a plan to open a store in Korea. Since the Wal-Mart had a plan for expanding to Korean market, the Shinsegae Corporation started a strategic alliance with the Price Club in USA to learn management know-how. The Shinsegae Corporation agreed to return 3% of the revenue to the Price Club and opened the first store of Price Club in Yangpyung on the 15th of September, 1995. KWON went to San Diego where the headquarter of the Price Club locates, several times to learn IS of the Price Club. He became very close to the CIO of the Price Club and learned quite a bit of IS of the Price Club. The Price Club in Yangpyung marked the number in sales among 6000 US stores. The headquarter of the Price Club pressured the Shinsegae Corporation to open more stores in Korea. Over 1995-1996, Daegu and Daejeon stores were opened.

In 1996, KWON moved to the Credit Card business unit in the Shinsegae Corporation as a CEO. HWANG¹ became a CEO of the E-MART. HWANG had work experiences in the IS

1 HWANG was the CEO of the E-Mart during the expansion period from 15 stores to 120 stores.

department in the Cheil Industries when KWON was there. HWANG had experiences in working in Seomun Market (the biggest outdoor market in Daegu) before joining in the sales team of the Cheil Industries. Since then he had worked both in the sales and IS area of the Cheil Industries..As Uruguay Round became effective in 1996, foreign businesses were allowed to have no limitation in both the number of stores and the size of each store. In 1996, the Carrefour Korea started its first operation in Korea. On the same year, threatened by the opening of the Carrefour Korea, the E-MART had to start chain operations to achieve the economy of the scale and cut the cost of their operations. The E-MART set up the Logistics Center in Yongin. At that time, the number of the E-Mart stores was less than ten.

In 1997, Asian Financial Crisis occurred and Korean economy went under the control of IMF. The luxurious market of the Shinsege Department Store (Shinsegae hereinafter) diminished in sales. The Shinsege saw the E-MART as an opportunity during the financial hardship of the country and decided to make an aggressive investment into the E-MART. Although the Price Club of Daegu and Daejeon ranked the number two and three in sales, the Shinsege Corporation decided to sell the Price Club stores and the Credit Card business unit to obtain 25 million dollar in cash; and poured the cash into the E-MART. The land sites originally developed for the construction of the department stores were changed to build the E-MART chain stores. The E-MART also could buy 20-30 additional land sites in the major commercial areas in Korea at a lower price than the usual market price due to IMF situations. The Shinsege Corporation set up the Shinsege E&C for the construction of the E-MART chain stores. The 1st of May, 1997, KWON became the first CEO of the Shinsegae I&C, an IT service firm for the Shinsegae Corporation.

The Wal-Mart Korea was scheduled to open in Korea in 1988. The E-MART was panicked about the fact that the number 1 retailer in the world starts its operation in Korea. The E-MART diligently benchmarked the Wal-Mart and other discount

stores in Japan; and realized that the Wal-Mart's limitation was the fresh food products. In 1997, after benchmarking trip to Japan and USA [19, p. 65], the E-Mart decided to completely subsidize the fresh food section to have a buying power and develop the cooked food section.. Based on Confucian culture, Korean housewives like to buy the fresh vegetable and fish whenever they go out for shopping. In addition, due to expected woman participation in the economic activities, the cooked food section was expected to grow. To induce customers to make frequent trips to the stores, the E-Mart determined to focus on the fresh-food distribution. The E-Mart viewed that the success of the firm in Korean market depended on the fresh-food distribution In 1999, the E-Mart declared the fresh-food distribution to be its core competency (Seoul Economy, April 29, 2003).

Overview of the E-MART

- 1993 the E-MART open
- 1996 Uruguay Round
 - ✓ Foreign businesses are allowed to have no limitation in the number of stores; the size of each store
- 1996 the Carrefour Korea open
- 1996 the E-MART started its chain operation
- 1997 Asian Financial Crisis (Under IMF)
 - ✓ Aggressive investment into the E-MART
 - ✓ Sold out the Price Club and Credit Card business units and obtained 25 million dollar cash
 - ✓ Poured the cash into the E-MART
 - ✓ Sites originally developed for the department store were changed to the E-MART
 - ✓ Bought 20-30 additional sites in major commercial areas at lower price due to IMF
 - ✓ Set up the Shinsege Construction to build the E-MART stores
 - ✓ Set up the Shinsege I&C for IT service
- 1998 Wal-Mart Korea open
- 1999 E-Mart focused on Fresh Food Distribution to be its core competency

Confucian Ethics and Korean Women

The Confucian ethics are characterized as complete royalty to a hierarchical structure of the authority. Strict rules of the conduct, involving

complete obedience and respectful behavior within superior-subordinate relationships such as male-female, parent-children, old-young, and teacher-student have impacted on women's life in Korea. The Yi Dynasty (1392-1910) reinforced patrimonial institutions rooted in the family as the basis of the smooth governance under the Confucian ideology. As indicated by Dr. Kim Young-chung, a professor of History at Ewha Womans University, the Korean women have followed Confucian family ethics, which dictate the man in public affairs and the woman in the family:

"The wife was responsible for the education of the children, especially girls up to the age of marriage. There were no educational institution for girls, and the mother assumed the role of teacher... her influence was not limited to her daughter's upbringing. She was often honored and awarded for her model behavior and contribution when her husband or sons were successful in public life."

As indicated above, the Korean woman could only obtain social recognition as the wife of a prominent man or the mother of a successful son. With the opening of Korea during the last quarter of the nineteenth century, the Korean people began to establish contact with the outside world. The first formal educational institute for girls, Ewha Hakdang (Origin of Ewha Womans University) was established. By the beginning of the 21 century, Korean women are participating in political, social justice and equal rights. The Confucian ethics still have a wide impact on the modern life of women in Korea.

Strategic Capability of the E-MART

As the number of stores increase over 1997 and 1998, KWON emphasized to HWANG that discount store business is the system business; and the system should lead the business. HWANG seemed to think that he knew IT very well. In 2000, when E-Mart had about 15 stores, E-Mart decided to develop a system that can be used even when E-Mart had 100 stores [19]. For cost

reduction, discount stores' operation must be IS-based chain operation. E-Mart viewed that their competitive edge would come from IS-based low cost operation. The CEO of the Shinsegae I&C, KWON always thought that the discount store business was a system business.

In 2000, the CEO of the Shinsegae I&C advised HWANG that the E-Mart should hire an IS advisor. KWON presented both the Wal-Mart IS and the Itoyokado IS to HWANG. The E-Mart decided to contract a former IS director of the Itoyokado instead of a former IS employee of the Wal-Mart as a consultant..The Japanese consultant's name is Mr. Hamajaki. The E-Mart hired him up to 2011. Once every month, the Shinsegae I&C held 4 day consulting workshop in which the previous-month achievement as well as the next-month plan were presented. After workshop, an executive board meeting was held to approve the plan. At the meeting, all the business directors of the E-Mart along with all levels of the Shinsegae I&C's management in charge of the E-Mart, were attended.

To develop One-Day Fresh-Food Replenishment Capability (from harvest to the consumers), E-Mart needed efficient process, information systems, and good suppliers. The main components of One-Day Fresh-Food Distribution Capability include:

- GOT (Graphical Order Terminal) system
- Fresh Food Delivery System
- Wet (product) Distribution Center
- Mobile Buying System

Each is described below.

GOT (Graphical Order Terminal) System

In the discount store industry, one of CSF (critical success factors) is MTO (Merchandise Turnover = annual revenue/inventories; a large ratio means a faster flow of the merchandise). To maintain a higher MTO, a firm must have a higher revenue and a smaller inventory. For a higher MTO, an accurate and just-in-time inventory replenishment is essential. Since the products sold in the discount

store are so many, the orders should be made completely by IS. The inventory on the shelf must be matched with the inventory amount in the system. The Inventory Replenishment Capability is an essential part of the overall process of keeping retail selves filled while minimizing inventory and purchasing in truckload quantities. To implement this capability, superior IT systems are essential, which connects the vendor's supply operation with the store's distribution network. The IT system minimizes inventory and allows significant cost cutting.

Regarding the fresh and cooked food section, E-Mart had the policy of 'Everything has to be sold within a day'. The E-Mart needed a system, with which the sales team in the store can place orders accurately based on the sales data, real-time weather information and customer preference of each store. The E-Mart wanted a system that allowed each store to order inventory, which is reviewed and provided feed-back by the headquarter. Through the graphical presentation of the inventory fluctuation, the trend analysis and real-time weather forecast, the GOT system facilitates the order of the inventory by the sales team in the store. Using the GOT system, every store can order based on weather, sales, customer preference of each store. GOT system is easy to use. For only 2 days training, the system use can be trained even for the house-wife employees who is usually considered to be less proficient in using technology. Before the development of the GOT system, the IT team brought a bunch of the sales and inventory data to the sales team every morning and took them back every evening. However the sales team ignored the data due to the complexity of understanding the data [19]. E-Mart consistently educated employees for the orders to be placed 100% automatically using the GOT system.

Customer Care system in the E-Mart had synergy effects with the GOT system. The customer care system facilitated gathering customer voices to provide appropriate products and services that the customer wanted. E-Mart diligently educated the employees about the importance of the customer voice. HWANG was known as a person who got

along with the employees very well during and after work.

Thanks to the GOT system, MTO (Merchandise Turnover = annual revenue/inventories; a large ratio means faster flow of merchandise) of the E-MART is 34.7 compared to 19.2 of the Carrefour and 14.7 of the Wal-Mart. While the Carrefour's operating costs for the sales were over 17%, the E-MART costs were about 12% (Secret behind the E-MART success). The cost minimization is critical for the discount store. In 2006, while the E-MART opened 100th store, the Wal-Mart sold 16 stores to the E-MART. The Carrefour also exited Korean market.

Fresh Food Delivery System/ Wet Distribution Center

The implementation of a fresh-food focused strategy involved structuring the business processes by which fresh-food sources are identified, bar-coded, transported and delivered to the stores directly or via the Wet Distribution Center with the Cool Chain System. To create One Day Fresh Food Replenishment capability (successful implementation of the strategy), empowerment of the buying specialists; and proactive collaboration between the specialists and the distributors in timely manner, were essential.

Mobile Buying System

Using the Mobile Buying System, the E-MART buyers with the notebook computer can order products at the production site and send them to the store with a bar-code attached. It takes 1 day from the harvest to the consumer. When the production sites are close to the stores, the goods could be delivered to the store within 3 hours.

Major Competitor: Wal-Mart Korea

The Wal-Mart is the world's largest retailer, operating in 15 countries with 8500 stores. Its revenue in 2009 was \$408 billion. The Wal-Mart initiated its international expansion in the early 1990s with the following reasons:

- Due to market saturation in the US market
- Other retailers followed the Wal-Mart's

strategy

- Not much difference in price between the Wal-Mart and other retailers
- Consumer's incentives to visit the Wal-Mart became weak

The Wal-Mart's international sales had grown from 9% of the Wal-Mart's total sales in 1998 to 22% in 2007. The international sales succeeded in Mexico, Canada and UK but failed in S. Korea and Germany. The Wal-Mart Korea started its operation in Korea in 1998. From 2000 to 2003, the Wal-Mart Korea was a success with 14 million dollar revenue per year with a total of 16 stores and 3356 employees. However, the Wal-Mart Korea lost about 10 millions in 2005. In May, 2006 the Wal-Mart Korea finally decided to exit from Korean market by selling 16 stores in Korea to the E-Mart. The Wal-Mart Germany also exited from Germany in July 2006.

Wal-Mart insisted a global policy such as warehouse-look stores and ignored Korean consumer's preference. The following is excerpt from KWON:

"the Wal-Mart headquarter's less-data open policy led to the lack of localization. In Korea, the fresh food would have to be ordered as many times per day as possible and toilet paper would have to be ordered as many times per day as possible due to the lack of the storage space. The order in discount store have to be based on information systems. Suppose the Wal-Mart's existing system has 3 day lead time. Then someone in the Wal-Mart Korea has to open up information system to change their existing system to order the fresh food an many times per day as possible. But it did not work that way."

The following is an interview with a founder & CEO of the E-MART [19]:

"Instead of mimicking foreign cases, we tried to listen what customers want. While the Carrefour Korea and the Wal-Mart Korea did as what the moth-

er companies said, we tried to look for what the customers want. We listened to the customers as long as it is profitable. Wal-Mart focused on package products because dealing with the vegetable and fish is not profitable. Often fresh food is called moneyless MD (merchandise) which means not profitable items. However, Korean housewives like to buy the fresh vegetable and fish whenever they are out for shopping.

To induce the housewives' travel to the E-MART, we had to sell those items. We subsidized the fresh food section 100% and also started to sell the cooked products like Bulgogy. We wanted the fresh food distribution to be our core competency."

Preliminary Conclusions and Research Plan

In Korea, the Confucian Ethics is penetrated in every aspect of people's life. An important aspect of the Confucian Ethics is women's role and responsibility in society, which still have strong impact on education, professional life and daily life of women in Korea. For the multi-national firms, Korean women are their consumers, colleagues and employees. The multi-national firms need to understand Korean women's preferences and needs as consumers; and develop and implement strategies accordingly. From the IS point of view, this study found that understanding Korean women's needs and preferences are important for multi-national firms in the process of aligning business and IS strategies to develop IT-based strategic capabilities, thus gaining competitive advantages in Korean market.

By the time of the conference, analyses of the case data will be completed. The results will be presented during the conference.

Reference

- [1] Broadbent, M. and Weill, P., "Management by maxim: how business and IT managers can create IT infrastructures," **Sloan Management Review**,

- Vol. 38, No. 3, 1997, pp. 72-92.
- [2] Byrd, T. and Turner, D., "Measuring the Flexibility of Information Technology Infrastructure: Exploratory Analysis of a Construct," **Journal of Management Information Systems**, Vol. 17, No. 1, 2000, pp. 167-208.
 - [3] Chandler, A., *Strategy and Structure*, Cambridge, MA: MIT Press, 1962.
 - [4] Earl, M. "Putting IT in its place: Polemic for the nineties," **Journal of Information Technology**, Vol. 7.1992, 100-108
 - [5] Eisenhardt, K. "Building Theories from Case Study Research," **Academy of Management Review**, Vol.14, No.4, 1989, pp.532-555.
 - [6] Eisenhardt, K., "Better Stories and Better Constructs: The Case for Rigor and Comparative Logic," **Academy of Management Review**, Vol. 16, No. 3, 1991, pp. 620-627.
 - [7] Fredrickson, J., "The strategic decision process and organization structure," **Academy of Management Review**, Vol. 11, No. 2, 1986, pp. 280-99.
 - [8] Galunic, C. and Eisenhardt, K., "Architectural Innovation and Modular Corporate Forms," **Academy of Management Journal**, Vol. 44, No. 6, 2001, pp.1229-1249.
 - [9] Galunic, C. and Rodan, S., "Resource Recombination in the Firm: Knowledge Structures and Potential For Schumpeterian Innovation," **Strategic Management Journal**, Vol.19, 1998, pp.1193-1201.
 - [10] Glaser, B., & Strauss, A., *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New Brunswick, N.J., Aldine Transaction, 1999.
 - [11] Hills, C., *International Business*, McGraw-Hill, 2009.
 - [12] Hitt, M., Harrison, J., Ireland, R. and Best, A., "Attributes of Successful and Unsuccessful acquisitions of US firms," **British Journal of Management**, Vol.9, 1998, pp. 91-114.
 - [13] Huang, C., Hu, Q., "Achieving IT-Business Strategic Alignment via Enterprise-Wide Implementation of Balanced Scorecards," *Information Systems Management*, Vol. 24, No. 2, 2007, pp.173-184.
 - [14] Kieser, A., "Why Organization Theory Needs Historical Analyses – An How This Should be Performed," *Organization Science*, Vol. 5, No. 4, 1994, pp. 608-620.
 - [15] Konsynski, B. and Karimi, J., "Globalization and Information Management Strategies," **Journal of MIS**, Vol. 7, No. 4, 1991, pp. 7-26.
 - [16] Lipset, S., Trow, M., & Coleman, I., *Union democracy*, New York: Free Press, 1956.
 - [17] Luftman, J., Van Slyke, C. and Watson, R., "Information Systems Enrollments: Can They Be Increased?," *Communications of AIS*, Vol.20, No. 20, 2007, pp. 649-659.
 - [18] Mason, R., McKenny, J. and Copeland, D., "Developing an Historical Tradition in MIS Research," *MIS Quarterly*, 1997, pp. 257- 278.
 - [19] Meng, M., *Secret behind E-MART Success*, VisionKorea, 2007.
 - [20] Neustadt, R. and May, E., *Thinking in Time: The Uses of History for Decision Makers*, **The Free Press**, New York, 1986.
 - [21] O'Brien, J., *Management Information Systems*, Mcgraw-Hill, 2011.
 - [22] Pepper, J., and Ward, J., "Mind the Gap:" Diagnosing the relationship between the IT organization and the rest of the business," **Journal of Strategic Information Systems**, Vol.8, No.1, 1999, pp. 29–60.
 - [23] Sanchez, R., "Strategic flexibility in product competition," **Strategic Management Journal**, Vol.16, Special Issue 1995, pp. 135-159.
 - [24] Sauer, C. and Willcocks, L., "The Evolution of Organizational Architect," *MIT Sloan Management Review*, Vol. 43, No. 3, 2002, pp.41-49.
 - [25] Sirmon, D.; Hitt, M.; Ireland, R., "Managing Firm Resources In Dynamic Environments to Create Value: Looking Inside the Black Box," **Academy of Management Review**, Vol. 32, No. 1, 2007, pp. 273-292.
 - [26] Stalk, G, Evans, P. and Shulman, L., "Competing on Capabilities: New Rules of Corporate Strategy" **Harvard Business Review** March-April, 1992 pp. 57-69.
 - [27] Teo, T, and Ang, J., "An examination of major IS planning problems," **International Journal of Information Management**, Vol. 21, 2001, pp. 457-470
 - [28] Uhlenbruck, K., Meyer, K. and Hitt, M., "Organizational Transformation in Transition Economies: Resource-based and Organizational Learning Perspectives," **Journal of Management Studies**, Vol. 40, No. 2, 2003, pp. 257-282
 - [29] Ward, J. and Pepper, J., *Strategic Planning for Information Systems*, Wiley, 2002.
 - [30] Yin R.K., *Case Study Research: Design and Methods*, Sage Publications Inc., New York, CA., 1994.
 - [31] Zahra, S. and George, G., "Absorptive Capacity: A Review, Reconceptualization, and Extension," **The Academy of Management Review**, Vol.27, No.2, 2002, pp.185.

IT Platform Value Creation: An Inquiry on Platform-base IT Innovations

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Abstract

IT was at the verge of losing innovation leader to the biotechnology and to the nanotechnology when dot-com burst struck at the dawn of 21st century. Thanks to the idea of platform-based innovation, a number of IT platforms have been invented and followed by numerous IT innovations. IT platform is traditionally conceptualized as an IT artifact and is framed using IT adoption theories. Framing this way discounts relationship between the platform and its platform-based innovations. This relationship is crucial because the value of platform-based innovation does not come about by itself. It sits on the value systems of the platform. Employing the traditional framing on platform-based innovation does not offer much insights. Values of IT platform-based innovations operate differently from that of the non-platform IT innovations. This study sees the need for further inquiring into the relationship. It asks a fundamental question "How does an IT platform create value for platform-based IT innovations?" This study conducts a literature review to answer this question and proposes a set of positions.

Keywords: Innovation value, Two-sided IT platform, platform-based innovation

Introduction

Creating innovations in volatile and fast changing environment is challenging. Organizations therefore increasingly turned to platform-based innovation to better meet this challenge. The primary reason for this increase is that the innovation is supported by platforms. Platform provides a reference framework and basic functions. Organizations no longer need to develop skills from the ground up to take on an

innovation. They only need to develop skills to extend what the platform left off. As a result, they can innovate quicker. Furthermore, scope and functions of existing platform-based innovations can be easily expanded [12]. The core of this idea is that one innovation is the basis of other innovations. The one innovation is platform and the others are platform-based innovations.

When dot-com bust, IT innovation was severely disrupted. However, a decade passed, IT survives the burst and is increasingly relevant to everyone's life. IT no longer requires specialized skills to fully appropriate it. IT innovations become common in everyday life. This transition does not happen overnight and cannot happen by the idea of standalone IT innovation. The exponentially growth of IT innovations can be traced its root to the idea of platform-based innovation. IT platforms' capabilities are utilized to deliver new innovations and to enhance values of existing innovations.

The study on relations between IT platform and platform-based IT innovation has not been popular among scholars. This unpopularity is stemmed from two different means-end conceptualizations of IT platform. The first conceptualizes IT platform as an end. This conceptualization sees IT platforms as IT artifacts and follows frameworks of IT adoption study. The tradition of IT adoption study is very long. Relationships between platform and its platform-based artifacts have been overlooked. However, the second conceptualizes IT as a means to an end. This conceptualization pays attention to behaviors (i.e., means) of IT platform in conjunction with the rising of platform-based IT innovation (i.e., an end). Literature based on this latter conceptualization is thin when compared

with that of first conceptualization.

Some recent explorations have been carried out on the ground of relation between IT platform and platform-based IT innovation. Bergvall-Kareborn & Howcroft [3] draw on evolutions of two IT platforms and lay out process for platform-based IT innovations. These processes demonstrate dependences between IT platform and the platform-based innovations. Lahiri and associates [14] compare effects of innovation pricing on consumer surplus between two competing IT platforms. This comparison reveals linkages between value of IT platform and that of platform-based IT innovations. Observing these explorations reveals that IT platform must somehow help platform-based IT innovations in value creation. However, no study has inquired about this observation. To understand a nature of it, this study asks a fundamental question “How does an IT platform create value for platform-based IT innovations?” It is hoped that addressing this fundamental question would enable the second IT platform conceptualization to gain a more solid theoretical ground.

The goal of this study is to investigate factors that enable an IT platform to create value for platform-based innovations. The outcome is this study is a set of position regarding to the factors for future study. To satisfy this goal and outcome, this study conducts a literature review on two-sided platform and platform-based innovation. It then consults literature in the area of value creation on two-sided platform. A limited number of IT platform characteristics will be inquired in light of the literature. This inquiry leads to a set of propositions. Lastly, this study put the propositions in a context for future academic exploration.

IT Platform as a Two-sided Platform

IT platform is considered a technology platform. It is a realization of integrated IT artifacts equipped with complex IT capabilities [4]. However, this realization does not really set an IT platform apart from any IT artifacts because IT platform is sometimes understood as IT artifact. The significant departure of an IT platform from any other IT artifacts is the integrations between the integrated IT artifacts and agents [6]. IT platform creates something akin to ecosystem. The grand desire of an IT platform is to facilitate exchanges within its ecosystem [16].

Studies about IT platform have made distinctions between two types of platform’s appropriations. The first appropriation is to be an exchange mechanism of an agent with its peripheral. Examples are supply chain management platform and knowledge management platform. This type of appropriation mostly fail into IT platform as IT artifact study. The second appropriation is to mediate connections among agents. Examples are software as a service platform and application programming interface platform. This type of appropriation is taken cared by platform-based innovation study. This study follows the latter literature to address the research goal.

The platform-based innovation literature commonly recognizes phenomenon associated with the second type of IT platform appropriation as the two-sided platform phenomenon. The word two-sided comes from the fact that IT platform is situated in the middle between two different agents. One agent utilizes platform to innovate products and services. Another agent consumes these products and services. Zhu & Iansiti [20] compiled a list of examples of two-sided IT platforms illustrated in the table 1.

Table 1 - Examples of two-sided IT platforms

Side 1 (innovator)	IT platform	Side 2 (consumer)
Application developers	Operating systems	Computer users
Clip makers	Video sharing services	Clip watchers
Advertisers	Search engines	Searchers
Game developers	Console game machines	Game players
Document writers	Documentation software	Document readers

Platform-based IT innovation

According to Krishnan & Gupta [13] a platform-based innovation is an innovation that shares underlying components across a family of innovations. Evans & Schmalensee [9] recognize four common types of platform-based IT innovations: advertiser-supported media, information exchange, transaction systems, and software platforms. One common thread across all these types is the ability of innovators to connect to their targeted consumers. Interestingly, Casey & Töyli [5] reveal that the success of platform-based IT innovation does not depend on the innovation itself but on the management of the platform. The platform owner must have strategy to help both innovators and the consumers of the innovations. The adoption of platform-based IT innovation is a more complex decision making than that of non-platform IT innovation [2]. The customer not only adopts the innovation itself but he or she also adopts the platform. Furthermore, when platform is taken into account, the customer looks at the portfolio of innovators who support the platform. The opposite of this decision is also true. From the point of view of innovators, platform's capability and quality are not enough to persuade them to create innovations. A significant part of their decision is the adoption of the platform's users [20].

Value creation of two-sided IT platform

Evans & Schmalensee [9] argue that value creation of two-sided platform is different from that of one-sided platform (i.e., the platform that focuses only on its users). Two theoretical lens are utilized by researchers to understand this creation. These lens are rather complementary than mutually exclusive. Casey & Töyli [5] suggest that the creation can be understood by the lens of value chain system. However, they point out that this value chain must recognize linkages between innovator and consumer through the IT platform. A case study by Tran and associates [19] reveals that an intermediary innovation such as IT platform may add values to the final innovation through a basic product development value chain. This chain consists of five processes, which are planning, concept development, design,

testing, and production. At each process, the intermediary innovation adds different values to the final innovation. The authors conclude that values added come down to a mix of speed enhancement, cost cutting, risk reduction, and product differentiation.

Not only the value chain system, the value creation can also be understood by the lens of network effects. The platform is gatekeeper of connections between different types of agents [10]. The value of a platform-based innovation is influenced by parameters that affect connections among these agents. Mantena & Saha [16] inquire the significance of technology advances in a context of platform asymmetry. Their guiding principle is that advanced platform enhance collaboration between agents across the two sides. Thus, more values are created on both sides. When platform asymmetry is taken into account, the reserachers found that technological advances may actually benefit value creation on the dominant platform more than on the inferior platform. Lin et al., [15]. take a closer look at platform access fees. They found that the platform owner has to carefully manage the fees. Access fees disrupt value creation by innovators. Any surplus created by them will be extracted by the fees. Furthermore, consumers will find no differences between innovations from diverse innovators if the consumers have to pay high fees.

Platform characteristics and the value creation

Thus far, researchers have put forward a broad understanding about the value creation mechanism of the two-sided platform. The central interest of this study is at the platform-based IT innovation and this value creation mechanism of IT platform contributes to the innovation. An insightful to this interest is still lacking. This study believes that platform's characteristics may help revealing some the insights. Platform's characteristics are often used to shed light on relationships between a platform and its ecology. A few important IT platform's characteristics are selected based on the two theoretical lens explored earlier.

Platform Openness

First characteristic is the platform openness. The openness is associated with less control by one party and has transparency of information as its core value. Platform openness has been utilized to understand the value of IT platform. However, it has not been utilized in the context of value of platform-based innovation in relation with its platform. Nonetheless, the value of platform literature has discovered many useful insights to the value creation of platform-based innovation. A theoretical work in the area of software platform by [8] illuminated that open source platform helps both proprietary and open source software innovators to better extract surplus. This illumination is very much in line with the observation by [15] that platform access fee hinders platform-based innovations. Economides & Katsamakas [8] further illuminated that there is more variety of software in an open source platform than that of a proprietary platform. Open platform enables firms to see more alternatives than proprietary does. The innovator does not feel restrictions imposed by the platform owner [1]. Current discussion points to the following proposition.

Proposition 1: Open platform adds more value to platform-based innovations than proprietary platform does

Platform flexibility

The second characteristic is the platform flexibility. Flexibility in IT literature is the degree to which IT resources are able to evolve with the changes in environment [18]. In terms of IT platform, this study sees flexibility is an ability of the platform to operate in various hardware and software configurations. Platform flexibility is important because it enables innovators to better address their markets by aligning innovations with changes in customer's preferences and with emerging opportunities. From the position of network effects, platform flexibility allows innovator to capture rapid network growth by adapting products and services to the demands of consumers [11]. From the position of value

chain, platform flexibility greatly benefits the design-to-manufacturing chain by helping in cost management and improving speed to market. With similar budget and time constraints, an innovator can introduce a family of products instead of just one product [13]. A model by Smit & Trigeorgis [17] advance that the basis to value creation by flexibility is the resource redeployment. A resource (e.g., technology, skill, or knowhow) can be implemented multiple times on innovations because these innovations are related through the platform. The second proposition is the following.

Proposition 2: Flexibility platform adds more value to platform-based innovations than inflexible platform does

Conclusion

This study reviews the two-sided IT platform literature and put forward a set of propositions. Its main goal is to address the question "how does an IT platform create values for platform-based IT innovations?" The propositions address this question by postulate the importance of some of the IT platform's characteristics on the value creation. This postulation is based on two complement theoretical point of views. The value chain explains how activities related to the characteristics add values to final platform-based innovation. The network effects explains how the characteristics influence agents surrounding the platform in value creation.

To move these propositions forward, an empirical investigation will be carried out. There are many missing components before the investigation. Hypotheses and control variables are needed to be put in place. Measure and data collection are to be implemented. Statistical modeling is required.

The main contribution at this state is the theoretical explanations of how an IT platform may add values to platform-based IT innovations. The author sees that these explanations lay a ground work on the linkages between IT platform and the value of platform-based IT innovations. As Dhar & Sundararajan [7] put, the IT innovation has mature to a point where an organization can have

business around platform-based IT innovations rather than being the owner of an IT platform. Understanding these linkages makes conducting business with platform-based IT innovations easier because the organization can systematically create a better value proposition for its customers.

References

- [1] Almirall, E., & Casadesus-Masanell, R. Open versus closed innovation: A model of discovery and divergence. **Academy of Management Review**, 35(1), 2010, 27-47.
- [2] Aoki, R., & Schiff, A. Promoting access to intellectual property: Patent pools, copyright collectives, and clearinghouses. **R&D Management**, 38(2), 2008, 189-204.
- [3] Bergvall-Kareborn, B., & Howcroft, D. Mobile applications development on apple and google platforms. **Communications of the Association for Information Systems**, 29, 2011 December, 565-580.
- [4] Bharadwaj, A. S. A resource-based perspective on information technology capabilities and firm performance: *An empirical investigation*. **MIS Quarterly**, 2000 March, 169-196.
- [5] Casey, T. R., & Töyli, J. Dynamics of two-sided platform success and failure: An analysis of public wireless local area access. **Technovation**, 32(12), 2012, 703-716.
- [6] Ceccagnoli, M., Forman, C., Huang, P., & Wu, D. J. Cocreation of value in a platform ecosystem: The case of enterprise software. **MIS Quarterly**, 36(1), 2012, 263-290.
- [7] Dhar, V., & Sundararajan, A. Information technologies in business: A blueprint for education and research. **Information Systems Research**, 18(2), 2007, 125-141.
- [8] Economides, N., & Katsamakas, E. Two-sided competition of proprietary vs. open source technology platform and the implications for the software industry. **Management Science**, 52(7), 2006, 1057-1071.
- [9] Evans, D. S., & Schmalensee, R. The industrial organization of markets with two-sided platforms. **Competition Policy International**, 3(1), 2007, 151-179.
- [10] Guo, H., Cheng, H. K., & Bandyopadhyay, S. Net neutrality, broadband market coverage, and innovation at the edge. **Decision Sciences**, 43(1), 2012, 141-172.
- [11] Hanseth, O., & Lyytinen, K. Design theory for dynamic complexity in information infrastructures: The case of building internet. **Journal of Information Technology**, 25(1), 2010, 1-19.
- [12] Hsieh, K.-N., & Tidd, J. Open versus closed new service development: The influences of project novelty. **Technovation**, 32(11), 2012, November, 600-608.
- [13] Krishnan, V., & Gupta, S. Appropriateness and impact of platform-based product development. **Management Science**, 47(1), 2001, 52-68.
- [14] Lahiri, A., Dewan, R. M., & Freimer, M. The disruptive effect of open platforms on markets for wireless services. **Journal of Management Information Systems**, 27(3), 2011, 81-109.
- [15] Lin, M., Li, S., & Whinston, A. B. Innovation and price competition in a two-sided market. **Journal of Management Information Systems**, 28(2), 2011, 171-202.
- [16] Mantena, R., & Saha, R. L. Co-opetition between differentiated platforms in two-sided markets. **Journal of Management Information Systems**, 29(2), 2012, 109-139.
- [17] Smit, H. T., & Trigeorgis, L.. Strategic planning: Valuing and managing portfolios of real options. **R&D Management**, 36(4), 2006, 403-419.
- [18] Tallon, P. P. Value chain linkages and the spillover effects of strategic information technology alignment: A process-level view. **Journal of Management Information Systems**, 28(3), 2011, 9-44.
- [19] Tran, Y., Hsuan, J., & Mahnke, V.. How do innovation intermediaries add value? Insight from new product development in fashion markets. **R&D Management**, 41(1), 2011, 80-91.
- [20] Zhu, F., & Iansiti, M. Entry into platform-based market. **Strategic Management Journal**, 33, 2012, 88-106.

Cognitive Processing of Text-based versus Visual-based Questions: The Case of Computer-based Training on Deferred Tax Accounting

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Abstract

A CBT application was developed for the 2013 newly enforcement of an International Accounting Standard #12, the Deferred Tax. The application incorporated two types of question representation formats: text-based and visual-based. The latter format was developed in order to reduce cognitive processing load of a user. A quasi-web experiment was conducted to investigate whether the fit between two different types of question representations (text-based and visual-based) and two modes of tasks (spatial and symbolic) will affect how professional accountants are able to get the essence and meaning of the exercise questions correctly. A total of 38 accountants and auditors participated in the online survey samples. The results show that the fit between question types and task characteristics did not affect the extent of accurate conveyance of the exercise questions being processed by CBT's users. Contrary to the common belief, participant presented with text-based performed more accurate than with visual-based questions.

Keywords:

Text-based versus Visual-based question representation formats, Symbolic versus Spatial tasks, Deferred Tax Accounting.

Introduction

Accounting professionals are required to maintain their practice licenses by continually taking professional development training courses in accounting and related fields. Computer-based Training (CBT) becomes a tool that can be used as supplemental face-to-face training mechanism or an alternative training solution for today's technologically zealous organizations.

In order to keep up with newly enforced accounting standards and their interpretations, accountants would attend seminars, workshops, and classes continually. Lately, CBT has been used by some organizations to help their staffs on their toes as fast as possible. However, these tend to be done in large organizations that have abundant technical savvy resources to develop the applications quickly and effectively. In Thailand, accountants in smaller firms rely on academic institutions, professional training centers, and professional organizations such as the Federation of Accounting Professions. In some cases, new contents can be incorporated into the existing CBT faster. However, the rapid changes in computer and communication technologies make many of the CBT applications outdated.

The International Accounting Standard #12, Deferred Tax, is one of the most difficult standards to understand and implement. Nevertheless, it is critical for Thai professional accountants to learn this standard and its related practices before legal enforcement in 2013. Thus, to readily prepare for actual implementation, training need had started two years ago. As part of this preparation, a CBT application was developed in 2012. The application was written in HTML5 employing iPad devices to display with gesture technology. Also, the design requirements of visual questions lent themselves to colossal use of pictures in the application. Although this accounting standard was originally issued in English, the Federation of Accounting Professions had issued a parallel Thai standard and had it enforced accordingly.

In order to develop an effective accounting CBT, practice exercises are perhaps the most important components of the application. Drawing from the Paivio's dual coding theory [8], pictures have different internal representation from text. This line of research found learning outcomes from processing text and pictures to be richer than from text-only. Thus, the present study incorporates of visual questions in practice exercises so as to enhance learners' cognition and their subsequent learning outcomes. Task characteristics as classified by the Vessey's Cognitive fit theory [11], symbolic and spatial, is also used to address the factors affecting learners' mental representation while processing text-based and visual-based questions.

The objective of this study is to investigate whether the fit between two different types of question representations (text-based and visual-based) and two modes of tasks (spatial and symbolic) will affect how professional accountants are able to get the essence and meaning of the exercise questions correctly.

Theoretical Base and Hypotheses

The design of present study is based on two major theories, Dual Coding Theory and Cognitive Fit Theory. The former is prominent in cognitive

learning literature whereas the latter in business information systems literature. Both theories complement one another in explaining task-related learning of a CBT.

Dual Coding Theory

Addressing mental structures and processes, Clark & Paivio explained the applicability of Dual Coding Theory in education [11]. They argued that human cognition is based on two complimentary mental representations, verbal and nonverbal (imagery). The application of the theory to our research setting is that verbal codes are represented in word-like or text-based representations whereas nonverbal codes comprise shapes and other nonlinguistic objects or visual-based representations. The joining of words to words or images to images forms associative connection of network of mental representations that in turns influence learner's ability to comprehend materials. However, the thrust of this line of research is that nonverbal processes play an important role in verbal processes, vis-à-vis images processing can enhance text processing in learning.

Thus, this research hypothesizes that visual-based questions will allow users to understand the meaning of a question better and faster.

H1: Visual-based questions increase learning outcomes than text-based questions by conveying more accurate content with less amount of time performed by CBT participants.

As problem solver gurus always say that to understand the question is half-way through solving it. For the development of a CBT system, visual-based questions were included in order to capitalize the spatial visualization ability of professional learners. The study of spatial visualization ability and problem solving tasks has received greater attention by researchers in human computer interface (HCI) [6]. In our previous study on the usability of visual questions, we found that respondents preferred visual-based questions over text-based questions but they did not find visual-based question as being overwhelmingly

useful [10]. In that study, no consideration of consideration of task differences was made; only different question representations were examined.

Cognitive Fit Theory

Research in accounting visualization relies on Vessey's Cognitive Fit Theory to reduce mental effort of financial data users by fitting problem representations with problem-solving tasks [11]. Many followers of the theory provided empirical evidences to support its premise. Variations of problem representations in spreadsheet applications and accounting models were examined [1] [2] [4] [7]. Findings from these studies had supported the main thrust of this theory. The variation of problem representations, text-based and visual-based questions as introduced in the present study, is in line with previous research. Similar to other studies, two types of tasks, symbolic and spatial, were employed. However, the task manipulation scheme being designed and controlled for the present study is similar to Peng's study of the drill-down paths of accounting data [9]. Processing the meaning of questions correctly is the learning outcomes in the present study. Symbolic task requires the participant to pick out correct accounting numbers from the two types of questions; spatial task, on the other hand, requires the participant to correctly compare the magnitude of those accounting numbers. Thus, the fits between problem representations and tasks as a moderator of learning outcomes are hypothesized as follows:

H2: Cognitive fit moderates learning outcomes such that visual-based questions increase learning outcomes more than text-based questions by conveying more accurate content with less amount of time when spatial task is performed by CBT participants.

H3: Cognitive fit moderates learning outcomes such that text-based questions increase learning outcomes more than visual-based questions by conveying more accurate content with less amount of time when symbolic task is performed by CBT participants.

Research Method

In order to compare user's cognitive processing experience of text-based versus visual-based question formats, a within-subject quasi-web experimental study was conducted. The data was collected from a web-based survey developed by one of the authors was conducted. The web link (<http://www.thanachart.info/DeferredTax/>) was sent via Facebook invitation and emails to accounting professionals who had taken classes and/or professional training programs in selected universities. Due to time constraint and accessibility, convenient sampling method was chosen. Participants were encouraged to refer to the site by snowballing to their colleagues.

Study Constructs

The present study relies on learner's self-reported assessment on the following constructs:

1. **Dependent Variables:** Two measures are used for the cognitive processing construct. Accurate conveyance of question content was assessed by the number of correct answers each participant gave while performing text-based and visual-based practice exercises. The amount of time spent on completing these exercises was also recorded. Usability of text-based versus visual-based question formats was also assessed with Brook's 10 usability questions [3].
2. **Independent Variables:** With a 2x2x2 design-- task (symbolic and spatial) x order of practice exercises (Ex1 and Ex2) x question format (text-based and visual-based)—the treatments were manipulated as independent variable. Task type and order of practice exercises are between subject factors and question format is within subject factor.
3. **Control Variables:** To control for cognitive processing differences being inherent by participants, experiences with CBT and with deferred tax accounting subject were assessed as well as visual versus verbal learning style measure.

A general hypothesis for this study is, if all other things being equal, information and cognitive load

will be less, perception toward types of questions in terms of their usability will be higher and the time required in solving practice exercises will be less for visual-based question format than the traditional text-based question format.

Data Collection

At the beginning of study, a pre-test questionnaire was used to obtain demographic data and user experience of visual oriented questions and CBT technology. Participants of the study are accounting professionals. Among 104 taking part in the survey, 38 completed questionnaires. The general profile of participants is shown in Table-1. Six participants (15.79%) are male and 29 participants (76.32%) are female. Most participants reported to have the education level at Master or above (71.05%). Majority of them are accountants (47.37%). Table 2 shows the descriptive statistics of control variables. Overall, participants did not exhibit extreme preference towards a particular learning style. They had moderate experiences regarding CBT and deferred tax accounting subject.

Table 1- Participants' Profile

Profile	No (%)
Gender:	
Male	6 (15.79%)
Female	29 (76.32%)
Missing	3 (7.89%)
Education:	
Bachelor and Below	10 (26.32%)
Master and Above	27 (71.05%)
Missing	1 (2.63%)
Occupation:	
Accountant	18 (47.37%)
Auditor	9 (23.68%)
Others	10 (26.32%)

Table 2 - Descriptive statistics of control variables

Control Variables	Mean (SD)
Learning Style: (1 more towards Verbal and 7 more towards Visual)	4.26 (1.182)
Experience:	
With CBT	3.35 (1.476)
With Deferred Tax	3.38 (1.891)

The study comprises two between subject manipulations: First, the online survey incorporates two types of tasks, TSym=Symbolic Task, TSpa=Spatial Task. Each individual participant either did a symbolic or a spatial task. Each participant would use the data of both sets of exercises in performing the tasks. Mixed order of exercises was manipulated. Each subject would work on different order of the two sets of exercises (Ex1 and Ex2). Since each participant had to work on both types of question formats, QTxt = Text-based Question, QVis = Visual-based Question, this becomes within subject manipulation.

All in all there are four conditions being manipulated as shown in Table 3 below. Participants were randomly assigned to the distinct web link URLs being setup for the online questionnaires created for each condition. The amount of time being spent on each task was tracked.

Table 3: Conditions and Number of Usable Data

Cond	Tasks	QTxt	QVis	No. of Usable Subjects
A	Symbolic	Ex1	Ex2	7
B	Symbolic	Ex2	Ex1	15
C	Spatial	Ex1	Ex2	8
D	Spatial	Ex2	Ex1	8
Total				38

Analyses and Results

This study comprises between-subjects and within-subjects variables in order to investigate whether the fit between two different types of question representations (text-based and visual-based) and two modes of tasks (spatial and symbolic) will affect how professional accountants are able to correctly understand the essence and meaning of the exercise questions.

Learning outcomes were measured using number of correct answers to indicate the accuracy (accuracy) and time to complete a task (time). There were ten questions in each task. The maximum correct answers for each task are

ten. Tasks and order of the tasks are between-subjects variables. Format or types of question representations is the within-subjects variable. In addition, experiences with CBT (CBTExp) and with deferred tax accounting subject (DFExp) as well as visual versus verbal learning style measure (Learning) were included as control variables. Thus, the analysis employed a mixed between-within subjects analysis of variance to test effects of each variable and hypotheses set forth in this study.

Table 4 and Table 5 report the results of the repeated-measures ANOVA for accuracy and time, consequently. The accuracy was significantly affected by Format, $F(1, 27) = 7.795$, $p < 0.05$ and DFExp, $F(1, 27) = 5.327$, $p < 0.05$. There were no main effects from the manipulation factors. On the other hand, the time spent was significantly influenced by the interaction between Format and Learning, $F(1, 27) = 7.090$, $p < 0.05$.

The influence of the cognitive fit on learning outcomes can be investigated by the interaction effect between Format and Task. Hence, the cognitive fit did not appear to moderate the learning outcome. There are no evidences to support H2 and H3.

Table 6 and Table 7 reports the descriptive statistics of the learning outcomes measured by accuracy and time spent on exercise in visual-based questions and visual-based questions.

Table 4 - Results of the Repeated-Measures ANOVA for Accuracy

Source	DF	MS	F	p-value
Between-Subjects				
Task	1	3.821	0.764	0.390
Order	1	6.859	1.370	0.252
Task x Order	1	1.550	0.310	0.582
Learning	1	15.446	3.086	0.090
CBTExp	1	1.740	0.348	0.560
DFExp	1	26.660	5.327	0.029
Error	27	5.005		

Within-Subjects				
Format	1	8.174	7.795	0.010
Format x Task	1	0.555	0.530	0.473
Format x Order	1	0.254	0.242	0.627
Format x Task x Order	1	3.883	3.703	0.065
Format x Learning	1	2.399	2.288	0.142
Format x CBTExp	1	0.135	0.129	0.722
Format x DFExp	1	3.540	3.375	0.077
Error (Format)	31	1.129		

Table 5 - Results of the Repeated-Measures ANOVA for Time

Source	DF	MS	F	p-value
Between-Subjects				
Task	1	200.155	0.883	0.356
Order	1	26.101	0.115	0.737
Task x Order	1	0.360	0.002	0.969
Learning	1	258.827	1.142	0.295
CBTExp	1	144.290	0.636	0.432
DFExp	1	87.451	0.386	0.540
Error	27	226.731		
Within-Subjects				
Format	1	422.436	1.209	0.281
Format x Task	1	55.226	0.158	0.694
Format x Order	1	146.332	0.419	0.523
Format x Task x Order	1	55.226	0.158	0.694
Format x Learning	1	2476.482	7.090	0.013
Format x CBTExp	1	524.030	1.500	0.231
Format x DFExp	1	448.729	1.285	0.267
Error (Format)	31	349.273		

In addition, a paired t-test was performed to further investigate the learning outcomes from visual-based questions and text-based questions. Contrary to H1, participants with text-based performed more accurate than with visual-based questions, $t = 2.867$, $p < 0.01$. On average,

participants spent around 30 seconds on each exercise. There was no significant difference in time spent to complete a task.

Table 6 - Means (Standard Deviations) for Learning Outcomes - Accuracy

Cond	Textual	Visual
A	7.33	7.14
B	7.79	6.20
C	9.00	8.57
D	7.63	7.50
Average Accuracy	7.94	7.11

Table 7 - Means (Standard Deviations) for Learning Outcomes - Time Spent (seconds)

Cond	Textual	Visual
A	33.83	31.00
B	31.93	31.53
C	36.88	34.14
D	32.75	33.13
Average Time	33.53	32.27

Discussion and Conclusion

Accounts and auditors continually update their knowledge with new accounting standards and their interpretations. With the help of CBT, they have an alternative means of acquiring new knowledge besides attending seminars or classes. In Thailand, an International Accounting Standard #12, the Deferred Tax was recently enforced. It is one of the most complex standards. Thai professional accountants and auditors were under pressure to be ready for this new standard. Thus, this study enquired the use of CBT to aid the needs in this new accounting standard training.

Derived from the Paivio's dual coding theory[8] and the Vessey's Cognitive fit theory [11], the hypotheses set forth in this study are to investigate whether the fit between two different types of question representations (text-based and visual-based) and two modes of tasks (spatial and symbolic) will affect the learning outcomes measured by accuracy of the answers to the exercise questions and time spent during the exercise.

Even though the dual coding theory suggested that

images processing can enhance text processing in learning, text-based questions were found to aid participants in learning better than visual-based questions. In addition, the fit between question types and task characteristics did not affect the extent of accurate conveyance of the exercise questions being processed by CBT's users. However, the results show that the fit between types of question representations and individual learning styles significantly influenced the time spent in performing the task.

In sum, all hypotheses were not supported by the empirical evidences collected in this research. This may owe to the fact that the concept of Deferred Tax is very difficult. Most accountants and auditors found it hard to understand. Further analysis revealed that experienced with deferred taxaccounting subject was significantly related only with the accuracy scores of visual questions. It implies that accountants and auditors with significant previous experiences in the subject of deferred tax will find visual questions useful and performed more accurate the novices.

The results of this study offer some managerial implications and suggest future research directions. CBT is a technology that can be exploited to facilitate the professional development, especially accountants and auditors. The format of exercise questions can enhance learning experiences. However, this is subject to learners' experiences with the learning subjects. Visual questions appear to be useful with learners with high experiences. Text questions might be appropriate with novices. Moreover, learning style is also an important aspect to be considered in the design of CBT.

This study faced some limitations. The use of a web-based survey allowed the authors to reach a large group of audience but still lacks the control of participation. This resulted in the small number of participants in this research. Future research can be replicated in the laboratory setting where researchers can better control the environment. Also, a single usage of CBT may not truly reflect the learning outcomes. Longitudinal study design may be better in capturing the learning outcomes.

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References

- [1]. Amer, T., An experimental investigation of multi-cue financial information and decision making. **Journal of Information Systems**, 1991. **5 (Fall)**: p. 18-34.
- [2]. Amer, T., Bias due to illusion in the graphical presentation of accounting information. **Journal of Information Systems**, 2005. **19(1 (Spring))**: p. 1-18.
- [3]. Brooke, J., A “quick and dirty” usability scale, in Usability Evaluation in Industry, P.W. Jordan, et al., Editors. 1996, Taylor & Francis: London, UK. p. 189-194.
- [4]. Chan, H.C., S. Goswami, and H.-W. Kim, An Alternative Fit through Problem Representation in Cognitive Fit Theory. **Journal of Database Management**, 2012. **23(2 (April-June))**: p. 22-43.
- [5]. Clark, J.M. and A. Paivio, Dual Coding Theory and Education. **Educational Psychology Review**, 1991. **3(3)**: p. 149-210.
- [6]. Downing, R.E., J.L. Moore, and S.W. Brown, The effects and interaction of spatial visualization and domain expertise on information seeking. **Computers in Human Behavior**, 2005. **21**: p. 195-209.
- [7]. Dunn, C.L. and S. Grabski, An Investigation of Localization as an Element of Cognitive Fit in Accounting Model Representations. **Decision Sciences**, 2001. **32(1 (Winter))**: p. 55-94.
- [8]. current status. **Canadian Journal of Psychology**, 1991. **45**: p. 255-287.
- [9]. Peng, J., R.E. Viator, and S. Buchheit, An Experimental Study of Multidimensional Hierarchical Accounting Data: Drill-Down Paths Can Influence Economic Decisions. **Journal of Information Systems**, 2007. **21(2)**: p. 69-86.
- [10]. Tanlamai, U., et al. Usability of Visual Questions in Learning Advanced Accounting Practices. in The 9th International Conference on IT Applications and Management: Digitally Networked Global Society. 2012. Yonsei University, Wonju, Korea: KDB Korea Database Agency.
- [11]. Vessey, I., Cognitive fit; a theory-based analysis of the graphs versus tables literature. **Decision Sciences**, 1991. **22(2)**: p. 219-240.

Structural Immunity to Technology Diffusion in Nepal: Planned Technology and Unplanned Adaptation

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Abstract

This paper analyzes the technology planning priorities of the government of Nepal. The analysis covers the last fifty years of the country's planned economy at one part and examines the organizational setting for technology diffusion on the other part. An overview of national plan documents determines the planning priorities and initiatives for technology diffusion in Nepal. An examination of the organizational setting in the country identifies the congruence between the planning priorities and organizational setting in the enduring process of technology diffusion. An analysis of the response of opinion leaders from selected organizations involved in technology works/projects supplements to the analysis and conclusion of the study. This study concludes with identification of unplanned organizational setting as a structural immunity to technology diffusion in a planned economy of Nepal.

Keywords: Nepal, technology diffusion, technology planning priorities, organizational setting, structural immunity to change

Introduction

Structural settings and technology diffusion in a country are prerequisites and reciprocals of each other. The structural setting refers the set of organizations or institutions working in the area of technology development and transfer. The process of technology dissemination, transfer, and absorption in multiple areas like infrastructure, socioeconomic development, governance, and compliance sectors of an economy refers as the diffusion of technology.

An assimilation of national technology planning priorities and functional priorities of the organizations working in the areas of technology dissemination and transfer is a condition of technological advancement in a country. The process of technology diffusion is an integration of the priorities with the working priorities of the technology adopters.

The instrumentality of organizations involving in the process of technology diffusion needs to be assessed at different levels of analysis. It is necessary to understand the dialectical relationships between the forces of conflict, coercion, and disruption at one level and forces of consensus, unity, and integration at another level of the organization (Astley & Van de Ven, 1983).

Organizations and their leaders master the immunity to change which will be dominant in their functional areas. They will set the standard in terms of accomplishing their own goals and they will have the greatest loyalty and commitment of their internal constituents (Kegan & Lahey, 2009). There may be incongruence between the national technology planning priorities and the priorities of the organizations involved in technology diffusion as well.

In the context like Nepal, where government presence in the economy is nominal but the private and non-government sectors are enjoying freedom for the establishment and operationalization of organizations in the areas of their own choice, diffusion of technology intended in the national plan documents is in limbo. Unplanned permission for organization establishment increases the number of organizations but it does not assimilate the technology planning priorities and functional priorities of the organizations established as such.

The organizations develop their own structural immunity with strong commitment to their own constituencies or stakeholders. The immunity does not only prevent the organization in bringing change but remains incompatible with the intended change initiatives and planning priorities.

Statement of the Problem

In pursuance of self-reliance, Nepal developed technological capabilities in some specific areas such as agriculture, civil engineering, architecture, metallurgy, water management, medicine, textile and paper manufacture, dyeing and food technology (Singh & Bhuj, 2001) in its own way until the beginning of her planned economy. Traditional technologies like constructing religious artifacts, images, and temples; construction of temples, pagodas, and stupas; textiles using handlooms; handmade paper; brewing wine and hard liquor preserving meats, fruits, and vegetables (Joshi, 2007) were in practice during the period.

Modern science and technology began along with the beginning of the planned economy. The country has made only a little progress in a few areas like biogas, biomass, micro-hydro power, solar energy, software development, construction materials, and food processing. Although, science and technology systems in Nepal still need much more structural improvement in almost all the sectors like infrastructure, socioeconomic, governance and compliance. In view of the statement, this paper concentrates on the following two problems:

What were the technology planning priorities during the planned economic efforts of more than 50 years in Nepal? Diffusion of technology represents the cumulative number of adopters of a new product, material, or process. It follows S-shaped curve and needs an integrated efforts of all the actors. It is passing through various channels to the socioeconomic sector of a nation.

How well the technology planning priorities and structural setting aligned for the technology diffusion in Nepal? An alignment between the structural/organizational setting and national technology priorities is significant in order to develop and diffuse the technology because organizations are the carrier of technology as well.

Methods

This study overviewed technology planning priorities of Nepal for the period from 1956 to 2013. An overview of 5849 plus pages of the periodic plan and review documents of Nepal had completed in order to determine the planning priorities for technology diffusion. An exploration on the organizational setting had been made to identify the major organizations involved in the process of technology diffusion. Overview of the objectives and working areas of the selected organizations was also done in order to ascertain their functional priorities. Unstructured interviews with selected opinion leaders associated with one or more of such organizations at different point of time were also incorporated while determining the reasons of structural immunity to change.

Overview of the plan and review documents determined the technology diffusion priorities and initiatives well as achievements in technology branding, grading, and diffusion in the country. Subsequent exploration of the organizations found some major works/projects aiming at technology development/diffusion in different sectors in different ways. The opinion leaders' response complemented the discussion section as well.

Triangulation of the planning priorities, initiatives, and responses of the opinion leaders over the works/projects of their organizations had been made in order to determine the structural immunity to technology diffusion in the country.

Analysis

Technology advancement program in less developed countries like Nepal is influenced by the diffusion of imported technology. The adaptation process of a new technology encounters structural barriers like sociocultural, psychological, and economical in due course of its diffusion (Pandey & Yadama, 1992).

Institutional interdependence mainly between the organizations involved in training, education, research and development and the technology adopters, supporting service industry actors are derailing the process of technology diffusion in the less developed country. It has been assumed that role of the regulators and government officials in bringing these two sets of institutions and actors

needs to be consultative and participative instead of authoritative one.

National Periodic Plan Documents

Nepal adopted planned economy from the beginning of second half of the twentieth century (NPC, 2012). The technology planning priorities of least developed countries like Nepal may be concentrated into two paths of technology diffusion. The first one is to develop and diffuse the indigenous technology and the second one is to transfer already developed technology from developed countries. The priority of Nepal was on both the paths of developing the indigenous technology and transfer of foreign technology as well.

First Plan (1956 - 1961)

Technology and capital equipment considered key factors in the growth of production. The Plan assumed that improvement of economic condition within the country was depending upon knowledge of technology and expanded programs in education. Until the end of the first plan, there were nine institutions in the field of technical knowledge and skills development in the country, and 6351 persons were getting education and training in different fields.

Second Plan (1961 - 1965)

Technical knowledge shortage was realized sharply and high emphasis was given on technical training. Low and medium level skills training was intended to deliver within the country and foreign countries were sought for higher-level training. The country was receiving technical assistance from foreign countries and agencies namely America, India, China, Russia, Britain, Australia, Switzerland, New Zealand, Canada, United Nations, and Ford Foundation as well during the period.

In the first and second plans, special attention was given for the establishment of experimental farms and livestock centers and the training of middle-grade technicians. During the second plan period, 680 middle-grade technicians were trained and sent them to the districts.

Third Plan (1965 - 1970)

Technology transfer/diffusion was sought in

the field of agriculture in order to replace the primitive practices. Agriculture extension to date had not been very successful because of the lack of transport facilities, technicians, and coordination with other developmental programs, improved seeds, fertilizer, credit, and efficient administration. Decentralization of authority was in priority and the government agencies (*Panchayats*) were expected to handle the tasks of developing and/or diffusing technical skills. High emphasis was on the vocational and adult education. Most of the high-level technicians like doctors, engineers, and agriculture specialists were receiving education and training in India. Technical assistance for private sector development was assured and high priority was on the production of food grains. Technical assistance for training facilities, transport development, storage, as well as private sector development was quite laudable during the period.

Fourth Plan (1970 - 1975)

Expansion of foreign trade considered as a mean of obtaining capital goods and technical expertise. Labor-intensive technology and use of indigenous resources had been realized as an important vehicle for employment generation. It was expected that the use of labor-intensive technology would bring multiplier effects in the economy. Emphasis was given to the technical education especially in the fields such as engineering, health, education, and commerce.

Several technical and vocational training centers were opened during the period; however, foreign assistance was sought in order to train the personnel in technical fields. Research programs in agriculture sectors were considered to be carried out as an integrated way of the various units- agricultural botany, agronomy, agricultural engineering, entomology, plant pathology, soil science, etc. Emphasis was on the production of agriculture sector technicians like Junior Technician (JT) and Junior Technical Assistant (JTA) in district agriculture offices.

Lead farmer training program, food research program, and forestry programs were much more desired at that time. The World Bank group was expected to conduct technical and economic feasibility survey for roads throughout the country. Technical experts and equipment were

sought from the United Nations for the development of telecommunications facilities. Computer technology was introduced from the year 1971 and National Computer Center was established in 1974.

Fifth Plan (1975 - 1980)

Encouragement of labor-intensive techniques and extensive rural works programs were major concentration of the plan. Emphasis was given for the development of technical manpower from concerned institutions in the field of engineering, medicine, agriculture, and so on.

Sixth Plan (1980 - 1985)

Development and use of technology involving biogas, solar energy, wind power, and natural gas was emphasized. Maximum use of local skills and technology was desired in the implementation of development project.

The plan intended to improve technology in the area of breed development of calves, bulls, buffaloes, goats, sheep, chicken, fish, fingerlings and the improved technology was expected to disseminate very soon. The emphasis was put on the development of practical production technology that had immediate relevance to the problems confronting the farmers.

Intention of labor-intensive technology and job creation was continuous. Drug research and productivity improvement of the cottage industries were also emphasized in the Plan. There was also encouragement to adopt foreign technology and capital in the extraction of mineral deposits as well as establishment of mineral processing industries.

The plan intended to adopt cost efficient technology in connection with the construction of small hydel projects. Similarly, maximum use of labor-intensive technology and development of construction technology which would permit maximum use of locally available construction material as well as was emphasized.

This Plan specified national science and technology objective, policy and program for the first time in the history of planned economy of Nepal. The objectives were focused to increase the capability of national science and technology that would enable to embrace the entire development

processes of the country, to inform the people at large on the use and utility of science and technology, and to maintain coordination among the different units that were engaged in developing and extending science and technology.

Seventh Plan (1985 - 1990)

This plan intended to expand and diversify the export market by enhancing the competitiveness of the exportable goods from the adoption of high technology and own skills as well. It was assumed that judicious use of science and technology would shift the dependence from agriculture to industries. The Plan set objective of developing science and technology in the same pace as that of economic and social development of the country; upgrading the capability of science and technology by developing scientific and technical manpower, conducting research and development activities, transfer of know-how on organizational development and management; and expanding the use of science and technology by bringing awareness among the people.

The plan intended to make amendments and changes in the imported technology in order to suit the local needs as well as manpower training for the use of appropriate science and technology. It was expected that indigenously developed technology would be further tested for its improvement and people would be informed about the concept, utility, and importance of science and technology in their daily lives.

The attempt of transfer of technology to the cottage industry continued during the period. The plan intended to continue research works for the development of technology in the areas of low cost construction and use of local raw materials. The emphasis was given to maximize the use of local technology, expertise, and skills and to explore and develop new and appropriate technology as well.

Eighth Plan (1992 - 1997)

It was assumed that advanced technology and institutional reforms would be made indispensable tools of support to the private sector and organizations

down to the village level. Dissemination of appropriate technology in agriculture sector was continuous in the plan as well.

In order to accelerate the technology transfer process, it was aimed to increase the participatory role of agricultural research in training and communication programs. Some joint venture and technology promotion institutions were expected to be set up with a view to providing support to manufacture energy related equipment. Indigenous labor, skill and resource as well as foreign investment and technology were desired to utilize in the development of hydropower. Rural telecommunication services were intended to be provided by adopting technology appropriate to the geographical features of the country.

Foreign investment was expected to be increased for the maximum utilization of managerial and technical skills, modern technology, and foreign capital in the process of promoting industries. The Plan made institutional arrangements to familiarize the cottage and small-scale industries with market, technology, skills, and the like. There was an intention to establish technology transfer and development center to collect and publish statistics related to technology development and transfer, and to assist technically in the selection, evaluation, and replication of suitable technology. Technical schools started to be established in different parts of the country. The plan included activities like development of national information bank and network system, social communication program, and development of technology for the poor.

The plan continued with the objectives of developing science and technology in a way that it could support the all-round development of the nation; supporting rural development sectors such as agriculture, cottage and small scale industries by enhancing the scientific and technological capabilities available in the country; and encouraging the import of foreign technologies that have a direct bearing on the country's economic development.

Major programs of the plan included the management and expansion of infrastructure

necessary to enhance the potentials of scientific research and development; promotion of the technology transfer and replication; productivity of quality workforce; and publicity and dissemination of technology.

The Plan attempted to promote technology transfer and replication in agriculture, industry, transport, communication, and construction, and if necessary, it was intended to permit for import of such technology. The concerned government, private and non-government organizations, and institutions were encouraged to undertake this task.

Ninth Plan (1997 - 2002)

Priority to the communication and information technology was given more in the Plan in order to adopt the changing technology. It was essential to launch programs such as experiment and development of indigenous and advanced technology, reforms in education, and development of information and communication infrastructure. Similarly, development of indigenous technology and adoption of new and advanced technology were also in priority.

Establishment of an Information Technology (IT) Park and production and export of software at lower cost were other attractions of the Plan. Emphasis was continuous on adoption of employment-oriented technology. Appropriate technology for food industries in the areas of collecting, grading, processing, and marketing was desired to develop even after several trials and findings.

Attention was given to the environment and pollution control. It was planned that National Broadcasting Authority (NBA) would be established and an effective broadcasting of radio and television would be arranged. It was desired to prepare national information infrastructure for contributing to the development of agriculture, health, education, tourism, and commerce sectors through the information technology park and information highway.

Focus of the objectives were maintaining sustainability in economic, social, cultural and

environmental perspectives; improving traditional technologies; developing and transferring appropriate rural technology; developing and transferring advanced technology in order to reduce foreign trade deficit; improving teaching and learning in higher education; improving energy use efficiency; expanding hydro and meteorological services; and emphasizing the research and development activities.

System of developing science and technology sectors was expected to be initiated in the districts, municipalities, and village development committees. A twenty-year science and technology perspective plan was likely to be formulated during the plan period; application of hydro, solar and wind energy was encouraged to replace imported energy through the adaptive study, research and development and commercialization of energy technology.

Advanced technology transfer and development programs were intended to be conducted through the agencies that were interested to produce goods having comparative advantage, alternative energy use was emphasized; and arrangement of subsidy was also be made for those efforts that were developing and transferring for export and/or trade promotion.

Tenth Plan (2002 - 2007)

The plan included the use of high-tech technology in rural area. Micro and rural industrial technology, telecommunication, and information technology, appropriate and environment friendly technology, agricultural technology, biotechnology, labor-intensive technology in rural areas were some areas of concentration.

Technology related with geographic information system was intended to apply to prepare the soil database. Use of technology was considered instrumental in fulfilling basic needs, alleviating poverty, promoting income generating activities, generating employment opportunities, conserving environment and natural resources. The plan wished for making children, women, and deprived section economically independent with science and technology.

A national level electronic network of science and technology information centers was in priority to integrate the scattered science and technology libraries and records across the country. Commercialization of alternative energy technologies and reducing the dependence on imported energy through the planned technology development and expansion programs were also included in the plan.

Three Years Interim Plan (2007 - 2010)

The industry sector faced problems in technology transfer and absorption. Rural information centers were started to be established in different parts of the country. Promotion of indigenous skill, efficiency, and technology became the conditions of foreign aid acceptance. Priority had been accorded to industries, professions and programs based on labor-intensive technology to generate employment opportunities in the rural areas.

The agricultural production system would be made more competitive and commercial through the extension of appropriate agricultural technology. Promotion of rainwater harvesting in rural areas was emphasized. Utilization of information technology in order to make farmers capable of making decision by disseminating advanced technology and market information to the rural levels emphasized. Multi sector technology development trials were expected to carry out. Agriculture research and technology transfer got high priority in public investments. National Agriculture Research and Development Fund (NARDF) was intended to be involved to develop and expand technologies for short terms, with social mobilization.

Department of Food Technology and Quality Control was expected to be extended to districts to render the service of maintaining food hygiene and safety. Introduction of Safety Management System by utilizing the advanced technology of international standard in the civil aviation sector was proposed to ensure the flight safety. The concept of a working system of cleaner production technology and green productivity was also highlighted. The Plan had mentioned the

physical improvement of urban and rural houses by using earthquake resistant technology.

Use of information technology in government works was intended to be expanded and provisions had been made to give legal recognition to e-information dissemination. Quality human resource in the science and technology sector was also in priority.

Preservation of indigenous technology and its research as well as development of competitive capability, reduction of the digital divide and prevention of brain drain was noticed some of the major challenges to the country.

Three Years Plan (2010 - 2013)

There was quite satisfactory improvement had been made in the adoption of solar energy technology, but nominal progress in the adoption of other sources of alternative energy. Employment creation was a major criterion in the selection of investment projects.

The Plan emphasized the adoption of information technology in the government revenue offices including custom offices. Adoption of new technology in food laboratory, promotion of technology to minimize the impact of climate change, transfer of technology through electronic communication media, establishment, and operation of technology development fund with the collaboration of private and cooperative sectors, technology transfer through economic diplomacy, promotion, and extension of telecommunication services for technology transfer were some other attractions in the plan.

Use of information technology in corporate governance, emphasis on the research and development of information technology, encouragement of construction and operation of the electronic Hardware Technology Park, promotion of the information Technology Park, establishment of Public Key Infrastructure (PKI) data center as well as government integrated data center were other focused areas of the plan.

There was emphasis on the public-private partnership for the development of science

and technology as well as the study and use of biotechnology, information technology, Nano technology, nuclear technology, and space technology. Establishment of space science and technology center, nuclear technology center, biotechnology research center, and preparation of Bioinformatics database were a few ambitions of the Plan.

Technology Policies and Sectorial Priorities

The country adopted a couple of policies in line to the planning priorities set by the national periodic plan documents. Foreign investment and technology transfer act 1982, national science and technology policy 1988, science and technology policy 1990, information technology policy 2000, science and technology policy 2004, bio-technology policy 2006; rural energy policy 2006; technology directives 2006 were a couple of major technology related policy initiatives and changes in the country.

This study has categorized the sectorial priorities of the periodic plan documents into three main categories- research and infrastructure development, socioeconomic development, and good governance and compliance (*see Table 1*). Research and infrastructure category included road transport; electricity and power; irrigation; information and communication facilities; housing and urban development; environment, science and technology as well as research and development activities. Education, culture and sports; health, population, water supply and sanitation; children; youth; senior citizens; natural disaster management; local development; non-governmental organizations; and human resource development, agriculture; cooperatives; land reform and management; forest and soil conservation; tourism and civil aviation; industry; commerce; supply management; labor management and employment; and transport management are included in socioeconomic development category. Decentralization and deregulation; planning and statistical system development; and implementation, monitoring, evaluation and reporting included in the category of governance and compliance.

Table 1- Sectorial priorities concerning technology diffusion in Nepal

Plan	Research and infrastructure	Socioeconomic development	Governance and compliance
First 1956 – 1961	Mineral and hydropower exploration; technical institution establishments; investment in technology and capital equipment	Technical training; provision of scholarships; emphasis on agricultural and forestry education	Desire of competent administrative and technical personnel, formation of technical committees and provision of advisors
Second 1961 – 1965	Focus on engineering institute establishment and development	Technical training assurance; establishment of experimental farms and livestock centers; technical training assurance	Technical training to the personnel at the government agencies, and the <i>Panchayats</i> were made more effective in technology transfer
Third 1965 – 1970	Technical assistance for transport development, storage, and private sector	Intended to replace the primitive technology in agriculture; technical assistance for private sector development; emphasis on vocational education and adult education	Consider <i>Panchayats</i> as a vehicle for technology transfer in social sectors; decentralization prioritized; coordination among the development programs emphasized
Fourth 1970 – 1975	Focus on vocational and training centers establishment; nucleus seed production program; food research programs, forestry programs; feasibility survey for roads; expansion of telecommunication facilities and industrial services	Foreign trade considered as a mean of obtaining technical know-how; leader farmer training program; provision of JTs and JTAs	Maintaining records of technical manpower realized; foreign technical assistance sought; labor intensive technology and indigenous resources emphasized;
Fifth 1975 - 1980	Emphasis on strengthening the organizational network; agricultural research and education; promotion of technology center	Extensive rural work programs; manpower development in technical field	Encouragement of labor intensive programs and technology
Sixth 1980 - 1985	Wish-for the studies on production and use of bio-gas, solar energy, wind power, and natural gas; programs on drug research and development; cost effective technology in building small hydel projects; labor intensive technology promotion in road building	Efforts to disseminate technology that improves the breed of calves, bull, buffalo, goat, sheep, chicken, fish, etc. Efforts on the improvement of production technology of the cottage industries; encourage foreign technology and capital in the extraction of mineral deposits	Emphasis on the use of local skills and technology; use of locally available construction materials; determination of national science and technology objective, policy and programs
Seventh 1985 - 1990	Intended to upgrade science and technology capabilities; desire to reduce dependency on agriculture; shifting attention to industrial sectors as well	Desire of high technology and skills development to expand export; enlarge the international assistance and its participation in the field of science and technology	Intended to increase awareness on the usefulness of science and technology; maximum use of local technology, know-how and skills emphasized
Eighth 1992 - 1997	Institutional arrangement to familiarize small and cottage industries with technology; establishment of technical schools; development of the national information bank and network system; computerization of commercial banks; research works on low cost construction and use of local raw materials	Agriculture extension program in outreach; foreign investment and technology transfer for hydropower development; rural communication services; mineral exploration and development; social communication program, development of technology for the poor	Priority in dissemination of appropriate technology in agriculture sector; advance technology and institutional reforms; promotion of technology transfer and replication; publicity and dissemination of technology

Ninth 1997 - 2002	Emphasis on the development of indigenous technology; development of adaptive and advanced technology; provision for the establishment of IT park; preparation of national information infrastructure; twenty years science and technology prospective plan	Emphasis on communication and information technology; adaption of environment conducive and labor intensive construction technology; use of appropriate technology in foods processing; rural technology development and dissemination program	Intention of reform in education; emphasis on employment oriented technology; environment pollution control initiatives; encouragement for application of hydro, solar and wind energy
Tenth 2002 - 2007	Desire of an electronic networking of scattered science and technology libraries and records; national level science and technology information center formation	Intention of high-tech in rural area; adoption of agricultural technology, bio-technology, micro and rural industrial technology, telecommunication and information technology; environment friendly technology; commercialization of alternative energy technology	Priority for the technology that promotes employment opportunities; use of geographic information system; use of labor-intensive and environment friendly technology; technology directives
Eleventh 2007 - 2010	Rural information center; multi-sector technology development; land management technology; safety management system in aviation; concept of science and technology university; health management research and technological development institutions	Self-employment promotion; employment opportunities in rural areas; rain water harvesting in rural areas; physical improvement of urban and rural houses; development of high level human resources, bio-technology; information technology; institutional capability enhancement and strengthening program	Technology dissemination; conditions to foreign aid-indigenous skill, efficiency and technology; cleaner production technology, and green productivity; use of information technology in government works
Twelfth 2010 - 2013	Concern to climate change; telecommunication considered as a major vehicle of technology transfer; expansion of IT facilities emphasized; concept of electronic hardware technology park; study and use of bio-technology, Nanotechnology, nuclear technology, and space technology	Adoption of solar energy; employment creation emphasized; technology development fund; Bioinformatics database preparation	Emphasis on the adoption of IT across government revenue offices; priority in food technology adaption; technology transfer through economic diplomacy; use of information technology in corporate governance

Source: *The national periodic plan documents of Nepal*

Structural Setting

Unplanned efforts of technology diffusion were dominating until the end of the first half of the twentieth century. Planned efforts started to take place in the country only from the beginning of the second half of the century (*also see Table 2*). The interrelationship among the organizations involved in technology education, training, research and development; national planners

and regulators including national planning commission, ministries, and departments; supporting industries and intermediaries including telecommunication and Internet service providers, banking and financial institutions as well as accessories, parts and support service providers; and technology suppliers and the technology adopters is considered structural setting for technology diffusion.

Table 2- Selected organizations working on technology diffusion

From the year	Institutions	Major works/projects
1951	Department of Agriculture (DOA)	Food security, agricultural productivity; screening and standardization of the technologies
1951	Department of Industry (DOI)	Technology and environment, foreign investment and technology transfer, technology development; industrial data system improvement and monitoring
1969	Center for Economic Development and Administration (CEDA)	Socioeconomic and administrative development assisting/working with the policy makers
1972	The Institute of Agriculture and Animal Science (IAAS)	Education, research and technology transfer in the agriculture sector
1972	The Institute of Forestry (IOF)	Education and training to middle and high level professional in forestry and natural resource management
1972	Institute of Medicine (IOM)	Research, education and services in the health sector
1972	Institute of Engineering (IOE)	Research, education and training in engineering; consultancy services
1973	Department of Cottage and Small Industries (DOCSI)	Business incubation; technology diffusion and consultation services
1977	Research Center for Applied Science and Technology (RECAST)	Renewable energy; bio-technology; appropriate technology; plant science; natural product utilization; low cost building materials
1982	Royal Nepal Academy of Science and Technology (NAST)	Advancement of science and technology for all-round development; preservation and further modernization of indigenous technologies; identification and facilitation of appropriate technology transfer; promotion of research in science and technology
1989	Institute of Science and Technology (IOST)	Research, education, training, publications and advisory services in the area of science and technology
1991	Nepal Agricultural Research Council (NARC)	Research on agriculture; coordination, monitoring and evaluation of agricultural research activities
1992	Asia Network for Sustainable Agriculture and Bio resources (ANSAB)	Biodiversity conservation and livelihood improvement in South Asia
1996	Industrial Enterprise Development Institute (IEDI)	Need-based programs to develop technical know-how and skills
1998	Nepal Telecommunication Authority (NTA)	Regulates telecommunication sector
1998	Micro-Enterprise Development Program (MEDEP)	Appropriate technology and quality assurance, micro-enterprise management information system; entrepreneurship development; and others
2000	Department of Food Technology and Quality Control (DFTQC)	Development and dissemination of appropriate food (processing) technology
2005	Ministry of Science, Technology and Environment (MOSTE)	Program of action on climate change; climate resilience; technology needs assessment; mountain initiative; environmental impact assessment; and others
On top of the above mentioned organizations, the universities, colleges, schools, training institutions and other governmental and non-governmental organizations were also involved in the process of technology diffusion in Nepal		

Source: The webpages of respective organizations

Technology diffusion requires a strong network of reciprocal interdependence among the organizations involved in the diffusion process. Individual organizations in isolation find it hard to diffuse technology in an effective and efficient way because of a number of shortcomings in the areas of technology development, transfer, adoption, and supporting multiple actors. Organizations may be working in all the stages of technology diffusion ranging from the technology development, adoption to the disposition.

The organizations under study were quite tall and hierarchical instead of flat and networked as required for the diffusion of technology. The traditional pyramid types of organizational structure of individual organizations and absence of integrated efforts of all the organizations involved in the area of technology development and diffusion was not instrumental in transforming the national technology planning priorities into the reality. The plan documents were not acknowledging the urgency of control and monitoring in the establishment and operationalization of the organizations in the field of technology. There was absence of priorities about the carriers of the technology planning policies and priorities in the country.

The government of Nepal adopted liberal economic policy from the very beginning of the 1990s and encouraged private sector for their active participation in technology development and transfer; but the government did not regulate the registration and formation of the organizations. In absence of technology regulator in the country, haphazard entry or no entry of organizations into the economy becomes obvious. The working areas of the organizations already established as such could not address and carry the technology planning priorities. Ultimately, the organizational setting could not assimilate the technology planning priorities and the subsequent development as well as diffusion process of it.

Discussion

Agriculture sector was one of the priority areas for technology development and diffusion in Nepal. Most of the farmers/cultivators were illiterate and they were reluctant/ hesitant to change from their traditional system of cultivation to the modern one.

Almost all the development projects were based on technical assistance of the foreign countries. Consequently, the materials, parts, and expertise required for the project were accordingly foreign. Foreign technology transfer could not promote employment at the higher level because of the slow technology absorption capability of the country.

The plan documents could not determine the priority areas specifically for locally available technology development and other supporting areas, if there was any foreign technology transfer. There was policy shifts as well like the seventh plan intended to shift focus from an agricultural based economy to industrial economies in absence of sufficient evidence of agriculture sector failure.

The ninth plan acknowledged that traditional technology, skill, and knowledge were disappearing gradually in the country, which means the past efforts of indigenous technology development were ineffective. The tenth plan intended the use of high-tech in rural area as well which contradicts with the commitment made to develop and promote indigenous technology from the beginning of the planning period.

Promotion of indigenous skill, efficiency, and technology became the conditions of foreign aid acceptance but the donor funded project specifications included internationally standardized technology, products, and services thereof. Similarly, employment creation had been made one major criterion in the selection of investment projects, but the statistics of about 500,000 youths leaving the country every year in search of employment in foreign countries (Bhattarai, 2010) could not support the effectiveness of the government's policy of selecting only projects that provide employment first.

There was adoption of information technology in the government revenue offices including the custom offices as well. However, delay in customs clearance, unnecessary and unethical behaviors at the revenue offices have not been decreased; the government officials especially high ranking officials tend to use their authority instead of expertise in due course of providing services, implementing policies, acts, rules and regulations.

There was emphasis on the technology dissemination in absence of mechanism for its dissemination. The structural setting and technology planning priorities were in parallel. A There were a few attempts in the area of institutional capability enhancement during the planned period. However, such attempts could not establish appropriate and effective linkages among the actors in the process of technology diffusion. Strong linkages among the organizations/institutions engaged in technology assessment, research and development, technology adaptation, and the supporting service providers would have defused technology in the country, if such linkage were established.

Science and technology system needs to establish linkages between knowledge creation and social demands. The linkages need to strengthen in order to meet the social demands and solve problems. This study has assumed that the organizational setting in a country is an interface between technology and the society. The structural setting is linking the technology development, utilization, and diffusion in the society.

The crux of the problem was absence of regulator along with the increasing dependence on foreign technology; neglecting indigenous technology; the parallel standing of the organizational setting and technology planning priority; and emphasis on the search of international economic aid than developing the self-reliance capability.

Conclusion

Extensive overview of the national plan documents and organizational setting followed by interviews with opinion leaders concluded with the determination of structural immunity to technology diffusion in Nepal. Despite the continuous efforts for the promotion of indigenous technology at one part and foreign investment and technology transfer on the other, there were no more significant improvements in the areas instead of near extinction of indigenous technology. There was continuous emphasis to the labor-intensive technology from the very beginning of the planned efforts at one part and import of advanced technology was encouraged on the other part.

There was incongruence between the organizational settings and the periodic planning

priorities in absence of technical organizations cooperation coordination mechanism for technology development, diffusion, and absorption. The planning priorities could not enhance the alignment of the structural setting with the requirement for technology transfer and diffusion in the country. More specifically:

- Agriculture sector was immune to technology diffusion. The farmers were habitual with traditional technology/processes and they were unable to adopt new technology in absence of socioeconomic compatibility;
- The industrial sector was immune to technology diffusion. There was incompatibility with hardware, software, brainware, know-how and know-why;
- Educational sector was immune to technology diffusion. The instructors and students both were uncomfortable with the new course contents and the teaching pedagogy;
- Governmental sector was immune to technology diffusion. Governmental officials were more authoritarian instead of cooperative consultant;
- Compliance sector was immune to technology diffusion. Good (corporate) governance was a compulsion and ethical business was questioning; and
- Organizational setting was immune to technology diffusion. Solidarity was mechanistic with a rigid authority hierarchy in parallel of national planning priorities.

The planned efforts remained unable to identify what type and level of indigenous technology was in effect to what extent. There were insufficient efforts for new technology development and existing technology enhancement. The technology planning priorities were confined within the plan documents rather than fitting them into the structural setting. The periodic planning priorities did not acknowledge the urgency of a strong congruence between the national technology priorities and the organizational settings in the country.

Technology diffusion is deliberately coordinated effort of the actors in the structural setting with their strong interdependence. Unplanned hierarchical structural setting of mainstream organizations in an economy stands as a barrier in the process of technology diffusion. Advancement in telecommunication facilities and access to the Internet has shadowing the hierarchical taboos in most of the organizations in these days. Adoption of information technology shall help to maintain the congruence at one part and the same will facilitate in order to overcome the barrier of structural immunity to technology diffusion on the other part.

References

- [1]. ANSAB. (2011). Welcome. Retrieved June 20, 2013, from Asia Network for Sustainable Agriculture and Bioresources: <http://www.ansab.org/>
- [2]. Astley, G. W., & Van de Ven, A. H. Central Perspectives and Debates in Organization Theory. **Administrative Science Quarterly**, 28 (2), 1983 June, 245-273.
- [3]. CEDA. (2013). Introduction. Retrieved June 19, 2013, from Center for Economic Development and Administration: http://www.tribhuvan-university.edu.np/index.php?option=com_content&view=article&id=184..
- [4]. DFTQC. (2013). Brief introduction. Retrieved June 20, 2013, from Department of Food Technology and Quality Control: <http://www.dftqc.gov.np/>
- [5]. DOA. (2013). Objectives. Retrieved June 16, 2013, from Department of Agriculture: <http://www.doanepal.gov.np/content.php?id=129>
- [6]. DOCSI. (2012). Welcome to the website of department of cottage and small industries. Retrieved June 20, 2013, from Department of Cottage & Small Industries: http://www.dcsi.gov.np/dcsi_en/index.php
- [7]. DOI. (2013). Introduction. Retrieved June 20, 2013, from Department of Industry: <http://www.doind.gov.np/>
- [8]. IAAS. (2013). Introduction. Retrieved June 19, 2013, from Institute of Agriculture and Animal Science.
- [9]. IEDI. (2013). Objectives of IEDI. Retrieved June 19, 2013, from Industrial Enterprise Development Institute: <http://www.iedi.org.np/Objectives.html>
- [10]. IOE. (2013). Introduction. Retrieved June 19, 2013, from Institute of Engineering: http://www.tribhuvan-university.edu.np/index.php?option=com_content&view=article&id=175
- [11]. IOF. (2013). About. Retrieved June 20, 2013, from Institute of Forestry: http://www.iof.edu.np/about_iof.htm
- [12]. IOM. (2009). Welcome to IOM. Retrieved June 19, 2013, from Institute of Medicine: <http://www.iom.edu.np/>
- [13]. IOST. (2013). Vision and objectives. Retrieved June 20, 2013, from Institute of Science and Technology: http://www.tribhuvan-university.edu.np/index.php?option=com_content&view=article&id=174
- [14]. Joshi, D. R. (2007). Science and technology policy in Nepal. Retrieved June 19, 2013, from Nepal S&T Policy Research Conference: www.mis.nsf.ac.lk/.../Nepal
- [15]. Kegan, R., & Laskow Lahey, L. (2009). Immunity to change: How to overcome it and unlock potential in yourself and your organization. Boston: Harvard Business Press.
- [16]. MEDEP. (2008). What we do. Retrieved June 17, 2013, from Micro-Enterprise Development Program: <http://www.medep.org.np/index.php?page=page&id=1>
- [17]. MOSTE. (2013). About us. Retrieved June 15, 2013, from Ministry of Science, Technology and Environment: http://moste.gov.np/ministry/about_us
- [18]. NARC. (2007). About NARC. Retrieved June 19, 2013, from Nepal Agricultural Research Council: <http://narc.gov.np/about/index.php#2>
- [19]. NAST. (2009). Objectives. Retrieved June 18, 2013, from Nepal Academy of Science & Technology: <http://www.nast.org.np/page.php?id=36>
- [20]. NTA. (2012). Welcome to NTA website. Retrieved June 18, 2013, from Nepal Telecommunications Authority: <http://www.nta.gov.np/en/home-en/12-english/page/1-welcome>
- [21]. Pandey, S., & Yadama, G. N. Community development programs in Nepal: a test of diffusion of innovation theory. **Social Science Review**, 66(4), 1992, 582-597.
- [22]. RECAST. (2013). Introduction. Retrieved June 18, 2013, from Research Center for Applied Science and Technology: http://www.tribhuvan-university.edu.np/index.php?option=com_content&view=article&id=187&Itemid=244
- [23]. Singh, R. M., & Bhujju, D. R. Development of science and technology in Nepal. **Science, TEchnology & Society**, 6(1), 2001, 159-178.

Servant Leadership in Indian Organizations

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Abstract:

This paper attempts to study two main issues. The first issue is to study the relationship between servant leadership (SL) and employee retention in Indian organizations. Second, to study the degree of servant leadership style practised by Indian Leaders. A sample of 60 respondents, males and females working in public and private organizations of India participated in the survey. The results of the study indicated that overall servant leadership score for India (Mean=3.2) comes out to be lower in comparison with Italy (Mean=3.6), The Netherlands (Mean=4.1) and United Kingdom. (Mean=3.7) The findings also indicates that some dimensions of the SL are positively associated with the employee retention. Only three dimensions of SL (Empowerment, Authenticity and courage) found to be predictors employee retention, with empowerment being the most important predictor and one dimension of SL i.e. forgiveness is negatively associated with employee retention.

Keywords: servant leadership, Indian Leaders, employee retention, forgiveness, empowerment

1. Introduction

In the dynamic business environment, with the confidence shake in business leadership, the traditional concepts of leadership are emerging on the surface and are proved to be significant model in themselves: one which is based on teamwork and community; one which seeks to involve others in decision making; one which is strongly based in ethical and caring behaviour; and one which is enhancing the growth of people, while at the same time improving the caring and quality of our many institutions. We call this emerging approach to leadership and service, servant-leadership [33, 34] in which the organizations have continuously

shown interest and focusing on developing and nurturing leaders those set their own self-interest aside for the good of their followers and organizations [3]. Seeing the recent demand for more ethical and people oriented management, the organizations are now in the strong need of leadership inspired by Servant Leadership theory as concern about social responsibility has become a matter of company policy [37]. The theory of servant leadership is characterized as a more ethical [6] and people centered theory of leadership as cited in the servant leadership survey [37]. The importance of servant leadership theory can easily be traced by the fact that most of fortune magazine's 100 best companies to work for in America added servant leadership as a core company value [29]. Servant leadership is indeed an effective leadership behavior in terms of fostering a favourable service climate, inducing positive follower behaviours and reducing turnover intentions and disengagement [15]. Servant leadership also helps in enhancing the job performance and commitment to the organization, leaders may inspire followers to take an active role in serving community in which organization is flourishing [21]. Empirical evidence also suggested that servant leadership style improves the organizational performance [5]. Research also indicates that the organizations with leaders who serve their people have more satisfied, committed, and better performing employees [20]. Another interesting fact about this leadership theory is that it creates a lot of interest in the researchers to study the influence of servant leadership across cultures. The concept of "Servant Leadership" believed to have western origin in research, but various researchers have critized the notion of western origin of servant leadership rather they argued that the concept servant leadership is a global concept, the traces of which can be found in African (Ubuntu, Harambee); East Asian

(Taoist, Confucianism); Mediterranean (Jewish); and Indian (Hindu) value systems [40].

1.1 Concept and Definition: Servant Leadership

The concept of “Servant Leadership” was first coined by Robert K. Greenleaf in 1970 in an essay entitled, *The servant as Leader*

Definition:

“The servant-leader is servant first. It begins with the natural feeling that one wants to serve. Then conscious choice brings one to aspire to lead. The best test is: do those served grow as persons: do they, while being served, become healthier, wiser, freer, more autonomous, more likely themselves to become servants? And, what is the effect on the least privileged in society; will they benefit, or, at least, not be further deprived”? [11]

The servant-leader is governed by creating within the organization opportunities to help followers grow [22]. Compared to other leadership styles where the ultimate goal is the well-being of the organization, a servant leader is genuinely concerned with serving followers [11], as is also indicated by [35]. Where on one side work by McClelland and Burnham [25] indicated that the need for power could also be used in a beneficial way. Greenleaf goes one step further and makes this need to serve the key to good leadership; it leads to a commitment to the growth of individual employees, the survival of the organization, and a responsibility to the community [27].

2. Review of Literature:

Most of the researchers in the area of *servant leadership* (SL) have focused upon the scale development and validation. A little evidence of empirical research of servant leadership with other organizational variables open up the vistas for future research. Literature review conducted by Brewer [4] indicates that the application of servant leadership principles creates increased job satisfaction and improves organizational productivity. Evidence of the increased employee retention by following servant leadership practices is also supported by the literature. Author suggested that the ten characteristics of a servant leader coined by [32] is a question of fundamental moral character. Literature research supports that contemporary servant leadership

philosophies perform above the norm in all type of private organizations and can manifest positive changes in the organizations. The ten characteristics of servant leader discussed in the paper are **1. Listening, 2. Empathy, 3. Healing, 4. Awareness, 5. Persuasion, 6. Conceptualizing, 7. Foresight, 8. Stewardship, 9. Commitment to growth, 10. Community building** Spears, L. [32] & Sendjaya, S. [31] in her study on Development and validation of Servant Leadership Behavior scale has proposed the Dimensions (6) and its sub dimensions(22) associated with servant leadership. The various dimensions and its sub dimensions are: 1. **Voluntary Subordination** (Being a servant, Acts of service), 2. **Authentic Self** (Humility, Security, Vulnerability, Accountability), 3. **Covenantal Relationship** (Acceptance, equality, Availability, Collaboration), 4. **Responsible Morality** (Moral reasoning, Moral actions), 5. **Transcendent Spirituality** (Religiousness, sense of mission, Inner consciousness, holistic mindset), 6. **Transforming Influence** (Vision, Trust, Role Modeling, empowerment, Mentoring). Liden, R.C et al., [21] in their study on Servant Leadership: Development of a multidimensional measure and multi-level assessment defined and validate the 28 dimensions that Constitute servant leadership as construct. Based on their interpretation and existing taxonomies of servant leadership the researchers identified 7 dimensions on the basis of exploratory and confirmatory factor analysis as: 1. **Emotional healing**, 2. **Creating value for community**, 3. **Conceptual skills**, 4. **Empowering**, 5. **Helping Subordinates grow and succeed**, 6. **Putting subordinates first**, 7. **Behaving ethically**. The purpose of the research work conducted by [1] was to clarify the construct of servant leadership and operationalize it for empirical research. The study focuses upon the development of servant leadership scale with 23 items. Factor analysis indicate 5 factors derived from 11 potential servant leadership characteristics as: 1. **Altruistic Calling**, 2. **Emotional healing**, 3. **Wisdom**, 4. **Persuasive mapping**, 5. **Organizational stewardship**. The result of the study conducted by Van Dierendonck & Nuijten [37] includes development an eight dimensional measure of 30 items as: 1. **Standing Back**, 2. **Forgiveness**, 3. **Courage**, 4. **Empowerment**, 5. **Accountability**, 6. **Authenticity**, 7. **Humility** and 8. **Stewardship**. It is the first measure of its kind where the underlying

factor structure was developed and across several field studies in two countries. It can be further used in future studies to test the underlying premises of servant leadership theory. This instrument provides a clear picture of key servant leadership qualities and shows where improvements can be made on the individual and organizational levels. Laub [19] in his study conducted on 847 people from 41 organizations developed a scale to measure servant leadership with 43 items. The various factors identified by the study are: 1. **Develops people**, 2. **Shares leadership**, 3. **Displays authenticity**, 4. **Values people**, 5. **providing leadership**, 6. **Builds community**. Wong & Davey [41] in a study conducted on 24 leaders, self-rating; 1157 people from diverse backgrounds resulted in a servant leadership scale with 62 items. The factors identified are: 1. **Serving and developing others**, 2. **Consulting and involving others**, 3. **Humility** and 4. **Selflessness**. Dennis & Bocarnea [7] developed a scale including 23 items to measure servant leadership by studying the sample consists of 250, 406 and 300 people from diverse backgrounds.

Barbuto & Wheeler [1] in their study on Scale development and construct clarification of servant leadership with 388 persons rating leaders from countries in the Midwestern United States concluded that there exists a significant relationship between servant leadership factors and organizational outcomes such as extra efforts, satisfaction and organizational effectiveness. Ehrhart [10] collected and analysed the data collected from 120 departments with at least 5 respondents and their managers from a grocery store chain in the eastern region of United States concluded that servant leadership has a significant correlations with procedural justice climate and organizational citizenship behavior. Hale & Fields [13] found a significant correlations between servant leadership and leadership effectiveness in a study conducted on 60 people from Ghana, 97 people from United States. It is quite interesting to note here that one third of the respondents in both the samples worked with religious organizations. Irving & Longbotham [16] conducted a survey on 719 participants from U.S. division of an international non-profit organization and concluded that servant leadership helps in team effectiveness. The total variance explained by servant leadership in team effectiveness is 38%.

The research work done by Jaramillo, et al. [17] on 501 sales professionals drawn from a U.S. consumer panel indicated that there exists a positive correlation between SL and organizational commitment, Job satisfaction and there exists a negative correlation between SL and turnover intentions and job stress. In a study conducted by Liden, et al. [21] on a sample of 182 individuals from a Midwestern company it was found that servant leadership is a multidimensional construct and at the individual level makes a unique contribution beyond transformational leadership and LMX in explaining community citizenship behavior, in role performance and organizational commitment. Mayer, Bardes & Piccolo [24] in their study analysed that there exists a strong correlations between servant leadership and organizational outcomes such as organizational justice, need satisfaction and job satisfaction. The results were produced from the data collected from 187 business undergraduate with work experience. Neubert, et al. [26] in their study conducted on 250 full time individuals working found that in-role performance, helping behavior and creative behavior are positively correlated with servant leadership and deviant behavior is negatively correlated with servant leadership. Reinke [28] in the study conducted on 254 employees of suburban country in Georgia found that servant leadership and trust are positively correlated. Sun & Wang [36] studied the relationship between SL and satisfaction with supervisor and perceived organizational support by collecting data of 209 paired supervisor-subordinate dyads from China and results indicated the average correlations between the variables under study. Washington, et al. [38] studied the data collected from 283 employees rated 126 supervisors working at governmental organisations and found that there exists the significant correlations between SL and supervisor's value of empathy, integrity and competence. West, et al. [39] in a study conducted on 164 respondents from professional organizations in the Philippines summarized the finding stating that there exists an average correlation across all SL dimensions and organizational commitment, job satisfaction and perceived organizational support. Bobbio, et al. [2] in their study titled "Servant leadership in Italy and its relation to organizational variables" found

that servant leadership expressed by Italian leaders turned out to be lower than in the Netherlands and in UK. SL scores were positively correlated with leadership integrity, organizational commitment and organizational citizenship behavior and negatively associated with cynicism. The result were produced by analysing the data from 800 respondents currently employed in profit and non-profit organizations. The purpose of research work carried on by Hunter E.M., et al. [15] was to investigate the relationship between personality, servant leadership and critical follower and organizational outcomes. The researchers proposed that leader agreeableness and extraversion affect follower perceptions of servant leadership. The findings of the study indicate that leader agreeableness was positively and extraversion was negatively related to servant leadership, which was associated with decreased follower turnover intentions and disengagement. The study also provide initial evidence that servant leadership style is an effective leadership style in influencing favourable service climate, reducing withdrawal (i.e. turnover intentions and disengagement), and positive follower behaviours. The study also indicates that the positive results will help the adoption of servant leadership values in large number of companies to cultivate servant leadership qualities among their managers. The research findings also predicts that followers of servant leaders are not likely to disengage from their work and hence increased retention.

3. Rationale of the study:

Literature review supports the fact the most of the studies conducted on the concept of servant leadership focused upon scale development and validation of the servant leadership construct. Although there exists a little evidence on the research on servant leadership of construct and other organizational variable of interest, yet it is important to note here that most of the studies on Servant leadership are conducted in the regions of the world with Lower power distance (Netherlands, U.K) as per GLOBE study by Dorfman, et al. [9]. The countries where the servant leadership scores are high are scoring low on power distance, which means that the country where power is distributed equally in the society. The examples of the countries are Netherlands, UK and Italy. It is evident from the study of [2] in

their study titled “Servant leadership in Italy and its relation to organizational variables” found that servant leadership expressed by Italian leaders turned out to be lower than in the Netherlands and in UK. The power distance index of these countries in GLOBE study also indicated that the power distance index in Italy is more than the Netherlands and UK, it is because of this reason that Italy scored low on servant leadership in comparison with these countries. The status of servant leadership in the countries with high power distance is unexplored still. Literature clearly identifies the gap of studying the servant leadership in the countries with high power distance as it remains an unanswered empirical question [21]. In this research paper an attempt has been made to understand and assess the servant leadership style in Indian organizations and its relation to employee retention.

Objectives

1. To study the relationship between servant leadership style and employee retention.
2. To study the level of servant leadership in Indian organizations.

Hypotheses:

Hypothesis 1(a): There exists a significant positive correlation between Empowerment and employee retention.

Hypothesis 1(b): There exists a significant positive correlation between Accountability and employee retention.

Hypothesis 1(c): There exists a significant positive correlation between Standing Back and employee retention.

Hypothesis 1(d): There exists a significant positive correlation between Humility and employee retention.

Hypothesis 1(e): There exists a significant positive correlation between Authenticity and employee retention.

Hypothesis 1(f): There exists a significant positive correlation between Courage and employee retention.

Hypothesis 1(g): There exists a significant positive correlation between Forgiveness and employee retention.

Hypothesis 1(h): There exists a significant positive correlation between Stewardship and employee retention.

Hypothesis 2: All the dimensions of (Empowerment, Accountability, Standing Back, Humility, Authenticity, Courage, Forgiveness and Stewardship) predicts the variance in employee retention.

Hypothesis 3: The level of servant leadership style practised by Indian leaders will be lower than leaders in Italy, The Netherlands and the United Kingdom.

4. Methodology

Participants

The data was collected from 60 respondents working in Indian organizations. From total 60 respondents, 38 (63%) were males and 22 (37%) were females, working in 7 (12%) and 53 (88%) service organizations. The number of private and public organizations participated in survey was 49 (82%) and 11 (18%) respectively. Most of the respondents 36 (60%) were less than 25 years of age, followed by 21 (35%) falls between 26-30 years of age and 3 (5%) were above 30. The majority of responds 53 (89%) were post graduate followed by 5 (8%) graduate and 2 (3%) higher than post graduate. The hierarchical level on which respondents were working comprises of 14 (23%) at junior level, 40 (67%) at middle level and 6 (10%) at senior level. In terms of experience, most of the respondents 50 (83%) have less than 5 years of experience, 8 (13%) have experience between 6 to 10 years and 2 (4%) have experience more than 15 years. The majority of respondents had a male leaders 49 (82%) in comparison to female leaders 11 (18%). The majority of respondents 25 (42%) had their leaders in the age bar of 36-45 years, followed by 23 (38%) between 25-35 years of age, 9 (15%) between 46-55 and 3 (5%) above 55 years of age. The demographic profile of respondents is also summarised in Table 1.

Table 1- Demographic profile of respondents

Sr. No.	Demographic	Category	No. and Percentage
1.	Gender	Male	38 (63%)
		Female	22 (37%)
2.	Industry	Manufacturing	7 (12%)
		Service	53 (89%)
3.	Organization Type	Public	11 (18%)
		Private	49 (82%)
4.	Age	Less than 25 years	36 (60%)
		26-30	21 (35%)
		Above 30	3 (5%)
5.	Education	Graduate	5 (8%)
		Post Graduate (PG)	53 (89%)
		Higher than PG	2 (3%)
6.	Hierarchical Level	Junior level	14 (23%)
		Middle level	40 (67%)
		Senior Level	6 (10%)
7.	Experience	Less than 5 years	50 (83%)
		6-10 years	8 (13%)
		Above 10 years	2 (4%)
8.	Gender of leader	Male	49 (82%)
		Female	11 (18%)
9.	Age of the leader	25-35	23 (38%)
		36-45	25(42%)
		46-55	9 (15%)
		Above 55	3 (5%)

Survey Instruments

The data was collected with the help of standardised questionnaires. The servant leadership scale (SLS) developed by Van Dierendonck and Nuijten [37] was administered to collect data for the assessment of servant leadership style in Indian organizations. The instrument consists of eight factors and these factors are: 1. Empowerment (7 items), 2. Standing back (3 items), 3. Accountability (3 items), 4. Forgiveness (3 items), 5. Courage (2 items), 6. Authenticity (4 items), 7. Humility (5 items), 8. Stewardship (3 items). The total items in SLS are 30. All the participants were instructed to answer each item keeping in mind the behaviour of their immediate supervisor.

The questionnaire on employee retention (RFMS) validated by Dockel, et al. [8] has been chosen for the study. Only five factors have been studied for the research purpose in Indian context and the factors chosen are: 1. Compensation (11 items) 2. Job Characteristics (4 items) 3. Training (4 items) 4. Career development (5 items) 5. Work life balance (4 items). One additional factor that has been included in the current study is Intentions to stay (11 items) Kyndt, et al. [18]. The total score of employee retention is calculated by summing up the scores of individual factors of employee retention for the purpose of analysis. The instrument consists of 39 items. The participants were instructed to answer each item keeping in mind the employer with whom they are working. The data was collected on a five point likert scale (1-Strongly Disagree to 5- strongly agree) accept for one factor in employee retention scale i.e. Compensation (1-Very dissatisfied to 5- very satisfied). The questionnaire was administered online.

Data analysis and Discussion

The data was analysed by using SPSS 20.0. First of all the reliability of items in the questionnaire was tested. The value of cronbach's alpha (α) (reliability coefficients) for 30 items of SLS and 39 items of employee retention comes out to be .917 and .899 respectively which depicts the reliability of the data as the value more than 0.6 generally indicates satisfactory internal consistency reliability Malhotra, N.K. & Dash, S.[23]. Correlations and regression statistics were performed to test the hypotheses. The assumptions of normality of data for regression was tested, in order to avoid any violation of these assumptions. One sample K-S test was also applied to test the normality of data and test confirmed that the data is normally distributed. The kurtosis and skewness for all the individual items was also calculated. The Kurtosis and skewness for all the SLS items ranges between -1 and +1 which are acceptable as values that falls between -1 and +1 assume to be fit Malhotra, N.K. & Dash, S.[23].

Pearson's correlation statistics between SLS dimensions and employee retention were calculated and are summarised in (Table 2). Out of the eight dimensions of SLS, empowerment is the one dimension which shows the highest

positive correlation (.669) at .01 significant level, that depicts that higher the level of empowerment, higher will be the retention in the organizations. The high positive correlation found above is well understood with the notion that India stands high on Human orientation as per GLOBE study by [9]. It is followed by a positive correlation of Authenticity (.642), standing back (.604), stewardship (.575), humility (.574), courage (.515), accountability (.489) and a negative correlation with forgiveness (-.433) with employee retention. The result indicates that all the dimensions have positive correlation with employee retention except one which shows negative correlation. This means all the SLS dimensions help in increasing the retention in the organizations except forgiveness. If one look closely at the items of forgiveness like "My manager keeps criticizing people for the mistakes they have made in their work", "My manager maintains a hard attitude towards people who have offended him/her at work", "My manager finds it difficult to forget things that went wrong in the past", one can easily analysed that if this type of attitude of managers is on higher side in the organization, obviously the retention of employees in the organization will decrease. So there is a strong need to train the managers on their behaviour towards their subordinates in order to increase the retention of employees in the organizations. It may also important to note here that as per the GLOBE study India belongs to Southern Asia cluster which is characterised by high power distance, human orientation and low on gender egalitarianism Gupta, et al. [12]. This may be a possible reason that why Indian managers are low on forgiveness dimension of SLS as the power is unequally distributed because of high power distance in the Indian society. A possible reason for the high power distance in the Indian society can easily be traced by the presence of historically very rigid and hierarchical organization of society into various socio-economic classes Gupta, et al. [12]. The lowest positive correlation for accountability (4.89) with employee retention also indicates that, even if employees are held accountable for their work, it has not much impact on the employee retention, which means employees believe that they may be held accountable for any work they are given as it will not change their intentions to stay in the organization. So, therefore Hypothesis

1 (a), (b), (c), (d), (e), (f), (h) are accepted and 1(g) is rejected.

To understand the relationship between the SLS dimensions (independent variables) and employee retention (dependent variable), a series of multiple regression (stepwise) analysis was conducted to check the most important predictors of dependent variable. The results of the analysis are summarized in the Table 2 below.

In the analysis it was found that out of the retention was positively influenced by only three SLS dimensions (Empowerment, Authenticity, and Courage) and negatively influenced by forgiveness. The model that includes four dimensions of SLS was deemed fit was at the adjusted R square value of .599, which means that 4 independent

variables explain 59.9% of variance in the retention (dependent variable) at a significance level of 0.05. Durbin Watson statistics with a value of 2.03 indicates that there is no autocorrelation in the residuals. Table 4 below shows the coefficients of employee retention. The standardized beta coefficients of empowerment, authenticity, forgiveness and courage indicates that empowerment ($\beta=.374$) is influencing the employee retention positively and is the most important predictor of employee retention in the analysis and is supported by the literature support (Schneider & George, 2011) followed by authenticity ($\beta=.277$). The standardized beta coefficient of forgiveness ($\beta=-.263$) indicates that employee retention is negatively influenced

by forgiveness. It is important to note here that the correlation matrix in Table 2 also indicates a negative correlation between forgiveness and employee retention.

The results of the correlation and regressions analysis proves that there does not exist positive correlations between all the dimensions of SLS and employee retention

as only seven dimensions shows positive correlations. Also, only four dimensions of SLS out of eight predicts variance in dependent variable, so therefore hypothesis 2 is rejected.

To study the level of servant leadership in Indian organizations, a comparative analysis is conducted with the samples from Italy, The Netherlands and United Kingdom. The mean score for the SLS dimensions such as empowerment, accountability, humility, authenticity, courage, forgiveness and stewardship comes out to be less in Indian sample in comparison with Italy, The Netherlands and United Kingdom. The comparative data of servant leadership dimensions is summarised in Table 5 above. Within Indian sample the mean scores of empowerment and stewardship comes out to be higher as it is expected to be displayed by the leaders in people oriented culture [37]. In case of standing back the Indian sample scores higher than Italy, but lesser than The Netherlands and United Kingdom, which indicates that Indian leaders enjoy the success of their followers more than leaders from Italy, but less than leaders

Table 2: Descriptive statistics and Pearson's correlations among Servant Leadership Dimensions and Employee retention.

SLS Dimensions and Retention	2	3	4	5	6	7	8	9
1. Empowerment	.551**	.734**	.648**	.634**	.477**	-.261**	.762**	.669**
2. Accountability		.461**	.250	.334**	.278*	-.351**	.353**	.489**
3. Standing Back			.648**	.709**	.414**	-.266*	.688**	.604**
4. Humility				.785**	.467**	-.047	.758**	.574**
5. Authenticity					.481**	-.206	.722**	.642**
6. Courage						-.060	.493**	.515**
7. Forgiveness							-.109	-.433**
8. Stewardship								.575**
9. Employee retention								

**Correlation is significant at the level 0.01

* Correlation is significant at the level 0.05

Table 3: Model Summary

Model	R	R ²	Adjusted R ²	SE of estimate	R square Change	Change Statistics				
						F change	Df1	Df2	Sig. F change	D u r b i n Watson
1.	.669 ^a	.448	.438	.35518	.448	47.050	1	5	.000	2.034
2.	.729 ^b	.532	.516	.32988	.084	10.237	1	57	.002	
3.	.773 ^c	.598	.576	.30845	.066	9.197	1	56	.004	
4.	.791 ^d	.626	.599	.30019	.028	4.124	1	55	.047	

a. Predictors: (Constant), Empowerment

b. Predictors: (Constant), Empowerment, Authenticity

c. Predictors: (Constant), Empowerment, Authenticity, Forgiveness

d. Predictors: (Constant), Empowerment, Authenticity, Forgiveness, Courage

e. Dependent Variable: Retention

Table 4: Coefficients ^a

Model	Unstandardized Coefficients		Std. Coefficients		Correlations				Collinearity Statistics	
	B	Std. Error	Beta	t	Sig	Zero-order	Partial	Part	Tolerance	VIF
Constant)	1.693	.300		5.652	.000					
Empowerment	.261	.076	.374	3.445	.001	.669	.421	.284	.577	1.735
Authenticity	.218	.088	.277	2.483	.016	.648	.317	.205	.546	1.832
Forgiveness	-.186	.059	-.263	-3.148	.003	-.375	-.391	-.260	.971	1.030
Courage	.113	.056	.193	2.031	.047	.503	.264	.167	.750	1.333

a. Dependent variable: Retention

Table 5: SLS scores in samples from India, Italy, The Netherlands and United Kingdom.

SLS Dimensions	India		Italy		The Netherlands		United Kingdom	
	M	SD	M	SD	M	SD	M	SD
1. Empowerment	3.81	0.47	3.97	1.07	4.39	0.90	4.06	1.12
2. Accountability	3.62	0.72	4.95	0.85	4.86	0.70	4.84	0.81
3. Standing Back	3.16	0.77	2.92	1.14	3.67	0.95	3.61	1.27
4. Humility	3.22	0.75	3.30	1.14	4.13	0.93	3.56	1.12
5. Authenticity	3.06	0.60	3.25	1.05	3.62	0.94	3.50	1.23
6. Courage	3.19	0.80	3.57	1.30	3.86	1.08	3.61	1.23
7. Forgiveness	2.37	0.66	3.33	1.09	3.87	1.05	2.81	1.33
8. Stewardship	3.52	0.76	4.15	1.06	4.43	0.91	3.90	1.14

Source: Data for comparison extracted from Andrea Bobbio, Dirk Van Dierendonck & Anna Maria Manganelli (2012)

from The Netherlands and United Kingdom. The Indian leaders scored lowest on the dimension forgiveness means that Indian leaders cannot forget the mistakes of their subordinates easily in comparison with the leader's attitude from Italy, The Netherlands and United Kingdom. Out of the total eight dimensions of SLS, Indian leaders scored lowest in seven dimensions (empowerment, accountability, humility, courage and stewardship), only in case of standing back Indian leaders scored higher than leaders of Italy, so there Hypothesis 2 cannot be rejected.

Conclusion

The paper aims at studying the current literature on servant leadership and its relationship with other organizational variables of interest. Literature review supports the fact the most of the studies conducted on the concept of servant leadership focused upon scale development and validation of the servant leadership construct. Although there exists a little evidence on the research on servant leadership of construct and other organizational variable of interest, yet it is important to note

here most of the studies on Servant leadership are conducted in the regions of the world with Lower power distance as per GLOBE study [14]. The countries where the servant leadership scores are high are scoring low on power distance, which means that the country where power is distributed equally in the society. The examples of the countries are Netherlands, UK and Italy. This paper attempts to assess the servant leadership style in India, which is characterized by high power distance as per GLOBE study [14]. As expected the score of servant leadership style in India is lower than the countries in comparison. It is evident from the study of [2] in their study titled "Servant leadership in Italy and its relation to organizational variables" found that servant leadership expressed by Italian leaders turned out to be lower than in the Netherlands and in UK. The power distance index of these countries in GLOBE study also indicated that the power distance index in Italy is more than the Netherlands and UK, it is because of this reason that Italy scored low on servant leadership in comparison with other two countries. The another important finding is that the descriptive statistics of the sample indicated that in all the study respondent group consists of students, individuals from diverse background working both in profit and non-profit organization which is the major limitation of the studies. The organizational variables which are studied with the servant leadership construct in the above mentioned literature review are not diverse. Same variables are studied with SL construct but with different samples, so there exists a strong need to explore the other organizational variables of interest. The literature available so far does not indicate any cause and effect relationship between SL construct and other organizational variables, because there is no evidence of longitudinal study on servant leadership in literature. Literature also suggested that still the concept of servant leadership is in confusing state as multiple scale produce varied results for the studies.

References

- [1]. Barbuto, J.E., Jr., & Wheeler, D.W., Scale development and construct clarification of servant leadership. **Group and Organization Management**, Vol. 31, No.3 2006, pp. 300-326.
- [2]. Bobbio, A., Van Dierendonck, D., & Maria Manganelli, A., Servant leadership in Italy and its relation to organizational variables. *Leadership*, Vol. 8, No. 3 2012, pp.229-243.
- [3]. Boyatzis, R. E., & McKee, A., *Resonant leadership: Renewing yourself and connecting with others through mindfulness, hope, and compassion*. Cambridge, MA: **Harvard University Press**, 2005.
- [4]. Brewer, C., Servant Leadership: A Review of Literature. **Journal of Workforce Education and Development**, Vol. 4, No. 2, 2010, pp.1-8
- [5]. Choudhary, A.I., Akhtar, S.A., & Zaheer, A. Impact of Transformational and Servant Leadership on Organizational Performance: A Comparative Analysis. **Journal of Business Ethics** DOI 10.1007/s10551-012-1470-8, (2012). Changed the reference.
- [6]. Clegg, S., Kornberger, M., & Rhodes, C., Business ethics as practice. **British Journal of Management**, Vol.18, 2007, pp.107-122.
- [7]. Dennis, R. S., & Bocarnea, M., Development of the servant leadership assessment instrument. **Leadership and Organization Development Journal**, Vol. 26, 2005, pp.600-615.
- [8]. Dockel, A., Basson, J.S. & Coetzee, M., The effect of retention factors on organizational commitment: An investigation of high technology employees, **SA journal of Human Resource Management**, Vol. 4, No. 2 2006, pp.20-28.
- [9]. Dorfman, P., Javidanb, M., Hanges P., Dastmalchiand, A. & Housee, R., GLOBE: A twenty year journey into the intriguing world of culture and leadership, **Journal of World Business**, Vol. (47), 2012, pp. 504-518
- [10]. Ehrhart, M. G., Leadership and procedural justice climate as antecedents of unit-level organizational citizenship behavior. **Personnel Psychology**, Vol. 57, 2004, pp. 61-94.
- [11]. Greenleaf, R. K., *Servant leadership*. Mahwah, NJ: **Paulist Press**, 1977.
- [12]. Gupta, V., Suri, G., Javidan, M. & Chhokar, J., Southern Asian cluster: Where the old meets the new? **Journal of World Business**, Vol. 37, 2002, pp. 16-27.
- [13]. Hale, J. R., & Fields, D. L., Exploring servant leadership across cultures: A study of followers in Ghana and the USA. *Leadership*, Vol. 3, 2007, pp. 397-417.
- [14]. House R.J. et al. (eds.), *Culture, Leadership, and Organizations: The GLOBE Study of 62 Societies*. Thousand Oaks, CA: Sage, 2004
- [15]. Hunter, E.M., et al., Servant leaders inspires servant followers: Antecedents and outcomes for employees and the organization, **The Leadership Quarterly**, Vol. 24, No. 2 2013, pp.316-331.
- [16]. Irving, J. A., & Longbotham, G. J., Team effectiveness and six essential servant leadership themes: A regression model based on the items in the Organizational Leadership Assessment.

- International Journal of Leadership Studies**, Vol. 2, 2007, pp.98-113.
- [17]. Jaramillo, F., Grisaffe, D. B., Chonko, L. B., & Roberts, J. A., Examining the impact of servant leadership on salesperson's turnover intention. **Journal of Personal Selling and Sales Management**, Vol. 29, 2009, pp.351-365.
 - [18]. Kyndt, E., Dochy, F., Michielsens, M. & Moeyaert, B., Employee retention: Organizational and Personal Perspectives, *Vocations and Learning*, 2009, DOI 10.1007/s12186-009-9024-7
There was a spelling mistake.
 - [19]. Laub, J. A., Assessing the servant organization; Development of the Organizational Leadership Assessment (OLA) model. **Dissertation Abstracts International**, Vol. 60, No. 2 1999, pp. 308A
 - [20]. Liden, R. C., Wayne, S. J., & Sparrowe, R. T., An examination of the mediating role of psychological empowerment on the relations between job, interpersonal relationships, and work outcomes. **Journal of Applied Psychology**, Vol.85, 2000, pp. 407-416.
 - [21]. Liden, R. C., Wayne, S. J., Zhao, H., & Henderson, D., Servant leadership: Development of a multidimensional measure and multi-level assessment. **Leadership Quarterly**, Vol. 19, 2008, pp. 161-177.
 - [22]. Luthans, F., & Avolio, B., Authentic leadership development. In K. S. Cameron & J. E. Dutton (Eds.), *Positive organizational scholarship* San Francisco: Berrett-Koehler. 2009, pp. 241-254.
 - [23]. Malhotra, N.K. & Dash, S. *Marketing Research*, Pearson Education, 2009
 - [24]. Mayer, D. M., Bardes, M., & Piccolo, R. F., Do servant-leaders help satisfy follower needs? An organizational justice perspective. **European Journal of Work and Organizational Psychology**, Vol. 17, 2008, pp.180-197.
 - [25]. McClelland, D. C., & Burnham, D. H., Power is the great motivator. **Harvard Business Review**, Vol. 54, 1976, pp.100-110.
 - [26]. Neubert, M. J., Kacmar, K. M., Carlson, D. S., Chonko, L. B., & Roberts, J. A., Regulatory focus as a mediator of the influence of initiating structure and servant leadership on employee behavior. **Journal of Applied Psychology**, Vol. 93, 2008, pp.1220-1233.
 - [27]. Reinke, S. J., Service before self: Towards a theory of servant-leadership. **Global Virtue Ethics Review**, Vol. 3, 2004, pp.30-57.
 - [28]. Reinke, S. J., Does the form really matter? Leadership, trust, and acceptance of the performance appraisal process. **Review of Public Personnel Administration**, Vol.23, 2003, pp. 23-37.
 - [29]. Ruschman, N. L., Servant-leadership and the best companies to work for in America. In L. C. Spears, & M. Lawrence (Eds.), **Focus on leadership: Servant-leadership for the twenty-first century** Wiley, 2002, pp.123-140
 - [30]. Schneider, S.K. & George, W.M., Servant leadership versus transformational leadership in voluntary service organizations, **Leadership & Organization Development Journal** Vol. 32, No.1 2011, pp. 60-77.
 - [31]. Sendjaya, S., Sarros, J. C., & Santora, J. C., Defining and measuring servant leadership behaviour in organizations. **Journal of Management Studies**, Vol. 45, 2008, pp.402-424.
 - [32]. Spears, L. C., Reflections on leadership: How Robert K. Greenleaf's theory of servant-leadership influenced today's top management thinkers. New York: John Wiley, 2004.
 - [33]. Spears, L.C., Character and Servant Leadership: Ten Characteristics of Effective, Caring Leaders. **The Journal of Virtues & Leadership**, Vol. 1, No. 1 2010, pp. 25-30.
 - [34]. Spears, L.C., Reflections on Robert K. Greenleaf and servant-leadership. **Leadership & Organization Development Journal** Vol. 17, No.7 1996, pp.33-35.
 - [35]. Stone, A. G., Russell, R. F., & Patterson, K. (2004). Transformational versus servant-leadership: A difference in leader focus. **Leadership & Organizational Development Journal**, Vol.25, pp. 349-361.
 - [36]. Sun, J.-M. & Wang, B. (2009). Servant leadership in China: Conceptualization and measurement. **Advances in Global Leadership**, Vol. 5, 321-344.
 - [37]. Van Dierendonck, D., & Nuijten, I., The servant Leadership Survey: Development and validation of a multidimensional measure. **Journal of Business psychology**, Vol. 26, 2011, pp.249-267.
 - [38]. Washington, R. R., Sutton, C. D., & Field, H. S., Individual differences in servant leadership: The roles of values and personality. **Leadership and Organization Development Journal**, Vol. 27, 2006, pp.700-716.
 - [39]. West, G. R. B., Bocamea, M., & Maranon, D., Servant-leadership as a predictor of job satisfaction and organizational commitment with the moderating effects of organizational support and role clarity among Filipino engineering, manufacturing, and technology workers. **International Journal of Servant-Leadership**, Vol. 5, 2009, pp.129-162.
 - [40]. Winston, B.E., & Ryan, B., Servant Leadership as a Humane Orientation: Using the GLOBE Study Construct of Humane Orientation to Show that Servant Leadership is More Global than Western. **International Journal of Leadership Studies**, Vol. 3, No.2 2008, pp.212-222.
 - [41]. Wong, P. T. P., & Davey, D. (2007). Best practices in servant leadership. Servant leadership research roundtable—July 2007. Virginia Beach: Regent University.

Effect of Nepali Language Features on Nepali News Classification Using Vector Space Model

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Abstract

With an increasing trend of publishing news online on website, automatic text processing becomes more and more important. Automatic text classification has been a focus of many researchers in different languages for decades. This research identifies various Nepali language features and also their impact on the classification of Nepali news using Vector Space Model, which is applicable in news search engine, news clustering and news recommendation systems. The total number of dimensions used in Vector Space Model for classification is very large. The results show that the number of dimensions can be reduced by 37.715% using Nepali language specific techniques such as filtering most common-words, word replacements and removal of word suffices using morphology. The average precision and recall increased by 0.539% and 1.317% respectively when common-words were filtered and replacement of words were done. Average precision and recall increased upto 1.217% and 1.558% with addition of Latent Semantic Indexing.

Keywords:

Latent Semantic Indexing, document similarity, Nepali text classification, morphological analysis, Vector Space Model

Introduction

The availability of news in electronic form is ever increasing mainly because of the rapid growth of the World Wide Web. The task of automatic classification of such colossal news is emerging

as the key challenge for organizing that huge information and also for any processing with an aim of knowledge discovery in this information. Proper classification of online news needs text level analysis using various natural language processing and machine learning techniques to get meaningful knowledge. Text classification is becoming interesting to many researchers, which consists of several challenges like appropriate document representation, dimensionality reduction to handle algorithmic issues and an appropriate classifier function to obtain good generalization. The language level specifics, which might be entirely different from one language to another language both at syntax and semantics adds other challenging issues on text classification problem.

Vector Space Model (VSM) represents each document as a feature vector of the terms in the document. Each feature vector contains term weights of the terms in the document. First step in classification system based on Vector Space Model (VSM) is the generation of words. Words are generated using analyzer. Different analyzers available for English text cannot be used for Nepali text due to the differences in the language. Preprocessing is done by analyzer before generating final set of words for VSM.

An analyzer tokenizes text by performing number of operations on it, which include extracting words, discarding punctuation, removing accents from characters (for certain languages), lowercasing, removing common-words which is also termed as stopwords, reducing words to a root form, etc. These operations are language

dependent and exact implementations vary from language to language.

For an example, in English, words such as the, an, a, etc., are very common and are used as stopwords. In Nepali text, these stopwords do not exist and new stopwords are needed to be identified. It is also common to process verbs to reduce them to their roots for English text. In Nepali language, root verbs are combined in different ways to form new verbs. Similarly, different suffixes are added to nouns and pronouns to form different words. There are various forms of word reduction based on suffixes as per the nouns and pronouns used in a particular sentence and context. Such feature is not seen in English text. Lowercasing is common in English but is not applicable in Nepali text. Similarly, accent is used in Nepali text. Another feature common in Nepali language is different forms of words with same meaning. These words are not the synonym words, rather similar words but written in different forms with minor variations on characters being used in writing. Examples are अवर्द्ध - अबर्द्ध, उपलब्धि - उपलब्धि, कमिटि - अमिटि, इकाइ - इकाई, आइतवार - आइतबार etc. It is required to substitute such different forms with single form.

In addition to these all syntax level processing, this paper also investigates the effects of combining semantics based processing method such as Latent Semantic Indexing (LSI) and preprocessing based on Nepali language features. However the principle focus of this research work is in news classification, this research contribution is equally applicable in building news clustering models for news search engine optimization similar as Zhang and Dimitroff models [15] and also building a recommender system like Timalsina [13] and Krestel and Mehta [8] for the purpose of designing efficient news recommendation systems.

The rest of this paper is organized as follows. Section 2 discusses previous works related to this paper. Section 3 introduces baseline approach and LSI. It then discusses the proposed approach using preprocessing based on Nepali language features followed by the combination of LSI. Section 3 then discusses the experimental setup for the methods. Based on the experiments, section 4 shows the evaluation of these methods and discusses the performances of the classifier. Finally, section 5 summarizes and concludes the paper.

Related Works

VSM represents each document as a feature vector of the terms including both words and phrases [14]. Each feature vector contains term weights of the terms in the document. In the simplest form, it does not consider the dependency between the terms and ignores the sequence and structure of the term in the document. A document is represented by n-dimensional term vectors in VSM. A term vector is a collection of term-weight pairs. The weight of a term depends on the frequency of occurrence of the term called Term Frequency (TF). Term Frequency - Inverse Document Frequency (TF-IDF) weight outperforms TF and is commonly used weights [5,6]. A wide variety of distance functions and similarity measures have been used, such as squared Euclidean distance, cosine similarity, and relative entropy. Cosine similarity is a commonly used similarity measure [3,4].

Khan et.al proposed the semantics based feature vector using Parts-of-Speech (POS) model for text classification [5]. The feature space was reduced remarkably considering parts of speech. Masuyama and Nakagawa presented the roles of the different POS in feature selection and showed that nouns best describe a category's contents [10]. Krestel and Mehta used Latent Dirichlet Allocation (LDA) to find the hidden factors of important news stories [8]. Authors focused on verb, adjective and noun for part-of-speech (POS) information. For Named-Entity information, the most common named-entities like person, locations, organization and job-titles were used for efficient results. Lo, He and Ounis generated stopwords automatically using frequency of occurrence of words for information retrieval system [9]. Basnet and Pandey have shown different aspects of morphological analysis of verbs in Nepali [1]. The study focused on inflection aspect of verb morphology and the use of compounding of verbs for Nepali language.

Latent Semantic Indexing (LSI) remained one of the predominantly used techniques in information retrieval systems because of the method featuring in dimensionality reduction and overall quality improvement in results [2,3,12]. LSI uses Singular Value Decomposition (SVD) to find low rank approximation of the original

term space. Users in different contexts, or with different needs, knowledge, or linguistic habits will describe the same information using different terms. In contrary, same word may have more than one distinct meaning. LSI captures the essential meaningful semantic associations while reducing redundant and noisy semantic information [2]. Paulsen and Ramampiaro combined LSI with a new clustering algorithm to retrieve and cluster biomedical information using Lucene and JAMA API in Java [11]. They obtained best result when rank was reduced to few hundreds. Gleich and Zhukov used SVD to recommend related terms at varying levels of generality by varying the rank of SVD space [3].

Methodology

The proposed method uses various Nepali languages features to reduce the dimension of feature space. These feature based improvements are cascaded in similar style as Masuyama and Nakagawa [10] nevertheless the authors used different method than the proposed method. After the generation of terms, LSI is applied to improve the performance of the classifier. Finally the results are verified using cross-fold validation techniques detailed out as in [7].

Algorithm of Baseline Method

1. Split the whole documents into training and testing datasets. The splitting ratio will be different in each iterations of validation cycle following k-fold cross-validation.
2. Analyze the news document using Standard Analyzer in Lucene¹.
3. Calculate the term weight using the standard TF-IDF calculation scheme.
4. Using the training documents compute the term-weight vectors, which is also known as document vectors.
5. Use term-weight vectors associated with training documents of each class to compute corresponding centroid vector.
6. Compute term-weight vector of test documents, exactly repeating similar steps of

training documents.

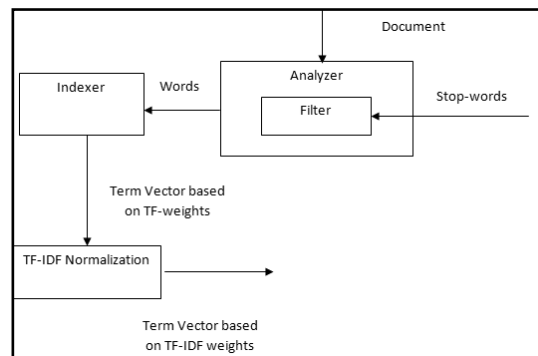
7. Compute similarity measure between the test document and news classes. Similarity measure between a document and a class is calculated by computing the cosine similarity between the test vector of the former and centroid vector of the latter.
8. Classify the test document to a class which gives minimum similarity measure.
9. Repeat whole processes to evaluate using k-fold cross-validation.

Algorithm of Proposed Method

Generate stopwords using frequency thresholding where frequency is the total number of documents in which a term appears. Remove stopwords from the complete set consisting total terms.

1. Replace ब with व, ई with इ, ु with , ि with ी, ढ with घ, ढ with ढ, ठ with थ, ट with त and श with स.
2. Remove word suffices such as बाट, द्वारा, मार्फत्, देखि, सँग, तर्फ and सम्म.
3. Calculate weights of the reduced term space.
4. Calculate term-document matrix from the reduced term space.
5. For LSI, apply SVD² algorithm to generate new term-document matrix.
6. Generate term-weight vector from the new term-document matrix.
7. Evaluate the classifier using k-fold cross-validation.

A basic document classification model based on standard TF-IDF weights with similarity measure consideration is depicted as in Figure 1.



¹ Lucene 3.6.1 and JDK 1.7.0 were used for processing and baseline evaluation purpose. Lucene can be downloaded from <http://lucene.apache.org/>

² SVD algorithm was implemented in Matlab using svds command.

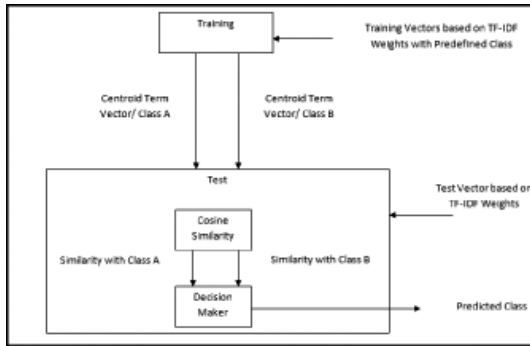


Figure 1 – Document classification model block diagram

Experiment and Evaluation

The data required for this work was prepared from the raw dataset used for morphological analysis of Nepali text by Basnet and Pandey [1]. The original dataset consists of 71981 news documents, occupying 453 MB disk space, collected from various sources of Nepali daily newspapers such as Gorkhapatra, Kantipur, Samacharpatra, Mahanagar, Nagariknews and Annapurna Post published during January 2009 to November 2009. The dataset was used for morphological analysis of Nepali text by Basnet and Pandey [1]. Data cleaning was required before the dataset could be used. Duplicate news documents were replaced with unique news documents. The dataset containing non-Nepali encodings were also removed. Many news documents contained more than one news items in the same document, which was useless for classification, as each news document must belong to a single category.

To test the performance of the classifier, actual category of news document must be compared with the category predicted by the classifier. A web-based application was developed for this purpose. A web-interface displays news from the dataset and human user can select respective category. After selection, the provided category was stored in a database. The web-interface was developed using HTML, PHP and mysql. The database consists of two tables: “**ncategory**” and “**news**”. The table “**ncategory**” stores the news categories which are loaded as options for classification. A user is provided the content of the news to be categorized and available options. The

information submitted by the user is stored in the table “**news**”. The information includes the news, category selected and user’s name. Figure 2 shows the screenshot of the web-interface developed for manual categorization of news documents.



Figure 2 – Screenshot of web interface used for manual classification

After going through such rigorous process of cleaning and manual categorization, dataset of 700 news documents is prepared. Initially, 50% were used for training and 50% were used for testing. Later the document set splitting was done following k-fold cross-validation.

Different categories chosen for the model experimentation are shown in Table 1.

Table 1 – Categories of the news documents

No.	Category (Abbreviation)	No. of documents
1	Accidents (A)	100
2	Politics (P)	100
3	Sports (S)	100
4	Development (D)	100
5	Health (H)	100
6	Education (E)	100
7	Crime (C)	100
	Total	700

Confusion matrix was created from the result of classification. Precision, recall and accuracy were used for evaluation of the classifier. Precision of a class measures the ratio of correctly classified

documents to the total documents classified in the class. Recall of a class measures the ratio of correctly classified documents to the total documents in a class. Table 2 shows the confusion matrix of one of the experiments using baseline method. Table 3 shows the calculation of precision, recall and accuracy using True Positives (TP), False Negatives (FN), False Positives (FP) and True Negatives (TN) derived from confusion matrix of Table 2.

Table 2 – Confusion matrix of an experiment on baseline method

		Predicted class						
		A	D	C	S	H	E	
Actual class	P	93	2	2	0	0	2	1
	A	0	83	5	4	0	0	8
	D	0	1	70	16	8	1	4
	C	0	0	13	70	4	1	12
	S	0	0	9	10	71	6	4
	H	0	0	8	2	3	83	4
	E	0	2	6	22	3	0	67

Table 3 – Performance measures of an experiment on baseline method

Class	TP	FN	FP	TN	Pr	Re	Acc
P	93	7	0	600	1	0.93	0.99
A	83	17	5	595	0.94	0.83	0.96
D	70	30	43	557	0.61	0.7	0.89
C	70	30	54	546	0.56	0.7	0.88
S	71	29	18	582	0.79	0.71	0.93
H	83	17	10	590	0.89	0.83	0.96
E	67	33	33	567	0.67	0.67	0.90
Avg.	76.71	23.28	23.28	576.71	0.78	0.76	0.93

Average precision for 7 classes were calculated for each experiment using 2-fold cross-validation. Experiments were repeated 20 times and average values were recorded. Baseline method uses standard analyzer to generate terms. First step was to filter commonly occurring words. Stopwords were generated using frequency thresholding. Top two most frequent terms छ and र were selected as stopwords.

Table 4 - Effect of word replacements on dimension reduction

Word replacement forms	No. of terms reduced
ब व	233
इ ई	51
उ ँ	228
ः ी	134
ढ ध	3
ड द	7
ठ थ	4
ट त	11
श स	82
All combined	746

Second step was to replace various word forms. Different forms of replacements and corresponding number of terms reduced are shown in Table 4. After this, suffices that occur in nouns and pronouns were removed to reduce the dimension further. Suffices that gave best results are बाट, द्वारा, मार्फत्, देखि, सँग, तर्फ and सम्म.

Table 5 – Effect of preprocessing on classifier performance.

Code	Methods	Average Precision	Average recall	No. of terms
B	Baseline	0.7863	0.7699	28903
BS	Baseline with stopword filtering	0.7878	0.7773	28901
BSR	Baseline with stopword filtering and word replacement	0.7905	0.7800	28157
BSRS	Baseline with stopword filtering, word replacement and suffices removal	0.7902	0.7803	27292

Table 5 shows the effect of addition of various new methods applied to the baseline method. These three methods remarkably reduced the dimension of the feature to be used for classification and also increased average precision and recall compared to the baseline method as shown in Figure 3.

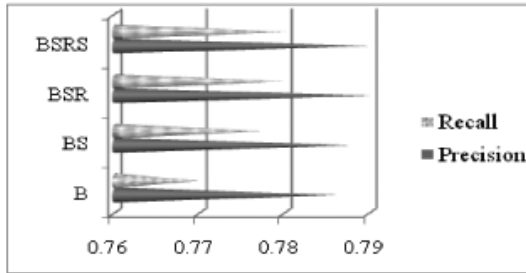


Figure 3 - Classifier performance comparison among different methods

Similarly the Figure 4 shows the comparison of average accuracy percentage among different methods. Baseline method accuracy is improved tremendously with extra effort of additional processing as outlined in Table 5 method details.

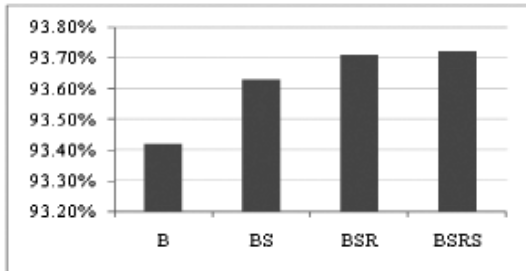


Figure 4 – Average accuracy percentage comparison among different methods

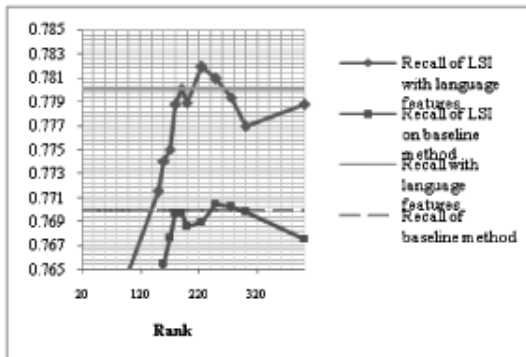


Figure 5 – Effect of LSI on recall

The last step was to apply LSI in the result of previous methods. Effect of LSI on baseline method was also tested by applying SVD on term-document matrix generated from baseline method. Figure 5 shows the effect of LSI implementation on recall of classifier. Similarly Figure 6 shows the effect of LSI on precision of classifier.

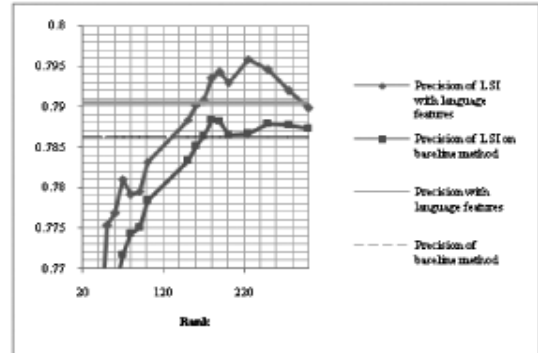


Figure 6 – Effect of LSI on precision

Conclusion and Future Works

New methods showed promising results than baseline method. Stopword filtering increased average precision by 0.199% and average recall by 0.964%. Word replacement when combined with stopwords filtering increased the average precision by 0.53% and the average recall by 1.317%. The corresponding reduction in number of terms was 2.58%. Morphological analyzer that removed specific suffixes increased both the average precision and average recall compared to the baseline method. It increased average precision by 0.499% and average recall by 1.35%. The decrease in number of terms was 5.57%.

Application of LSI increased the average precision and recall when applied to the baseline method. Further improvement was obtained when language specific processing was followed by LSI. Maximum gain in precision was obtained at rank of 180 and best gain in recall was found at rank of 250 in case of baseline method. With language specific processing, the best gains in average precision and average recall were obtained at rank of 225. The LSI increased the average precision of baseline method by 0.209% and average recall by 0.074%. The LSI on the result using language features increased the average precision by 1.217% and the average recall by 1.558%.

Suffices that occur in nouns and pronouns were only considered in this paper. Stemming algorithms in Nepali may be used to reduce different forms of verbs. Only common forms of word replacements were considered in this paper. Other forms of replacements are still possible. Examples of such replacement possible word pairs are ओखलढुंगा - ओखलढुङ्गा, एवं - एवम्, काठमाडौं - काठमाडौ, इन्स्टिच्युट - इन्स्टिच्युट etc. More replacements may improve dimension reduction and classifier performance further.

References

- [1] Basnet, S. B. and S. B. Pandey, "Morphological Analysis of Verbs in Nepali", *Nepalese Linguistics* 24, 2009, pp. 21-30.
- [2] Deerwester, S., S.T. Dumais, G. W. Furnas, T. K. Landauer and R. Harshman, "Indexing by Latent Semantic Indexing", *Journal of the American Society of Information Science*, 1990.
- [3] Gleich, D., and L. Zhukov, "SVD Subspace Projections for Term Suggestion Ranking and Clustering", *SIGIR-2004*, 2004.
- [4] Huang, A., "Similarity Measures for Text Document Clustering", *New Zealand Computer Science Student Conference 2008*, 2008, pp. 49-56.
- [5] Khan, A., B. Baharudin and K. Khan, "Semantic Based Features Selection and Weighting Method for Text Classification", *IEEE, ITSIM*, 2010, pp. 850-855.
- [6] Khan, A., B. Baharudin and K. Khan, "Efficient Feature Selection and Domain Relevance Term Weighting Method for Document Classification", *ICCEA-2010*, 2010.
- [7] Kohavi, R. "A Study of Cross-validation and Bootstrap for Accuracy Estimation and Model Selection", *Proceedings of the Fourteenth International Joint Conference on Artificial Intelligence*, 1995.
- [8] Krestel, R., and B. Mehta, "Learning the Importance of Latent Topics to Discover Highly Influential News Items", *33rd Annual German Conference on AI* 2010, pp. 221-218.
- [9] Lo, R. L., B. He and L. Ounis, "Automatically Building a Stopword List for an Information Retrieval System", *5th Dutch-Belgium Information Retrieval Workshop*, 2005.
- [10] Masuyama, T. and H. Nakagawa, "Cascaded Feature Selection in SVMs Text Categorization", *CICLing 2003*, 2003, pp. 588-591.
- [11] Paulsen J. R. and H. Ramampiaro, "Combining Latent Semantic Indexing and Clustering to Retrieve and Cluster Biomedical Information: A 2-step Approach", *NIK-2009 Conference*, 2009.
- [12] Susan T. Dumais, "Latent Semantic Indexing (LSI): TREC-3 Report", *TREC-3*, 1995.
- [13] Timalsina, A. K., "A Framework for Personalized Dynamic Cross-Selling in e-Commerce Retailing", Ph.D. dissertation, School of Engineering, Wayne State University, 2012.
- [14] Turney, P.D. and P. Pantel, "From Frequency to Meaning: Vector Space Models of Semantics", *Journal of Artificial Intelligence Research* 37, 2010.
- [15] Zhang, J. and A. Dimitroff, "The Impact of Webpage Content Characteristics on Webpage Visibility in Search Engine Results", *Information Processing & Management*, Vol. 41, Issue 3 2005, pp. 665-690.

A Study on the Difference in Acceptance of Smart Work according to Tendencies of Leadership Styles

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Abstract

According to development of smart technologies such as smart phone, tablet PC, and SNS communication, necessity of smart work that can change environment of working in organizations has been emphasized. Lots of organizations, however, wish to do work with smartness through adoption of smart work technologies, those are not sure whether smart work will be successful or not till now.

Especially, viewpoints of leaders concerning efficiency and effectiveness of smart work who operate the organizations may be different in many circumstances such as industries, characteristics of work, etc.

Therefore, by empirical and exploratory approach, the purposes of this research investigate whether there may be differences between leader and non-leader group, tendencies of leadership styles or not.

Keywords:

Smart work, Telecommuting, Flexible working time, Leadership styles, Teleworking, Smart work center, Telecommuter

Introduction

Recently, lots of organizations are fiercely competing to survive and the boundaries of business activities of companies are expanding to the global area. Under these situations, to improve and get the competitive advantages of firms, they try to find out more effective and efficient business activities through smart work that means working with smart.

Considering environment of firms under the age of limitless competition, firm have to promptly make sense and properly response to rapid wave of changes. For the sake of these circumstances, firms should drastically break the traditional working styles and reengineer the way of conducting business activities by using smart technologies. And it is expected that rapid development of smart technologies can make quality of human life be better. As increasing female workers and entering into the super-aged society, working times and age of retirement must be adjust flexibly.

Through smart work, firms can save opportunity costs, improve productivity and satisfactory level of workers. Furthermore, these elements may be crucial factors to improve quality of products and services of organizations.

Therefore, it is important how executives or managers recognize whether smart work can be innovative solution to change the way of traditional working custom or not. Physically, however, concerning effectiveness and efficiency of smart work, leaders who are leading an organization may have different perspectives each other [7]. Consequently, under the circumstances of requiring changes of working custom, this research can give important implications that, according to tendencies of leadership styles, whether there will be significant differences in acceptance of smart work or not. Both negative perspectives and vague overestimate can be problems. Especially, this research assumed that there may be significant difference between leader and non-leader groups.

The results of this research can give insights to leaders who want to adopt concept of smart

work in their own organization. On the basis of tendencies of six leadership styles, if there may be significant difference in acceptance of smart work, leaders have to recognize their own leadership styles. Additionally, they should make a decision whether their organization accept or swim against the wave of change.

Theoretical Background

Leadership Styles and Tendencies

The leadership can be defined as management competence driving thought and activities toward the right direction. Recently, lots of organizations have had deep interests in studies concerning leadership and in academic areas, in not only management but also psychology [16]. According to styles of leaderships, organizational cultures and nature, this may be different and productivity is also depended on these [15].

Leadership styles proposed by HBR(2008) were such six leadership styles as democratic, affinitive, coercive, authoritative, coaching and dominant leaderships.

Usually, leaders who have styles of coercive leadership make an order, indication or directions to their own members and force obedience and urge to follow his order unilaterally.

The authoritative leaders make a pressure to their followers and strongly require achieving the organizational goal. The authoritative and one-sided behaviors are the characteristics of leaders who tend to act authoritatively. The affinitive leaders think that relationship among people is more important than works. They usually emphasize affinity and solidarity among members.

The democratic leaders try to not lead dogmatically but induce their persons to participate in decision making processes. Namely, for right decision making, they assign duties to each of persons and lead the process of decision making. In case of dominant leader, they establish high level criteria of performance and motivate their persons to reach that. Finally, the coaching style leaders let their persons develop and maximize personal abilities. Additionally, they give opportunities, guidance and chances to achieve their own goals maximally.

Smart Work

The teleworking is such as telecommuting, video conferencing, and working at smart work center, etc. In 1970s and 1980s, economic recession and labor issues might be the major reasons why these working styles are happened. In 1980s and 1990s, various types of working had been tried experimentally and, through these trials, many firms, public organizations and personals have had many interests until now.

In Europe or America, teleworking i.e. smart work is popular working style and the bigger companies, the higher ratio of teleworking [19]. As expansion of broadband network in Europe, number of companies adopting smart work has been increased consistently [3, 4].

As developing digital technologies, circumstances surrounding firms consistently compel organizations to innovate traditional working custom. Especially, smart technologies increase opportunities of mobility and communicability in organizations and personal daily life. From these, there may be lots of beneficial aspects for firms and personal life such as diminishing space for working, improving productivity, upgrading worker's quality of life, decrease of traffic jam and savings energy, etc.

With smart work, organizations have to escape from control and administration-centric organizational culture to networked organizational culture. But, many leaders in organizations cannot discard their own working styles yet [17].

Behind requiring innovative activities toward successful smart work, there may be side effects such as negligence of duties, low productivity and lack of reasonable performance evaluation system, etc that have to solve. Therefore, the research concerning side effects of smart work may be necessary.

Research Methodology

Research Model

Research model is depicted like figure 1. Leader group (managers, PM, team leader, factory supervisor, etc.) and non-leader group(staffs or workers who don't have right of performance assessment) are suggested as control variables, Based on clas-

sification of the HBR (2008), this research used six leadership styles and measures for evaluating tendencies of leadership styles were modified and supplemented subjectively. To measure the acceptance of smart work, items of questionnaire consist of four dimensions such as time, places, people and technologies for working.

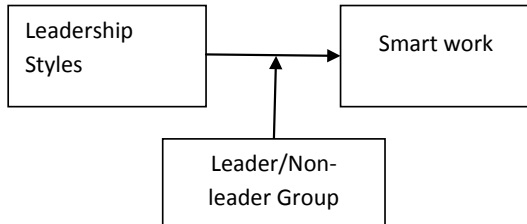


Figure 1 – Research Model

Research Hypotheses

Hypothesis 1: according to tendencies of each leadership styles, there may be significant differences in acceptance of smart work.

Hypothesis 2: There may be significant differences in acceptance of smart work between leader and non-leader group in organizations.

Hypothesis 3: There may be significant differences in acceptance of smart work among tendencies group of leadership styles controlled by control variables such as leader or non-leader group.

To verify above hypotheses, this research conducted the empirical study with questionnaire survey. By using SPSS 21.0 as a tool of analysis, one-way ANOVA, t-test for mean differences between groups and Bonferroni for post-hoc verification were conducted.

Zero hypothesis $H_0: \mu_i = \mu_j (i \neq j)$

Alternative hypothesis $H_a: \mu_i \neq \mu_j (i \neq j)$

Research Results

Data Collection

The targeted companies for survey are located at Gyungi and Chugnam area. By visiting and email survey, total 118 responded questionnaires were collected.

The respondents consist of positions such as staffs

(20.3%), assistant managers (28%), managers (22.9%), deputy head of department (15.3%), department head (9.3%) and executives (2.5%). Respondents based on duty consist of such as team managers (22%), team members (68.6%), PM (4.2%), factory managers (2.5%) and board of directors (1.7%).

Reliability and validity of measures

In order to verify reliability and validity of measures, factor analysis was conducted by using responded data. For extracting factors, the principal component analysis was performed. Varimax methodology was used for rotating factors. Table 1 show that 17 items were regrouped into six factors. The first factor group consists of five items from 10th to 14th related to democratic leadership (DM). The rest of items were regrouped as below table 2.

Table 1 - Reliability and Validity

Item	Leadership Styles						Cronbach Alpha
	DM	AF	CO	AU	CC	DO	
114	.776						0.777
112	.730						
110	.643						
113	.612						
111	.549						
18		.846					0.812
19		.821					
17		.790					
12			.855				0.732
11			.804				
16				.767			0.670
15				.629			
13				.611			
116					.599		0.620
117					.795		0.620
118					.636		0.620
115						.825	

DM: democratic, AF: affinitive, CO: coercive, AU: authoritative, CC: coaching, DO: dominant

Categorization of leadership level

For categorizing tendencies of each leadership styles of respondents such groups as high, mid, and low, this research adopted the techniques of frequency distribution table like below expressions.

Table 2 - Results of Categorization

Leadership	Min	Max	Mean	LOW	MID	HIGH	class size
DM	2.40	5.00	3.845	2.40~3.26	3.26~4.12	4.12~5	0.86
AF	1.00	5.00	4.097	1.00~2.32	2.32~3.65	3.65~5	1.32
CO	1.50	5.00	3.483	1.50~2.66	2.66~3.82	3.82~5	1.16
AU	1.67	5.00	3.581	1.67~2.73	2.73~3.87	3.87~5	1.10
CC	1.67	5.00	3.810	1.67~2.73	2.73~3.87	3.87~5	1.10
DO	1.00	5.00	2.881	1.00~2.32	2.32~3.65	3.65~5	1.32

DM: democratic, AF: affinitive, CO: coercive, AU: authoritative, CC: coaching, DO: dominant

Hypotheses Test Results

Difference of Acceptance in Smart work among Leadership Styles

Through one-way ANOVA and test of mean difference, this research tried to find out difference in acceptance of smart work among tendencies (high, mid, low) of leadership styles each.

First, the results showed that there were significant differences in acceptance of smart work such as higher mobility of works (.016) and at least one day a week in office work (.046) among three groups showing democratic leadership tendency ($p < 0.05$).

Second, in case of lower tendency of affinitive

leadership, they responded that working at cafeteria or coffee house is more effective way (.046) and positive study of smart work is necessary on the basis of task styles ($p < 0.05$). The respondents with higher tendency of affinitive leadership answered that, even though telecommuting, have to do work at office at least one day a week (.014).

Third, the respondents who answered lower tendency of authoritative leadership emphasized that working at cafeteria or coffee house and teleworking are more effective way than working in office.

Fourth, the respondents who answered lower tendency of coaching leadership preferred that working at cafeteria or coffee house (.000) and teleworking (.020) are more effective way than working in office. And they emphasized that company have to positively study for adopting smart work (.023).

Fifth, the respondents who answered higher tendency of dominant leadership felt concern about outflow of operational secrets and difficulties to evaluate performance of tasks of employees.

Table 3 - Acceptance Gap among Leadership Styles

Styles	Smart working	Leadership level		Mean diff. (I-J)	Std. err	95% C.I.	
						Upper	Lower
AF	Café or Coffee shops are more effective way to work	LOW	MID	.100	.619	-1.40	1.60
			HIGH	.781	.597	-.67	2.23
		MID	LOW	-.100	.619	-1.60	1.40
			HIGH	.681***	.205	.18	1.18
		HIGH	LOW	-.781	.597	-2.23	.67
			MID	-.681***	.205	-1.18	-.18
	Telecommuting but office work at least one day a week	LOW	MID	-1.100	.659	-2.70	.50
			HIGH	-1.521	.635	-3.06	.02
		MID	LOW	1.100	.659	-.50	2.70
			HIGH	-.421	.219	-.95	.11
		HIGH	LOW	1.521	.635	-.02	3.06
			MID	.421	.219	-.11	.95
	Positive study of Smart work on the basis of task styles	LOW	MID	-.050	.668	-1.67	1.57
			HIGH	.489	.643	-1.07	2.05
		MID	LOW	.050	.668	-1.57	1.67
			HIGH	.539*	.222	.00	1.08
		HIGH	LOW	-.489	.643	-2.05	1.07
			MID	-.539*	.222	-1.08	.00

CC	Café or Coffee shops are more effective way to work	LOW	MID	.161	.493	-1.04	1.36
			HIGH	.857	.479	-.31	2.02
		MID	LOW	-.161	.493	-1.36	1.04
			HIGH	.696***	.171	.28	1.11
		HIGH	LOW	-.857	.479	-2.02	.31
			MID	-.696***	.171	-1.11	-.28
	Teleworking is more effective than office work	LOW	MID	.505	.522	-.76	1.77
			HIGH	.932	.508	-.30	2.16
		MID	LOW	-.505	.522	-1.77	.76
			HIGH	.426	.182	-.02	.87
		HIGH	LOW	-.932	.508	-2.16	.30
			MID	-.426	.182	-.87	.02
	Positive study of Smart work on the basis of task styles	LOW	MID	.613	.541	-.70	1.93
			HIGH	1.024	.526	-.25	2.30
		MID	LOW	-.613	.541	-1.93	.70
			HIGH	.411	.188	-.05	.87
		HIGH	LOW	-1.024	.526	-2.30	.25
			MID	-.411	.188	-.87	.05
DO	Worry about operational secret outflow in case of using personal device	LOW	MID	.007	.204	-.49	.50
			HIGH	-.508	.226	-1.06	.04
		MID	LOW	-.007	.204	-.50	.49
			HIGH	-.515	.225	-1.06	.03
		HIGH	LOW	.508	.226	-.04	1.06
			MID	.515	.225	-.03	1.06
	Difficult to evaluate performance of teleworkers	LOW	MID	-.097	.202	-.59	.39
			HIGH	-.689**	.224	-1.23	-.14
		MID	LOW	.097	.202	-.39	.59
			HIGH	-.592*	.223	-1.14	-.05
		HIGH	LOW	.689**	.224	.14	1.23
			MID	.592*	.223	.05	1.14

***p<.001, **p<.01, *p<.05

Consequently, according to tendencies of leadership styles, there might be significant differences in acceptance of smart work. Therefore, hypothesis 1 partly accepted.

Difference of Acceptance in Smart work between Leader and Non-leader Group

Through t-test of independent samples, smart work items that showed the significant differences in ac-

ceptance between leader and non-leader group were such as BYOD(bring your own device) for tasks, effectiveness of teleworking and flexible working time. In comparison with non-leader group, leader group relatively prefer to bring their own devices for working. In comparison with leader group, non-leader group responded that teleworking and flexible working time will be more effective than working in office. So, hypothesis 3 partly accepted.

Table 4 - t-test results between leader and non-leader group

Smart work t-value		t-test for mean difference					
		d.f.	Mean diff.	Std. err.	95% C.I.		
					Lower	Upper	
BYOD (Own device)	A	-2.265*	107	-.533	.235	-1.000	-.066
	B	-2.139*	51.554	-.533	.249	-1.034	-.033
Teleworking is more effective than office work	A	2.546*	107	.469	.184	.104	.834
	B	2.833**	74.699	.469	.165	.139	.798
Flexible time	A	2.697**	107	.501	.186	.133	.869
	B	2.501*	49.767	.501	.200	.099	.903

*p<.01, *p<.05, A-Assumed equal variance, B-No assumed equal variance

Difference of Acceptance in Smart work Controlled by Leader or Non-leader Group

This research performed the analysis whether differences of acceptance in smart work controlled by leader or non-leader group as control variables are or not.

First, in case of leader group who showed higher tendency of democratic leadership, for successful smart work, they emphasized that companies have to invest more resources and felt concern about difficulties in evaluation of performances. Reversely, in case of non-leader group who responded higher tendency, their works are higher mobility and they thought that cafeteria or coffee shops are more effective way to work.

Second, leader group with higher level of affinitive leadership suggested that, for co-work or meeting with other members, telecommuters have to work in office at least one day a week. However, non-leader group with higher level of affinitive leadership responded that cafeteria or coffee shops are more effective places to work.

Third, in case of coercive leadership, there were no significant differences between leader and non-leader group.

Fourth, in case of leader group, respondents who answered higher tendency of authoritative leadership felt concern about outflow of operational secrets if use own devices for works. They did not agree that smart work can save cost for nations and societies. In case of non-leader group, there were no significant differences.

Fifth, leader group with higher tendency of coaching leadership answered that telecommuters have to work in office at least one day a week for co-work or meeting with other members. Non-leader group with higher tendency of coaching leadership responded effectiveness of working at cafeteria or coffee houses or smart work center negatively.

Sixth, leader group with dominant leadership did not show the significant differences. But non-leader group showing higher tendency of dominant leadership answered that productivity and efficiency of tasks will be diminished. Additionally, they worried about that if teleworkers use their own devices for works there may be operational securities outflow to outside

and thought that there may be difficulties in evaluation of performances for telecommuters.

Consequently, hypothesis 4 that, according to tendencies of leadership styles controlled by leader and non-leader group, there will be significant differences in acceptance was partly accepted.

Table 5 - Leadership controlled by leader or non-leader group

Leadership		2	3	8	11	14	15	17	18	23	29
DM	Leader									✓	✓
	Non-leader	✓				✓					
AF	Leader						✓				
	Non-leader	✓									
CO	Leader										
	Non-leader										
AU	Leader							✓	✓		
	Non-leader										
CC	Leader						✓				
	Non-leader	✓	✓								
LD	Leader										
	Non-leader			✓	✓			✓			✓

2. Mobility of tasks
3. Work at Smart work center
8. Productivity of work in telecommuting
11. Efficiency of work in telecommuting
14. Effective way to work in cafeteria or coffee house.
15. Telecommuting but office work at least one day a week
17. Worry about operational secret outflow in case of using personal device
18. Cost saving is possible from Smart work in national and social perspectives.
23. More investment for Smart work is required
29. Difficult to evaluate performance of teleworkers

Research Limitation and Conclusions

According to the empirical research, this study can investigate the difference in acceptance of smart work among levels(high/mid/low) leadership styles, leader and non-leader groups.

First, among three levels of leadership styles categorized according to tendencies, there were statistical significant differences in acceptance of smart work. Second, this research can also find out differences between leader and non-leader

groups in acceptance attitudes of smart work. Third, according to tendencies of leadership styles controlled by leader and non-leader groups as variables, there were partly differences in accepting attitudes of smart work. Consequently, three hypotheses are partly accepted.

This research may have some limitations such that have to complement for further researches. First, according to the industrial field, there may be differences in attitude of embracing smart work. As this research, however, is exploratory phase, the comparative researches among industries can give us more implications in further studies.

Second, as for not systematic and reasonable sampling but random sampling methodologies, research results may not have higher reliable conclusions. Therefore, there should be guaranteed the balanced sample sizes between leader and non-leader groups by systematic sampling.

Third, the design of measures for evaluating tendencies of leadership and acceptance level of smart work should be improved by more sophisticated and clear methodologies. On the basis of above limitations, the further research will be conducted.

References

- [1] Adams, D.A., Nelson, R.R., and Todd, P.A., "Perceived Usefulness, Ease of Use, And Usage of Information Technology: A Replication", *MIS Quarterly*, Vol. 6, No. 2, 1992, pp. 227-247.
- [2] Armenakis, A. A., & Bedeian, A. G. Organizational change: A review of theory and research in the 1990s. *Journal of Management*, 25(3), 1999, pp.293-315.
- [3] Barkman Center for Internet & Society at Harvard University, "Next Generation Connectivity Report", Feb., 2010.
- [4] Bush, W. R. "Telecommuting: The case of research software development," *Technological Forecasting and Social Change* 37, 1990.
- [5] Daft, R. L. *The leadership Experience*. USA: Thomson, 2002.
- [6] Davis, F.D., Bagozzi, R., and Warshaw, P.R., "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models", *Management Science*, Vol. 35, No. 8, 1989, pp. 982-1003.
- [7] Handy, S. L. and P. L. Mokhtarian. "Planning for telecommuting: Measurement and Policy Issues," *Journal of the American Planning Association*. Vol. 61, No. 1. 1995, Winter.
- [8] Hemphill, J.K. and Coons, A.E. (1957), Development of the Leader behavior Description Questionnaire. In R.M. Stogdill, and A.E. Coons (Eds.), *Leader Behavior: Its Description and Measurement*. Columbus: The Ohio State University, Bureau of Business Research, Monograph No. 88.
- [9] Hendrickson, A.R., Massey, P.D., and Cronan, T.P., "On the Test-Retest Reliability of Perceived Usefulness and Perceived Ease of Use Scales", *IS Quarterly*, Vol. 17, No. 2, 1993, pp. 227-230.
- [10] Jacobs, T. O., & Jaques, E. (1990). *Military executive leadership*. In K. E. Clark and M. B. Clark (Eds.), *Measures of leadership*. West Orange, New Jersey: Leadership Library of America, pp 281-295.
- [11] Jacobs, T. O., & Jaques, E. (1990). *Military executive leadership*. In K. E. Clark and M. B. Clark (Eds.), *Measures of leadership*. West Orange, New Jersey: Leadership Library of America, pp 281-295.
- [12] Jaques, E., & Clement, S. D. (1994). *Executive leadership: a practical guide to managing complexity*. Cambridge, MA: Carson-Hall.
- [13] Katz D. (1978), *The social psychology of organizations*. New York: Wiley, p833.
- [14] Kim, D. (2005). The Paradigmatic Shift in Organizational Design Principles from a Knowledge Perspective. *International Review of Public Administration*. 10(1): 71-82.
- [15] Manz, C. C. and Sims Jr., H. P., *Leading Workers to Lead Themselves: The External Leadership of Self-Managing Work Teams*, *Administrative Science Quarterly*, 32, 1987, 106-128.
- [16] Park, K. H., Park, S. H. and Rangnekar, S., "Finding the Causal Relationship between Self-Leadership Strategies Academic Performance and Class Attendance Attitudes : Comparative Research between Korean and Indian Students", *Journal of Information Technology Applications and Management*, Vol. 19, No. 1, 1-13.
- [17] Pflaeging, N., "Un-leadership: How to make Smart Work by getting rid of management", 2012
- [18] PwC, 2012, <http://www.pwc.com/kr/ko/challenges/Smartwork.jhtml?query=smart&live=1>
- [19] Rane, A. and Argawal, T., "The Future of Workplace", March, 2011.
- [20] Rauch, C. F., & Behling, O. (1984). Functionalism: Basis for an alternate approach to the study of leadership. In J. G. Hunt, D. M. Hosking, C. A. Schriesheim, and R. Stewart (Eds.), *Leaders and managers: International perspectives on managerial behavior and leadership*. New York: Pergamon Press, pp. 45-62.
- [21] Stogdill, R. M. (1974). Person factors associated with leadership: A survey of the literature. *Journal of Psychology*, 25, 35-71
- [22] Stogdill, R.M., Goode, O.S., and Day, D.R. (1962), New leader behavior description subscale. *J. Psychol.*, p54, p259-269.
- [23] Subramanian, G.H., "A Replication of Perceived Usefulness and Perceived Ease of Use Measurement", *Decision Sciences*, Vol. 25, No. 5/6, 1994, pp. 863-874.
- [24] Sveiby, K. E. (1997). *The New Organizational Wealth: Managing and Measuring Knowledge-Based Assets*. Berret-Koehler.
- [25] Taylor F.W. (1923), *Principles of scientific management*. New York: Harper, p144.
- [26] van Dyne L, Kossek E, & Lobel S (2007). Less need to be there: Cross-level effects of work practices that support work-life flexibility and enhance group processes and group-level OCB, *Human Relations*, 60: 1123-54.

Knowledge Sharing System for Community Learning Centers

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Abstract

Nepal, a country with more than 34.1% illiterate people, as Central Bureau of Statistics reports, is a challenge to her government to literate all her people through formal education system. To achieve 100% literacy, the government of Nepal started Community Learning Center (CLC) under non-formal education program. In this regard, to achieve the goals of CLC, the Knowledge Sharing System (KSS) can be useful as it provides opportunities to share information and knowledge faster and more efficiently among different centers. In KSS, data and information are converted into information system (IS). Then, IS is converted into Management Information System (MIS) where MIS facilitates KSS. This study helps CLC stakeholders change the information and knowledge of CLC programs from manual system to computerized one. I argue that, KSS can be a milestone in eradicating illiteracy faster in future.

Keywords: Community Learning Center, Database, Information, Knowledge Sharing System, Literacy

Introduction

Community Learning Center (CLC) as a social institution that accords priority to the involvement of local beneficiaries and other stakeholders for its entire management and operation and to work as a strategy for instigating development at the grassroots level has

a strong foothold on the alternative development paradigm [6].

During the last several years, organizations realize that they own a vast amount of knowledge and that this knowledge needs to be managed [7].

The speed, flexibility and efficiency are important within the application and the development of knowledge. Looking at the power and importance of knowledge to work collaboratively, one can come into acquaintance that there is a need for a system known as knowledge sharing system (KSS) in order to allow people to work together at any given time and place, regardless of any platform that they have. Knowledge management is not about managing technology alone, but is about managing how human beings can *share their knowledge* effectively [3]. At the heart of knowledge sharing lie two types of individuals: knowledge seekers - those who are looking for knowledge, and knowledge sources - those who either have the knowledge the seeker needs or who can point the seeker to another knowledge source. Effective knowledge sharing occurs when appropriate connections are built between these parties.

At present Nepal has more than 3000 Community Learning Centers [5]. All of the centers are running manually. The Government of Nepal (GON) and donor agencies are funding huge amount of money to this sector. However, this sector does not have proper way of managing information. The KSS would be good and effective mechanism to manage various types of information of CLCs such as no. of participants, trainings provided by CLCs, relevance of trainings, social impact after having such trainings, role of donor agencies and GON to make people literate and so on.

The necessity of KSS arises from the questions that go as: i.) Is there any record, how participants have been benefitted from the CLC programs? ii.) What are new concepts and ideas of the participants? and iii.) How the country is helping

the poor and illiterate people uplift from poverty and illiteracy to prosperity and literacy? In this regard, this paper seeks to answer these questions, based on which, the findings will be significant for faster and more reliable dissemination of information within CLCs and other concerned stakeholders.

My research focuses on the present scenario and working model of the CLC. I go through many more literature that directly addressed my questions that I present on the introduction section. The methodology section provides the architectural design of the CLC-KSS. Later on the case relate with the CLC helps to identify the findings and discussion of the research and finally, closes with concluding remarks.

Literature Review

A community Learning Center is a Local Education Institute outside the formal education system, for villages or urban areas usually set up and managed by local people to provide various learning opportunities for community development and improvement of people's quality of life" [8]. With a particular focus on poverty reduction and the inclusion of women, Dalits and other disadvantaged groups, United Nations Educational, Scientific and Cultural Organization (UNESCO) put emphasis on supporting national efforts to achieve the goal of literacy for all, focusing on improving life-long learning through non-formal means of education. The main activities include the provision of policy advice, including the establishment of a non-formal education management information system (NFE-MIS), and capacity building for NFE officials to develop and implement evidence-based planning towards achieving literacy for all. Special attention was given to strengthening Community Learning Centres (CLCs) by developing the capacities of CLC planners, managers and facilitators, with a view to assisting them in implementing the national literacy campaign. A special focus was on mother tongue-based basic and post literacy programs for girls and women [9].

As society develops and becomes more complex, the educational system has to be flexible to meet changing needs and problems. Hence many countries promote a non-formal education

system to provide basic literacy programs for adults as well as primary, secondary, vocational educational and community development programs for the communities. "The idea of providing an infrastructure and an institutional base for holistic life-long education gradually emerged and became operational though the establishment of local community based Learning Centers organized and managed by the people themselves" [5]. UNESCO, Asia-Pacific Program for Education for All (APPEAL) supported implementing CLCs in Asia-Pacific countries to provide quality education, to empower people to develop new skills to enhance living standards and to promote the human, social and economic development of the country.

In [1] are considered the following three types of knowledge sharing within organizations:

- i. **Knowledge retrieval:** Knowledge sharing from the organization to the individual has the purpose of retrieving existing organizational knowledge.
- ii. **Knowledge exchange:** Knowledge sharing from an individual to other individuals has the purpose of exchanging existing individual knowledge.
- iii. **Knowledge creation:** Knowledge sharing among individuals has the purpose of generating new knowledge, resulting from new combinations of existing individual, shared, or organizational knowledge.

In spite of the fact that the GON and donor agencies are investing huge amount on CLC through non-formal education, still we don't have proper information about the participants of the CLC and their social impact after learning. There are many reasons why knowledge should be managed properly in an organization. Regarding this, information overload, technology advancement, increased professional specialization, competition, workforce mobility and turnover, and capitalize on organizational knowledge are some of the few issues that highlights the importance of knowledge management. Associated with knowledge management, the KSS is a fundamental issue in the area of knowledge management and knowledge sharing that must be well resolved in order to deliver relevant information to the

users as well as the organization. KSS has same components like those of KMS architecture that processes a combination of all the aspects stated below as well as other components that enable to perform according to the requirement of the organization [4]. These components consist of technology, function and the knowledge by itself.

In terms of technology, knowledge sharing should have the following features such as computer– mediated collaboration (CMC), e-mail, video-conferencing, web browsing (portal), search engine, intelligent agent, and document management. Furthermore, in terms of its functionality, KM involves the processes for acquiring or collecting, organizing, disseminating or sharing knowledge and using knowledge among the stakeholder. Although this system has many more function, we use this to store information, disseminate information, and create new ideas as well as to solve individual, group and social problem.

Methodology

This research is organized into several phases starting from Phase One that describes the performance of fieldwork such as literature study and pre- KSS implementation. Doing so, it develop and distribute the questionnaire as well as produce the model and architecture for KSS related to collaborative environment. To create the KSS Database we required to gather data from existing records and information sources of the participants. Later on we did sample survey to measure the relevancies of the trainings and participants with their social life. We also conduct, in addition, the interview with the stakeholders of CLC whether their input is properly functioning or not? Finally, comparison is made between pre and post implementation of KSS. Below is the sample architectural design that shows how it is beneficial for stakeholders of the KSS database.

The literature study focuses on the working model of the CLC present. At this step, I try to find out the detail about the CLC like, no. of participants, no. of mobilizer, no. of CLC persons, year wise no. of participants, nature of participants, dropout rate of the participants, rejoining ratios of the participants, government coordination to the CLC, donors roles etc.

And on the basis of literature analysis, I realize the necessity of the KSS database. I try to show how the stakeholders of the CLC will be benefited through this model by following Figure1.

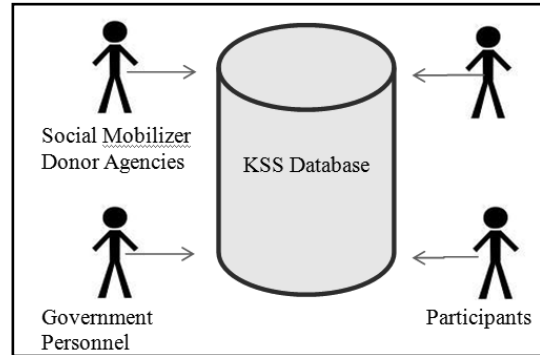


Figure 1: KSS Database

The proposed system of CLC-KSS is used to store information, disseminate information, and solve individual, group and social problem. When the system is established it would be very helpful to the mobilizer, participants and other stakeholders of the CLC.

Table 1: List of visited people during research

Types of Sources	Number	Data Collection Strategies
Director of Department of Education	1	Interview
Chief of Non-Formal Education Center	1	Interview
Facilitators	3	Interview and Discussion
CLC Mobilizers	5	Interview and discussion
CLC Participants	50	Interview and discussion
Community Members	8	Interview and discussion

During my research, I visited different types of people who are equally important to the CLC. I visited to head of Non Formal Education (NFE), government personal, CLC participants, CLC mobilizers, community members and other people as shown in Table 1.

A Case Study

Based on the KSS-CLC survey results and the literature review that has been done, it is seen that the architecture of pre-KSS implementation should be considered in terms of protocol interface application, technology, infrastructure, and repository in order to support knowledge sharing in the organization. During my research, I directly visit one of the oldest CLC center of Nepal named Tansipakha community learning center. According to the mobilizer of that center, they are providing different types of income generated program except literacy program like, Candle making, beautician training and agro-based training. Based on this, she argues that without proper management of the center, it is being difficult to call the participants again, to know about their life standard after having such types of training and literacy program. Moreover, she asserts, "If we have computer based data and detail information of the participants, we will be able to know what we did, as a social mobilizer." Similarly, I visited the nearest community learning center from Kathmandu named Dhapasi Community Learning Center. According to social mobilizer of Dhapasi CLC, they have near about 80 students with age group that ranges from 4 to 56, and it is being difficult to teach all of them on the same time and class.

Based on the data I collected from CLC, I found that most of the students come from those family who have low social status and totally illiterate. Some people are orphans but they have interest on studies. The satisfactory part of the CLC is that after completion of the training, some people are living the life of social value. During my research, I meet with some of the participants who are currently doing very well agro-based vegetable farming and with their income they are sending their child to private boarding school as well.

After visiting these two CLC, I realize that the CLC are helping the country to minimize the illiteracy as well as making a poor and skill-less people skill-full. I believe, they are doing great job without getting small amount of money as allowance. In this regard, KSS is capable to perform as a knowledge portal using the collaborative technologies by supporting the networking infrastructures in order to process

knowledge for CLC. Besides that, psychological and cultural issues, as well as a knowledge audit should be considered in the process of pre-KSS implementation to ensure KSS work successfully. When I go through the UNESCO country report 2012-2013 to Nepal, I found that most of their programs demands CLC to the villagers and poor people. However, till date they are not focusing on the KSS system for the CLC. The case with some other countries is different. In the countries like Philippine, Bangladesh and India they have already started to give awareness and literacy program through ICT based system. So, I argue that KSS database is the compulsion to the CLC. In this regard, the main responsibility of the government is to make people literate and provide them social life. Until and unless people are illiterate and they don't have any forms of income generating skills, we can't think about that. The KSS database not only helps to keep the detailed data of the CLC participants but also helps to keep the data of skilled people belongs to any CLC.

Result and Discussion

The major finding of the interview and discussion can be described as: i.) Most of the participants come for the training to generate income after completion of the course. ii.) Only the children come for their literacy. iii.) The mobilizer and facilitator tries to make more participation to the non-formal classes for adult. iv.) Though the government personal argues that they are investing more and in its comparison, the outcome is very less.

Although we have many more centers in Nepal, they are running manually. The Community Learning centers are running without having a single computer as well. In this condition, it is great challenging and difficult job to establish a KSS for participants of CLC. With help of KSS, the participants of CLC can share the information with in the participants and among the mobilizer and facilitators as well. Although the donor agencies and GON invest huge amount in non-formal education center like CLC, the outcome is not satisfactory. They are trying to decrease illiteracy. However, implementation is not going effective. The fact is that the adult participants are more interested to get training that may help to increase their life-standards, i.e.,

income generating trainings like those of candle making, agro-based training etc. If we will be able to establish an ICT based center like KSS, that would help the poor people and participants to know about the information and the way how the world is moving around as well how a small resource can help to change the life also.

Based on the finding of this research, I conclude that this KSS architecture will help to minimize the problem faced by the mobilizer, facilitators, participants, government personnel and donor agencies of the CLC. It may help as a bridge and transparent system to address the questions of government personal. I argue that this system may help to minimize the queries of donor agencies on the area of effective mobilizing and utilizing the fund properly.

Nepal has still more than 34.1% people are illiterate and more than 25% people are under poverty line [2]. The main responsibility of the government is to reduce the poverty and make people literate. A model of non-formal education center like CLC may assist to the government to this common goal. And the KSS-database may help to know the number of people who are benefited from such trainings and be literate on that area.

Conclusion

As the findings of this research, we found that KSS database could be developed by using four components, which includes social mobilizer, government personal, donor agencies, and CLCs participants. After establishment of the KSS-Database, the information can be shared through:

- Intranets
- Electronic Document Management System (EDMS)
- Information Retrieval (IR) technique
- Relational and Object Database system
- Electronic Publishing System

To conclude with, the KSS is the centralized database system where all participants of the CLC can share the knowledge among them. This system helps to solve the problem of individual, group as well as society.

Acknowledgement

To conduct a research on a particular field is not so easy works. Without help of so many people it was impossible to complete my research. So, my sincere thanks go to all the people and organization that help me to collect the data form CLC. I am also thankful to those people who have guided me during writing my research article. Among them my special thanks goes to Prof. Dr. Tanka Nath Sharma, Prof. Dr. Mahesh Nath Parajuli, Mrs. Nani Hira Maharjan (Social Mobilizer of Tansipakha CLC), Prof. Dr. Tika Paudel, Mr. Prabin Raj Joshi, Mr. Prakash Chandra Bhattarai and Shree Krishna Wagle who helped me during my research and preparing research article. Finally I am grateful to my wife Mrs. Sunita Baral Paudel and my son Samrat Paudel who always encourage me to conduct the research.

References

- [1]. Ackerman, M., Pipek, V., Wulf V., *Sharing Expertise: Beyond Knowledge Management*, Cambridge: MIT Press, London ,2003
- [2]. Central Bureau of Statistics (CBS) Report 2011, Nepal. Available online: <http://cbs.gov.np/wp-content/uploads/2012/11/National%20Report.pdf>
- [3]. Liebenau, J., Backhouse J., *Understanding Information: An Introduction*. London: MacMillan, 1990
- [4]. Meso, P. and Smith, R, "A Resources based View of Organizational Knowledge Management Systems" *Journal of Knowledge Management*, Vol. 4 No. 3, 2002, pp 224-234.
- [5]. NFEC (2009) National Literacy Campaign Implementatin Guidelines, Bhaktapur, Non Formal Education Center
- [6]. Pieterse, J.N, *Development theory, deconstructions/reconstructions*. New Delhi: Visstar Publications, 2001
- [7]. Satyadas, A., Harigopal, U., and Cassaigne, N. P., "Knowledge Management Tutorial: An Editorial Overview", *IEEE Transactions on Systems, Man and Cybernetics-Part C: Applications And Review*, vol. 31, no. 4, 2001, pp. 429-437.
- [8]. UNESCO World Sciences Report 2004, Paris. Availableonline:<http://www.unesco.org/new/en/natural-sciences/science-technology/prospective-studies/unesco-science-report>
- [9]. UNESCO Country Programming Document for Nepal 2011–2013 (2011), Published by the UNESCO Office in Kathmandu Sanepa-2, Lalitpur

Negative Word-of-Mouths Diffusion in Online Community

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Abstract

Word-of-mouth (WOM) has been considered as an important factor in consumer decisions process and became an important research topic recently. Consumers can write and share their opinion and consumption experiences, either positive or negative, on different Internet platforms. These WOMs may be diffused to a significant amount of Internet users. Previous literature revealed that negative WOM is more influential than positive WOM. Consumers tend to be more attention to negative WOM than positive WOM, and trust negative messages more than positive messages. Therefore, this study focuses on Internet users' participation in and the impact of negative WOM diffusion. To understand the diffusion pattern of WOMs, the study used data collected from a large online community. Our results report the diffusion profile of WOM diffusion.

Keywords:

Word-of-mouth, Service failure, Content analysis, Word of mouth diffusion.

Introduction

In the development of network technology, the Internet has changed traditional face-to-face Word-of-Mouth (WOM) communication into online electronic WOM (e-WOM) communication. Consumers now use the Internet to share experiences and narrative. Consumers can write their consumption experiences and read peer consumers' online rating on different platforms [21]. Online WOM has been considered as an important factor in consumer decisions process

[17]. Given the easy access to information over the Internet, WOM effects can spread quickly to more users recognize the existence of the WOMs. Therefore, WOM is one of the most influential communication media in delivering product/service information provided by consumers [3].

WOM is a low cost way of delivering information about products and services, WOM plays an important role in information diffusion and shaping consumers' attitudes [8]. Previous research on e-WOM has studied how online reviews have influenced message credibility, acceptance and review valence (positive, negative message) has been the most frequently investigated topic. However less research focus on the pattern of WOM diffusion and the antecedents of WOM diffusion. Thus, this research was focused on the pattern of WOM diffusion. And explore what attributes were affected the WOM diffusion.

WOM is regarded as an important factor in consumer decision making. Often WOM has a valence, which is either positive or negative [10]. It is generally considered that negative WOM is more influential than positive WOM. In psychology, this is referred to as a 'negativity effect', negative information exerts more impact on peoples' judgment and perceptions than positive information [16]. Therefore, this study focuses on customer participation or discuss for the impact of negative WOM delivery or diffusion. And explore the relationship between the customers' response and negative WOM.

The purpose of this study is to understand the pattern of negative WOM diffusion, to understand the activities of this discussion, the number of

customer who response, agree or against with the content of negative WOM. In addition, we observed the negative WOM how long were discussed by customer, that was a article life cycle. We conducted the correlation analysis to understand what kind of attributes for the impact on the negative WOM diffusion. In this study, question to be answered as follows:

1. What kinds of service failure are included in negative WOMs.
2. The pattern of negative WOM diffusion.
3. What kind of attributes affect the life cycle of negative WOMs.

Literature Review

WOM

Harrison-Walker[18] defined WOM as “informal, person to person communication between a perceived noncommercial communicator and a product, and organization, or a service.”

WOM have received extensive attention from academics for decades. Since the early 1950s, researchers have demonstrated that personal conversations and Unfamiliar people exchange of information not only influence consumers' choices and purchase decisions [3], but also shape consumer expectations [2], pre-usage attitudes [21], and even post-usage perceptions of a product or service [7]. Some research has reported WOM affect as greater than print ads, personal selling, and radio advertising [14]. Positive WOM proved to be able to help generate more stronger purchase intention [12], and positive comments or recommendations typically accelerate purchase in [13]. About positive eWOM motivations, (Hennig-Thurau et al., [20] described for others is closely related to altruism. For example, preventing others from purchasing a bad product or service again would be altruistic. Positive ratings can positively influence the growth of product sales [11].

Consumers distribute negative WOM to communicate a dissatisfying consumption experience [1]. Consumers may through a negative WOM to narrated the cause of their dissatisfaction in order to get a solution [36] or as a mechanism to vent negative feelings in order to reduce anxiety [32, 34]. However, there is evidence that NWOM

is more (or less) influential than PWOM. Arndt [3] shows the impact of NWOM to be twice that of PWOM. Consumers tend to more attention to negative WOM than positive WOM [40], and trust negative messages more than positive messages, but consumers express more products with positive reviews than products with negative reviews; positive reviews have stronger influence on purchase intention than negative reviews [39].

However, negative WOM which were the major factor contributing to detrimental impact on businesses. It was found that the action most frequently reported by consumers who were dissatisfied with a purchase or service was telling friends about the experience and avoid it [26].

Service failure

According to Hess et al., [22], a service failure can be defined as service performance that below a customer's expectations, where customers find the service to be flawed and irresponsible, as a situation the service to be flawed and irresponsible [33]. In brief, service failure is the customer service encounter scenario that caused by the dissatisfaction [19]. Such failures can lead to lost customers [6]. Previous studies Bejou & Palmer [4] indicate the negative link between service failure severity and customer relationships with that service provider. Yi-Shun et al., [41] indicate that service failure severity has a significant negative relationship with customer loyalty.

By referring to the items identified in previous research Bitner et al., [5] service failure were divided into four classifications: employee response to service delivery system failures, employee response to implicit or explicit customer requests, unprompted and unsolicited employee actions, and problematic customer behaviour.

Methodology

The research is primarily focus on the diffusion of negative WOM with service failure. We divide the WOM negative articles into the original negative WOM and WOM ramification two groups. In this research, the original WOM which were WOMs posted by customers for their experience and narrative. The other one, WOM ramification, which were WOMs posted by other customers who have the similar experiences or against

experiences for the original negative WOM. We also discussed response quantity for the impact of WOM life cycle by analyzing other users' responses to the original and ramification WOM.

Data collection

In this research, we use the web crawler software Easy Web Extract 2.7 to extract web data, which is an easy to use tool. It not only can scrape desired web content include text, URL, image, HTML but also can extract the second layer web page. We use this tool to extract each negative WOM which included date of publication, the author, response, title and the URL of the content.

Sample

The data retrieved negative WOMs from a large online community PTT (URL: www.ptt.cc) which was established in 1995. It is kind of a half-closed network community which enables users to with certain stickiness, and thus into society. The growing influence of PTT BBS is the most remarkable speciality of the Taiwan Internet culture, makes an “outdated” text-based information system can survive [24]. That is also the main reason why PTT is still very popular in Taiwan.

Through the web crawler software Easy Web Extract 2.7, we extracted the web data of user's article and information from the hotel discussion board. The data collection was conducted from March 2008 to February 2013. In total, this study collected 11640articles, 788 were negative WOM. After eliminated incomplete articles, that obtained 782 negative WOMs. The study focuses only on negative WOMs. Among the 782 negative WOMs, 683(87.34%) ones were original WOMs, while the other 99(12.26%) were ramification WOMs. Among the 683 original negative WOMs, 517(66.11%) ones were with others responses of like/neutral/dislike, while the other 166(21.23%) were without any response. Among the 99 ramification WOMs, 65(8.31%) ones were with like/neutral/dislike responses, while the other 34(4.35%) were without any response. The WOM articles distribution is shown in Figure 1.

Procedure and measure

Two coders were assigned to read independently the WOMs articles to evaluate consumers'

consumption experience, emotion status and failure rating in the articles. The two coders coding the articles based on the following procedures. First, coders observed whether service failure existed. If there was service failure, the coders evaluated the degree of service failure with a five-point scale (5 for major mistake, 1 for minor mistake, 0 for no failure) and chose the main service failure type. By referring to the items identified in previous research Bitner et al., [5] they were divided into four groups, as listed in Table 2. In the research, we used the 18 categories of service failure proposed by [37] to classify the service failure existed in the negative WOMs, as listed in Table2. Besides, coders were asked to evaluated the degree of consumption experience and emotion status with an eleven-point scale (-5 for very poor, 5 for very good).

The two coders adopted the same procedures to valuate consumption experience, emotion and service failures type. If the two coders divided negative WOMs into different types of service failure, and the difference in rating scores of consumption experience and emotion were greater than 3 point the two coders discussed and evaluated again.

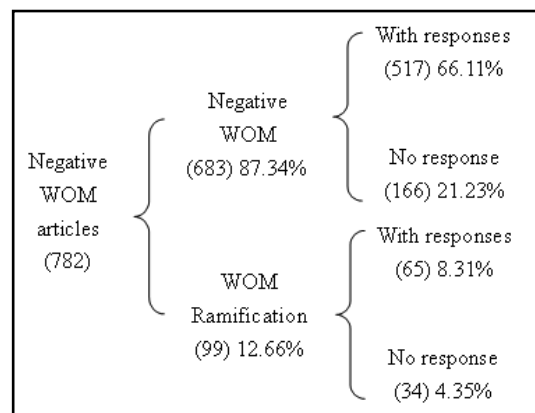


Figure 1- The WOM articles distribution.

Data Analysis

Negative WOMs life cycle

We eliminated the last outlier response time, and record the article was published time and the last normal response time and then calculated the life cycle of each negative WOM, that is the difference

in time between the article was published time and the last normal response time. Among the 782 negative WOMs, 683(87.34%) ones were original WOMs, the average of life cycle was 23 hours 33 minutes (s.d=30 hours 37 minutes), as listed in Table1. Among the 782 negative WOMs, 99(12.66%) ones were original WOMs, the average of life cycle was 16 hours 17 minutes (s.d=23 hours 46 minutes), as listed in Table1. In total, the all of life cycle was 22 hours 38 minutes (s.d=29 hours 55 minutes), as listed in Table1.

Table 1- Distribution and life cycle of negative WOM.

	N	%	Mean	S.D
WOM	782			
Original WOM	683	87.34		
WOM Ramification	99	12.66		
WOM	782			
With other's responses	582	74.42		
Without	200	25.58		
Life cycle(all)	782		22hours 38mins	29hours 55mins
Life cycle(with Original WOM)	683	87.34	23hours 33mins	30hours 37mins
Life cycle(with WOM Ramification)	99	12.66	16hours 17mins	23hours 46mins

Service failure categories

After eliminated incomplete articles, that obtained 782 negative articles to conduct content analysis. This study referred to the items identified in previous research (Bitner et al., [5]we were defined and divided into four groups: employee provide for service, employee response to customer needs and requests, unprompted and unsolicited employee actions and customer behavior, as listed in Table 2.

First, service failure resulting from *Employee Provide for Service* belonged to *Group 1*. It comprised 404 (51.66%) of all service failure categories. Among the *Group1* of all service failure categories, the major mistake of failure was facility problems which accounts for 148 (18.93%) and the average of failure rating was 3.43 (s.d=1.04). In addition to the failure rating, the consumer experience was also the most serious, the average of degree was -3.40 (s.d=1.26). The part of emotion, the most serious was out of stock which accounts for 3.71% and the average of degree was -3.33 (s.d=1.21), as listed in Table 2.

Employee Response to Customer Needs and Requests belonged to *Group 2*. It comprised 118

(15.09%) of all service failure categories. Among the *Group 2*, unsatisfied customer preferences was the most serious of failure, consumption experience and emotion. It accounts for 73 (9.34%), and the average of degree, one was 2.99 (s.d=1.11), another was -3.29 (s.d=1.35), the other was -3.23 (s.d=1.18), as listed in Table 2.

Unprompted and Unsolicited Employee Actions was assigned to *Group 3*. It comprised 227 (29.03%) of all service failure categories. Among the *Group 3*, impolite of employee behavior was belonged to the largest failure item, it accounts for 90 (11.64%), and the average of failure rating was 3.45 (s.d=1.18). And the second one was wrong booking or lost booking. According to the part of verbal and physical abuse which was higher score of consumption experience and emotion. It accounts for 0.38%, and the average of degree, one was -4.33 (s.d=0.58), another was -4.33 (s.d=0.58), as listed in Table 2.

Customer Behavior was assigned to *Group 4* that has the least service failure of item. It comprised 7 (0.90%) of all service failure categories, while the failure rating of 1.28, consumption experience of -2.56, and emotion of -1.85, as listed in Table 2.

In this study, 26 negative WOM articles were no service failure. It comprised 3.32% of all service failure categories, as listed in Table 2.

Diffusion diagram

After eliminate with the last outlier responses or those that incomplete articles, we pick up more than two of article quantity from the same WOM ramification. Diffusion diagram is conducted to explore the correlation between user response and life cycle, as shown in *Case 1* and *Case 2*.

Case 1

In this Case, 5 ramification WOMs are derive from original negative WOM of the same title. There are 25 active users participate to this discussion, 1 original WOM by 1 user (user A), 5 ramification WOMs by 5 users (user A, B, C, D, E). In total, there are 26 responses by 21 users (user A, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y), as shown in Figure 2.

Case 2

In this Case, 3 ramification WOMs are derive from original negative WOM of the same title. There

Table 2 - Negative WOM articles service failure.

Failure category	Number	%	Failure rating*	Consumption experience†	Emotion‡
GROUP1 □ Employee Provide for Service					
Slow/unavailable service	30	3.84	3.10(1.17)	-3.15(1.08)	-2.90(1.27)
Facility problems	148	18.93	3.43(1.04)	-3.40(1.26)	-3.22(1.18)
Unclear policy	68	8.70	3.26(1.11)	-2.90(1.57)	-3.01(1.51)
Out of stock	29	3.71	2.52(1.26)	-3.07(1.09)	-3.33(1.21)
Others	129	16.50	3.34(1.22)	-3.31(1.58)	-3.01(1.46)
Subtotal	404	51.66	3.13	-3.17	-3.09
GROUP2 □ Employee Response to Customer Needs and Requests					
Unsatisfied "special needs"	14	1.79	2.25(1.00)	-2.54(1.77)	-2.86(1.31)
Unsatisfied customer preferences	73	9.34	2.99(1.11)	-3.29(1.35)	-3.23(1.18)
Others	31	3.96	2.76(1.18)	-3.10(1.13)	-2.68(1.19)
Subtotal	118	15.09	2.67	-2.98	-2.92
GROUP3 □ Unprompted and Unsolicited Employee Actions					
Impolite	91	11.64	3.45(1.18)	-3.57(1.07)	-3.49(1.07)
Wrong booking or Lost booking	70	8.95	3.36(1.13)	-3.50(1.05)	-3.42(1.21)
Mischarged	15	1.92	3.10(1.35)	-3.30(1.26)	-3.50(1.02)
Gestalt evaluation	4	0.51	3.00(1.41)	-2.88(1.93)	-4.13(0.85)
Verbal and Physical Abuse	3	0.38	3.33(2.08)	-4.33(0.58)	-4.33(0.58)
Others	44	5.63	3.30(1.16)	-3.05(1.47)	-3.02(1.47)
Subtotal	227	29.03	3.26	-3.44	-3.65
GROUP4 □ Customer Behavior					
Aberrant customer behavior (Drunkness, Verbal and Physical Abuse)	2	0.26	2.50(0.71)	-4.00(0.00)	-3.00(1.41)
Breaking company policies or laws	1	0.13	1.00(0.00)	3.00(0.00)	-1.00(0.00)
Uncooperative customer	0	0.00	0.00(0.00)	0.00(0.00)	0.00(0.00)
Others	4	0.51	1.63(0.75)	-3.25(1.19)	-3.38(1.11)
Subtotal	7	0.90	1.28	-2.56	-1.85
No failure	26	3.32	0.00(0.00)	0.65(1.41)	0.65(1.41)
Column total	782	100	2.07	-2.30	-2.17

*Failures were rated on a scale of 0 (no failure) to 5 (major mistake).

†Consumption experience was rated on a scale of -5 (very poor) to 5 (very good).

‡Emotion was rated on a scale of -5 (very poor) to 5 (very good).

are 26 active users participate to this discussion, 1 original WOM by 1 user (user A), 3 ramification WOMs by 3 users (user B, C, D). In total, there are 34 responses by 23 users (user A, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z), as shown in Figure 3.

Correlation analysis

We conducted the correlation analysis between the user response (like response, dislike response and neutral response) and life cycle, service failure, consumption experience, emotion, as shown in Table 3. For response, life cycle and

response (like, dislike, neutral) show a significant positive relationship. In addition to response, service failure and consumption experience show a significant negative relationship, while emotion shows a significant negative relationships.

Table 3 - Correlation of 484 negative WOMs.

		Mean	S.D.	LR	DR	NR	LC	SF	CE
Like response	LR	2.85	3.36						
Dislike response	DR	0.14	0.74	.063					
Neutral response	NR	1.37	1.56	.355**	.194**				
Life cycle (min)	LC	1357.74	1795.18	.433**	.158**	.387**			
Service failure	SF	3.12	1.29	-.043	-.078	-.052	-.099**		
Consumption experience	CE	-3.15	1.53	.039	.053	.029	.004	-.689**	
Emotion	EM	-3.06	1.46	.034	.073	.072	.000	-.640**	.804**

Research findings

According to content analysis, what kind of service failure categories, there were with major mistakes and serious degree of service failure, consumption experience and emotion. This study conducted a correlation analysis to explore the relationship between the article life cycle and user response for the same negative WOM.

According to the Table 1, shows the all of articles life cycle average and standard deviation, then explore response quantity for the impact of negative WOM article life cycle, and explore the ramification WOMs derived from the original

negative WOM of overall life cycle, as shown in Figure2, 3.

For diffusion diagram, we can be observed relationship between the user response and original WOM, ramification WOMs. Therefore we adopted correlation analysis to verify the relationship between the online response and article life cycle. The result of the correlation analysis, life cycle and response (like, dislike, neutral) show a significant positive relationship. For the higher degree of mistake, consumption experience, and emotion show a significant negative relationship, while consumption experience and emotion show a significant positive relationship.

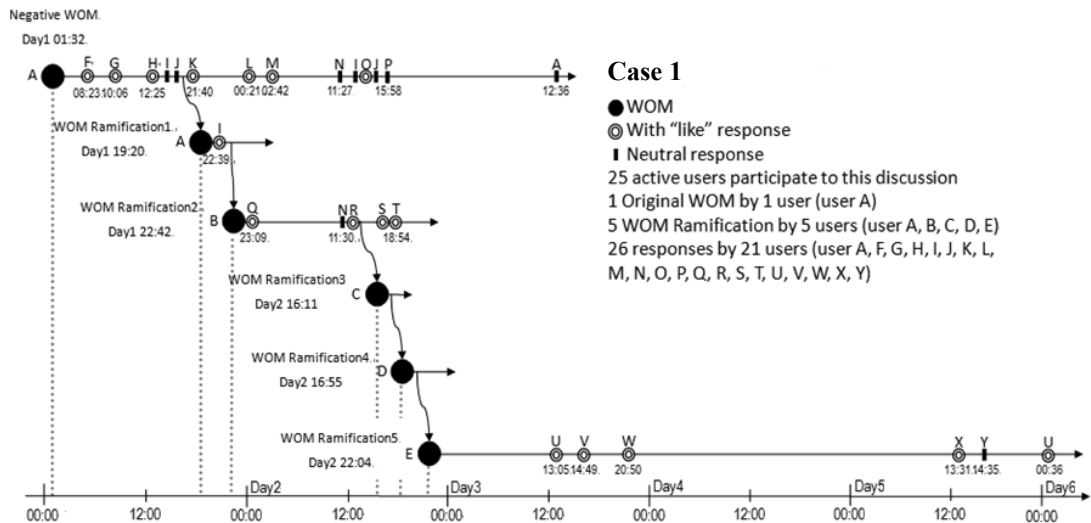


Figure 2 - Diffusion diagram for Case 1.

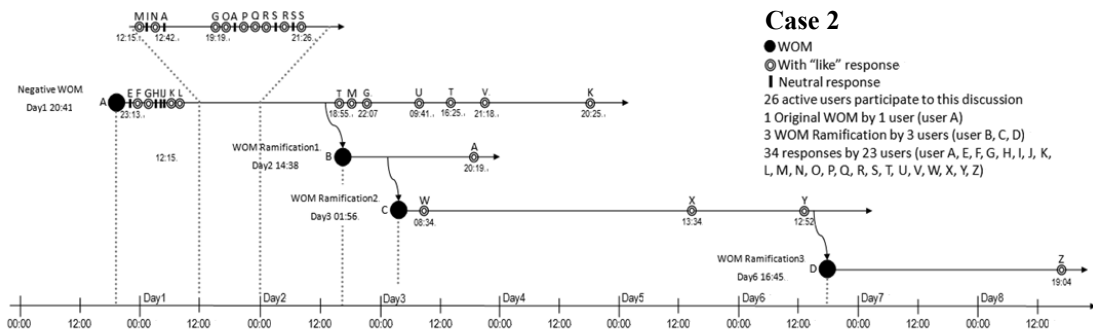


Figure 3 - Diffusion diagram for Case 2.

Reference

- [1]. Anderson, Eugene W. Customer satisfaction and word of mouth. **Journal of service research**, 1(1), 1998, 5-17.
- [2]. Anderson, Eugene W. The Formation of Market: Level Expectations and Its Covariates. **Journal of Consumer Research**, 30(1), 2003, 115-124.
- [3]. Arndt, Johan. Role of product-related conversations in the diffusion of a new product. **Journal of marketing Research**, 1967, 291-295.
- [4]. Bejou, David, & Palmer, Adrian. Service failure and loyalty: an exploratory empirical study of airline customers. **Journal of Services Marketing**, 12(1), 1998, 7-22.
- [5]. Bitner, Mary Jo, Booms, Bernard H, & Mohr, Lois A. Critical service encounters: the employee's viewpoint. **The Journal of Marketing**, 1994, 95-106.
- [6]. Bitner, Mary Jo, Brown, Stephen W, & Meuter, Matthew L. Technology infusion in service encounters. **Journal of the Academy of marketing Science**, 28(1), 2000, 138-149.
- [7]. Bone, Paula Fitzgerald. Word-of-mouth effects on short-term and long-term product judgments. **Journal of Business Research**, 32(3), 1995, 213-223.
- [8]. Brown, Jacqueline Johnson, & Reingen, Peter H. Social ties and word-of-mouth referral behavior. **Journal of Consumer Research**, 1987, 350-362.
- [9]. Burzynski, Michael H, & Bayer, Dewey J. The effect of positive and negative prior information on motion picture appreciation. **The Journal of Social Psychology**, 101(2), 1977, 215-218.
- [10]. Buttle, Francis A. Word of mouth: understanding and managing referral marketing. **Journal of strategic marketing**, 6(3), 1998, 241-254.
- [11]. Clemons, Eric K, Gao, Guodong Gordon, & Hitt, Lorin M. When online reviews meet hyperdifferentiation: A study of the craft beer industry. **Journal of Management Information Systems**, 23(2), 2006, 149-171.
- [12]. Doh, Sun-Jae, & Hwang, Jang-Sun. How consumers evaluate eWOM (electronic word-of-mouth) messages. **CyberPsychology & Behavior**, 12(2), 2009, 193-197.
- [13]. East, Robert, Hammond, Kathy, & Lomax, Wendy. Measuring the impact of positive and negative word of mouth on brand purchase probability. **International Journal of Research in Marketing**, 25(3), 2008, 215-224.
- [14]. Engel, James F, Kegerreis, Robert J, & Blackwell, Roger D. Word-of-mouth communication by the innovator. **The Journal of Marketing**, 1969, 15-19.
- [15]. Feldman, Sidney P, & Spencer, Merlin Clifford. *The Effect of Personal Influence on the Selection of Consumer Services*: Center for regional studies, 1965.
- [16]. Fiske, Susan T. Attention and weight in person perception: The impact of negative and extreme behavior. **Journal of Personality and Social Psychology**, 38(6), 1980, 889.
- [17]. Godes, David, & Mayzlin, Dina. Using online conversations to study word-of-mouth communication. **Marketing Science**, 23(4), 2004, 545-560.
- [18]. Harrison-Walker, L Jean. The measurement of word-of-mouth communication and an investigation of service quality and customer commitment as potential antecedents. **Journal of Service Research**, 4(1), 2001, 60-75.

- [19]. Hays, Julie M, & Hill, Arthur V. A longitudinal study of the effect of a service guarantee on service quality. **Production and Operations Management**, 10(4), 2001, 405-423.
- [20]. Hennig-Thurau, Thorsten, Gwinner, Kevin P, Walsh, Gianfranco, & Gremler, Dwayne D. Electronic word-of-mouth via consumer-opinion platforms: what motivates consumers to articulate themselves on the internet? **Journal of interactive marketing**, 18(1), 2004, 38-52.
- [21]. Herr, Paul M, Kardes, Frank R, & Kim, John. Effects of word-of-mouth and product-attribute information on persuasion: An accessibility-diagnostics perspective. **Journal of Consumer Research**, 1991, 454-462.
- [22]. Hess Jr, Ronald L, Ganesan, Shankar, & Klein, Noreen M. Interactional service failures in a pseudorelationship: the role of organizational attributions. **Journal of Retailing**, 83(1), 2007, 79-95.
- [23]. Hoffman, K Douglas, Kelley, Scott W, & Rotalsky, Holly M. (1995). Tracking service failures and employee recovery efforts. *Journal of Services Marketing*, 9(2), 49-61.
- [24]. Hsieh, Chia-Lung. **Privacy Disclosure: Personal Information and Images on Social Networking Sites in Taiwan**. Paper presented at the Applications and the Internet, 2009. SAINT'09. Ninth Annual International Symposium on.
- [25]. Katz, Elihu, & Lazarsfeld, Paul. (1955). Personal influence. *Glencoe, IL: Free Press. Planning and Exploratory Buying Behavior*, 95.
- [26]. Lau, Geok Theng, & Ng, Sophia. Individual and Situational Factors Influencing Negative Word-of-Mouth Behaviour. **Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration**, 18(3), 2001, 163-178.
- [27]. Lee, Jung, & Lee, Jae-Nam. Understanding the product information inference process in electronic word-of-mouth: An objectivity-subjectivity dichotomy perspective. **Information & Management**, 46(5), 2009, 302-311.
- [28]. Leonard-Barton, Dorothy. Experts as negative opinion leaders in the diffusion of a technological innovation. **Journal of Consumer Research**, 1985, 914-926.
- [29]. Mittal, Vikas, Ross Jr, William T, & Baldasare, Patrick M. The asymmetric impact of negative and positive attribute-level performance on overall satisfaction and repurchase intentions. **The Journal of Marketing**, 1998, 33-47.
- [30]. Mizerski, Richard W. An attribution explanation of the disproportionate influence of unfavorable information. **Journal of Consumer Research**, 1982, 301-310.
- [31]. Mourali, Mehdi, Laroche, Michel, & Pons, Frank. Antecedents of consumer relative preference for interpersonal information sources in pre-purchase search. **Journal of Consumer Behaviour**, 4(5), 2005, 307-318.
- [32]. Nyer, Prashanth U. A study of the relationships between cognitive appraisals and consumption emotions. **Journal of the Academy of Marketing Science**, 25(4), 1997, 296-304.
- [33]. Palmer, Adrian, Beggs, Rosalind, & Keown-McMullan, Caroline. Equity and repurchase intention following service failure. **Journal of Services Marketing**, 14(6), 2000, 513-528.
- [34]. Richins, Marsha L. Word of mouth communication as negative information. **Advances in consumer research**, 11(1), 1984, 697-702.
- [35]. Senecal, Sylvain, & Nantel, Jacques. The influence of online product recommendations on consumers' online choices. **Journal of Retailing**, 80(2), 2004, 159-169.
- [36]. Thøgersen, John, Juhl, Hans Jørn, & Poulsen, Carsten Stig. Complaining: A function of attitude, personality, and situation. **Psychology & Marketing**, 26(8), 2009, 760-777.
- [37]. Tsai, Chen-Tsang, & Su, Ching-Shu. Service failures and recovery strategies of chain restaurants in Taiwan. **The Service Industries Journal**, 29(12), 2009, 1779-1796.
- [38]. Whyte Jr, William H. The web of word of mouth. *Fortune*, 50(1954), 1954, 140-143.
- [39]. Xue, Fei, & Zhou, Peiqin. The effects of product involvement and prior experience on Chinese consumers' responses to online word of mouth. **Journal of International Consumer Marketing**, 23(1), 2010, 45-58.
- [40]. Yang, Jun, & Mai, Enping Shirley. Experiential goods with network externalities effects: An empirical study of online rating system. **Journal of Business Research**, 63(9), 2010, 1050-1057.
- [41]. Yi-Shun, Wang, Shun-Cheng, Wu, Hsin-Hui, Lin, & Yu-Yin, Wang. The relationship of service failure severity, service recovery justice and perceived switching costs with customer loyalty in the context of e-tailing. **International Journal of Information Management**, 31(4), 2011, 350-359.

Organizational Citizenship Behavior in Indian Organization – A Demographic Analysis

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Abstract

Organizational citizenship Behavior is having huge implications on conduct of business now a day's Different level of commitments of employees' leads to different functionality .This paper discusses the OCB patterns of different demographics in India. A Sample size of 56 is taken from different Industries. Conscientiousness was found higher in Married Employees compared to Unmarried ones. Courtesy was found higher in Employees having above post Graduate Degree compared to just Graduate ones. No significant Difference was found in overall OCB Level in terms of Monthly Income and Experience in same organization. It is interesting to see how level of OCB varies among different demography. The results will help to understand various categories of employees who require special attention to increase OCB Level.

Keywords:

Organizational Citizenship behavior, Extra-role behavior , Conscientiousness , Courtesy.

Introduction

Organizational citizenship behavior is “individual behavior that is discretionary or flexible,not directly or explicitly recognized by the formal reward system, andthat in aggregate promotes the effective functioning of the organization, as explained by[16]. Bydiscretionary, it means that the behavior is not an enforceable obligation of therole or function, or the job description, that is, the noticeably specifiable terms of person's

employment agreement with the organization; the behavior is rather a concern of individual's personal choice, such that its exclusion is not generally taken as punishable.”

It can also be referred as pro-social organizational behavior as mentioned by [1], extra-role behavior by [36] and contextual behavior by [21]. Researchers are fascinated towards and involved in OCB mainly because it is assumed to have a positive and affirmative impact on organizational performance.

Literature review

Background of OCB

A good number of researcheshave examined the antecedents of OCB. Researchers have focused on individual factors as well as organizational factors. Individual factors include attitudinal factors (like job satisfaction and organizational commitment), perceptual factors (such as perceived organizational support), and dispositional factors (such as personality traits). Attitudinal factors including job satisfaction, organizational commitment, perceived fairness [10]; McNeely & Meglino, 1994;[21, 24], and job ;involvement Diefendorff et al.,[5]have been found to be strongly related to OCB. For instance, Organ and Ryan [21] conducted a meta-analysis on the attitudinal and dispositional predictors of OCB and found that job satisfaction showed a stronger relationship with OCB than with in-role performance. Other attitudinal factors such as perceived fairness, organizational commitment,

and leader supportiveness correlated with OCB at the same level as job satisfaction.

Research also examined the connection between individual perceptual variables and OCB. Factors identified include perceived organizational support [12] usefulness of work-life benefits (Lambert, 2000), leader member exchange [29 Wayne et al., 1997).

Though the results regarding relationship between OCB and dispositional factors are usually disappointing, research has revealed increasing attention in situational predictors and obtained more promising results. Recent studies have acknowledged many situational factors, which include team characteristics, leadership and organizational characteristics. For instance, studies have looked at leadership behaviors and found that leader reward behavior, punishment behavior, leader role clarification, and servant-leadership are strong predictors of OCB [6, 24]. In addition, a study suggested that team identification (Van Der Veegt et al., 2003) were associated to OCB, and team identification played a partial mediating role in the relation between team educational dissimilarity and OCB.

Bommer and colleagues found that the consistency of OCB across coworkers was associated with more OCB by individuals [3]. A more recent study found that organizational learning values and learning structures [32] were strongly related to OCB. Overall, current research has identified many new situational factors that have strong relationships with OCB.

On computing, prior research has identified both individual and organizational antecedents of OCB. The findings have been fairly consistent, suggesting that employee attitudes including job satisfaction, organizational commitment, perceived fairness, employee perceptions including perceived organizational support, LMX, usefulness of work-life benefits, abusive supervision, and organizational factors including leader behavior, team identification, and organizational learning values and learning structures are strongly related to OCB. Dispositional factors including conscientiousness, agreeableness and positive affectivity only show a rather weak relation with OCB.

Scope of OCB

Even if there is a lack of consensus on the scope of OCB, Organ [16] projected five dimensions of OCB, which are most often used in studies worldwide. The dimensions are:

Altruism refers to as helping behaviors aimed at particular persons and will eventually profit the organization. An illustration of altruism is sharing a co-worker's workload.

Courtesy is defined as trying to avoid job-related interpersonal problems or difficulties from taking place. A good example is noticing others about being absent from work in advance.

Conscientiousness means doing things that are beneficial to the organization, and it involves performing one's role or implied duties in the organization even under no surveillance, such as following rules when nobody is watching.

Sportsmanship is taken as tolerating less than model situations on the job without making unreasonable complaints.

Civic virtue simply means responsibly being concerned and alarmed about the well functioning of the company. An exemplar is attending meetings and keeping up with major issues about the company.

With reference to the five dimensions of OCB by Organ [16], altruism and courtesy are more individual oriented (OCBI), and conscientiousness, sportsmanship, and civic virtue are much more oriented towards the organization (OCBO).

In a detailed and methodical analysis of the OCB literature and other associated constructs, Podsakoff et al. [27] classified OCB into seven dimensions, adding two new dimensions to those given by [16] that is individual initiative and self development.

The added two dimensions are not as normally and frequently used by current research for two reasons. First, these two dimensions are not conceptually distinguishable from rest of the dimensions of OCB. For case in point, individual inventiveness involves getting engaged in task-related behaviors at a level that is ahead of what is necessary, and it includes behaviors such as

voluntary acts of creativity and innovation and persistence with extra eagerness to achieve one's job. It is quite similar to the conscientiousness dimension of OCB. Self development takes account of performance based on voluntary behaviors employees engage in to improve and enhance their knowledge, skills and abilities, which is similar to the civic virtue dimension of OCB.

Van Dyne and her colleagues [34] developed a new chief and interesting framework involving OCB dimensions. Van Dyne and colleagues empirically recognized five dimensions of OCB: obedience, social participation, functional participation, loyalty and advocacy participation. Her framework has some common characteristics with that of Organ's OCB dimensions. For instance, obedience having its focus on subsequent rules and procedures and meeting deadlines over laps with Organ's conscientiousness dimension.

Functional participation involves taking additional work assignments and volunteering for special duties, and advocacy involves making suggestions and maintaining high standards of work, both of which share some similarity with the civic virtue dimension. Van Dyne's framework is not as widely used as Organ's five OCB dimensions [27].

Although Organ's five-dimension structure has been widely used in prior research [10, 27] current research has not reached consensus in regards to which specific dimensions should be included when examining OCB. To address this issue, LePine et al. [10] conducted a meta-analysis to examine the relationship among these dimensions. The results thus produced indicated that these dimensions were highly correlated with the exception of sportsmanship, and the dimensions did not differentially relate to the several predictors of OCB including satisfaction, commitment, fairness, leader support, and conscientiousness. Based on these results, LePine and colleagues [10] suggest that researchers should consider OCB at the aggregate level, and distinguish OCB by the target towards which such behavior is directed. Thus, this study used a two-factor model which consisted of OCB directed at organization (OCBO) and OCB directed at individuals (OCBI).

Consequences of OCB

Outcomes of OCB mainly fall into two categories; individual-level outcomes and the firm-level outcomes. In terms of individual-level outcomes, researchers have found that OCB has an impact on both employee objective and subjective performance evaluations (MacKenzie et al., 1991; MacKenzie et al., 1993; MacKenzie et al., 1999; [14]. For instance, MacKenzie and colleagues (MacKenzie et al., 1999) looked at sales productivity as well as subjective overall performance evaluation. They found that manager's evaluations were determined as much by OCB as they were by objective measures of performance. After common method variance was controlled for, OCB accounted for a significant proportion of a sales manager's evaluation of employee performance. Motowidlo and Van Scotter [14] looked at both in-role and extra-role behaviors and found that both explained unique variance in performance evaluations. Taken together, these findings suggest that OCB has a strong impact on both objective and subjective performance evaluations.

Organ [16] suggested that OCB, in aggregation, should improve firm-level performance and effectiveness. Researchers have found strong support for his contention [22]; MacKenzie, et al., 1996). For instance, Podsakoff and colleagues [22] found strong effects for OCB on the quantity and quality of unit performance. They also found that OCB made an important contribution to the overall firm-level objective measure of performance. Thus, studies consistently find that OCB has a positive impact on firm performance and firm effectiveness.

Research methodology

Participants

This section will provide a description of the sample; the measures applied; and the data analysis conducted. A sample size of 56 respondents was taken to write the paper. The technique used to

Collect data was Random sampling. The questionnaire was sent to 80 Executives but only 56 responded, the response rate was 70 %. The respondents came from different walks of life. Out of total 56 respondents 20 were female and 36 were male. The detail information of distribution of demographic variables is listed in Table below

Age	No. of Respondents
21-25	34
26-30	21
31-35	1
Education	
Graduate	19
Post Graduate	35
above post graduate	2
Job Hierarchy	
Junior Level	20
Middle Level	31
Senior Level	5
Monthly salary	
Upto 25,000	24
25,000 - 40,000	20
40,000 - 55,000	6
55,000 - 70,000	5
above 70000	1
not for profit	1
Experience with Current Organization	
0-5	54
10-15	4

Many demographical Traits were included in the research so that a true picture can be presented about OCB. There a huge difference between the ratio of male and female gender in the sample. The respondents are quite young with 34 falling between 21-25 years and 21 falling between 26-30.so we can say that approx. whole sample is between 21-30 years of age. On education front the sample is faring well with 35 respondents holding Post Graduate Degree and 19 with Graduate Degree with them. There are 2 respondents with above Post Graduation Degree as well. Not a single respondent was there with just Diploma. Hence, the respondents were quite educated to become part of this kind of research. Another demographic trait used was the Job Hierarchy in the organization .31 of the respondents were in middle Level and 20 in junior level followed by 5 people in Senior Level.

So, majority of respondents were from Middle level. about the compensation, 24 respondents were drawing salary below Rs 25,000 p.m. ,as the salary slabs were increasing ,the respondents number decreased with 20 people drawing salary between 25,000-40,000 , it decreased to a level of 1 respondent drawing salary above Rs 70,000 p.m. Majority of respondents taken were from private organizations followed by Public organization and only 1 from Not for Profit institution.

Measure

OCB was measured on five- point Likert Scale taken from Podsakoff [26], prior permission was taken to use the scale. Scale consisted of 24 items representing 5 types citizenship behavior.

Personal attributes in the study include Gender, age, organizational tenure, job Hierarchy, and educational level.

Primary Collection of data was done to analyze the Problem. ANOVA and independent Sample t-test was used for testing the difference in OCB between groups

Research hypothesis

*H1.*There is significant difference in level of Conscientiousness between married and Unmarried Employees

H2 . There is significant difference in level of Courtesy between Employees with Different Education Levels

H3 . There is significant difference in level of OCB between Employees with different Income Levels.

H4 . There is significant difference in level of OCB between Employees with different Experience Level in same Organization.

Because the Age Level, Gender , Education Level ,Job Hierarchy , Salary , Tenure in the Organization are different between respondents ,the difference may lead to difference in OCB level of individuals

The results

An independent-samples t-test was conducted to compare Conscientiousness in Unmarried

and Married Employees. There was a significant difference in the scores Unmarried and Married Employees; $t(54) = -2.714$, $p = 0.20$.

These results suggest that Conscientiousness is higher in Married Employees as compared to Unmarried once. Specially our results show that Conscientiousness increases in Married Employees (Table 1)

(Table 2) The Sig. value here is .014. This value is less than .05. Because of this, we can conclude that there is a statistically significant difference between the mean Courtesy Level for all of our groups (graduate, post graduate and above post graduate).

We have found statistical significance between

conditions but we don't know where the significant differences are. so we deployed a **post hoc test Tukey HSD** (Table 3).

Looking at the Sig. column, we can see that most of the values are greater than .05. However, there are two values that are 0.033. These values correspond with the comparison between the graduate and above post graduate employees. For this reason, we can conclude that the graduate and above post graduate employees are significantly different in terms of Courtesy. Courtesy in above Post Graduate Level Employees was found more than that of Just Graduate Employees. However, the other condition comparisons are not significantly different from one another. This means that the

Table 1 - Conscientiousness Marital Status Wise

Independent Samples Test						
		F	Sig.	t	Sig. (2-tailed)	Mean Difference
Conscientiousness	Equal variances assumed	0.388	0.536	-2.714	0.009	-2.65652
	Equal variances not assumed			-2.447	.031*	-2.65652

Table 2 - Education wise

ANOVA					
		Sum of Squares	Mean Square	F	Sig.
Courtesy	Between Groups	44.066	22.033	4.631	.014*
	Within Groups	252.148	4.758		
	Total	296.214			

Table 3

Multiple Comparisons					
Tukey HSD					
Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.
Courtesy	1	2	-1.36992	0.62155	0.08
		3	-4.18421*	1.62147	0.033
	2	1	1.36992	0.62155	0.08
		3	-2.81429	1.58578	0.188
	3	1	4.18421*	1.62147	.033*
		2	2.81429	1.58578	0.188

*. The mean difference is significant at the 0.05 level.

Table 4 - By Monthly Income

ANOVA				
OCB				
	Sum of Squares	Mean Square	F	Sig.
Between Groups	494.314	123.579	2.353	.066†
Within Groups	2678.525	52.52		
Total	3172.839			

Table 5 - Experience with same organization

ANOVA				
OCB Total				
	Sum of Squares	Mean Square	F	Sig.
Between Groups	176.89	176.89	3.188	.080†
Within Groups	2995.95	55.481		
Total	3172.839			

*Only significant results were added in the analysis

post graduate and graduate employees are not significantly different. It also means that the post graduate and above post graduate employees are not significantly different.

(Table 4) By analyzing the OCB level based on monthly salary of Employees we found that Sig value is above .05. we can conclude that there is no statistically significant difference between the Groups. We can conclude that the differences between group Means are likely due to chance and not likely due to the manipulation.

By analyzing the OCB level based on Experience with same organization of Employees we found that Sig value is above .05. we can conclude that there is no statistically significant difference between the

Groups. We can conclude that the differences between group Means are likely due to chance and not likely due to the manipulation (Table 5).

Discussion

Conscientiousness in married respondent was found higher than unmarried once. Also with time it keeps on increasing. Employees after getting married learn to be more dedicated and disciplined. It does have impact on their way of working in the

organization. Self management increases because they have responsibility of family and that reduces constant need of supervision on them. They will perform their duty religiously even when nobody is watching them. On the other hand, Unmarried people are more relaxed and careless in their approach. They, at certain point try to run from hard work and tries to take short cuts, often breaking the organization's rules and regulations and hence scoring low on Conscientiousness. The findings of this research are against the popular notion that married Employees by virtues of being married will devote most of the leisure time to family and hence will not contribute to extra – role Behavior. Unmarried Employees have more time and energy to perform extra-role activities. Russell and Rush [28] Trainings should be imparted to make employees dedicated and motivated.

Courtesy , that istrying to avoid job-related interpersonal problems or difficulties from taking place was measured on the bases of Education level of the Employees. Although no significant difference was found between graduate and post graduate employees..Also no significant difference was found between post graduate and above post graduate employees. There was significant difference between level of courtesy between Graduate and above post Graduate Employees.

Our findings are in sync with previous researches done by [7, 31]. Graduate employees who are quite young, are less concerned about impact of their actions on others and also how their job do have impact on other's work. On the other hand Highly Educated employees who hold a degrees above post Graduation have experienced how the organizations functions and how to conduct themselves so as to create minimum interpersonal problems. This study proves that Education level do have an impact on Courtesy of Employees. Employees should be give ample of opportunities to learn and grow. Programs for higher education should be launched to increase the Courtesy Level of Employees in organization.

Income which is considered important part of any Job and crucial to every Employee was also taken to find its impact on overall OCB. Against the much popular Belief, Monthly Income had no significant impact on OCB level of Employees. There were insignificant variations between OCB levels of employees who are drawing high salary and who employees who are drawing low salary. The open communication and culture gives freedom to every individual in organization and hence the Citizenship behavior develops in Employees at even lower income levels. Employees who are just joining the organization have high Expectations and aspirations from the new job and they try to give their best even though the Income may not be that great. With rise in Income, the trust and attachment is maintained leading to continuous OCB. These results are contradictory to the results of [33] insisting that work benefit Packages increases the probability of employees helping others at work place, or will participate in discussion or gives suggestions and attend meetings.

We are of the view that employees with higher Experience in same organization would perform more OCB and our research here also supports the logic that they are more attached both psychologically and emotionally with the organization. Their organizational Experience makes them quite familiar with organization and its environment and they know where and how to contribute. On the other hand Employees with Less Experience in the organization will lose lot of their energy in performing in – role activities to institute job security. The research findings

regarding this variable are mixed. O'Reilly and Chatman [15] as well as Morrison [13] found that Employees with longer tenure performed more extra-role activities, while [31] did not find a relationship between the two variables.

Limitations and Scope for future work

The study do have significant implications but the same is subject to limitations. The overall sample size was only 56 with majority of people from private sector with only 11 from public sector. Therefore the finding of the research is subject to change with increase in sample size. The respondents were generally from service industry and therefore the findings cannot be generalized to all Indian organizations from every sector. The data was collected through questionnaire survey and therefore the responses were not free from personal bias. The significant differences were pointed out and discussed based upon preliminary scores but only implementation of the suggestions by the organizations will actually determine the effectiveness.

In addition to address the above mentioned limitations, the future research can incorporate samples from different nature of industries. A cross industrial as well as a cross national study on OCB can be performed to mark out the differences across. Moreover few independent variables can be incorporated (for e.g. leadership, motivation, decision making) to predict OCB. That will add new dimensions to the research.

References

- [1]. Brief, A. P., & Motowidlo, S. J., Prosocial organizational behaviors. *Academy of Management Review*. Vol. 11, 1986, pp. 710-725.
- [2]. Bolino, M.C. & Tureley, W. H.. The personal costs of citizenship behavior: The relationship between individual initiative and role overload, job stress, and work family conflict. *Journal of Applied Psychology*. Vol. 90, 2005, pp. 740-748.
- [3]. Bommer, W. H., Miles, E. W., Grover, S. L. ., Does one good turn deserve another? Coworker influences on employee citizenship. *Journal of Organizational Behavior*. Vol. 24, 2003, pp. 181-196.
- [4]. Chien., An investigation of the relationship of organizational structure, employee's personality and organizational citizenship behaviors. *Journal of American Academy of Business*. Vol. 5, 2004

- ,pp. 428-431.
- [5]. Diefendorff, M. M., Brown, D. J., Kamin, A. M., & Lord, R.G., Examining the roles of job involvement and work centrality in predicting organizational citizenship behaviors and job performance. *Journal of Organizational Behavior*. Vol. 23,2002 , pp. 93-108.
 - [6]. Ehrhart, M. G., Leadership and procedural justice climate as antecedents of unit level organizational citizenship behavior. *Personnel Psychology*. Vol. 57, 2004 ,pp. 61-94.
 - [7]. Gregerson, H.B., Multiple commitments at work and extra-role behavior during three stages of organizational tenure, *Journal of Business Research*, Vol. 26 No.1,1993 , pp.31-47.
 - [8]. Konovsky, M. A., & Organ, D. W., Dispositional and contextual determinants of organizational citizenship behavior. *Journal of Organizational Behavior*. Vol. 17,1996 ,pp. 253-266.
 - [9]. Konovsky, M. A., & Pugh, S. D., Citizenship and social exchange. *Academy of Management Journal*. Vol. 37, 1994,pp. 656-669.
 - [10]. LePine, J. A., Erez, A., & Johnson, D. E., The nature of dimensionality of organizational citizenship behavior: A critical review and meta-analysis. **Journal of Applied Psychology**. Vol. 87,2002 ,pp. 52-65.
 - [11]. Moorman, R. H., Relationship between organizational justice and organizational citizenship behaviors: Do fairness perceptions influence employee citizenship? **Journal of Applied Psychology**. Vol. 76, 1991,pp. 845-855.
 - [12]. Moorman, R. H., Blakely, G. L., & Niehoff, B. P., Does perceived organizational support mediate the relationship between procedural justice and organizational citizenship behavior? **Academy of Management Journal**. Vol.41,1998 ,pp. 351-357
 - [13]. Morrison, W.E., Toward an understanding of employee role definition and their implications for organizational citizenship behavior.**the Academy of Management Journal**,1993.
 - [14]. Motowidlo, S. J., & Van Scotter, J. R., Evidence that task performance should be distinguished from contextual performance. **Journal of Applied Psychology**. Vol. 79,1994 ,pp. 475-80.
 - [15]. O'Reilly, C. and Chatman, J., Organizational commitment and psychological attachment: the effect of compliance, identification and internalization on prosocial behavior, **Journal of Applied Psychology**, Vol.71 No.3,1986 , pp.492-99.
 - [16]. Organ, D. W., Organizational citizenship behavior: The good soldier syndrome. Lexington, MA: Lexington Books.1988.
 - [17]. Organ, D. W., The motivational basis of organizational citizenship behavior.1990
 - [18]. Organ, D. W., Personality and organizational citizenship behavior. *Journal of Management* .Vol.20, 1994 ,pp. 465-478.
 - [19]. Organ, D. W., &Konovsky, M., Cognitive versus affective determinants of organizational citizenship behavior. *Journal of Applied Psychology*. Vol.74,1989 ,pp. 157-164.
 - [20.] Organ, D.W. &Lingl, A., Personality, satisfaction, and organizational citizenship behavior. *Journal of Social Psychology*. Vol.135,1995 ,pp. 339-350.
 - [21]. Organ, D. W., & Ryan, K., A meta-analytic review of attitudinal and dispositional predictors of organizational citizenship behavior. *Personnel Psychology*. Vol.48,1995 ,pp. 775- 802.
 - [22]. Podsakoff, P. M., Aheame, M., &MacKenzie, S. B., Organizational citizenship behavior and the quantity and quality of work group performance. **Journal of Applied Psychology**. Vol.82, 1997 ,pp. 262-270.
 - [23]. Podsakoff, P. M., &MacKenzie, S. B. , Organizational citizenship behaviors and sales unit effectiveness. **Journal of Marketing Research**.Vol. 31,1994 ,pp. 351-363.
 - [24].Podsakoff, P.M., MacKenzie, S.B., &Bommer, W.H., Meta-analysis of the relationships between Keer and Jermier's substitutes for leadership and employee job attitudes, role perceptions, and performance. **Journal of Applied Psychology**. Vol. 81,1996 ,pp.380-399.
 - [25]. Podsakoff, P. M., MacKenzie, S. B., &Hui, C., Organizational citizenship behaviors and managerial evaluations of employee performance: A review and suggestions for future research. In G. R. Ferris & K. M. Rowland (Eds.), *Research in Personnel and Human Resources Management*. Vol.11,1993, pp. 1-40. Greenwich, CT: JAI Press.
 - [26]. Podsakoff, P. M., McKenzie, S. B., Moorman, R. H., & Fetter, R., Transformational leader behaviors and their effects on followers' trust in leader, satisfaction, and organizational citizenship behaviors. **Leadership Quarterly**. Vol.1,1990 ,pp. 107-142.
 - [27]. Podsakoff, P. M., McKenzie, S. B., Paine, J. B, &Bachrach, D. G., Organizational citizenship behaviors: A critical review of the theoretical and empirical literature and suggestions for future research. **Journal of Management**. Vol. 26 ,2000

- ,pp. 513-63.
- [28]. Russell, J.E. and Rush, M.C., The effects of sex and marital/parental status on performance evaluations and attributions, *Sex Roles*, Vol. 17, No.3,1987 , pp.221–36.
 - [29]. Settoon, R. P., Bennett, N., &Liden, R.C. 1996. Social exchange in organizational: Perceived organizational support, leader-member exchange, and employee reciprocity.**Journal of Applied Psychology**. Vol. 81, 1996 ,pp. 219-227.
 - [30]. Settoon, R. P., &Mossholder, K. W. , Relationship quality and relationship context as antecedents of person- and task-focused interpersonal citizenship behavior. *Journal of Applied Psychology*. Vol. 87, 2002,pp. 255-267.
 - [31]. Smith, C.A., Organ, D.W. and Near, J.P. Organizational citizenship behavior: its nature and antecedents, **Journal of Applied Psychology**, Vol.68, No. 4,1983 , pp.653–63.
 - [32]. Somech&Drach-Zahavy., Exploring organizational citizenship behavior from an organizational perspective: The relationship between organizational learning and organizational citizenship behavior. **Journal of Occupational & Organizational Psychology** , 2004,281-298.
 - [33]. Susan J. Lambert , The Link between Work-Life Benefits and Organizational Citizenship Behavior , **The Academy of Management Journal**, Vol. 43, No. 5 (Oct., 2000), pp. 801-815
 - [34]. Van Dyne, L., Graham, J. W., &Dienesch, R. M., Organizational citizenship behavior: Construct redefinition, measurement, and validation. **Academy of Management Journal**. Vol.37,1994 ,pp. 765-802.
 - [35]. Van Dyne, L., &LePine, J., Helping and voice extra-role behaviors: Evidence of construct and predictive validity. *Academy of Management Journal* ,Vol. 41,1998 ,pp. 108-119.
 - [36]. Wright, P. M., George, J. M., Farnsworth, S. R., & McMahan, G. C., Productivity and extra-role behavior: The effects of goals and incentives on spontaneous helping. **Journal of Applied Psychology**. Vol.78, 1993 ,pp. 374-381.

Emotion Recognition of Infants from Speech Signals

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Abstract

This paper proposes pattern recognition technique based on the analysis of infants' emotional states classification and corresponding descriptions of speech information from emotional expression characteristics and major physical and psychological demands in response to certain situations. After collecting and preprocessing of normal infant emotional speech information data, Mel frequency cepstrum coefficient (MFCC) signal analysis is used as features for corresponding parameter selection and extraction, and then Dynamic Time Warping (DTW) technique is employed as a classifier to realize the infants' emotional information recognition. The input data of three most common emotions following the application of either happy, hunger or sleepy are considered, which reflect typical physical and mental state of normal infants. The experimental findings from acoustic data show that DTW based MFCC method gives good infant emotion recognition accuracy and can effectively meet daily recognition needs. The results in this paper provide exploratory research for relevant studies.

Keywords:

Pattern recognition, electronic equipment, infant emotion, speech signals

Introduction

Emotion is social development tools of young infants, which is similar to adult speech.

Emotional expression is considered as important factor in human communication, because they provide feedback information [1]. Infants' emotional expression is not only the main channel to communicate with the outside world, but also is the important information source of attaining the physiological and psychological needs, discomforts, mental health status and mental development level of infants. Effective emotional recognition can make parents have more contacts with their babies, allowing parents to learn more about their needs from expression, and can also adjust the practices of child rearing according to infants' emotional reaction. Those infants who can express their emotions in different states will have the ability to better understand others' emotions, and will have stronger social skills and more harmonious interpersonal relationship in future. Findings of research suggested different infants' emotional classification methods, such as from speech information, from expression information, from gesture and action information, and from electrophysiology information (e.g. Pulse, blood pressure, ECG, EEG etc.). According to the current findings, speech information will be used in this paper due to ease of accurate acquisition and appropriate reflection of the infant unique vocal cord movement and emotion characteristic among these classification methods. Speech signal conveys not only linguistic information but also paralinguistic information such as emotions and speaking styles [2]. It is believed that some emotional information of different infants presented share many common features in certain physiological, psychological needs corresponding

to environmental characteristics [3]. In order to find out these general rules, this paper introduces the research and implementation of infants' emotional information pattern recognition technology to contribute to the health of infants.

Previously, Wasz-Höckert [4] distinguished different infants' needs from healthy and suffering from disease in Scandinavia. Since then, infant cry research has drawn increasing attention. Infant laughing and crying is special case of human voice, and the generation of infant laugh and cries can also be modeled similarly to the generation of adult speech [5]. It is justifiable to apply the speech signal processing and pattern recognition techniques, such as cepstrum analysis, Dynamic Time Warping, and hidden Markov modeling, to infant cry analysis for objective research [6]-[8].

The characteristics of duration, pitch, intensity, vocal-tract transfer and glottal pulse in different conditions have been analyzed by Hansen and Patil [9]. The corresponding findings are described in the literature. Although infant have vocal organ genetic mechanisms, it cannot use articulate speech until after at least 3 years of maturation process [5]. Among the infant acoustic characteristics that have been studied, it is practical to consider the effects of duration, pitch and energy as main feature parameters in infants' emotional recognition system. In this paper, the duration corresponding to the lasting time that infant from begin uttering to the end; the pitch represents the perceived periodicity of voice generated by vocal cords vibration, and the influence on variations of pitch has been investigated in [10] and [11]; whereas the energy distribution refers to time domain signal that can be classified by energy sequence.

On the other hand, Linear Prediction Cepstrum Coefficient (LPCC) and Mel Frequency Cepstrum Coefficient (MFCC) have been widely used as parametrically representing speech signal for speech recognition to DTW or HMM based systems etc. [12], [13], [14]. LPCC computing method is a recursion from LPC Parameter to LPC cepstrum according to All-pole model [15]. However, The LPCC parameter cannot adequately reflect the human auditory characteristics [16]. It inherits defects of LPC. That is: all frequencies based on composite coefficients are tend to be

linear and include noise details at high frequencies segment. In fact, the human auditory system is a special nonlinear system so as to respond to the different frequency signals [17]. Based on the known variation of the human ear's bandwidths, MFCC spaced linearly below 1000 Hz frequencies and logarithmically above 1000 Hz frequencies, and the mechanism of input speech signal matched with auditory characteristics. Experiences show that the performance of MFCC parameter is better than that of LPCC parameter. Therefore, we put forward MFCC parameters on infants' emotional information pattern recognition, and analyze the influences of different order on emotion recognition accuracy.

Infants' emotional information pattern recognition process is a template matching process to measure the maximum similarity between test data and template library. The state-of-the-art in pattern recognition techniques includes Dynamic Time Warping (DTW), Hidden Markov Modeling (HMM), and artificial neural networks (ANN). Dynamic Time Warping (DTW) is an early and classical algorithm which is based on the thought of dynamic optimization and can resolve the matching problem of the difference of speech's length [18]. In the isolated word speech recognition, the disadvantage of HMM and ANN is limitation of heavy computations and training templates that are required for higher accuracy [19], but the DTW algorithm training hardly need the additional calculations. So DTW approach will be used in this paper due to ease of implement and flexibility. Different techniques and meta-analysis researches have been published, for instance, Lederman addressed the crying classification issue on normal and illness infants in [20], obtaining the average classification accuracy of 90%. Other classification techniques, considered in [21] and [22], presents models that use cry phoneme information.

Infants' emotional information recognition is a difficult task and it is still an active research area. A closer look at the current literature available will see more attention has been given to infant speech information by scholars, most of which focused on the recognition of different types of cries [13],[23], however, there is still lack of standard infants' emotion classification method and corresponding speech information description, especially those

rich emotional information containing infant laughing and crying, haven't yet formed a unified view in its recognizing and understanding of connotative meaning. To have a better implementation of infants' emotional information recognition, it is necessary to have a look at the mechanism for processing emotions of infant and the acoustic features.

The paper is organized as follows. In Section 2, the mechanisms of infant emotion are reviewed. The pretreatment methods in information process, in order to get character parameter extraction in calculating MFCC of emotional information, are detailed in Section 3. The proposed DTW technique and pattern recognition process are introduced in Section 4. Experimental results from acoustic data are reported in Section 5, and Section 6 concludes the paper.

The Mechanism of Infant Emotion

Emotion is an attitude and innermost feelings experience to environmental factors that are produced by brain [24][25]. In fact, infant laugh can reflect a sense of security or prediction of the development of things and it at least demonstrates a state of being active and healthy, without pain, illness or other bad things happening. The infant smile is very frequent especially after 4 months, so that parents should timely mine and analyze infant laugh. Whereas infant cry is often caused by some reasons such as, hunger, pain, fatigue, discomforts and so on, and can also be used to express their needs or other problems. From the cry, parents or trained professional can effectively monitor and detect problems earlier to avoid unnecessary and misdirected treatments. In that case crying will gradually disappear in favor of laughter, which in turn will benefit psychomotor and mental development of infants. The ability to correctly interpret emotional signals from infants is crucial for their healthy growth.

With the development of information technology, human dependence on computer also steadily increases. Naturally, infants' emotional information pattern recognition has become an important research subject in communication between man-machines and human beings, since Picard of MIT published the famous (Affective Computing) [26] in 1997. After year's development, research on

emotional intelligence have made great progress from theoretical basis, analysis and processing technology to the exploratory application. Another book also named "affective computing" from Cai Lianhong introduces theory and application of affective computing, which is instructive in applying affective computing in infant emotion recognition technology research and implementation [27]. Modern cognitive psychology consider that human emotion is caused by specific situations, which is the evaluation product of people need in response to specific situations [27][28]. Emotion changes is the unique psychological phenomena to human that can trigger a series of physiological responses through human nervous system, and form the unique subjective experience which may cause external expression changes such as gesture, action, language and so on [25]. Therefore, through various physiological signals and the external feature detection, combined with human subjective evaluation, it is possible to compute and identify the emotional state to a certain extent.

Four different basic emotions of angry, happy, sad and neutral have been classified in annular anomaly pattern [29]. Generally speaking, these emotions are linked to human basic needs, and usually have the feature of high tension [28]. Different from adults, infant mood can be achieved through different cries and laugh, which is the best expression of emotion: infants will make a "giggle" laughter when it is happy, will utter smooth and intermittent cries when it is hungry, and will make low and more irritable cries when the infant want to sleep. This observation results in the conclusion that there are similar or common features present in emotional information of infants who are in the same state, such as the state of happy, hunger or sleepy. With this, we performed DTW technique to realize the infants' emotional information recognition. It is hoped that just as a parent can learn to differentiate between different types of emotional information uttered by normal infants.

Information Processing and Feature Extraction

A. Information Sampling and Quantization

The first step in the proposed system is infant emotional information acquisition and processing

step, in which the ‘WAV’ files have been recorded and recognition of such isolated word has been made. Next, MFCC is applied to do the extraction of characteristic parameters in feature extraction. The speech input is typically recorded at a sampling rate above 10000 Hz. In this paper, infant emotional signal sampling frequency was chosen in 16 kHz, aiming at to reduce the noises and better promote infant emotional information pattern recognition effect.

Infant emotional information pre-processing is crucial to improve the processing precision that transform and process initial infant emotional signals in time domain or frequency domain, to improve signals treatment, especially in the sound quality, intensity and duration and so on, which is real reaction of infant needs from emotional information. And to some extent, preprocessing even directly relates with the success of speech recognition system. The preprocessing module typically includes infant emotional information sampling and quantization, the spectrum signal pre-emphasis, speech signal framing and windowing, the speech signal endpoint detection. Here is a detailed introduction following of the four steps.

Similar to speech signals, infant emotional signals are one-dimensional analog signal that continuously changes in time and amplitude, which required sampling and quantization before extraction.

Speech signals need pre-filtering before sampling, mainly inhibit those segments or noise which frequency over $f_s/2$ (here, f_s denotes the sampling frequency) so as to restrict the signal bandwidth within a certain range to minimize the effects of high frequency signals distortion caused by spectrum aliasing. Sampling is to discretize the time continuous speech signal into a sequence of samples. According to the sampling theorem, when the sampling frequency is two times over the maximum signal frequency, the digital signal will retain the integrity of the information in original signal after sampling [30]. Quantizing signals is due to the discrete form of infant emotional signals in time domain but still with continuous attributes in amplitude after sampling [5]. The purpose of quantization is to discrete amplitude values of infant emotional signal waveform, where the

amplitude value is divided into finite interval and those fall into the same interval samples are assigned the equal amplitude value [30].

B. *Pre-emphasis, Framing and Windowing*

In the general case, the higher the frequency generated by infant emotional signals is, the smaller the amplitude is, so if the frequency increases double and its power spectrum amplitude will decrease by 6dB. The main objective of pre-emphasis is to enhance high-frequency part of the spectrum processing and filter low frequency interference, especially 50Hz to 60Hz power, which make the whole spectrum more flat. By using the pre-emphasis filter, it can effectively reduce random noises, eliminate DC drifts effect, and can also boost part of energy, which may help the analysis of spectrum conveniently. Generally speaking, pre-emphasis is realized through a first-order high-pass filter, as it is showed in formula 1, and the value of a is close to 1.

$$H(z) = 1 - a^{-1} \quad (1)$$

After the original signal sequence has been pre-emphasized, we gain the pre-emphasis coefficient, and get a as values of 0.9375.

It is found that speech information boast short-time stationary properties that the spectrum characteristics remain stable in a short time [31]. Therefore, speech signal can be blocked into frames in actual processing. The continuous speech signal is blocked into small time division as the smallest unit, known as the “frame”, and the non-overlapping segments called frame shift [31]. However, the difficulty of complex computation and accuracy of emotional signal feature has to be taken into account, so in this paper, typical values for frame length is 20ms, and frame shift is $1/3 \sim 1/2$ of frame length.

In order to keep the emotional signal short-time stationary, should window each individual frame to reduce the Gibbs effect. The concept here is to minimize the spectral distortion through windowing. There are two issues to consider in using the window function, namely the window function shape and window length [32]. Typically the Hamming window is used, which has the following form: Suppose the window function is

$w(n)$, where N corresponding to window length, generally equal to the frame length:

$$w(n) = \begin{cases} 0.54 - 0.46 \cos[2\pi n / (N-1)], & 0 \leq n \leq N-1 \\ 0, & \text{others} \end{cases}$$

C. Endpoint Detection and Feature Extraction

Endpoint detection is an important step in speech signal processing, for the accuracy of endpoint detection directly affects the speed and results of speech signal processing. It is aim to find and processing effective part at the beginning and end of each speech signal by using digital processing technology. There are two important features of speech signals: short-time energy and short-time zero-crossing rate [16].

Due to the energy of infants speech signal changing with time, the energy difference between voiceless and voiced is very obvious. We use short-time energy analysis to describe infant speech feature change [16]. On the N th frame of the speech signal short-time energy E_n is defined as the following:

$$E_n = \sum_{m=-\infty}^{\infty} [x(m)w(n-m)]^2 = \sum_{m=-\infty}^{\infty} x^2(m)h(n-m) = x^2(n) * h(n) \quad (3)$$

In the above formula, $x(n)$ as the n th short-time speech from original sample sequence by window function, N indicates the frame length.

Short-term zero-crossing rate reflected signal spectrum characteristics, which is defined as the following:

$$Z_n = \sum_{m=-\infty}^{\infty} |\text{sgn}[x(m)] - \text{sgn}[x(m-1)]| w(n-m) \quad (4)$$

$$= |\text{sgn}[x(n)] - \text{sgn}[x(n-1)]| * w(n)$$

$$\text{Where, } \text{sgn}|x(n)| = \begin{cases} 1, & x(n) \geq 0 \\ -1, & x(n) < 0 \end{cases}$$

Short-time zero-crossing rate can determine the start and end positions of each infant emotional signal, and can effectively divide a string of consecutive infant's emotional signals into corresponding partition. Infant voiced sound is sent out due to vocal cord vibration, then the sound pressure waves set up resonance in the vocal tract and form multiple resonance peaks, but the glottal wave resulting in a spectrum of high frequency

decreased, therefore voiced energy focused on below 3kHz frequency; conversely, when the infants send out voiceless sound, vocal cord does not vibrate, airflow generated in the vocal tract is blocked that lead to produce white noise, so the average zero-crossing rate higher than voiced, and energy is concentrated mainly in the higher frequency. In this case, short-time average zero-crossing rate can be used to differentiate voiceless, voiced and silence [16].

Short-time average zero-crossing rate is voiceless and voiced segment between characteristic parameters. In general, the voiceless energy is concentrated in the higher frequency, voiced energy is concentrated in the low frequency, therefore, high frequency corresponding to a high zero crossing rates, and low frequency corresponds to a low zero crossing rates.

In this step, we need to do the character parameter extraction. The result is called the Mel frequency cepstrum coefficients (MFCC). A subjective pitch is measured in a 'mel' scale. Compared to traditional linear prediction cepstrum coefficient LPCC, MFCC coefficient performs better with strong recognition effect and capability of anti-noise, and the size of Mel frequency corresponds to the relation of actual frequency's logarithmic distribution [16]. The Mel-frequency scale is obtained by using the formula is as follow:

$$f_{Mel} = 2595 * \lg \left[1 + \frac{f}{700} \right] \quad (5)$$

Where, the dimension of actual frequency f is Hz. After windowing processing, speech signal turned into short time signal, and then transform through the FFT (Fast Fourier Transform), which converts each frame of N samples from the time domain into the frequency domain and gets the frame signal power spectrum of $S(n)$ [16]. Prior to this, it needs to set up a number of band pass filters (or hamming filters) within frequency spectrum of speech signal, is given according to following function (6):

$$H_m(n) \quad m = 0, 1, \dots, M-1; \quad n = 0, 1, \dots, N/2-1. \quad (6)$$

Here, M stands for the number of filters of speech signal over the frequency spectrum range, which is included in dynamic Mel filter bank, typically takes 24; N is speech signal point numbers of one frame and equals to 256 in this system. In

frequency domain, the center frequency of filter is uniformly distributed throughout Mel frequency axis. As a reference point, the speech signal sampling frequency takes 16 kHz [33]. MFCC characteristic extraction algorithm includes the following steps:

- Ascertain sample sequence length of each frame speech (such as $N=256$), and pre-emphasize, frame and window each frame $S(n)$.
- Transform pre-emphasized $S(n)$ through Discrete Fast Fourier Transform (FFT), then achieve discrete power spectrum $S(n)$ through the square of modulus.
- Calculate power value after $S(n)$ through M filters $H_m(n)$, namely the calculation on the sum of the product $S(n)$ and $H_m(n)$ for each discrete frequency points and get M parameters P_m , where $m=1, \dots, M$.
- Achieve the natural logarithm of P_m to get L_m , where $m=1, \dots, M$.
- On the calculation of the discrete cosine transform L_m to gain D_m , where $m=1, \dots, M$. Drop D_0 which represents the component of direct current, and then let $D_1, D_2, \dots, D_k$ as MFCC parameter.

MFCC feature extraction method is as shown in Figure. 1.

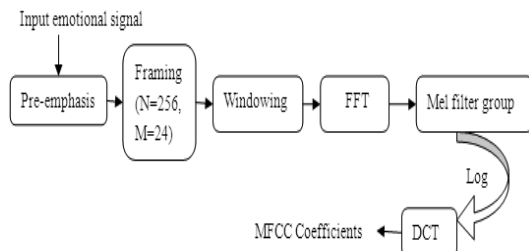


Figure 1 - Process Diagram of MFCC Feature Extraction

Pattern Recognition

A. Acoustic Data

The acoustic data of infant are grouped into 2 databases: one part is from open-source database in “the infant cries for acoustic feature analysis and recognition” that mainly contain cry signal used for accuracy comparison [5], the other is from recordings of 30 infants within 1 years old, the experiment subjects were aimed primarily at healthy ones who were all under the normal condition (does not contain these emotional information data such as injections, pains and illness). The data collections were conducted under the reference in [5]. We selected 3 kinds of emotional signals that reflect normal physical and mental state of infants for research such as happy, hungry or sleepy which are very typical as well as easy for evaluation and acquisition in infants’ daily life.

The recordings in this data were made on RecForge Pro-Audio Recorder with single-channel placed 10 cm from the infants’ mouth. The audio signals were sampled at 16 kHz using a 16-bit analogue-to-digital converter amounted to 52 files. The naming rule for files is like date_time_emotional state. After deleting some noise corrupted and other unsuitable samples, a total of 44 emotional signals were digitized and stored into computer, including 13 happy emotions, 21 files that indicate hungry and 10 sleepy emotional signals. In order to get more objective classification results, we divided each kind of acoustic data samples into three parts. Every time we took two parts from each type of emotional acoustic data, then chose two types of emotion as training samples (e.g. happy and sleepy), and the other type for testing (e.g. hungry), that is a total of 27 times in experiments. This experiment used Matlab 2011 as the development environment, took M-language as the Programming language, and did experiments towards MFCC feature extraction with DTW algorithm. The 3 typical infant emotional acoustic signals are as follows in Figure. 2:

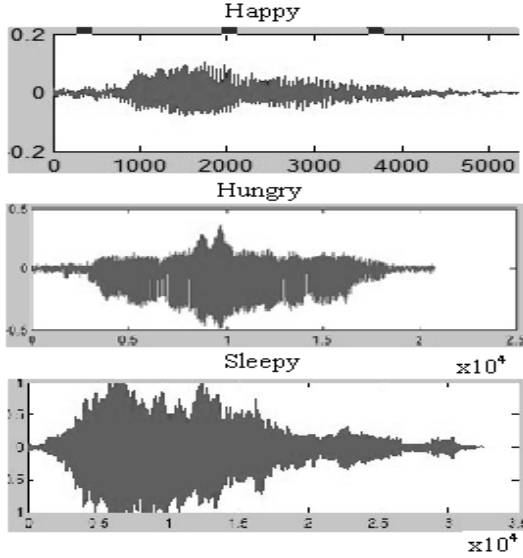


Figure. 2 Happy, Hungry, and Sleepy Acoustic Signals

B. DTW Algorithm

For the similarity between infant emotional information and isolated word, the most simple and effective way of recognition is using of DTW algorithm [19], it is a nonlinear warping technology combined with time and distance measure calculation, which is based on the idea of dynamic programming, aiming at finding the optimal matching path between test sample and training sample. And the DTW is also a warping matching algorithm of finding the minimum Euclidian distance between the test and the reference samples separately to ensure the maximum acoustic similarity between the two vectors [18].

The test vector time axis n nonlinearly mapped to the time axis of reference template m , and makes the warping function $i_m = \Phi(i)$ satisfies:

$$D = \min_{\Phi(i_n)} \sum_{i_n=1}^N d(T(i_n), R(\Phi(i_n))) \quad (7)$$

In the above formula, the value of distance is generally expressed by Euclidean distance. $d(T(i_n), R(\Phi(i_n)))$ refers to the distance between input test vector of No. n frame and the reference vector of No. m frame, D is the minimum length of the test samples with every reference sample corresponding to optimal warping time. In order to make the dynamic path search algorithm

meaningful, some limitations of warping function have to be added to satisfy the following constraint condition [18].

- (1) Boundary constraint. Warping function occurred mainly in the starting point of the frame when the processing of speech has been under endpoint detection, so, it must satisfy the boundary constraints:

$$\begin{cases} \Phi(1)=1 \\ \Phi(N)=M \end{cases} \quad (8)$$

- (2) Monotonicity constraint. Warping function should make sure the order of time series on speech signal in path matching, so, it must satisfy the property of monotonicity in the following form,

$$\Phi(i_n + 1) \geq \Phi(i_n) \quad (9)$$

- (3) Continuity constraint. Some special phonemic differences may be the basis for distinguishing different sounding unit in speech signal, in the purpose of minimizing the information loss, warping function needs to satisfy the following continuity constraint.

$$\Phi(i_n + 1) - \Phi(i_n) = \begin{cases} 0, 1, 2 & \Phi(i_n) \neq \Phi(i_n - 1) \\ 1, 2 & \Phi(i_n) = \Phi(i_n - 1) \end{cases} \quad (10)$$

C. Emotion Recognition

A block-diagram of pattern recognition process of infant emotional signals can be seen in Figure. 3.

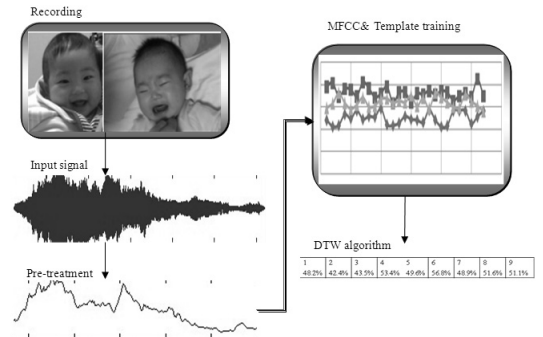


Figure 3 - Block Diagram of the Recognition Process.

Starting from recording the infant speech, we

get the raw audio signal (16 kHz, 16bits), then we perform pretreatment method which consists of pre-emphasis, framing, windowing and end point detection steps. After that, we calculated the MFCC of each speech in the reference templates, and labeled the types of infant emotional speech stored separately. Then we use the same method to extract the MFCC of test template, and calculate the template matching between test templates and training templates of emotional state through DTW technique. In this study we also consider three different order MFCC coefficients, namely 6, 12, and 24, and evaluate the recognition performance of the system by the standard of accuracy.

Experiment and Results

A. Signal Pre-treatment

In order to uniform different samples, energy normalization on emotional signals is needed. Each energy points are divided by maximum energy in this section to facilitate the final parameter comparison.

(1) Pre-emphasis

The main purpose of pre-emphasis is to increase dynamic range in the infant emotional signals in order to achieve more details. In this work, it is designed to remove the influence of vocal cords and the lip and to compensate for the high frequency part of the infant emotional signal, so that the infant emotional signal spectrum can be flat. The three type of infant emotional signal waveform of pre-emphasis is as Figure. 4.

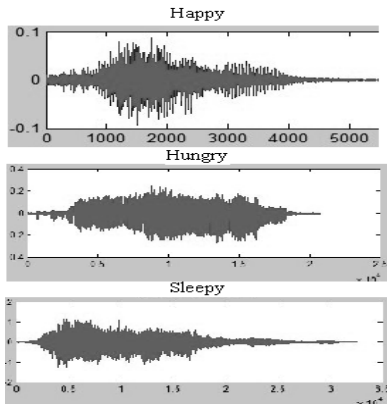


Figure 4 - Happy, hungry, and Sleepy Information Signal Waveform of Pre-emphasis

(2) Framing and windowing

Infant emotional signal is non-stationary signal, changing with the vocal movement. Generally, the frame size takes within 10ms~30ms to keep short-term smooth. In this experiment, the continuous infant emotional signal is subdivided into frames length of 256 points and with half of its length overlap between each frame, then it is windowed with hamming window to reduce the discontinuities at the edges. The framing and windowed signal is as shown in Figure. 5.

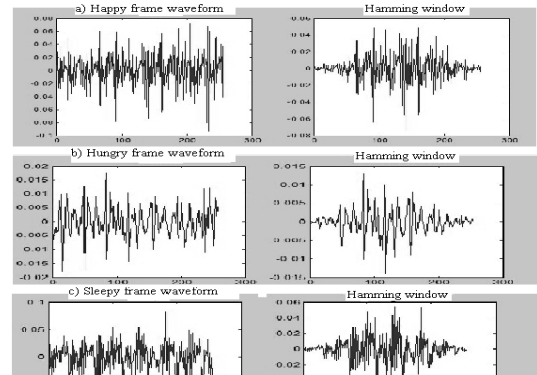


Figure 5 - Framing and Hamming Windowed Signal: a) Happy, b) Hungry, c) Sleepy

(3)Endpoint detection

Double threshold method is the classical method of endpoint detection, according to the feature of infant emotional signals, using short-time energy and short-time zero-crossing rate to complete the endpoint detection, which can effectively eliminate secondary information like silent periods in the infant emotional signals.

B. Experimental Analysis

This experiment tested recognition result with 6-order, 12-order, and 24-order MFCC coefficient using DTW classification algorithm, by the comparison of different order on infant emotional information pattern recognition rate to select suitable recognition feature parameters. We had recognized 27 times separately. The average recognition rate with 6-order MFCC coefficient is 49.8%, 12-order MFCC coefficient is 72.9%, and 24-order MFCC coefficient is 64.4%. Figure.6 shows the result.

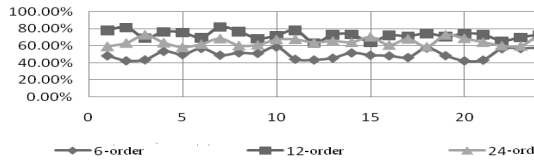


Figure 6 - MFCC Coefficient Recognition Rate of 6, 12, and 24 Orders.

The experiment indicated that speech recognition system based on 12-order MFCC characteristics by using DTW algorithm can greatly enhance the system's performance, particularly in recognition rate. To identify the applicability of this model and the effect of recognition, we will use the acoustic data from open-source database in "the infant cries for acoustic feature analysis and recognition" [5]. They are grouped into volunteer Library (Library 1) and Internet Public Library (Library 2). The recognition rates are shown in Table 1.

Table 1 - Results of the speech recognition experiment

Types	1	2	3	4	5	6	7	8	Average
Library 1	72.4%	70.8%	76.3%	75.0%	73.5%	71.2%	74.5%	71.8%	72.8%
Library 2	70.6%	71.8%	73.5%	71.6%	72.0%	68.2%	72.8%	73.5%	71.6%
Combination	71.2%	70.9%	73.5%	72.0%	70.8%	70.1%	71.5%	70.6%	71.1%

The result indicated that speech quality has relatively high recognition accuracy combined with 12-order MFCC parameter with the average recognition rate being more than 70%. The model can achieve good recognition effect of the recognition of happy, hunger, and sleepy emotion state, and bring the desired result.

Discussion and Conclusion

Infant emotion recognition technology research is a comprehensive study of infant psychology, speech signal and information processing, physiology, computer technology and other subjects. The purpose of the application of speech signal recognition technology to the infant emotion recognition is to let the outside correctly interpret the infants' actual demand, which is crucial for their healthy growth. In this paper, we proposed DTW of classical acoustic technique and MFCC to identify three typical infant emotion (Happy, Hungry and Sleepy), and achieved a relatively good result. The experiment proved

that the performance of DTW algorithm based on 12-order MFCC parameter.

However, the lack of efficient infant emotion classification mode, the problems and defects of characteristic extraction and parameter estimation algorithm may decrease the recognition accuracy. In order to improve the stability and accuracy of the infant emotional information pattern recognition system, the issues as follows, for instance, use different recognition algorithms or combination of multiple algorithms to improve accuracy[34][35]; choose more appropriate parameters or combined features to algorithms; apply more speech recognition technology such as the combination with facial recognition technology to establish a more perfect infant emotional information pattern recognition model; use more testing emotional signals in the future to algorithm and so forth, are still the main aspects of the research.

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References

- [1] G. Várallyay Jr., Z. Benyó, A. Illényi, Z. Farkas, L. Kovács, "Acoustic analysis of the infant cry: classical and new methods", in *Proceedings of the 26th Annual International Conference of the IEEE EMBS*, CA: San Francisco, pp. 313–316, 2004.
- [2] J.O. Garcia, C.A. Reyes García, "Acoustic features analysis for recognition of normal and hypoacoustic infant cry based on neural networks", *Lecture Notes in Computer Science*, Artificial Neural Nets Problem Solving Methods, 2003, pp. 615–622, doi: 10.1007/3-540-44869-1 78.
- [3] N. R. Carlson, *Foundations of Physiological Psychology*, USA: Pearson Education, Inc., 2005.
- [4] Wasz-Hockert, et al., *The Infant Cry: A Spectrographic and Auditory Analysis*, William Heinemann Medical Books Ltd., 1968.

- [5] Y.Fengling, "The infant cries for acoustic feature analysis and recognition", Xihua University, 2001.
- [6] Lindsalwa Muda, Mumtaj Begam and I. Elamvazuthi, "Voice Recognition Algorithms using Mel Frequency Cepstral Coefficient (MFCC) and Dynamic Time Warping (DTW) Techniques", *Journal of computing*, Vol. 2, No. 3, 2010.
- [7] Sharada C. Sajjan, C. Vijaya, "Comparison of DTW and HMM for Isolated Word Recognition", in *Proceedings of the International Conference on Pattern Recognition, Informatics and Medical Engineering of the IEEE*, pp.466 – 470, doi: 978-1-4673-1039-0/12, 2012.
- [8] M Haro, J Serrà, À Corral, P Herrera, "Power-Law Distribution in Encoded MFCC Frames of Speech, Music, and Environmental Sound Signals", in *Proceedings of the 21st International Conference Companion on World Wide Web of the ACM*, pp. 895-902, doi: 978-1-4503-1230-1/12/04. 2012.
- [9] B. Vlasenko, A. Wendemuth, "Heading toward to the natural way of human-machine interaction: the NIMITEK project", in *Proceedings of IEEE International Conference on Multimedia and Expo*, 2009, pp.950–953.
- [10] W. Guo, R. H. Wang and L. R. Dai, "Mel-Cepstrum integrated with pitch and information of voiced/unvoiced", *Journal of Data Acquisition and Processing*, Vol. 22, pp. 229–233, Jun. 2007.
- [11] Z. Xiang and C. J. Yin, "Design and Implementation of Speech Recognition by Mel-Cepstrum Integrated with Pitch". *Computer Systems and Applications*, Vol. 17, No.9, pp. 86–89, Sept. 2007.
- [12] R. Doddipatla, S. Umesh, "VTLN Using Analytically Determined Linear-Transformation on Conventional MFCC". *IEEE Transactions on Audio, Speech, and Language Processing*, Vol. 20, No. 5, pp.1573 – 1584.2012.
- [13] A. Zabidi, W. Mansor, LY. Khuan, "Discrete Mutative Particle Swarm Optimisation of MFCC computation for classifying hypothyroidal infant cry", in *Proceedings of International Conference on Computer Applications and Industrial Electronics (ICCAIE) of the IEEE*, 2010, pp.588 – 592, doi: 978-1-4244-9055-4/10.
- [14] M. Sheikhan, D. Gharavian, F. Ashoftehd, "Using DTW neural-based MFCC warping to improve emotional speech recognition". *Neural Computing & Applications*, 2011, Doi:10.1007/s00521-011-0620-8.
- [15] Y. Yujin, Z. Peihua, Z. Qun, "Research of Speaker Recognition Based on Combination of LPCC and MFCC", in *Proceedings of IEEE International Conference on Intelligent Computing and Intelligent Systems (ICIS)*, pp.765-767, 2010, Doi: 978-1-4244-6585-9/10.
- [16] W. Bingxi, Q. DanP. Xuan, "Fundamentals of speech recognition". National Defense Industry Press, 2004.
- [17] L. Yonghong, "The research of speaker recognition system". Xi'an University, 2003.
- [18] Z. Shuqin, "Research on the key technology of the speech recognition system". Xi'an Electronic and Science University, 2004.
- [19] L. Jianning, "Study and Implementation of Chinese Characters Isolated Words Recognition System". Xi'an: Northwestern University, 2007, pp.17-25.
- [20] D. Lederman, A. Cohen, E. Zmora, K. Wermke, S. Hauschildt and A. Stellzig-Eisenhauer. "On the use of Hidden Markov Models in Infants' Cry Classification", in *Proceedings the 22nd IEEE Convention*, Israel, 2002, pp.350-352.
- [21] X. Qiaobin. "Automatic Assessment of Infants' Levels-of-Distress from the Cry Signals". *IEEE*, 1996, pp.253-265.
- [22] Qiaobin Xie. "Determining Normal Infants' Level-of-Distress from Cry Sounds", *IEEE, CCECE/CCGEI*, 1993, pp. 1094-1096.
- [23] E. Amaro-Camargo, CA Reyes-García, "Applying statistical vectors of acoustic characteristics for the automatic classification of infant cry". Springer, 2007, pp.1078–1085.
- [24] <http://xinli.snnu.edu.cn/Article/ShowArticle.asp?ArticleID=198>.
- [25] L. Sen, "On teachers' emotion and classroom teaching effectiveness", *Contemporary Teacher Education*, 2011.
- [26] R. W. Picard, *Affective Computing*, Cambridge, USA: MIT Press, 1997.
- [27] C. Lianhong, "Affective Computing", *China Computer Society Newsletter*, vol.6, no.5, pp. 6-8, 2010.
- [28] Carlson N. R., *Foundations of Physiological Psychology*, USA: Pearson Education, Inc., 2005.
- [29] M. Petroni, A. S. Malowany, C. C. Johnston, et al. "A Comparison of Neural Network Architectures for the Classification of Three Types of Infant Cry Vocalizations", in *Proceedings of the IEEE 17th Annual Conference in Engineering in Medicine and Biology Society*, Vol.1, pp.821-822, 1995.
- [30] Z. Xinghui. "Research on strong noise environment speech detection". Changchun University of Science and Technology, 2009.
- [31] X. Fang, "Research on voice based robot control application". Xi'an University, 2010.
- [32] L. Dapeng, "Conversational speech in speaker recognition research". Chongqing University, 2007.
- [33] H. L. Haobo. "Research on Chinese speech pretreatment and isolated word recognition method". Shandong University, 2007.
- [34] Weihui Dai, Shouji Liu, Shuyi Liang, "An improved ant colony optimization cluster algorithm based on swarm intelligence", *Journal of Software*, Vol.4, No.4, pp. 299-306, 2009.
- [35] Weihui Dai, "Context awareness and emotional intelligence: the gateway to smart city", *Urban Management*, Vol.2012, No.4, pp. 29-32, 2012.

Big Data, How to Balance Privacy and Social Values

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Abstract

Big data is expected to bring forth enormous public good as well as economic opportunity. However there is ongoing concern about privacy not only from public authorities but also from private enterprises. Big data is suspected to aggravate the existing privacy battle ground by introducing new types of privacy risks such as privacy risk of behavioral pattern. On the other hand, big data is asserted to become a new way to by-pass tradition behavioral tracking such as cookies, DPIs, finger printing... and etc. For it is not based on a targeted person. This paper is to find out if big data could contribute to catching out behavioral patterns of consumers without threatening or damaging their privacy. Before the difference between traditional behavioral tracking and big data analysis from the perspective of privacy will be discerned.

Keywords:

big data, privacy, privacy commons, big data commons, personal data ecosystem

Big data, a big problem to privacy?

Big data is based on advances in data mining, analytics, massive increase in computing power, and expansion of data storage capacity. In addition, the increasing number of people, devices, and sensors that are now connected by digital networks has revolutionized the ability to generate, communicate, share, and access data. Data create enormous value for innovation, productivity, efficiency, and growth. At the same time, the 'data deluge' presents privacy concerns that could stir a regulatory backlash. The inferential techniques being used on big data can offer great insight into many complicated issues such as security, safety, and consumer needs. Potential abuses of

inferential data, however could imperil personal privacy, civil liberties and consumer freedoms (Bollier, 2010, p.2). In order to craft a balance between beneficial uses of data and the protection of individual privacy, policymakers must address some of the most fundamental concepts of privacy law, including the definition of 'personally identifiable information', the role of consent, and the principles of purpose limitation and data minimization (Tene & Polonetsky, 2012b, p.63).

Recent concerns on privacy harms caused by big data, however, seems to be too much exaggerated. They do not discern the increased privacy harms by big data itself, and those from personal data. This poses a problem because Big is accredited to the very source of privacy disaster, though the key is still up to personal data. To the contrary of common understanding, big data could be an alternative to harmonize the tension between social value of personal data and privacy. Big data is not always to be personal. It is rather based on and oriented to the non-personal, de-identified data. It needs to be clarified what is the privacy harms and risks added by big data. And, how is it different from those privacy harms caused by personal data. It is not easy to separate those harms from big data and those from personal data. It may be not meaningful to do so because big data and personal data is too much intermingled to be divided. This paper is to look into what is the real influence of big data on privacy. In order to do fully utilize the benefits of big data for security, safety, and innovation, we should scrutinize which is the real problem, big data or personal data.

Where comes the value of big data?

The term of big data was first used in science to refer to large data sets requiring the processing capacity of supercomputers (Boyd and Crawford 2011). Today, the term refers to the aggregation of

massive stacks of data originating from different sources, produced by humans or machines. The advantage over processing different data sets separately is that it becomes possible to find **correlations and infer additional information** by aggregating, comparing, or otherwise analyzing data combined into one single large data set (Filippi and Pordedda, 2012).

Values of big data can be easily recognized in such public areas as security, crime-prevention, healthcare, traffic management, insurance and employment. Big data analysis on a large medical dataset maintained by the FDA for more than 30 years, help researchers to make a groundbreaking discovery. Russ Altman and his colleges found that Paxil and Pravachol have a unknown dreadful side effect when taken together. They could confirm their hunch by examining de-identified search engine logs. Those users who searched both Paxil and Pravachol together turned out to type in more words related to diabetes than those who searched for just one of them (Tene & Polonetsky, 2012a). The finding of Altman and his team are not the sole major medical breakthrough based on big data analysis. The discovery of Vioxx's adverse effects was possible owing to the dataset collected by Kaiser Performance, the California-based care consortium. Google flu trends, which predicts and locates outbreaks of the flu was able to do so by analyzing aggregated search queries.

Another case is found in traffic management. Using data from toll pricing or bus payment system, public authorities can decide where to construct new roads or mass-transit systems. Not to mention, individual drivers can also benefit from smart routing based on real-time traffic information. Big data also could play a role in predicting and preventing crime as experimented in Santa Cruz' PredPol. PredPol's system features a map of a city marked with red squares to show zones where crimes are likely to occur. It calculates its forecasts based on times and locations of previous crimes, combined with sociological information about criminal behavior and patterns.

From several cases mentioned above we can easily notice that big data does not always mean to be personal data. It is certain that it come from generated and data collected and

behaviors of individual persons. But, this does not automatically mean that the data should be linked to a specific person or personally identifiable information (PII). The value of big data comes from finding out patterns of behavior from a huge amount of non-identified or anonymous data. The key virtues of the data included are in relevancy and sincerity, not in personality. After finding out a relation, we need some personal data such as sex, age, or location to do an inferential recommendation. Even in this stage, however, the PII is not essential to achieve its value. When Amazon and Apple use their databases of consumer purchases to make recommendations to prospective customers, most people welcome the advice. It may help them identify just the book or music that they want. On the other hand, people start getting very uneasy when buying suggestions are made based on how much we know about this particular person. This accrues to the realm of behavioral targeting (Bollier, 2010, p. 23)

Remaining issue is the reliability and accuracy of the analytics. The value of big data analysis comes from its ability to find correlations and make inference on relations. There are severe debates if correlation is enough to suggest inferential decision making. Critics suggest that big data rely not on causation but on correlations. The newly discovered information, therefore is not only unintuitive and unpredictable, but also results from a fairly opaque process. Inference from big data may be thought of as data mining on steroids (Rubinstein , 2012, p.3). The real problem is that big data enables authorities to make inferences that amount to "probabilistic cause." But it can not replace "probable cause". Probabilistic cause remains a less reliable and more abstract predictive standard (Boiller, 2010, p. 34). Extrapolating from correlations can yield specious results even if large data sets are used. The classic example may be "My TiVO Thinks I'm Gay." The Wall Street Journal once described a TiVO customer who gradually came to realize that his TiVO recommendation system thought he was gay because it kept recommending gay-themes films.

However, others say that "correlation supersedes causation, and science can advance even without coherent models, unified theories, or really any mechanistic explanation at all. It's time to ask:

What can science learn from Google?” (Boillier, 2010, p. 5). They strongly argue that probabilistic cause could be a legitimate tool for persuading a judge. The idea that you can’t use probabilistic data to get a probable cause standard is suggested to be silly. If there is relevant data for relations for making a judgment that is important to society, the goal should not be to ban the use of correlations and data analysis. The goal should be to monitor it properly.

Challenges of big data to privacy

Many scholars as well as professional stakeholders proposed and worried about additional privacy concerns caused by big data. This paper has reviewed several of them and summarized those suspected harms in Table 1. Though different terms are used by authors, major concerns are summarized into four items; re-identification, secondary use (consent, purpose, time limitation), new privacy reveal, increased accessibility.

Table 1- Privacy risks by big data

Boillier (2010)	Goldberg & Miller (2012)	Tene & Polonetsky (2012b)	Kuner et als. (2012)
-re-identification -secondary use	- re-identification -new privacy reveal -increased accessibility	-re-identification - inferential prediction -auto-decisionmaking - access & exclusion - chilling effect	-collection limitation -consent -right to to be forgotten -surveillance

First, re-identification is the new technology that disrupts the whole privacy policy landscape by undermining the faith of anonymization(Ohm, 2010). Anonymization is the main tool allowing data collectors to keep personal data in storage or hand them over to a third party without compromising the privacy of the people tracked. Over the past few years, however, computer scientists have repeatedly shown that even anonymized data can often be re-identified and attributed to specific individuals. De-identification could be possible because of big data analytics. Big data offers greater opportunities for re-identifying the data, linking a given set of medical information to a specific person (Bollier, 2010, p.31). Because of big data anonymization, that

is the process of removing identifiers to create anonymized data sets, can no longer remain effective in protecting users against tracking and profiling. (Rubinstein, 2012, p.5)

Second, inhibition of secondary use clash with the very premise of big data insisting that more is better (Bollier, 2010 p.36). Secondary use is the use of information collected for one purpose for a different purpose without the data subject’s consent. This has been strongly prohibited in various privacy principle and laws such as fair information practices of U.S. and DPR of EU. This principle has also been known as the purpose specification principle. And it is strongly coupled with notice and consent principle and data minimization principle. The very reason d’etre of looking to big data is to identify patterns that create answers to questions we didn’t even know to ask. So limiting data-collection in the first place could undercut the potential benefits that big data might deliver (Bollier, 2010, p.36). In the environment of cloud computing, the use of big data for secondary processing and profiling is amongst the most threatening for privacy and data protection (Filippi & Pordedda, 2012).

Third, analysis of large data sets sometimes reveals new information that is not just a summation of the individual underlying information (Goldberger & Miller, 2012). Big data systems make it relatively easy for companies and governments aggregate any number of data sets from any number of data markets, which, in turn, makes it that much easier to derive private information. The added value of bid data is obtained by aggregating different types of data extracted from different sources, connecting them together with other pieces of data about the same users, different users, users they are in connection with, or the whole community of users to which they belong (Filippi & Pordedda, 2012). The more data you are able to collect and connect to other data sets, the easier it is to obtain what was thought to be private information and then tie that information to a specific individual (Craig & Ludloff, 2012, p.56). The case of Target is one of the best examples of new privacy revealed by big data. Target has

collected and built a history dataset of buying records together with demographic information. Mining the data, Target was able to identify about 25 products that allow the assign each shopper a 'pregnancy prediction score'. Take a fictional Target shopper named Jenny Ward, who is 23. She lives in Atlanta and in March bought cocoa-butter lotion, a purse large enough to double as a diaper bag, zinc and magnesium supplements and a bright blue rug. There is say, an 87 percent chance that she is pregnant and that her delivery date is sometime in late August (Forbes, 2012.2.16). Does the girl in Target case argue for privacy rights in the new information obtained by analysis? Maynard case even in a slightly different situation told that she could. According to the judge, one can have a reasonable expectation of privacy in the sum of his/her behaviors even though he had no expectation of privacy in his/her individual behaviors in public space (Goldberger & Miller, 2012).

Fourth, increased accessibility also impedes the risk privacy disclosure. When publicly available information becomes more easily accessible as a result of big data, do the data providers retain privacy rights allowing them control over the continued use of the data? If there is a risk of increased harm by the republication, the answer is likely to be yes. In *Ostergren v. Cuccinelli* case, the court verdict that an individual's interest in controlling the dissemination of information regarding personal matters does not dissolve simply because that information may be available to the public in some form. Because there is a vast difference between the public records that might be found after a diligent search of courthouse files, county archives, and local police stations throughout the country, and a computerized summary located in a single clearinghouse of information (Goldberger & Miller, 2012). Even though the data is publicly accessible, that does not mean it is allowed to be widely distributed (Boyd, 2012)

We can accept privacy risks mentioned above as the increased harms caused by big data. But, it is not essentially created by big data, but instead by personal data. Take the Target case back to this issue. Privacy braking happened when Target attached the pregnancy prediction score to a specific person with their personally identifiable data such as guest ID, credit card, name and address. If they did not violate the privacy principles such as consent,

secondary use, purpose limitation, there would not have been such a big fuss. What if they just send similar targeted advertisements to everybody over a certain amount of score like the Amazon's book recommendations. The essence of this incident lies in the non-proper use of personal data rather than inferential advertisements enabled by bid data analysis.

Solove proposed a list of privacy taxonomy in an attempt to identify privacy problems in a comprehensive and concrete manner (Solovo, 2006). His goal was simply to define the activities which cause privacy harms, and explain why and how they can cause trouble. His taxonomy is worth intruding here as a framework to discern what is the real privacy harms which is purely exacerbated by bid data. There are four basic groups of harmful activities: (1) information collection, (2) information processing, (3) information dissemination, and (4) invasion. Each of these groups consists of different related subgroups of harmful activities (Figure 1).

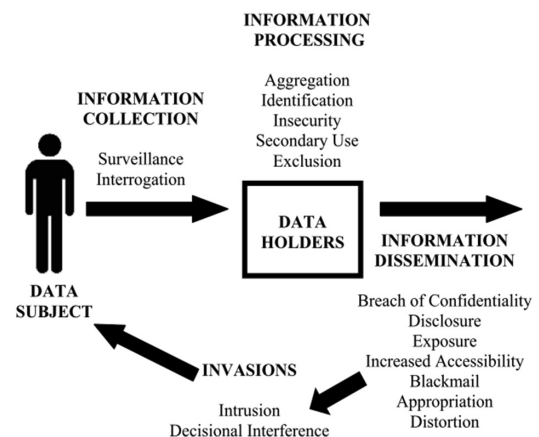


Figure 1 - Taxonomy of privacy by Solovo

In the first group of information collection, surveillance is the watching, listening to, or recording of an individual's activities. Interrogation consists of various forms of questioning or probing for information. Second group includes 5 activities involving the way information is stored, manipulated, and used, that is information processing. Aggregation means the combination of various pieces of data about a person. Identification is linking information to particular individuals.

Insecurity involves carelessness in protecting stored information from leaks and improper access. Secondary use is the use of information collected for one purpose for a different purpose without the data subject's consent. Exclusion concerns the failure to allow the data subject to know about the data that others have about her and participate in its handling and use. The third group of activities involves the dissemination of information. Breach of confidentiality is breaking a promise to keep a person's information confidential. Disclosure involves the revelation of truthful information about a person that impacts the way others judge her character. Exposure involves revealing another's nudity, grief, or bodily functions. Increased accessibility is amplifying the accessibility of information. Blackmail is the threat to disclose personal information. Appropriation involves the use of the data subject's identity to serve the aims and interests of another. Distortion consists of the dissemination of false or misleading information about individuals. Information dissemination activities all involve the spreading or transfer of personal data or the threat to do so. The fourth group of activities involves invasions into people's private affairs. Invasion, unlike the other groupings, need not involve personal information. Intrusion concerns invasive acts that disturb one's tranquility or solitude. Decisional interference involves the government or business' incursion into the data subject's decisions regarding her private affairs.

Big data as an environment includes data mining, analytics, massive increase in computing power, and expansion of data storage capacity. Big data in this wide sense should be responsible for all the increased privacy harms directly or indirectly incurred. But, when you look into the process and mechanism how big data is causing new or expanded privacy harms, we can notice most of them occur in close link with personal data (PII: personally identifiable data). Therefore, we need to separate the privacy harms of big data into two categories. The first is those harms aggravated through personal data problems by big data (indirect harms), and the latter is those caused directly from big data analysis (direct harms). The argument here is only the latter, harms related to analytical inference from correlations should solely accrued to big data rather than the both of them. The first is an issue originally related to personal data management. I am not contending that big data

is not a threat to personal data. Its impact is quite huge and detrimental because it fundamentally transforms privacy landscape regulated by existing norms and principles. It has shaken the core principles of personal data. In this regards, big data should be in charge of all the four increased privacy risks listed above. But, it is not the big data analysis itself to be fixed, rather personal data.

Borrowing the Solovo's taxonomy on privacy harms, the indirect privacy harms aggravated through personal data problems by big data is quite wide-spread (see Table 2.). The second harms (direct harms)s, however are more subtle and limited. It can increase some risks about interrogation, aggregation and decisional interference.

Table 2 - Indirect and direct privacy risks by big data

Taxonomy	Privacy Harm	indirect	direct
Information Collection - surveillance - interrogation	- chilling effect, self-censorship & inhibition - against self-incrimination	✓ ✓	 ✓
Information Processing - aggregation - identification - insecurity - secondary use - exclusion	- unexpected privacy risk, decision against oneself - information baggage, inhibit ability to change, fear of reprisal - potential future harm - not expected nor desired, misunderstood - vulnerability, frustration	✓ ✓ ✓	✓
Information Dissemination - breach of confidentiality - disclosure - exposure - increased accessibility - blackmail - appropriation - distortion	- betrayal of trust - reputation damage, inhibit autonomy & anonymity - loss of self esteem - more risk of disclosure - controlled by someone - affront of dignity, property - defamation, false reveal		

Invasion - intrusion - decisional interference	- solitude, - information disclosure, harm to autonomy	✓	✓
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And, direct harms can also give additional privacy harms, such as pattern privacy, inaccurate grouping, and discrimination. While it allows service providers to offer a more desirable product with high customization and personalization, categorizing users as a result of inferred information also allows providers to discriminate amongst customers according to the category in which they have fallen (Filippi & Pordedda, 2012). Newly discovered information derived from personal data can be unreliable and inaccurate, especially when that data has been anonymized or generalized by being transformed into group profiles. Profiles that apply to individuals as members of a reference group, even though a given individual may not actually exhibit the property in question. (Rubinstein, 2012, p.5). This often cause problem such as sending irrelevant targeted ads to miss-grouped people. Inferential predictions, however, does not automatically impede privacy.

Instead, it can lead to replacing personal data with anonymized big data. This means big data could lessen the dependency on personal data for targeted advertizing. With all the risk of re-identification, anonymization (de-identification) is an excellent approach. It is still an effective way to reconcile the public benefit while minimizing private harm (Boiller, 2010, p.31). Some scholar insists that no useful database can ever be perfectly anonymous, and as the utility of data increases, the privacy decreases. However, we should not deny the efficacy of anonymization, and question the effectiveness of personal vs. non-personal information. One possible conclusion, apparently supported by Ohm, is that all data should be treated as personally identifiable and subjected to the regulatory framework. Yet such a result would create perverse incentives for organizations to abandon de-identification and therefore increase, rather than alleviate, privacy and data security risks. A further pitfall is that with a vastly expanded definition of personally identifiable information, the privacy and data protection framework would become all but unworkable. The current framework, which is difficult enough

to comply with and enforce in its existing scope, may well become unmanageable if it extends to any piece of information (Tene & Polonetsky, 2012b, p.66).

How to deal with personal data in the big data environment

The separation of direct privacy risks of big data form indirect ones has a great implication to policy directions on big data as well as personal data. It is not a panacea to privacy to suppress the utilization of big data. Instead, we may need to build a data ecosystem where various anonymized data commons are collected and shared for public as well as private purposes. This might be the most feasible and possible way to harmonize tensions between personal data and privacy in the big data environment. In this regards, alternative policy directions on personal data should be reviewed and evaluated. Policy directions suggested hitherto can be boiled down to three categories – privacy concept as public good, strengthening existing scheme, personal data ecosystem.

Privacy concept as public good comes from constitutional privacy, meaning that privacy is constitutive of society (Solove, 2006). Constitutive privacy understands privacy harms as extending beyond the “mental pain and distress” caused to particular individuals; privacy harms affect the nature of society and impede individual activities that contribute to the greater social good. Privacy considerations no longer arise out of particular individual problems; rather, they express conflicts affecting everyone. More structural problems, called as architectural problems by Solove belong to this scope. They involve more the creation of the risk that a person might be harmed in the future. They are akin, in many ways, to environmental harms or pollution. In the taxonomy, two kinds of architectural issues emerge most often. First is the enhancement of the risk that a harm will occur. Activities involving a person’s information, for example, might create a greater risk of that person being victimized by identity theft or fraud and suffering dignitary harms as well as monetary or physical harms. Second, a particular activity can upset the balance of social or institutional power in undesirable ways. A particular individual may not be harmed directly, but this balance of power can affect that person’s life. People’s behavior

might be chilled, making them less likely to attend political rallies or criticize popular views. Surveillance can also have these effects. This kind of harm is often referred to as a “chilling effect. Privacy as public good means that it is better to keep it as stringent as possible. Proponents of this approach call for limits on the proprietization of personal information. Schwartz sees information privacy as a public good like clean air or national defense (Schwartz, 2004). He refers to the public good at stake as ‘the privacy commons—a space for anonymous and semi-anonymous interactions’ (Rubinstein, 2012, p.12). Privacy commons resemble creative commons in that individual can decide the position to his own privacy.

Remedy on existing scheme is the perspective of EU’s General Data Protection Regulation proposed in December 2012. In developing this new set of data protection rules, the Commission of EU was well aware of the ‘dramatic technological changes’ that have occurred since the DPD was first proposed in 1996. An also she was very concerned with problems raised by profiling and data mining. Despite this realization, the Commission held firm in its belief that ‘the current framework remains sound as far as its objectives and principles are concerned’. While the Regulation introduces several new privacy rights—notably the right to be forgotten and to data portability—the other changes it makes are incremental at best. For example, it proposes stricter transparency obligations and a tighter definition of consent. It strengthens the existing provision concerning ‘automated individual decisions’ by including a new provision on profiling, but the changes are limited and focus mainly on enhancing transparency. It also imposes new responsibilities on data controllers including data protection by design and default (Rubinstein, 2012, p.12). This is almost in same vein as ‘privacy by design’ prosposed by Caboukian (Filippi & Porcedda, 2012). The seven principles porposed by Cavoukian are: a proactive or preventative approach; privacy by default; privacy embedded in design; positive sum game; end-to-end security; respect for users; visibility and transparency.

The last approach, personal data ecosystem is a kind of ‘sharing the wealth’ strategy premised on data controllers providing individuals with access to their data in a usable format and allowing them

‘to take advantage of applications to analyze their own data and draw useful conclusions’ from it. New business model should give individuals the capacity to benefit from Big data and hence the motivation to learn about and control how their data are collected and used (Rubinstein, 2012, p.12). The pivot point of this ecosystem is the concept of ‘user-centricity’, which seeks to integrate diverse types of personal data while putting end users at the centre of data collection and use, subject to a set of global data principles that include transparency, trust, control, and value creation. (Rubinstein, 2012, p.9). Personal data services (PDSes) will be actual services provided by personal data ‘guardians’ who owe fiduciary duties to their individual. These agencies will provide both a secure data store for a wide variety of personal information (including official records like birth and marriage certificates, licences, and passports, transaction records, online profiles, and social media content, and user names and passwords) as well as a new class of user-driven services ranging from personal RFPs as described above, to more participatory forms of healthcare, to ‘FixMyStreet’ and similar grassroots citizenship efforts.

Comparing these three alternative policy approaches, we can conjecture each will have different ramifications on big data. The first approach will support a favorable formation of anonymous big data commons. Like privacy commons bid data commons also provide anonymous and semi-anonymous areas for data analysis. It will be difficult to exclude parties from the privacy commons once erected. Those who have provided their personal data for little or no compensation will still try to obtain the benefits of the privacy information space. In personal data ecosystem, to the contrary, personal data will be as much monetized as in the business market of behavioral tracking. Every personal data will belong to a private domain, and there will not be much room for big data analysis for public purposes. Of course, there is a possibility for big data commons. Lastly, the existing scheme could be put in between. In case of GDPR, it has paved a road toward personal data ecosystem with the adoption of data portability. On the other hand, the right to be forgotten preserve the way out of the ecosystem. There does not seem to have much room for bid data commons nor restrain it.

References

- [1] Boiller, D., 2010, *The Promise and Peril of Big Data*, Washing DC: The Aspen Institute.
- [2] Boyd, D. and Crawford, K., 2011, Six Provocations for Big Data. Paper presented at the Oxford Internet Institute's "*A Decade in Internet Time: Symposium on the Dynamics of the Internet and Society*" (September 21, 2011).
- [3] Boyd, D., 2010, Privacy and Publicity in the Context of Big Data, *WWW*, Raleigh, North Carolina, April 29.
- [4] Chester, J., 2012, Cookie wars: How new data profiling and targeting techniques threaten citizens and consumers in the "Big Data" era, In Gutwirth et al. (eds.), *European Data Protection: In Good Health?*, B.V: Springer cience+Business Media
- [5] De Filippi, P. and Porcedda, M.G., 2012, Privacy Belts on the Innovation Highway
- [6] Forbes, 2012.2.16, How Target Figured Out A Teen Girl Was Pregnant Before Her Father Did
- [7] Goldberg, N. and Miller, M., 2011, The practice of law in the age of 'Big Data'
- [8] Kuner, C. et als, 2012, The challenge of 'big data' for data protection, *International Data Privacy Law*, 2012, Vol. 2, No. 2, 47-49
- [9] Ohm, P., 2010, Broken promises of privacy: responding to the surprising failure of anonymization, *UCLA LAW REVIEW* 57, 1701-1776
- [10] Rubinstein, 2012, Big data: the end of privacy or a new beginning?, Public law & legal theory research paper series, working paper No. 12-56
- [11] Solove, 2006, A Taxanomy of privacy, *University of Pennsylvania Law Review*, vol. 154, no. 3., 477~560.
- [12] Schwartz, P., 2004, 'Property, Privacy, and Personal Data', *Harvard Law Review*, vol. 117, no. 7., 2055~2128.
- [13] Tene, O. and Polonetsky, 2012a, Privacy in the age of big data: a time for big decision, *StanfordLawReviewOnline*, vol.64, 63~69.
- [14] Tene, O. and Polonetsky, J., 2012b, Big data for all: privacy and user control in the age of analytics, *Northwestern Journal of Technology and Intellectual Property*, Available at SSRN: <http://ssrn.com/abstract=2149364>

The Past and Future of Korea's Information Technology Industry

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Abstract

Many countries drove development of an information society in the 1980s. Korea's information technology industry grew rapidly due to strong government support and aggressive investment by large conglomerates such as Samsung and LG. This paper reviews trends over the past fifteen years in Korea's IT industry, the related economic development, and identifies the issues leading to this progress. It also proposes ways to overcome the slowdown and increase competitiveness for Korea's future. First, it is necessary to strengthen government-industry collaboration. Second, it is crucial to make a fast transfer mechanism for national infrastructure knowledge and benefits to individuals and corporations alike. Finally, it is essential to have proactive investment in the software industry. The results may contribute to guidelines that developing countries may use to manage issues and barriers within IT industry future developments. This may help successfully upgrade Korea's national economy.

Keywords: Korea IT industry, Software industry

I. Introduction

The keen competition since the 1980s, to

establish an information society around the world, accelerated enormous changes and progress in computer and communications' technologies. Since Korea also influenced by this phenomenon, the Korean government announced diverse and strong IT industry driving policies that changed society. From 1987 through 1996, a public, land, and financial information database was built as a foundation for the nation's information society. Consequently, the operational efficiency of the financial industry and public services increased drastically in many ways ultimately improving various public services.

In the 1990s, the information superhighway became a hot issue in the US, Japan, Singapore and Korea. Korean announced its' IT superhighway as a national strategic business, and set up a plan with projects valued at 45 billion dollars between March of 1995 through 2015. Despite the already ambitious goal, the following government expedited completion from 2015 to 2010, and then 2005.

The first stage (1995~97) established the fiber ATM network across 80 national geographical points. The second stage (1998~2000) developed Korea's national information superhighway across 144 major cities - the first in the world. The third stage (2001~2005) established a nationwide

multimedia services' infrastructure to be "anywhere and anytime" (National Information Society Agency, 2005; Kyung J. Park, 2011).

The industry development may directly stem from proactive corporate investment in competitive products and services. Overall results came from a variety of factors including strategic decision-making and top management leadership, wise investment, timely research and development competency, and external factors such as governmental support and increased global market demand. The growth in the IT industry influences other industries, including automobile and shipbuilding which both utilize IT critical parts, but also the IT-based cultural industry and its' media channels. The IT industry tightly correlated with Korea's gross domestic product (GDP) per person. As stated by Foreign Affairs Canada, "the Korean ICT industry is one of the country's most important economic drivers, valued at USD 166.5 billion in 2011.

This paper investigates Korea's last 15 years of IT infrastructure development, including the production and exporting/importing of Korean IT industry. It also identifies characteristics and issues in the domain, and finally proposes ways to increase industrial competitiveness.

History of Korea IT Industry

Korea's Gross Domestic Products per capita

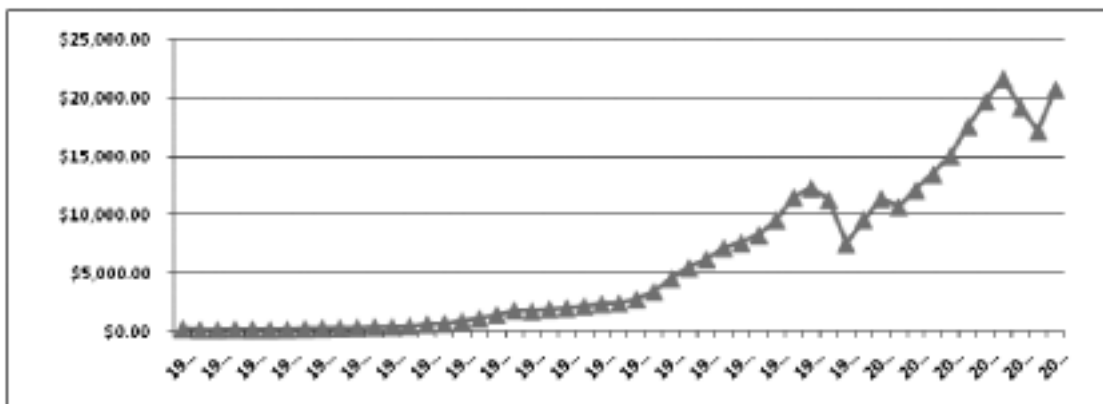
1962 was a monumental year in Korea as the gross domestic product (GDP) per capita exceeded 100 US dollars for the first time (US\$ 103.87). Since then Korea achieved 1,000 dollars GDP per

capita in 1977, 10,000 dollars in 1995, and 20,000 dollars in 2006.

As you can see in <Figure 1>, during the last 50 years, Korea had suffered from only three times of negative GDP per capita growth: first was the sudden death of ex-president Jung Hee Park by shot in 1980, which resulted in a temporary unstable political situation and was settled down in the next year. Second was due to the Asian financial crisis in 1997 whose impact was decrease of 6.85 percent of GDP per capita, and it could be returned to positive growth after three years. Final suffering was from the impact of US subprime crisis. Fortunately, Korea could overcome in a relatively shorter term of period thanks for the rapid growth of China economy and global competitive power of domestic manufacturers. According to the IMF report in 2011, Korea ranked 15th for GDP in the world, and currently explores various nationwide strategies toward 30,000 dollars of GDP per capita.

There are only seven countries in the world whose population is over 50 million and GDP per capita is over 20 thousand dollars: Japan reached in 1987, USA in 1988, France, German, and Italy in 1990, UK in 1996, and South Korea followed briefly in 2006, then stably since 2010 (Source: indexmundi.com, World Bank, and OECD data files). Considering that these countries continue growth above 20 thousand GDP per capita thereafter, it is expected that Korea will keep growing. Korea's impressive economic growth and the correlation to it's' IT industry, provides valuable implications and guidelines for developing countries.

Figure 1 - Korea's GDP per capita (1960-2010)



Source: indexmundi.com, World Bank, and OECD data files

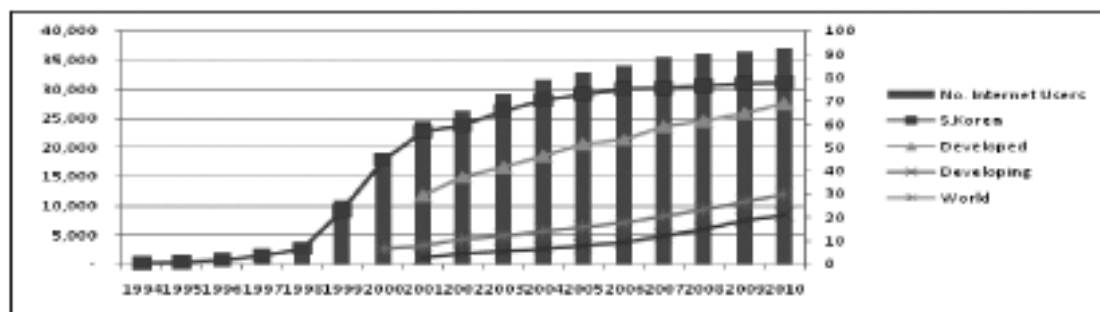
The Information Superhighway Establishment and Internet Users Growth

Internet users (number of internet users) may represent not only the level of a nation's information infrastructure, but also the utilization rate of internet related IT devices and, to some extent, the level of information society. As you can see in <Figure 2>, Korea's internet-users' trend follows a typical S-shaped growth curve. It is directly relate with the Korean government's comprehensive plan and implementation of an information superhighway. As mentioned earlier,

the three-staged plan, that started 1995, allowed Korea to complete its' information highway infrastructure in 2005 and therefore furnish multimedia services to anyone, anytime, and anywhere.

This development led to an explosion in internet users during four years from 1998 through 2001. Korea's internet users' growth curve passed an inflection point, continued to grow to over 40 million users as of June 2012, and reached near saturation across the nation in the mid 2000's (please see <Table 1>).

Figure 2 - Korea's Internet Users Trend (Unit: thousand people, %)



* From 2004, an internet user domestically was defined as a person that uses the internet within the last month and more than once a month, and includes mobile internet usage by cellular phones and portable devices.

Source: (Korea) <http://isis.kisa.or.kr>, (International) ITU Statistics (<http://www.itu.int/ict/statistics>)

Table 1 - Internet Use, Population Data and Facebook Statistics for June 30, 2012

	Population (2012 Est.)	Internet Users (Year 2000)	Internet Users 30-June-'12	Penetration (% Population)	Users % Asia	Facebook 31-Dec-2012
China *	1,343,239,923	22,500,000	538,000,000	40.1 %	50.0 %	633,300
Hong Kong *	7,153,519	2,283,000	5,329,372	74.5 %	0.5 %	4,034,560
India	1,205,073,612	5,000,000	137,000,000	11.4 %	11.4 %	62,713,680
Indonesia	248,645,008	2,000,000	55,000,000	22.1 %	5.1 %	51,096,860
Japan	127,368,088	47,080,000	101,228,736	79.5 %	9.4 %	17,196,080
Korea, North	24,589,122	--	--	--	--	n/a
Korea, South	48,860,500	19,040,000	40,329,660	82.5 %	3.7 %	10,012,400
Singapore	5,353,494	1,200,000	4,015,121	75.0 %	0.4 %	2,915,640
Taiwan	23,234,936	6,260,000	17,530,000	75.4 %	1.6 %	13,240,660
TOTAL ASIA	3,922,066,987	114,304,000	1,076,681,059	27.5 %	100.0 %	254,336,520
United States	313,847,465	33.3 %	245,203,319	78.1 %	46.4 %	166,029,240
Canada	34,300,083	3.6 %	28,469,069	83.0 %	5.4 %	18,090,640
Bermuda	69,080	0.0 %	61,025	88.3 %	0.0 %	30,500
Greenland	57,695	0.0 %	52,000	90.1 %	0.0 %	26,840
WORLD TOTAL	7,017,846,922	360,985,492	2,405,518,376	34.3 %	566.4 %	100.0 %

Source: <http://www.internetworldstats.com/stats3.htm>

As mentioned earlier, the rapid increase in internet users was feasible mainly due to the nationwide information superhighway established by government leadership. Korean government led the public administrative computerization since 1975 under the direction of ex-President Jung Hee Park. Continuing in the 1980's, the government led many national computerization strategies including within the five areas of administration, finance, education, military, and national security (The History of Korean Computerization Policy, 2005).

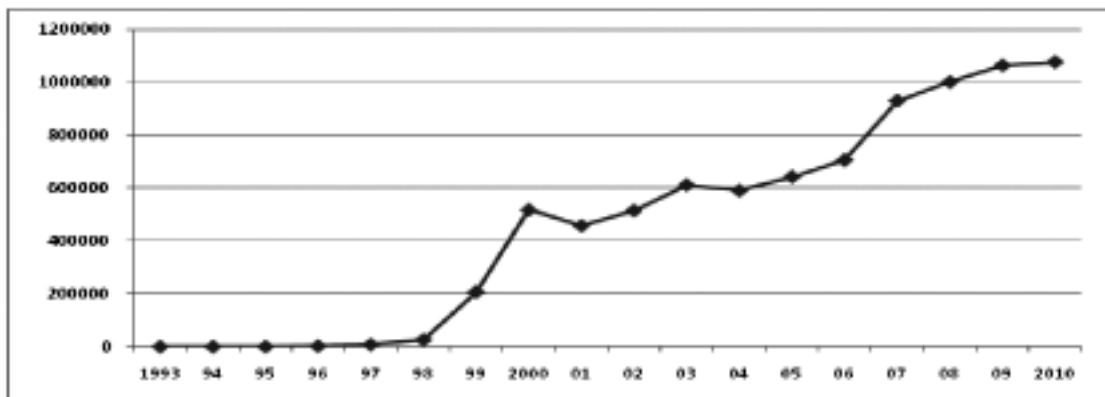
During the 1990's when the world's IT innovations and developments' trends took off, the Korea government organized a national committee to drive the information superhighway in the civilian environment with ex-President Young Sam Kim (1993~98). It also launched the anti-virus computer team and set up 4 separate five-years Computerization Promotion Plans, and continued

to develop a variety of additional plans including public computer education, and implementation of an e-government under a 'Cyber Korea 21' slogan.

Based on strong leadership and support from the government, the number of internet users drastically increased between 2000 and 2002, and e-business ventures became popular. The increase in numbers of '.kr' domain (versus .com) is shown in <Figure 3>.

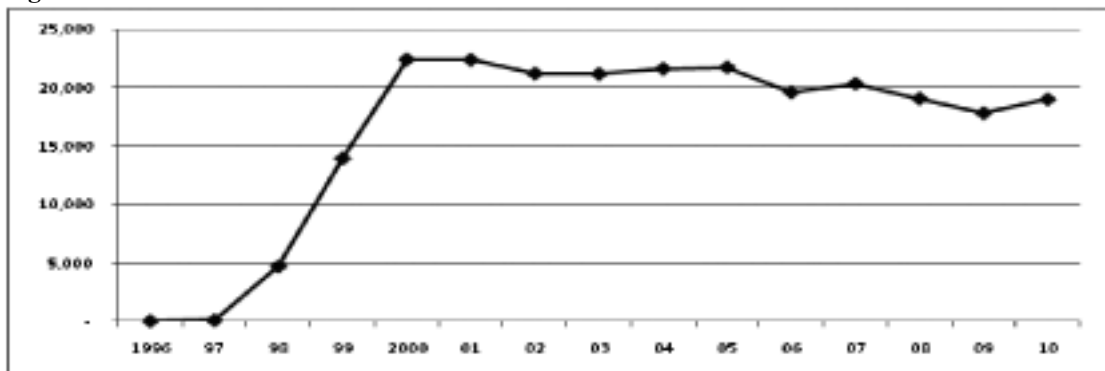
Together with the growth in ".kr" domains, another successful business area involves the internet game industry. Internet games created an enormous boom for internet cafés (please see <Figure 4>). Internet café actually played a critical role in early-stage internet user adoption by providing very easy access opportunities to internet at a low cost for people in their teens to their 40's.

Figure 3 - Growth Trend in '.kr' Domains



Source: Korea Internet Promotion Agency, A white paper on Korea's Internet (2000~2009). (Unit: number of domain)

Figure 4 - Growth in Korea's Internet Café Numbers



Cyber shopping mall transaction values also dramatically increased in the early 2000's due to the information superhighway (please see <Figure 5>). Cyber shopping malls handle standard items such as books, CDs, kitchen utensils as well as fashion clothes, accessories, and foods. It has grown to become a significant channel for purchasing and opens a new paradigm linked to social commerce, and extended not only to B2C (business to consumer), but also B2B (business to business), B2G (business to government), and B2B2C as a variety of business models.

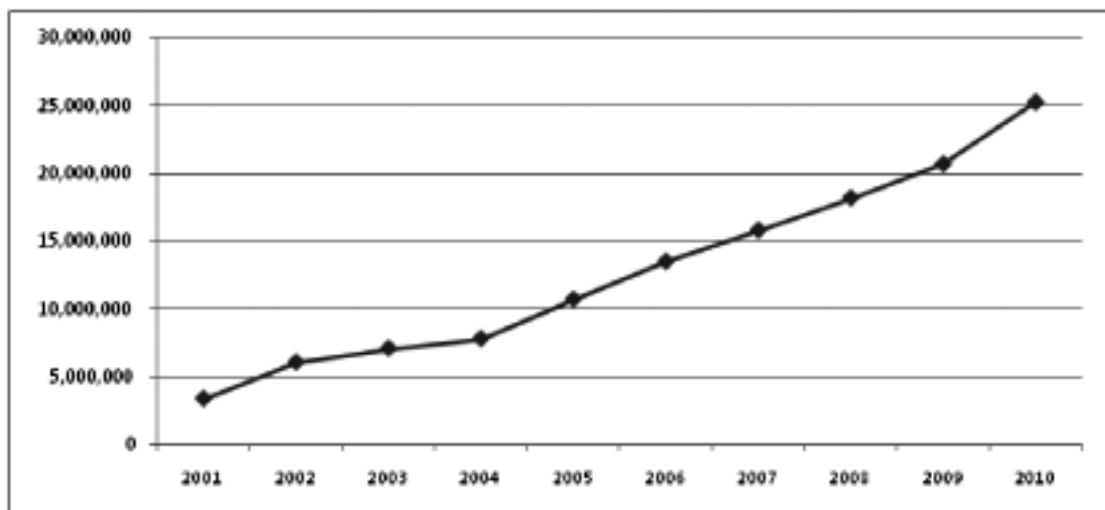
Production and Import / Export of Korea's IT Industry

The world economic recession triggered by the US subprime crisis in 2008 has continued and extended to the European economic crises including Greece and Spain. Consequently, the IT demand slowed down drastically - worse than the IT bubble collapse in 2001. According to Gartnergroup, the overall worldwide IT market of 2009 shrank by 4.5 percent, while computing hardware specifically dropped 12.5 percent.

The IT industry production is generally categorized into three components: (1) ICT devices and

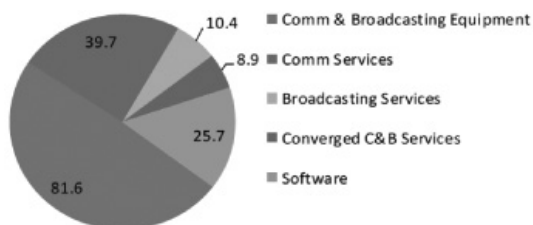
appliances, (2) telecommunications services, and (3) software, which consists of packaged software and IT services. In spite of the world economic slump, Korea's domestic IT production in 2008 was 308 billion dollars, an increase of 8.7 percent over 2007, yet continued to grow 1.1 percent in 2009. Of the three components' production volumes, ICT devices and appliances accounted for 73.1%, telecommunications services 19.3%, and software accounted for 7.6%. As stated above for Canada's Foreign Affairs, the Korean ICT industry is one of the country's most important economic drivers, valued at USD 166.5 billion in 2011. This includes USD 81.6 billion worth of communications and broadcasting equipment, USD 39.7 billion on communications services, USD 10.4 billion on broadcasting services, USD 8.9 billion on converged communications and broadcasting services and USD 25.7 billion on software. Of which, USD 19.7 billion worth of communications and broadcasting equipment and software were exported in the same year, while Korea's import of the same items during the same year were USD 6.5 billion. This sector contributed 11.9% to Korea's Gross Domestic Product (GDP) in 2011 and accounted for 30% of total Korean exports abroad.

Figure 5 - Trend of Transaction Value of Cyber Shopping Mall



Source: Korea Department of Statistics, 'Trend of e-Business and Cyber Shopping Mall (1st Quarter/2011), 2011. 5. (<http://kosis.kr/nsieng/view/stat10.do>)
(Unit: Million KRW)

Figure 6 - ICT Industry in Korea (Unit: \$ 1 billion)



Source: Foreign Affairs Canada (January, 2013) <http://www.tradecommissioner.gc.ca/eng/document.jsp?did=79936>

As you can see in <Figure 6>, in clockwise direction, the communications and broadcasting equipment market was valued at 81.6 billion dollars, communications services market at 39.7 billion Dollars, broadcasting services at 10.4 billion dollars, converged communications and broadcasting services 8.9 billion dollars and software market was valued at 25.7 billion dollars. Mobile handsets remained as a key strength of Korean ICT industry, valued at USD 37 billion in 2011, of which USD 15 billion was exported. By comparison, the country imported USD 2.4 billion worth of mobile handsets in the same year. Samsung, LG Electronics and Pantech were main producers of mobile handsets (Foreign Affairs Canada, 2013).

(1) IT Production of Korea

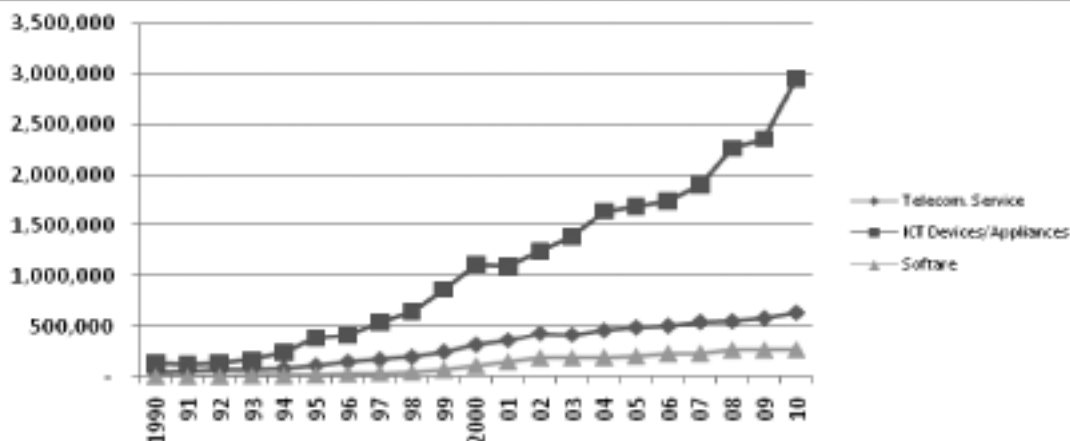
Within overall IT production volume, a dominant

component was ICT devices in the IT industry while telecommunication services and software showed increases that were more moderate (please see <Figure 7>). Computers and monitors were the major export items until 2004, at which point they decreased due to plant relocations overseas. The three new major production items became semiconductors, displays, and cellular phones, including the popular Samsung Galaxy.

Korea's IT production by domestic large companies aligned with the government industrial restructuring drive in heavy and chemical engineering, and electronic industries. For example, Samsung started as a fish and vegetable shop March 1, 1938, then started in electronic manufacturing in 1969, and then jumped into the semiconductor business by merging with the Hankook (or 'Korea') Semiconductor in the 1970s. After the founder passed away in 1987, the CEO and President Kun Hee Lee focused on the IT industry and Samsung Electronics enjoyed miraculous growth due to the phenomenal demand for semiconductors.

In 2009, the production volume of three items explained 62.5% of all ICT devices and appliances, which also accounted for 45.7% of the total IT industry production volume. The largest item was the flat panel display (53.3 billion dollars), and the cellular phone (48 billion dollars), and then the semiconductor (40.8 billion dollars). Digital TVs followed in fourth place with a production volume of just 4.6 billion dollars.

Figure 7 - Korea's IT Production Trend



Source: The Department of Statistics of Korea, 2011. (Unit: 100 million KRW)

Foreign Affairs Canada states: Korea's other main products during 2011 were Digital TVs (USD 5.4 billion), set-top boxes (USD 1.5 billion), and broadband equipment (USD 4.6 billion) exporting USD 1.1 billion worth of Digital TVs, USD 580 million worth of set-top boxes, and USD 1.6 billion worth of broadband equipment. Korean import of these products in the same year was USD 2.7 billion of which import of broadband equipment (USD 2.5 billion) took major share.

ICT service revenues totaled USD 59.2 billion in 2011, achieved mainly from wireless services (USD 18.4 billion), landline telecommunications services (USD 14.6 billion), broadcasting services (USD 10.4 billion), and the converged communications and broadcasting services (USD 8.9 billion). Other than the landline telecommunications services which showed a decrease of 2.1% from the previous year resulting 1.0% growth in telecommunications service, other services such as broadcasting and converged services have shown 8 ~ 14% increase in the same year.

The Korean computer software and service industry produced USD 25.7 billion in 2011 growing by 8% over 2010, led by computer services (USD 22.3 billion) and packaged software (USD 3.2 billion). Samsung SDS, LG CNS, SK C&C and IBM are the major players in the computer service market. Korean export of software was valued at USD 2.4 billion in 2011.

As ICT is an important sector for Korean economy, Korean government has invested USD 884.7 million on research and development in 2011 and will be investing USD 862.8 million in 2012. More needs to be done as outlined herein. Of these investment, more than USD 451.2 million goes into core ICT development.

Although overall Korean economy is underperforming due to global financial situation in 2011 and 2012 the Korean ICT sector is expected to post year-on-year gains. This was made possible by outstanding export growth in Korea's main ICT subsectors as mobile devices (mainly smartphones and tablet PCs) and Digital TV production will surge during the period, partially related to a weak Korean Won which provided a significant advantage to Korean exporters in many foreign markets, as well as

diversified export markets. Although some firms have undoubtedly experienced difficulty owing to the downturn, the overall performance of the sector rather performed well.

(2) IT Export/Import of Korea

Korea's IT industry had a two-digit growth rate up to the early 2000's due to a high volume of exports, rapid technological developments, and increased productivity. IT exports hinge on ICT devices and appliances, especially on very limited hardware items and therefore relies on limited countries.

Korea's total domestic IT industry exports increased from 23.1% in 1998 to 29.4% in 2004 because of major items such as cellular phones, LCD monitors, and setup boxes that have become world class. The over-dependant or skewed phenomenon continues today. In 2009, Korea's major exports were semiconductors, displays, and cellular phones, which accounted for 62.5% of total production of ICT devices and appliances, 45.7% of total production overall, and 71.3% of total exports for the IT industry.

Korea's total IT industry domestic imports decreased from 19.65% in 1998 to 18.2% in 2004, and led to a considerable surplus of goods balance in Korean trade. Since the 2000's, the trade balance took approximately 90% of the total goods balance and played a dominant role in maintaining Korea's trade surplus. The Korean ICT industry is now one of the country's most important economic drivers, valued at USD 166.5 billion in 2011.

However, the export and import of Korea's IT industry was mainly with five countries: China, USA, Japan, Taiwan, and Germany. These five countries IT export records account for 65.1%, approximately 2/3, of total exports. China, specifically, became the top export partner since 2002, while USA accounted for 15.7%, Taiwan for 6.9%, Japan for 6.4%, and Germany for 4.9% in 2004.

In 2009, China (including Hong Kong) and USA accounted for 66.4% of Korea's total trade surplus; EU had 14.1%, and then followed Japan, Mexico, Singapore, and Taiwan respectively. Korea benefited nicely from its diversification efforts

of export markets. The dependence on imports to major countries is still very high – rising to 75.9% for the five major countries for total IT industry import. By nation, China (including Hong Kong) accounted for 24.8%, and Japan for 20.4%, revealing the high dependency on critical parts and increased import volume of raw and subsidiary materials. USA follows with 18% and Taiwan with 10.5%. In 2009, both China and Japan still showed a high dependency on Korea accounting for 48.7%, followed by Taiwan, USA, and Singapore. This implies that the growth of Korea's IT industry may depend on the economic situation of these countries in terms of both exports and imports. It is definitely necessary for Korea to diversify its export markets and import sources in order to provide continuous and stable economic growth.

The proportion of world IT industry by category in 2009 showed that the hardware (computer and communication device/appliance) was 21.7%, the software (including IT service) was 30.9%, and telecommunication service was 47.4%. In the cases of USA and Japan, the software category of high value added domain accounted for over 40% while Korea's hardware industry explained 73.1%, telecommunication service of 19.3%, and software of 7.6%. This proves to be the most vulnerable area. Although the world market for software is drastically growing, Korea's domestic software industry lacks the technical capability to cause an industrial ripple effect. None of the Korean software firms are among the global 100 packaged software companies, and only three IT service companies were included in the global 100 IT service companies in 2009 (Samsung SDS was in the 55th position, LG CNS in the 70th, and SK C&C in the 96th). It is critical that the Korean

government support the software industry from a variety of perspectives for institutional devices, educational contents, policies and so on.

Prospect for the World IT Market

According to Gartner, the world IT market shows that telecommunication service accounts for the largest volume, however the fast growing market is computing hardware (Gartner, 2011). In terms of the geographical areas, the Asia/Pacific area is estimated to have the highest growth rate of 8.35%, followed by Central and South America at 7.0%, then Central and Eastern Europe, and Mideast and Africa with 5.2% each.

As economic growth creates demand in the IT market, different exporting strategies need to be customized for geographical market demands, i.e. depending on the degree of purchasing power, cultural taste, and level of infrastructure of the market.

Discussion and conclusion

Following the Asian financial crisis of 1997 and the US subprime crisis in 2008, the global financial crisis seems to be dissipating. However, it is still uncertain whether the world economy will continue to recover, whether developing countries will stabilize their demand-based growth pattern, and whether the green innovation will be successful in the future. This uncertainty can be detrimental to industrial output, including output from the ICT industry. However, the ICT industry has been cautiously growing and is expected to continue as the market restructures. The restructuring appears to be from hardware to software, including IT service and new emerging paradigm changes with the mobile, 3D, and big data trend in the IT industry.

Table 2 - World IT Industry Market Size Potential (Unit: billion dollars, %)

	2008	2009	2010	2011	2012	2013	2014	2015	CAGR (2010-15)
Computing hardware	379	333	374	409	438	469	505	554	8.2
Software	228	222	237	255	273	291	309	328	6.7
IT service	804	763	785	824	862	901	944	989	4.7
Telecomm.	1,977	1,905	2,011	2,110	2,186	2,271	2,355	2,430	3.9
Total	3,389	3,224	3,406	3,598	3,759	3,932	4,112	4,301	4.8

Source: Gartner, "Gartner Market Databook, 1Q11 Update," 2011. 3. 29

In addition, the market has been moving from advanced countries to emerging markets such as Latin America, Mideast/Africa, and Asia as well. In these emerging markets, the share of the world IT market is increasing due to coexistence of a high preference for brands, competitive prices and a preference for reasonable quality.

The ICT industry contributed as the driving engine for Korea's economic growth, and played the most important role in the recovery from the Asian financial crisis in 1997 and the global crisis in 2008-09. However, many issues remain before Korea enters the matured market stage: unbalanced growth of Korea's ICT industry; lack of competitiveness of software, small and medium business, parts and materials; and information security issues. The importance of business intelligence, based on big data, will sharply increase, especially with the growth in international, free access to online education and communications. This leaves the contents' business and industry, especially for Korea, more popular than ever before. In this turbulent business environment, for increasing competitiveness of Korea's IT industry we can resort to the following:

First, Korea needs to develop a more collaborative government – industry relationship. In the past, correct decisions about world trends in IT led to Korea's current position in the world economy. Proactive investment is now needed in both the information superhighway with infrastructure from the government, and technology innovation investment from the private sector. The future requires this kind of close collaborative relationship to sustain a leading position in the global market. The government should focus particular attention on providing support to maintain and upgrade infrastructure, reinforce R&D and education, and remove the unnecessary regulations to minimize the interferences on corporations.

Schumpeter insisted that the source of technological development in modern capitalism comes from systematic and professional R&D of large organizations rather than the unique ideas of small firms (Schumpeter, 1934). According to him, the R&D performance of large organizations is better than small and medium organizations, in terms of not only quantity, but also quality, because of the economies of scale and the reciprocal complementary relationship between R&D and

non-value added activities such as sales and financial planning. However, this is controversial in that some researchers insist there is a negative relationship between an organizations size and technological innovation due to the increased administration inefficiency (Cohen, 1996, Kim, 2000). Thus considering the fast growth rate and technology intensity in nature of the IT industry, it is very important to distinguish the roles required for success, of government and individual organizations.

Second, it is crucial to set up a quick mechanism to transfer knowledge and benefits from national infrastructure to individuals and organizations. In the past, the internet café boom provided easy access to internet for everyone, thus rapidly raising internet usage. Of course, it is necessary to prepare safety measures for such things as internet addiction, infringement of personal information, and cybercrime.

Critical factors that distinguish the information and knowledge industry from the traditional industry include network externalities, economies of scale, and positive feedback. The knowledge transfer mechanism is expected to strengthen Korea's global competency through network externality by inducing explosive growth after a certain latent period. In order to do so, educational content should be developed systematically, and knowledge sharing systems should be offered freely or at very low cost, and actively used throughout society through various government support policies and media promotions.

Third, it is urgent that we invest proactively in the software industry to secure competitiveness. As mentioned earlier, the software industry consists of packaged software and IT service, and a core industry of the digital economy is to improve productivity and generate high value-added, creative ideas. According to the OECD in 2004, the average growth rate of the world's top ten IT device manufacturers was about 1 percent while the average growth rate of the world's top ten software companies was almost 6 percent. Considering the high contribution rate on economic growth, the investment on software is obviously needed for a value-addition creator. The role of IT service is getting more important for the sophistication and acceleration of industries.

In the past, Korea did not cultivate a software

industry due to the long investment pattern of hardware oriented ICT devices and appliances. It was also hampered by the high entry barriers to global software companies, and thus IT manufacturing is three times bigger than that of IT service. It is necessary to raise a large magnitude of R&D investment to overcome the past constraints and secure the original technologies. In terms of developers or professional human resources, currently the low and medium level human resources will suffice. However, Korea's advanced professionals like system architects are scarce, and with wage levels 10 times higher than that of Indian professionals. There is a lack of human resources and simultaneously a lack of job positions. The initiative to cut this cycle must come from a variety of governmental software promotion policies.

Policies should include strong support for IT business incubator centers, policies for small and medium IT devices and software companies, and vitalization of overseas expansion, and training for professionals. Fortunately, since a motto of the current president Kun Hye Park's government is "creative economy" aligns with software, further development of Korea's software industry in the next five years is expected.

Unfortunately, the IT industry is too broad to cover in detail within one short research paper, all areas such as e-government, information security, mobile, and contents industry. Therefore, further research is needed for a comprehensive study. Second, it would be desirable to conduct a comparative study of other countries to Korea, to propose guidelines for successful development of the IT industry and/or the cultural differences among countries in the future.

Reference

- Cohen, W. "Empirical Studies of Innovative Activity", In *Stoneman, P. ed., Handbook of the Economics of Innovation and Technological Change*, Basil Blackwell, 1996.
- Hong, Dong Pyo, *Structural Change and Reaction Plan in Digital Economy*, Korea Information Society Development Institute, 2003.
- Hwang, Ju Sung, JH Lee, and NK Lee, "Change of Media Usage Pattern Due to the Mobile Internet", Korea Information Society Development Institute, December, 2010.
- Kim, Hyun Chang, *Competitiveness and Policy Issues on Electronic Parts Industry of Korea*, Korea Institute of Finance, 2004.
- Kim, P., "R&D and Firm Sizes in the Information and Telecommunications Industry of Korea", *Small Business Economics*, Vol. 15, 2000, pp. 183-192.
- Kim, Sung Tae, *Toward Another Future – Forecasting and Strategy for National Government*, Bubmunsu, 2007.
- Kim, Sung Tae and et al., *New Challenge and Opportunity of Next Generation of Korea*, 2011.
- Kwon, Ki Duck, "Future Opened by Smart Phone", *Samsung Economic Research Institute*, 2010.
- Park, Kyung Jin, *Information Telecommunication Policy and E-Government*, ORUEM Publishing House, 2011.
- Sohn, Seung Hye, HS Hwang, and YJ Choi, "Use and Effect of Adolescence and Women in Korea", Korea Communications Agency, December, 2010.
- Schumpeter, J. *The Theory of Economic Development*, Harvard University Press, 1934.
- Gartner, "Gartner Market Databook, 1Q11 Update", 2011. 3. 29.
- Annual Report on Information Communication Industry Promotion*, Korea Knowledge Economy, 2010.
- History of Korean Information Infrastructure Development*, Korea National Information Society Agency, 2005.
- Information Security Administration and Policy*, Korea Institute of Information Security and Cryptology, 2002.
- Information Society and E-Government*, Korea Academic Information, 2009.
- IT Industry and Korean Economy*, Korea Information Society Development Institute ed., Bubyongsa, 2005.
- National Informatization White Paper*, Korea National Information Society Agency, December, 2011.
- OECD Education Index*, Korea Ministry of Education and Human Resources Development and Korean Educational Development Institute, December, 2005.
- Understanding and Implementation of Information Ethics*, Korea National Information Society Agency, 2010.
- White Paper on Korean Educational Infrastructure*, Korea Ministry of Education and Science Technology and Korea Education and Research Information Service, December, 2010.
- White Paper on Resolving the Digital Divide*, Korea National Information Society Agency, 2004.
- White Paper on Resolving the Digital Divide*, Korea National Information Society Agency, 2005.
- White Paper on Resolving the Digital Divide*, Korea National Information Society Agency, 2008.
- White Paper on Resolving the Digital Divide*, Korea National Information Society Agency, 2009.
- <http://www.naver.com>, <http://www.etnews.co.kr>
<http://www.mospa.go.kr>, <http://www.kistep.re.kr>
<http://kisa.or.kr>, <http://kiisc.or.kr>

Development of Outbound Tourism Forecasting Models in Korea

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Abstract

This research analyzes the effects of some factors on the demands for outbound to the countries preferred by Koreans such as Japan, China, America, Thailand, the Philippines, Hong Kong, Singapore and Australia. The factors selected for the research are economic variables like Korea Composite Stock Price Index(KOSPI), which could have influences on outbound tourisms and exchange rate and unpredictable factors such as diseases, financial crisis and terrors.

Linear regression analysis was used to identify the cause-and-effect relationship based on monthly data from January, 2001 to December 2010. The result of the analysis shows that both exchange rate and KOSPI have effects on the demands for outbound trips and the former is the more influential a little bit of the two.

But in case of trips to America and the Philippines, the tourists usually have particular purposes like studying, visiting relatives, playing golf or honeymoon so they are less influenced by exchange rate. Beside, Koreans tend not to visit some particular locations for some time when shock reaction happens.

As the demands for outbound travels are different from country to country according to economic variables and shock variables, differentiated measures to overcome the crisis should be taken in order to come close to the target numbers of tourists by switching and creating the demands. In the future, we are going to build outbound tourism forecasting models using Artificial Neural Networks.

Key words:

Demand Forecasting, Stepwise Regression, Artificial Neural Networks

Introduction

As the tourist industry has been growing so rapidly since the overseas trips were liberalized in 1989, this research analyzes the effects of some factors on the demands for outbound to the countries preferred by Koreans such as Japan, China, America, Thailand, the Philippines, Hong Kong, Singapore and Australia. The factors selected for the research are economic variables like Korea Composite Stock Price Index(KOSPI), which could have influences on outbound tourisms and exchange rate and unpredictable factors such as diseases, financial crisis and terrors.

Related Research

Along with the growth in tourism demand in the world, interest in tourism research is growing. Among the important areas in tourism research, tourism forecasting modeling has attached much more attention of both academics and practitioners.

A number of articles on tourism demand forecasting reviewed and categorized by tourism direction, forecasting target level, and forecasting models as followed Table 1. Recently Artificial Intelligence techniques such as Artificial Neural Networks, Case-based Reasoning, and Business Rules are being used besides traditional Time-series analysis and Regression analysis.

Table 1 – Forecasting Models

Direction	Forecasting target level	Forecasting Models		
		Time-series analysis	Regression Analysis	Artificial Intelligence
Inbound tourism	Country level	Yang (1993) Song (2002) Lim and McAleer (2002) Lim and Pan (2005) Song (2007) Lim (1990)	Lee (2006) Sheldon (1993) Dritsakis (2004)	
	Tourism industry level	Kim et al. (1999) Choi (2000)		Cho (2003) Kwak (2007)
	Individual company level	Huh (2001) Cheong (2002) Kim et al. (2006) Kim et al. (2006) Chu (1998)	Shin (2001) Kim and Uysal (1998)	Pattie and Snyder (1996) Rob and Norman (1999) Law, R. and Ray (2004)
Outbound tourism	Country level	Ahn et al. (2005) Park (2004) Yoon et al. (2005) Moh (2008a)	Lim (2006) Moh (2008b) Webber (2001) Moh (2005)	
	Tourism industry level	Kim et al. (2001) Lim (2003) Lai and Lu (2005)	Guthrie (1961) Lim (2003) Moh (2004) Kim et al. (2002)	

Inbound/outbound tourism	Tourism industry level	Choi (1999) Kim (2006) Chi et al. (2009)	Moh (2010) Yoo et al. (2011)	
	Individual company level	Koo (2006)		

Research Models and Methods

We defined independent and explanatory variables as follows. The total number of outbound tourists from Korea and the number of outbound tourists to eight major destinations are defined respectively.

$\widehat{O}_t$: The number of outbound tourists from Korea in month t

$\widehat{JPN}_t$: The number of outbound tourists to Japan in month t

$\widehat{CHA}_t$: The number of outbound tourists to China in month t

$\widehat{USA}_t$: The number of outbound tourists to United States in month t

$\widehat{THA}_t$: The number of outbound tourists to Thailand in month t

$\widehat{PHN}_t$: The number of outbound tourists to Philippine in month t

$\widehat{HKG}_t$: The number of outbound tourists to Hong Kong in month t

$\widehat{SGP}_t$: The number of outbound tourists to Singapore in month t

$\widehat{AUS}_t$: The number of outbound tourists to Australia in month t

KI_t : Average KOSPI in month t

ER_t : Average won-dollar exchange rate in month t

FC_t : Occurrence of financial crisis in month t

ND_t : Occurrence of natural disaster, tsunami in month t

ID_{1t} : Occurrence of infectious disease, SARS in month t

ID_{2t} : Occurrence of infectious disease, H1N1 virus in month t

T_{1t} : Occurrence of terrorism, 911 attack in month t

T_{2t} : Occurrence of terrorism, bombing in the resort of Bali in month t

Stepwise regression analysis was used to identify the cause-and-effect relationship based on monthly data from January, 2001 to December 2010.

$$\widehat{O_t} = \beta_0 + \beta_1 KI_t + \beta_2 ER_t + \beta_3 FC_t + \beta_4 ND_t + \beta_5 ID_{1t} + \beta_6 ID_{2t} + \beta_7 T_{1t} + \beta_8 T_{2t} + \varepsilon_t$$

$$\widehat{JPN_t} = \beta_0 + \beta_1 KI_t + \beta_2 ER_t + \beta_3 FC_t + \beta_4 ND_t + \beta_5 ID_{1t} + \beta_6 ID_{2t} + \beta_7 T_{1t} + \beta_8 T_{2t} + \varepsilon_t$$

$$\widehat{CHA_t} = \beta_0 + \beta_1 KI_t + \beta_2 ER_t + \beta_3 FC_t + \beta_4 ND_t + \beta_5 ID_{1t} + \beta_6 ID_{2t} + \beta_7 T_{1t} + \beta_8 T_{2t} + \varepsilon_t$$

$$\widehat{USA_t} = \beta_0 + \beta_1 KI_t + \beta_2 ER_t + \beta_3 FC_t + \beta_4 ND_t + \beta_5 ID_{1t} + \beta_6 ID_{2t} + \beta_7 T_{1t} + \beta_8 T_{2t} + \varepsilon_t$$

$$\widehat{THA_t} = \beta_0 + \beta_1 KI_t + \beta_2 ER_t + \beta_3 FC_t + \beta_4 ND_t + \beta_5 ID_{1t} + \beta_6 ID_{2t} + \beta_7 T_{1t} + \beta_8 T_{2t} + \varepsilon_t$$

$$\widehat{PHN_t} = \beta_0 + \beta_1 KI_t + \beta_2 ER_t + \beta_3 FC_t + \beta_4 ND_t + \beta_5 ID_{1t} + \beta_6 ID_{2t} + \beta_7 T_{1t} + \beta_8 T_{2t} + \varepsilon_t$$

$$\widehat{HKG_t} = \beta_0 + \beta_1 KI_t + \beta_2 ER_t + \beta_3 FC_t + \beta_4 ND_t + \beta_5 ID_{1t} + \beta_6 ID_{2t} + \beta_7 T_{1t} + \beta_8 T_{2t} + \varepsilon_t$$

$$\widehat{SGP_t} = \beta_0 + \beta_1 KI_t + \beta_2 ER_t + \beta_3 FC_t + \beta_4 ND_t + \beta_5 ID_{1t} + \beta_6 ID_{2t} + \beta_7 T_{1t} + \beta_8 T_{2t} + \varepsilon_t$$

$$\widehat{AUS_t} = \beta_0 + \beta_1 KI_t + \beta_2 ER_t + \beta_3 FC_t + \beta_4 ND_t + \beta_5 ID_{1t} + \beta_6 ID_{2t} + \beta_7 T_{1t} + \beta_8 T_{2t} + \varepsilon_t$$

Experimental Results

The result of the analysis shows that both exchange rate and KOSPI have effects on the demands for outbound trips and the former is the more influential a little bit of the two.

But in case of trips to America and the Philippines, the tourists usually have particular purposes like studying, visiting relatives, playing golf or honeymoon so they are less influenced by exchange rate. Beside, Koreans tend not to visit some particular locations for some time when shock reaction happens.

$$\widehat{O_t} = 16780000 + 1183KI_t - 8968ER_t + \varepsilon_t (R^2 = 0.5651)$$

$$\widehat{JPN_t} = 269800 + 37.24KI_t - 143.3ER_t + 17320FC_t - 31810ID_{2t} + \varepsilon_t (R^2 = 0.6287)$$

$$\widehat{CHA_t} = 40500 + 76.20KI_t - 222.7ER_t - 54990ID_{1t} + \varepsilon_t (R^2 = 0.5958)$$

$$\widehat{USA_t} = 21780 + 14.49KI_t - 10390FC_t - 22860T_{2t} + \varepsilon_t (R^2 = 0.1845)$$

$$\widehat{THA_t} = 140700 - 72.27ER_t - 23730ND_t + \varepsilon_t (R^2 = 0.3694)$$

$$\widehat{PHN_t} = 36370 + 16.54KI_t + \varepsilon_t (R^2 = 0.5304)$$

$$\widehat{HKG_t} = 49020 + 25.39KI_t - 31.77ER_t + 13070FC_t - 14570ND_t - 12180ID_{1t} + \varepsilon_t (R^2 = 0.6392)$$

$$\widehat{SGP_t} = 43520 + 6.157KI_t - 24.59ER_t + 4900FC_t - 8770ND_t - 5815ID_{1t} + \varepsilon_t (R^2 = 0.5554)$$

$$\widehat{AUS_t} = 25970 + 1.880KI_t - 10.63ER_t + \varepsilon_t (R^2 = 0.2959)$$

Conclusion

As the demands for outbound travels are different from country to country according to economic variables and shock variables, differentiated measures to overcome the crisis should be taken in order to come close to the target numbers of tourists by switching and creating the demands.

In the future, we are going to build outbound tourism forecasting models using Artificial Neural Networks. Statistically significant explanatory variables which are found in this research for each regression models will become input nodes and independent variables will become output nodes in Artificial Neural Networks.

References

- [1] Ajayi, R.A., Friedman, J. & M, S. (1998). On the dynamic relation between stock prices and exchange rates: Tests of Granger causality. *Global Financial Journal*, 9(2), 241-251.
- [2] A.V. Vygodina (2006). Effects of size and international exposure of the US firm on the relationship between stock prices and exchange rates. *Global Finance*, 17, 214-223.
- [3] Chu, F.L. (1998). Forecasting Tourism Arrivals : A Combined Approach. *Tourism Management*, 19, 515-520.
- [4] Cho, V.A. (2003). Comparison of Three Different Approaches to Tourist Arrival Forecasting. *Tourism Management*, 24(3), 323-330.
- [5] Crouch, G.I. (1994). The study of International demand : A Review of Findings. *Journal of Travel Research*, 12-23.

- [6] Dritsakis,N. (2004). Cointegration Analysis of German and British Tourism D for Greece. *Tourism Management*, 25, 111-119.
- [7] Dimitrova,D. (2005). "The Relationship between Exchange Rates and Stock prices : Studied in a Multivariate Model. *Issues in Political Economy*, 14, 1-25.
- [8] Frechtling,D.C. (2001). *Forecasting Tourism Demand : Method and Strategies*, B.H: Oxford
- [9] Ferrario F.F (1997). The Evaluation of Tourist Resources : An Apply Methodology. *Journal of Research*, 18-22.
- [10] Holloway,J.C (1990). *The Business of Tourism* , 3rded, London : Pitman Publication. 103.
- [11] H.W.Guthrie (1961). "Demand Tourists Goods and Services in a World Market". *Papers and Proceedings of the Regional Science Association*. Vol.17.
- [12] Jorion,P. (1990). The exchange-rate exposure of U.S. multinationals. *Journal of Business*, 63, 331-345.
- [13] Kim,Y.T. and Uysal,M. (1998). Time-dependent Analysis for International Hotel demand in Seoul. *Tourism Economics*, 4(3), 253-263.
- [14] Lai,S.L. and W.L.Lu (2005). Impact Analysis of September 11 On Air Travel demand in the USA. *Journal of Air Transport Management*, 11(6), 455-458.
- [15] Law,R.and R.Pine (2004). *Tourism demand forecasting for the tourism industry*. The Hong Kong Polytechnic University, Hong Kong.
- [16] Lim,C. (1997). Review of international tourism demand models. *Annals of Tourism Research*, 24(4), 835-849.
- [17] Lim C. and M.McAleer (2002). Time Series Forecasts of International Travel demand for Australia. *Tourism Management*, 23(4), 389-396.
- [18] Lim C,and G.W.Pan. (2005). Inbound Tourism Developments and Patterns in Chine. *Mathematics and Computer in Simulation*, 68(5-6), 498-506.
- [19] Martin.C.A. and Witt.S.F. (1989). Accuracy of Econometric Forecasts of Tourism. *Annals of Tourism Research*, 53, 29-52.
- [20] Mishkin,F.S. (2001). "The transmission mechanism and the role of asset prices in monetray police". NBER Working Paper, 8617.
- [21] Pattie and Snyder (1996). Using a Neyral Network to Forecast Visitor Behavior. *Annals of Tourism Research*, 23(1), 151-164.
- [22] Song,W.G. (2002). Comparing Forecast Accuracy by Time Period in Tourism demand An Application of Different Univariate Time Series Methods. *International Journal of Tourism Sciences*, 2(2), 55-64.
- [23] Song, H. & S. F. Witt (2006). Forecasting international tourist flows to Macau. *Tourism Management*, 27(2), 214-224.
- [24] Sheldon,P.J. (1993). Forecasting Tourism : Expenditures Versus Arrivals. *Journal of Travel Research*, 32(1), 13-20.
- [25] Webbe,A.G (2001). Exchange Rate Volatility and Cointegration in Tourism Demand. *Journal of Travel Research*, 39, 398-405.
- [26] Yoo,K.S (2012). The Effects of KOSPI and Exchange Rate on Outbound, Master's Thesis, Department of Tourism Leisure, Graduate School of Tourism, Kyunghee University.

Why are 3D apparel CADs not used?

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Abstract

A 3D CAD is one of latest innovations in apparel industry. Despite a rapid progress of related technologies and an emergence of several commercial products in markets, an adoption of 3D CAD tools in apparel industry is much slower than originally expected. In an effort to diffuse such a technological advance in apparel industry, more behavioral studies of why and how apparel designers adopt and use a 3D CAD are needed. Toward that goal, this study aims to identify more about whether such an adoption decision would be more associated with organizations or individuals. Using TAM and TOE framework, the study findings show that the intention to adopt 3D garment CAD is more explained by individual attitudes rather than organizational characteristics.

Introduction

Three-dimensional modeling is an outcome of big advances in computer graphics. Such a technology soon began to be utilized in computer-aided design (CAD) as well. 3D CAD is a tool which allows users to create three-dimensional computer-generated imagery and then, based on that, change, stretch, and view that as they wish.

Among many CAD domains, apparel design field has also understood potential benefits from 3D technology. In 1992 Okabe et al. introduced using a three dimensional apparel CAD system. Thereafter, many more studies have been done about 3D apparel CAD system. Most of them, however, have focused on engineering aspects of such system [Kang, et al. 2000a,b; Liu, et al. 2010].

There have been some studies to deal with non-technical issues such as managerial and social aspects of apparel CAD. In an effort to facilitate CAD usage, McLoughlin [1991]

and Bertolotti, et al. [2004] have emphasized that more human-centered approach and more managerial interventions are needed. Though important issues with respect to CAD usage were suggested, their claim was not empirically tested. An empirical study was made by Yan & Fiorito [2007] to investigate why apparel firms adopt and diffuse an apparel CAD. In their study of examining determinants which would influence the diffusion of apparel CAD in apparel industry, they have found that an adoption of apparel CAD was driven primarily by the market pressure [Yan & Fiorito, 2007]. However, 3D CAD was not the target of their study.

3D CAD is an entirely different matter from 2D CAD. Despite the large potential of changing the way an apparel firm does business in future, 3D apparel CAD is being adopted at a lagging pace [Mastnak, 2000]. In his effort to study how British apparel firms adopt and use apparel CAD technologies, Easters [2012] identified that, whilst 2D CAD tools are currently used effectively in most apparel firms, 3D CAD technology is not seen yet as being effective enough. In this regard we believe it is important to understand why apparel designers adopts or not adopts 3D CAD.

Motivated by such concerns, we aim to determine whether the adoption of 3D apparel CAD comes to hinge more on organizational factors or individual designers' attitude. To be more specific, by comparing the power of explanation on the intention to adopt a 3D CAD tool through TOE framework or TAM respectively, we hope to deepen our understanding about the adoption of 3D CAD.

Backgrounds and research models

Models for explaining technology adoption

Why people adopt and use a technology is a major research question in the IS community. As expected,

the IS community attempted to propose a number of models to explain an adoption and use of a technology. These models can be classified into two: individual adoption and organizational adoption.

Among a number of individual adoption models, the most-known one is Technology Acceptance Model (TAM). TAM proposed by Davis [1989] is taking a quite parsimonious approach. That is, adoption intention can be explained by two belief constructs, perceived usefulness (PUS) and perceived ease of use (PEU), and furthermore PEU would have a positive association with PUS, as shown in Figure 1.

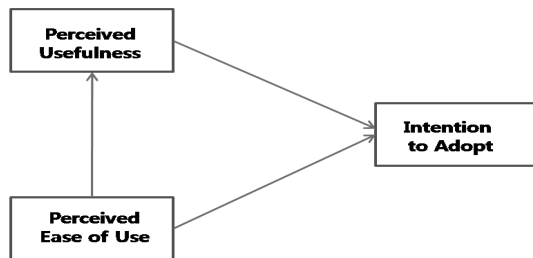


Figure 1- Technology Acceptance Model

Because of the simplicity and the strongly theoretical foundation of the model, TAM has been applied to a wide selection of technologies and users. Subsequently, extensions or revisions to TAM were made in its following studies. TAM2 [Venkatesh & Davis] and Unified Theory of Acceptance and Use of Technology (UTAUT) [Venkatesh, et al., 2003] are good examples. In an effort to compare these models, King & He [2006] has ever found, through a meta-analysis using 88 published TAM studies, that the original TAM is “a powerful and robust predictive model”.

From an organizational perspective, there are two models that have gained much attention from researchers. One is Rogers’ [1962] Diffusion of Innovation (DOI) theory. Using core constructs mainly from sociology, it was designed to explain how innovation spreads through an organization or a society. It was Moore & Benbasat [1991] that adapted its original constructs so that they could be used under individual technology adoption situations.

The second one is Technology-Organization-Environment (TOE) framework developed by

Tornatzky & Fleischer [1990]. This framework has identified three aspects which would influence organization’s technological innovations: technology, organization, and external environment. Figure 2 shows the general model of TOE framework.

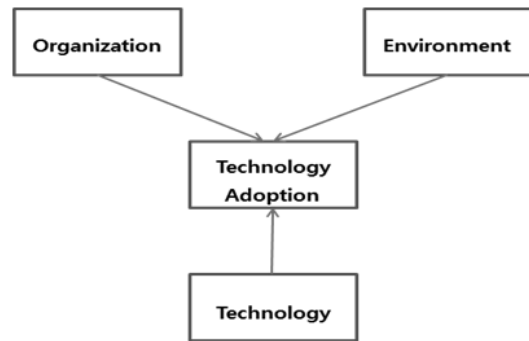


Figure 2 - TOE framework

The use of 3D apparel CAD technology

3D technology is one of latest technical breakthroughs. Each industrial player may adopt and use it in order to upgrade its internal process or to enhance its competitive advantage in the market. Industries following this track include gaming, entertainment, film, product designing, and manufacturing. They use 3D imagery technology as a tool for representation or manipulation, facilitating more automation in their work practices.

Recently apparel industry has also joined such voyage. However, the apparel sector which inherently requires more manual intervention by specialized humans could not achieve as much automation from 3D CAD technology as originally expected [Kang, et al., 2000a]. Most of subsequent studies, therefore, have focused on devising technical solutions or improvements [Kang, et al. 2000a,b; Lie, et al. 2010; Fontana, et al., 2005]. Driven by relentless studies in computer graphics and computer-aided design, major improvements were made with respect to 3D human body measurement and modeling, 3D apparel design on digital human models, 3D draping simulation, and 2D pattern generation from 3D space [Liu, et al, 2010]. Such improvements have contributed to an emergence of a number of commercial products. Nowadays, more than a dozen are available in the market.

An existence of commercial 3D apparel CAD products and an actual adoption and use are a lot different from each other. There are only a few studies about apparel CAD usage. Yan & Fiorito [2007] studied about how CAD/CAM is diffused in the apparel industry. They have found that the higher the external pressure they experience, the more diffused CAD/CAM will be within the firm. However, their study did not include 3D apparel CAD. The sharp distinction between 2D CAD use and 3D CAD use was identified by Easters [2012]. Through a set of interviews with apparel designers and managers, he has found that, whilst 2D CAD tools are currently used effectively in most apparel firms, 3D CADs are not. There is an indication that, unlike 2D CAD, the industry seems to resist the full adoption of 3D technology. Some of the interviewee suggested that 3D CAD would be irrelevant in the design stage. However, this unexpected result was not empirically validated.

Research model and hypotheses

An adoption or intention to adopt an innovative solution within an organization is not a simple decision-making. It is kind of a composite decision in which not only organizational aspects but also individual attitudes need to be reflected. With respect to organizational decisions, it may have to take into consideration whether such technology fits organizational contexts or environmental circumstances of the organization. At the same time how the technology is perceived by individual users in terms of usefulness or ease of use also does a part.

In this study we use TOE framework for organizational decision about 3D apparel adoption. With TOE studies, a wide range of determinants have been suggested in the literature [Wang, et al., 2010; Chau & Tam, 1997; Teo, et al, 2006]. In this study we selected a few determinants which are believed to be relevant to 3D apparel CAD adoption. Relative advantage, complexity, and compatibility were chosen for technological context. Top management support and firm size are the chosen factors for organizational context. And, competitive pressure was selected as one determinant for environmental context.

With respect to the dependent variable, we took into consideration the current situation that 3D

apparel CAD are not heavily adopted and used in the Korea apparel industry. So, instead of the adoption itself, we chose the intention to adopt 3D apparel CAD.

We therefore propose 7 hypotheses as below:

- H1: Relative advantage is positively related to the intention to adopt 3D apparel CAD.
- H2: Complexity is negatively related to the intention to adopt 3D apparel CAD.
- H3: Compatibility is positively related to the intention to adopt 3D apparel CAD.
- H4: Top management support is positively related to the intention to adopt 3D apparel CAD.
- H5: Firm size is positively related to the intention to adopt 3D apparel CAD.
- H6: Competitive pressure is positively related to the intention to adopt 3D apparel CAD.

Regarding individual decision about 3D apparel CAD, we just used two major determinants about individual intention to adopt: perceived usefulness and perceived ease of use [Davis, 1989]. Since the major goal of our study is about the relationship between TAM's two well-known determinants and the dependent variable, the intention to adopt, the relationship between perceived ease of use and perceived usefulness was disregarded.

So, another two hypotheses were proposed as following:

- H7: Perceived usefulness is positively related to the intention to adopt 3D apparel CAD.
- H8: Perceived ease of use is positively related to the intention to adopt 3D apparel CAD.

Research Design

We below describe in brief about the instrumentation, sampling method, and scale validation process.

Instrumentation

Our instrument was constructed by taking and adapting scales from previous studies. Relative advantage (ADV), complexity (CPX), firm size (SIZ), and compatibility (CPT) constructs were adapted from Grover [1993]. Management support (MAN) construct was adapted from Soliman &

Janz [2004] while competitive pressure (PRE) construct from Iacovou et al. [1995].

And, TAM's independent constructs such as perceived usefulness (PUS) and perceived ease of use (PEU) were adapted from Davis' original work about TAM [1989]. Intention to use (INT) construct was adapted from Davis [1989] with a little modification. Each item was measured using a 7-point Likert scale. Table 1 shows the measurement items.

Table 1 - Constructs and measurement items

Constructs	Theory Basis	Item description
ADV	TOE	ADV1 3D apparel CAD will help us to respond rapidly to market. ADV2 3D apparel CAD will help us to eliminate wastes during design stage. ADV3 3D apparel CAD will help us to bring an innovation in the design stage.
CPX	TOE	CPX1 Our firm thinks that it is complicated to use 3D apparel CAD. CPX2 Our firm thinks that complicated procedures are required to implement and use 3D apparel CAD.
CPT	TOE	CPT1 3D apparel CAD can be used associated with existing technology infrastructure (eg., 2D apparel CAD). CPT2 3D apparel CAD can be introduced without major changes in related processes and work practices.
MAN	TOE	MAN1 Our management is likely to invest in 3D apparel CAD. MAN2 Our management is likely to cope with risks occurring at the introduction of 3D apparel CAD. MAN3 Our management is likely to get interest in 3D apparel CAD in order to increase our competitive advantage. MAN4 Our management is likely to think that an introduction of 3D apparel CAD is a strategically important thing to do.
SIZ	TOE	SIZ1 The capital of my firm is high compared to the industry. SIZ2 The revenue of my firm is high compared to the industry.
PRE	TOE	PRE1 My company has ever faced competitive pressure to introduce 3D apparel CAD. PRE2 My company would have faced competitive disadvantage if 3D apparel CAD had not been adopted.

PUS	TAM	PUS1 3D apparel CAD will enhance my job quality. PUS2 3D apparel CAD will enhance my job efficiency. PUS3 3D apparel CAD will enhance my job satisfaction.
PEU	TAM	PEU1 It is not difficult to use 3D apparel CAD. PEU2 It is feasible to understand functionalities of 3D apparel CAD. PEU3 It is accustomed to using apparel CAD-related technologies.
INT	T A M / TOE	INT1 It would be meaningful to use 3D apparel CAD in my work. INT2 It would be desirable to use 3D apparel CAD in my work. INT3 It would be much better for me to use 3D apparel CAD. INT4 Overall, I like using 3D apparel CAD.

Data collection

To collect data for our study, a questionnaire survey was administered in Korea. A mailing list of apparel design professionals compiled by a private apparel CAD training institute was used. The list consists of apparel designers or managers who the institute usually contacts with in order to make an announcement about CAD training program or to help program graduates find a job. E-mail questionnaire was sent to the 148 professionals with a suggestion that email forwarding can be made to some other colleagues in the firm or in the industry as long as they are engaged in apparel design work. We received 80 useful responses. Among them, there were 5 respondents who are working at an organization in which 3D apparel CAD was already adopted. We decided to remove them from our analysis because a study of technology adoption intention presupposes that subjects have not yet decided to use such a technology.

Table 2. Summary of demographic information of respondents

Job title Percentage		Experience Percentage	
Fashion designer	31%	Less than 3 years	15%
Pattern Maker	31	3 – 5 years	12
Grader/Marker	11	5 – 10 years	41
Merchandise	15	10 – 20 years	19
Others	13	More than 20 years	13

As shown in Table 2, most of the survey respondents hold a job title directly related to apparel designing. They seem to have an enough experience to answer about our questions. And, 63% of the respondents had an experience with 2D apparel CAD before.

Data analysis and results

Reliability and validity

For validity analysis, factor analysis with principal components analysis and varimax rotation was used. Though six factors were originally expected, the results indicated that some of construct modification is necessary as shown in Table 3. Competitive pressure and management support were combined into a single factor, implying that the firm's stance to 3D apparel CAD in competitive environments and management's attitude with respect to 3D apparel CAD were viewed similarly. So we just renamed the combined construct as "competitiveness".

And, compatibility and relative advantage were also combined into one factor. We think that apparel designers are having a bigger picture in which both benefits from and prior requirements to 3D apparel CAD are viewed in a holistic sense. The newly integrated construct we call as "feasibility". Two other constructs were classified as expected. TAM's two constructs were classified successfully as shown in Table 4. All of their Cronbach's alpha values also met the criteria a e 0.70, as shown in Table 2 and 3.

Regression analysis

First, the regression analysis based on TOE framework shows a mixed result. As displayed in Table 5, complexity and feasibility were found respectively to be a significant predictor of 3D apparel CAD adoption. It indicates that the more feasible and the easier to use, the more likely apparel designers adopt 3D apparel CAD. However, competitiveness has no relationship with the intention to adopt 3D apparel CAD, implying that they do not yet view 3D apparel CAD as a strategic weapon. It appears that it is contrary to Yan & Fiorito[2007]'s finding. And, the result that there is no association between firm size and the intention may tell us that the amount of investment required in introducing 3D apparel CAD is not a big obstacle to adopting it.

Table 3 - Validity of TOE constructs

	factor				Chronbach's alpha
	1	2	3	4	
PRE1	.834	-.014	.022	.002	0.917
PRE2	.777	.112	.074	-.331	
MAN4	.698	.338	.452	-.091	
MAN3	.669	.357	.505	.005	
MAN2	.608	.480	.509	-.030	
MAN1	.601	.466	.514	.022	
CPT2	.125	.785	.113	.264	0.877
CPT1	-.098	.782	.287	-.195	
ADV2	.419	.690	.143	-.328	
ADV3	.393	.674	.209	-.407	
ADV1	.450	.652	.195	-.416	
SIZ1	.157	.113	.906	-.096	0.879
SIZ2	.136	.252	.865	-.102	
CPXC2	-.044	-.081	.011	.913	0.841
CPXC1	-.122	-.087	-.153	.871	

Table 4 - Validity of TAM constructs

	Factor		Chronbach's alpha
	1	2	
POU2	.925	.301	0.927
POU1	.891	.290	
POU3	.798	.416	
EOU2	.278	.851	0.856
EOU1	.302	.825	
EOU3	.344	.809	

Second, the regression analysis based on TAM, as shown in Table 6, confirms most of findings in previous TAM studies that perceived usefulness is a good predictor about technology adoption intention but perceived ease of use is not.

Table 5 - Regression analysis of TOE framework

model		Unstand. Coeff.		Stand. Coeff.	t	Signif.
		B	Stand. Error	Beta		
1	(constant)	5.249	.984		5.333	.000
	competitiveness	.123	.198	.093	.621	.537
	feasibility	.404	.201	.293	2.010	.048
	complexity	-.419	.136	-.335	-3.083	.003
	size	-.431	.138	-.393	-3.133	.003

Table 6 - Regression analysis of TAM framework

model		Unstand. Coeff.		Stand. Coeff.	t	Signif.
		B	Stand. Error	Beta		
1	(constant)	-.337	.371		-.907	.367
	PUS	.888	.090	.760	9.852	.000
	PEU	.177	.107	.128	1.656	.102

Finally, we compared the explanation power of both models in an effort to determine which models could explain the intention to adopt 3D apparel CAD by apparel designers. R² was used for this purpose. R² in TOE analysis was 0.283 while R² in TAM was 0.438. It indicates that TAM explains today's attitude of apparel designers about 3D apparel CAD much more than TOE does.

Discussion and conclusion

This study has attempted to answer why 3D apparel CAD is not much used as of yet. TOE framework and TAM were applied for organizational and individual perspective, respectively.

The results of our analysis show that feasibility and ease of use (the opposite of complexity) may be a good predictor of 3D apparel CAD adoption. And, perceived usefulness has a strongly positive relationship with the intention, as verified in a majority of existing TAM studies.

Based on the result, we can identify a couple of practical implications. For apparel firms, if they would like to make an innovation with their design process, they need to train their designers so that they can be more experienced with apparel CAD

technologies. And, they may have to streamline different, but closely linked activities. For instance, 2D apparel CAD has been mainly used in pattern-making stage. Fashion designers and apparel merchandisers were mainly not within functionalities of 2D apparel CAD. However, with 3D apparel CAD, the whole process of apparel designing activities including apparel planning, designing, pattern-making, and product simulating need all to be applied. It may be the case that, prior to their introducing of 3D apparel CAD, they have to streamline and adjust these interconnected activities so that these activities become more applicable to 3D apparel CAD.

This study has few limitations. First, we used the same dependent construct, the apparel designers' intention to adopt 3D apparel CAD, for organizational as well as individual perspectives. Organizational-level study should have used organization's intention or attitude, instead. One of prime objectives of this study was to compare the explanation power between organization-level adoption models and individual-level adoption models, so we had to use the same dependable construct. Second, an adoption of an innovative solution within an organization should be sort of a composite decision-making choice in which organizational issues and individual attitudes are all combined and affect each other in a reciprocal way. Such more realistic relationship was not reflected in our study.

Future research may have to incorporate these limitations. And, given the fact that apparel designers apparently have a strong intention to adopt 3D apparel CAD and their organizations actually tend not to adopt it, why is that so? This may probably be an intrinsically more essential question. We may have to borrow ideas from other than technology adoption theories.

References

- [1] Bertolotti, F., Macri, D. and Tagliaventi, M., "Social and organizational implications of CAD usage: a grounded theory in a fashion company," *New Technology, Work and Employment*, vol. 19, no. 2, 2004, pp. 110-127.
- [2] Chou, P. and Tam, K., "Factors affecting the adoption of open systems: an exploratory study," *MIS quarterly*, vol. 21, no. 1, 1997, pp. 1-24.

- [3] Davis, F., "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly*, vol. 13, no. 3, 1989, pp. 319-339.
- [4] Easters, D., "Global communication Part 1: The use of apparel CAD technology," *International Journal of Fashion Design, Technology and Education*, vol. 5, no. 1, March 2012, pp. 45-54.
- [5] Fontana, M., Rizzi, C. and Cugini, U., "3D virtual apparel design for industrial applications", *Computer-Aided Design*, vol. 37, 2005, pp. 609-622.
- [6] Grover, V., "An empirically derived model for the adoption of customer-based interorganizational systems," *Decision Science*, vol. 24, no. 3, 1993, pp. 603-640.
- [7] Heisey, F., Brown, P. and Johnson, R., "Three-dimensional pattern drafting: a theoretical framework," *Clothing Research Journal*, vol. 6, no. 3, 1988, pp. 1-9.
- [8] Iacovou, C., Benbasat, I. and Dexter, A., "Electronic data exchange and small organizations: adoption and impact of technology," *MIS quarterly*, vol. 19, no.4, 1995, pp. 465-485.
- [9] Kang, T., Kim, J. and Min, S., "Development of three-dimensional apparel CAD system Part1: flat pattern drafting system," *International Journal of Clothing Science and Technology*, vol. 12, no. 1, 2000a, pp. 26-38.
- [10] Kang, T., Kim, J. and Min, S., "Development of three-dimensional apparel CAD system Part1: prediction of garment drape shape," *International Journal of Clothing Science and Technology*, vol. 12, no. 1, 2000b, pp. 39-49.
- [11] Liu, Y., Zhang, D. and Yuen, M., "A survey on CAD method in 3D garment design" *Computers in Industry*, vol. 61, 2010, pp. 576-593.
- [12] Mastnajt, R., "3-d scanning and the apparel industry in North America – A new business paradigm," www.techexchange.com, August 2000.
- [13] McLoughlin, I., "Human-centered by design? The adoption of CAD in the UK," *AI & Society*, vol. 5, 1991, pp. 296-307.
- [14] Okabe, H., Imaoka, H. and Niwaya, "Three dimensional apparel CAD system," *Computer Graphics*, vol. 26, no. 2, 1992, pp. 105-110.
- [15] Soliman, K. and Janz, B., "An exploratory study to identify the critical factors affecting the decision to establish Internet-based interorganizational systems," *Information & Management*, vol. 41, no. 6, 2004, pp. 697-706.
- [16] Teo, T., Ranganathan, C. and Dhaliwal, J., "Key Dimensions of Inhibitors for the Deployment of Web-Based Business-to-Business Electronic Commerce," *IEEE Transactions on Engineering Management*, vol. 53, no. 3, August 2006, pp. 395-411.
- [17] Venkatesh, V. & Davis, F., "A theoretical extension of the technology acceptance model: Four longitudinal field studies", *Management Science*, vol. 46, no.2, 2000, pp. 186-204.
- [18] Venkatesh, V., Morris, M., Davis, G. & Davis, F., "User acceptance of information technology: Toward a unified view", *MIS Quarterly*, vol. 27, no. 3, 2003, pp. 425-478.
- [19] Wang, Y., Wang, Y. and Yang, Y., "Understanding the determinants of rfid adoption in the manufacturing industry," *Technological Forecasting & Social Change*, vol. 77, 2010, pp. 803-815.
- [20] Yan, H. and Fiorito, S., "CAD/CAM diffusion and infusion in the US apparel industry," *Journal of Fashion Marketing and Management*, vol. 11, no. 2, 2007, pp. 238-245.

Understanding software developers' intentions to adopt secure coding methods

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Abstract

This study proposed an extended model based on TAM to investigate the impact of two specific constructs of support programs on software developers' intention to adopt secure coding methods. The study findings show that organizational support program will significantly determine users' beliefs such as usefulness and ease of use. Practically speaking, policy makers, professional groups, and top managers of firm should take a lesson that more support programs to assist software developers' adoption of secure coding are well worth.

Regarding organizational support program, it was found to significantly determine both usefulness and ease of use, which implies that management should seek for specific support or investment mechanisms when deploying security-enhancing methods. One may assert that the more concrete support programs organizations have, the more smoothly a security-enhancing measure will be deployed, no matter how intricate it is to follow.

Introduction

Security must be a key feature of today's software system. We need to ensure that software system withstands an ever-present threat from hackers or a non-sparse malfunction caused by inadvertent misuse. Security of the software system can be enhanced in many ways. As software vulnerabilities are continuously exploited [Jones & Rastogi, 2004], software developers are required to write codes in which these software vulnerabilities are eliminated or significantly reduced. Such effort is called as 'secure coding'. Seacord [2006] defines it as a set of efforts to eliminate vulnerabilities resulting from coding errors before deployment.

The secure coding, however, is not an easy task [Graff & Wyk, 2003; Whittaker, 2003]. It contains quite difficult topics [Taylor & Kaza, 2011] such as programming language theory. The real issue is how to increase software developers' awareness about secure coding and how to enhance their ability to apply secure coding principles and techniques [Taylor & Kaza, 2011].

The adoption of a systems development method by software developers represents a significant change in their work practice [Pfleeger, 1999]. Since such change is burdensome to them, they tend to be hesitant to adopt and use it. So, Riemenschneider et al., [2002] emphasized that "organizations attempting to deploy a method tend to face much resistance from individual developers".

As a result, only a few methods have been adopted by software developers even though a wide selection of newly proposed methods has been available in the IS community [Tan, 2006; Recker, 2010]. Organizations, when implementing a new method, may encounter an unnecessary waste of expenditure and effort and an unexpected confusion during development period [Roberts et al., 1998].

These problems and issues have called for research attention in IS community. A few researchers have dealt with the adoption of methodologies or modeling methods. Their main research question was the determination of factors leading to successful adoption of methods. Specifically, Hardgrave et al. [2003] and Riemenschneider et al. [2002] studied software developers' adoption of a methodology while the adoption of process modeling methods was investigated by Recker [2010] and Tan [2006]. Theoretical models utilized in these studies include TAM(Technology Adoption Model), DOI(Diffusion of Innovation), and IT

Continuance Model. These studies have proved that the models originally proposed to describe users' intention of technology adoption would also be applicable to adoption of methods or techniques.

As compared with an existence of a fair number of studies on adoption of general methodologies, we have found only one study having dealt with adoption of secure development methods. Woon & Kankanhalli [2007] investigated factors determining the adoption of secure development method by information systems (IS) professionals. Though it should be credited for the first in this kind, it ranges over a number of secure practices including requirement analysis, design, and coding, etc. Currently the most pressing concern in security domain is secure coding, which is clearly distinct from efforts of other stages in secure software development [Chess & West, 2007; Jones & Rastogi, 2004]. Kumar et al. [2007] emphasizes that no matter how well requirements and design phases are performed, mistakes in coding can still occur since "code is developed by humans and humans are imperfect". Moreover, writing secure codes is quite difficult [Whittaker, 2003; Taylor & Kaza, 2011]. Many organizations are facing a difficulty in successfully deploying secure coding methods.

Motivated by such concerns, we aim to determine factors that may influence software developers' intention to adopt secure coding methods. To be more specific, it is to identify key variables explaining individuals' belief constructs in technology adoption models.

In fact, a number of MIS studies have searched extensively for antecedents influencing belief constructs. The antecedents identified were mainly related to individuals' characteristics (eg., experience [Lederer et al., 2000], self-efficacy [Venkatesh & Davis, 2000; Riemenschneider et al., 2003]) or the nature of technologies (eg., quality [Lederer et al., 2000], relative advantages [Venkatesh et al., 2003]). That seems to be natural because these studies were primarily designed to deal with individual decision of technology adoption. However, organizational issues may have to be taken into consideration as well in situations where the adoption decision is to be made in organizational context. With regard to adoption intention of collaborative commerce,

Zhao et al. [2010] identified organizational support and technical support as antecedents influencing belief constructs. When it comes to social initiatives like secure coding, not only organizational support but also social support may be needed in successfully implementing this initiative. In our study, we reflect both of them as antecedents explaining the TAM's belief constructs in the domain of software developers' intention of secure coding methods adoption.

Backgrounds and research models

Models for explaining technology adoption

Why people adopt and use a technology is a major research question in the IS community. As expected, the IS community attempted to propose a number of models to explain individuals' adoption and use of a technology.

One of the earliest and fundamental models is Theory of Reasoned Action (TRA) developed by Fishbein & Ajzen [1975]. Drawn from the field of social psychology, the model asserts that a person's behavior can be determined by his behavioral intention to perform and such intention would be explained by the person's attitude and subjective norm toward the behavior. Ajzen developed Theory of Planned Behavior (TPB) by adding another construct of perceived behavioral control, which is defined as "the perceived ease or difficulty of performing the behavior" [Ajzen, 1991].

The most-known one is Technology Acceptance Model (TAM). Grounded in the TRA, TAM proposed by Davis [1989] is taking a quite parsimonious approach in that regard. That is, adoption intention can be explained by two belief constructs, perceived usefulness (PU) and perceived ease of use (PEOU), and furthermore PEOU would have a positive association with PU, as shown in Figure 1.

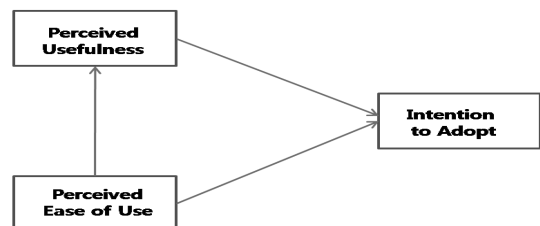


Figure 1 - Technology Acceptance Model

Because of the simplicity and the strongly theoretical foundation of the model, TAM has been applied to a wide selection of technologies and users. Subsequently, extensions or revisions to TAM were made in its following studies. TAM2 [Venkatesh & Davis] and Unified Theory of Acceptance and Use of Technology (UTAUT) [Venkatesh, et al., 2003] are good examples. In an effort to compare these models, King & He [2006] has ever found, through a meta-analysis using 88 published TAM studies, that the original TAM is “a powerful and robust predictive model”.

Adoption and use of a technology can be understood as innovation. Rogers [1962] developed Diffusion of Innovation (DOI) theory to explain how innovation spreads through an organization or a society. Its core constructs are mainly from sociology. It was Moore & Benbasat [1991] that adapted its original constructs so that they could be used under individual technology adoption situations.

An initial adoption of technology does not guarantee its continuous use. After a technology or an information system has been accepted and made available to users in performing their work activities, they may discontinue using it or use it in a way that deviates from the original usage mode. From this point of view, Bhattacharjee [2001], by differentiating initial adoption behavior and post-adoptive behavior, developed IS Continuous Use (ISCU) model. This model posits that the intent to continue using a technology is determined by both perceived performance and post-adoption satisfaction, which are influenced by initial pre-usage expectations.

Intention to adopt systems development methods

Software development method, which is composed of a set of formalized processes, representation constructs, and guidelines/techniques, is designed to improve software development practices. In IS community, having software developers accept and follow such methods means an essential innovation. Since adopting a method represents a greater change in their work practice, they are inclined to resist adoption and use. That is the reason why, despite an abundance of methods proposed for IS community, only a few methods have been widely accepted [Recker, 2010; Tan,

2006].

Such issue was tackled by a few researchers. Their major research question was why and how software developers accept and continue to use software development methods. As one of pioneering studies, Hardgrave et al. [2003] have combined TAM and DOI to come up with a research model in which an intention of methodology adoption can be predicted by belief-related constructs. The empirical result shows that PU, social pressure, compatibility, and organizational mandate were found to influence the methodology adoption intention, with the exception of complexity.

Adoption of process modeling methods were studied by Tan [2006] and Recker [2010b]. In Tan's study, TPB was used as the primary theoretical foundation, with antecedent factors such as modeling method characteristics and institutional factors. Its result shows that TPB validly explains software developers' intention to continue using a modeling method. Furthermore, two institutional factors, training and social influence, were found to have a significant impact of attitude, subjective norm, and perceived behavioral control [Tan, 2006]. Instead, Recker [2010b] used ISCU in explaining software developers' continuous use of process modeling methods. As their antecedent constructs, individual difference factors were employed, which are modeling experience, modeler background, and grammar familiarity. Empirical result indicates that TPB is valid in explaining software developers' intention to continue using a process modeling method and an individual factor, training', can determine both attitude and perceived behavioral control and 'social influence' can determine subjective norm.

With process modeling methods, a comparison among research models was ever made. In Recker [2010a]'s study, TAM, ISCU, and a combined model of the two were examined. As a result, the combined model “apparently outperformed” TAM and ISCU model.

Research model and hypotheses

Research model

xSecure coding is the act of writing source codes which cannot be exploited to perform illegal operations. The basic premise with secure

coding is that in cyberspace there will always be people attacking software systems. There is a fundamental difference between approaches taken by developers and hackers. While developers implements functional requirements so that the application is to perform as intended, attackers are “more interested in what an applications can be made to do and operates on the principle that any action not specifically denied is allowed” [OWASP, 2010]. An application that is coded not in secure way cannot help holding a number of vulnerabilities that later are exploited by attackers.

In that regard, secure coding is an awareness issue. Whittaker [2003] emphasizes that we can “hope to write secure applications” once we come to be aware of exploitable vulnerabilities. Above all things, developers’ awareness of secure coding is the key. Nevertheless, almost all secure coding studies have focused on technical issues [Seacord, 2006; Halfond & Orso, 2005]. It is a good time, though much late, to tackle software developers’ adoption of secure coding methods.

Up to the present, there have been no behavioral studies such as how and why developers perceive, accept, and continue to use secure coding method. There is one study by Woon & Kankanhalli [2007] which investigate whether IS professionals intend to practice secure development (not coding) practices. However, this study covers practices over the whole system development lifecycle. It also surveyed on all categories of IS professional including IT manager, analysts, and project managers, with programmers only 14% in the sample. Therefore, it is considered as a different kind from our study.

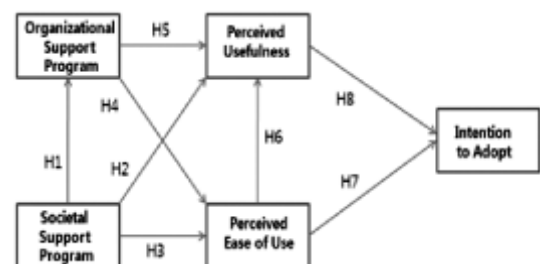
As to whether initial adoption model or continuous usage model is applied, we have decided that initial adoption is more appropriate since secure coding only recently entered scene in IS community. So TAM is the fundamental theoretical framework for our problem and two belief constructs, PU and PEOU, were selected as predictors of methods adoption intention.

Antecedents employed by most of TAM-related studies were individual-level constructs and technology-characteristic constructs. Experience [Lederer et al., 2000], self-efficacy [Venkatesh & Davis, 2000; Riemenschneider et al., 2003] or the nature of technologies (quality [Lederer

et al., 2000], relative advantages [Venkatesh et al., 2003]) are good examples. However, in secure coding what is more important would be organizational or social constructs. It is more reasonable to say that software developers’ adoption of secure method is influenced more by organizational and social issues than individual characteristics of developers.

When organizations deploy an innovation, they should not let it take its own course; all the more so when members within an organization or community would feel much pressure in accepting the innovation. Secure coding is the case. In order for organizational innovation to be successfully deployed, organizational support is needed. Zhao [2010], in the study of adoption of collaborative commerce by organizations, identified organizational support and technical support as antecedents influencing belief constructs. In secure coding, organizations ought to provide secure coding tools like static analysis [Chest & West, 2007] or specialist’ expertise and assistance. So we argue that ‘organizational support program’ is selected as one antecedent. Organizational support program is defined as the extent to which an organization provides aids for its members to perform their work practice.

Figure 2 - Research Model



In some cases an innovation may be just what is demanded at the society level. In order for society members to carry out their daily lives without the least risk, software systems in social IT infrastructure such as banking & finance, e-government, and transportation should be developed and coded in a most secure way. Towards the security-assured society, society has to play its own role. For instance, through a continued monitoring of hacking incidents, some of most critical software vulnerabilities

or risk facing organizations would be compiled and announced for the public on a regular basis. OWASP (<https://www.owasp.org><http://www.sans.org/>) Social support program is defined as the extent to which professional or public entities provide aids for its members to perform their work practice. Figure 2 shows our research model.

Research Hypotheses

Based on the research model, a number of research hypotheses can be derived, as shown below. First of all, an issue-raising by society as a whole can be very effective in increasing its members' awareness about it. Once the importance of a problem is understood by them, they will more actively participate in searching for viable solutions to that problem. Firms as an integral element of society will more likely play their part as well. Open seminars and training programs about secure coding may promote firms to take proactive steps in building secure applications. For instance, firms would probably purchase automatic tools such as static analysis tool and make them available to developers. In this sense, the higher the level of social support program (SSP) the higher the level of organizational support program (OSP).

Hypothesis 1: social support program will positively affect organizational support program.

As always, one can see it as much as he/she knows. Regarding secure coding, professional communities often hold seminars or training programs demonstrating real cases of security breach caused by software vulnerabilities with know-how of how to eliminate these vulnerabilities in source code. It may be the case that, once we come to recognize the importance of secure coding and get to know how to deal with it, we can probably perceive more benefits we may accomplish from secure coding practice.

Hypothesis 2: social support program will positively affect perceived usefulness.

By the same token, people who are educated and trained by social support programs will tend to recognize that much of discomfort and difficulties about an innovation can be removed. Through secure coding training courses, developers learn

why a particular coding practice is prone to be exploited after deployment and how to review codes. Such learning, we think, will lead to a perception that secure coding is not necessarily incomprehensible to ordinary developers and only with proper coding guidelines and secure coding tools one can manage it without great difficulty.

Hypothesis 3: social support program will positively affect perceived ease of use.

In many studies organizational support has been used to explain technology adoption behavior as antecedent [Mahmood et al., 2001; Zhao et al., 2010] and moderator [Lee et al., 2005]. Lewis et al. [2003] demonstrated the influence of organizational factors such as management commitment to new technology on belief constructs. By the same token, in order to successfully deploy secure coding practice, organizations have to provide various support programs. They may include cultivating secure coding specialists and purchasing code analysis tools and making them available to developers. Developers who have experienced such organizational support programs would lead to increase perceived ease of use and perceived usefulness.

Hypothesis 4: Organizational support program will positively affect perceived ease of use.

Hypothesis 5: Organizational support program will positively affect perceived usefulness.

Remaining hypotheses were drawn upon original TAM [Davis, 1989]. TAM proposed two constructs, perceived usefulness and perceived ease of use, as fundamental determinants of technology adoption behavior. At the same time, ease of use was asserted to have an influence on usefulness.

Hypothesis 6: Perceived ease of use will positively affect perceived usefulness.

Hypothesis 7: Perceived ease of use will positively affect behavioral intention.

Hypothesis 8: Perceived usefulness will positively affect behavioral intention (INT).

Research Design

We below describe in brief about the instrumentation, sampling method, and scale validation process.

Instrumentation

Our instrument was constructed by taking and adapting scales from previous studies and by constructing new scales where necessary. INT items were adapted from Hardgrave et al. [2003], using 2 items. PEOU items were from Lucas & Spitler [1999] and adapted for secure coding. PU measure was newly constructed based on Davis[1989]'s scale. His scale consists of 6 items: increase in 1) job performance, 2) productivity, 3) effectiveness, 4) efficiency, 5) task manageability, and 6) value on the job. Since the domain of our study is development methods, not a particular technology, we find some of the above 6 items are less relevant to our study and some would be better combined together. So, we used 3-item scales: 1) increased level of security in software system (similar to Davis's item 3), 2) decreased development cost which corresponds to direct outcome of secure coding (similar to Davis's item 2 and 4 combined) and 3) decreased maintenance cost which corresponds to outcome expected after the developed system is delivered (new item). Both OSP and SSP, because we did not find any prior study using these constructs, were constructed using 2-item scale. And, each item was measured using a 7-point Likert scale. Appendix A shows the measurement items.

Data collection

In order to test the above hypotheses, a field survey of developers who participated in a secure coding seminar held by a security-related public agency was conducted. The seminar was aimed to improve secure coding-related capabilities of developers employed by software development contractors whose main business is the development of government-operating systems. This seminar was for free and all the participants were voluntary. Through a previous consultation with the seminar organizer, we were allowed to conduct a survey on the seminar site. On the spot, a questionnaire was handed out together with seminar printed materials upon their sign-up at the registration desk. And at the beginning session of the seminar we were allocated a few minutes for conveying a brief introduction of survey

objectives. Participants were asked to fill out the questionnaire during coffee breaks and return it to the desk when leaving the room at the end.

Out of 138 forms handed out, 83 responses were collected yielding a response rate of 60.1%. With incompletely answered questionnaires of 4 excluded, the study used 79 samples for the analysis.

Table 1 - Summary of demographic information of respondents

Job title Percentage		Experience Percentage	
Programmers	70.9	Less than	29.1
System Designer	13.9	3 years	16.5
Tester	10.1	3 – 5 years	15.2
Project Manager	5.0	5 – 7 years	19.0
		7 – 10 years	20.2
		More than 10 years	

As shown in Table 1, all of the survey respondents hold a job title directly related to system development. Among them, more than 80% are programmers and testers who are supposed to deal with program codes. With respect to experience, survey respondents are diversely distributed.

Data analysis and results

Reliability and validity

For validity analysis, factor analysis with principal components analysis and varimax rotation was used. At the initial run of factor analysis, PU3 item itself was found to become a category. We decided to remove the item because the respondents are developers who were contracted to develop a system, not to do maintenance work after its deployment. In public entities, provision of system maintenance service is a totally separate contract, in which respondents have no interest. Table 2 shows the final run's factor loading values of the remaining items along with Chronbar's α .

To assess item reliability, we used square factor loading. The remaining 10 items all have met the criteria with SFL ≥ 0.50 . All of their Cronbach's alpha values also met the criteria $\alpha \geq 0.70$, as shown in Table 3. With composite reliability r ranging from 0.80 to 0.95, it was found to meet the criteria $\rho \geq 0.70$. And, to test convergent validity, average variance extracted (AVE) was

used. AVE values of all 5 constructs ranged from 0.66 to 0.91, meeting the criteria $AVE \geq 0.50$.

Table 2 - Validity of constructs

	component					Chronbara
	1	2	3	4	5	
INT1	.930	.117	.103	.234	.114	0.954
INT2	.925	.070	.080	.290	.054	
OSP1	.032	.843	.262	.198	.239	0.809
OSP2	.188	.776	.275	.102	.302	
PEOU1	.082	.246	.859	.207	.176	0.843
PEOU2	.118	.282	.832	.119	.244	
POU1	.231	.163	.153	.841	.204	0.798
POU2	.352	.120	.167	.821	.010	
SSP1	.109	.304	.242	.139	.887	0.915
SSP2	.097	.548	.324	.117	.692	

5.2 Structural equation modeling

Our research model was tested by structural equation modeling using AMOS with maximum-likelihood estimation. In structural equation modeling, model fit is indicated by various indices. As indicated in Table 3, all model fit indices met the recommended criteria.

Table 3 - Reported values of model fit

Model Fit Index	Recommended Values	Reported Values
X^2	$p \geq 0.05$	$P = 0.826$
X^2/df	≤ 3.00	0.191
GFI	≥ 0.90	0.998
AGFI	≥ 0.80	0.985
NFI	≥ 0.90	0.998
CFI	≥ 0.90	1.0
RMR	≤ 0.09	0.023
RMSEA	≤ 0.10	0.000

An analysis of causal relationships in the research model is next. Figure 3 shows its results with estimated path coefficients and associated t value. Only POU was found significantly affecting INT (H8) ($\beta = 0.58$, $t = 5.57$) while EOU had the indirect impact on INT through its significant direct effect on POU (H6) ($\beta = 0.22$, $t = 1.94$).

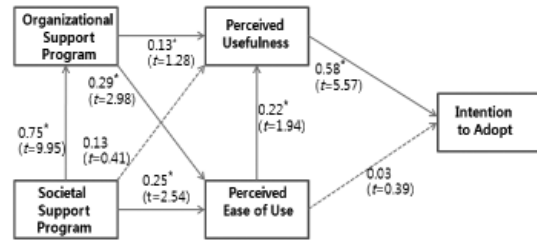


Figure 3- Results of structural model analysis

SSP, as posited in our research model, significantly influenced OSP (H1) ($\beta = 0.75$, $t = 9.95$) and also had the significant effect on PEOU (H3) ($\beta = 0.25$, $t = 2.54$) while its impact on POU (H2) was found insignificant ($\beta = 0.13$, $t = 0.41$). With OSP, it has significantly affected both POU (H4) ($\beta = 0.13$, $t = 1.28$) and PEOU (H5) ($\beta = 0.30$, $t = 3.17$). All things considered, the research model explained 32.4% of the variance in INT, 42.2% in EOU, 18.7% in POU, and 55.4% in OS.

Discussion

Theoretical Implication

An adoption of software development methods has been studied by a few MIS researchers. Their major research question was to identify factors that influence a firm's smooth introduction of systems development methodologies or modeling methods. Methods mainly covered in their study include Structured Methodology, Object-oriented Methodology, and various processing modeling methods. A decision to introduce such methods within a firm completely falls under the control of the firm. There exist development methods, an introduction of which matters not only to an organization but also to society as a whole. Secure coding method is a good example. Our research enriches the existing methods adoption literature in that not only organizational concerns but also social issues are suggested to be taken into consideration.

Perceptions and beliefs about innovation are not identical across individuals [Lewis et al., 2003]. Therefore, how individuals form beliefs about their use of innovation and in more specific what antecedents influence users' belief about technology use has become an important research issue. Actually, many studies were made in this direction. Since the theoretical frameworks

these studies were based upon are of individual adoption behavior models such as TAM and TPB, it is quite natural for these studies to have started to use individual-level antecedents. In the effort to increase more explanation power, Lewis et al. [2003] came to introduce additional antecedents from organization-level and society-level [Igbaria, et al. 1997]. In more specific, management commitment and social norms which correspond to indirect and attitudinal support were used. Their model also postulated that organizational and social factors have an impact not on PEOU and on POU only. Their study findings, however, have shown that social factors had no influence on users' beliefs.

In contrast, we introduced antecedents representing concrete events and investments which can be made directly by management, organization, and society. Our research model also established the influence of social support on organizational support and the influence of organizational and social factors on PEOU, which were missing in Lewis et al.'s study. That is, this study can be evaluated significant in that a comprehensive relationship between user beliefs constructs and their antecedents including organizational and social factors.

Practical Implication

The proposed research model and the study findings provide important guidance to companies and society as a whole to look into their support program aspects that affect software developers' acceptance of secure coding methods. The study found that perceived usefulness is a major determinant of the intention to adopt. It implies that usefulness is more important even though ease of use is clearly influencing usefulness.

Regarding organizational support program, it was found to significantly determine both usefulness and ease of use, which implies that management should seek for specific support or investment mechanisms when deploying security-enhancing methods. One may assert that the more concrete support programs organizations have, the more smoothly a security-enhancing measure will be deployed, no matter how intricate it is to follow.

The study findings also have a key implication on policy makers. Social support program was

found to have an impact on ease of use, implying that up-to-dated guidelines and relevant training programs about secure coding which are offered by professional and public entities will help software developers feel equal to follow secure coding practices. The found influence of social support on organizational support also indicates that the publicly available support programs will lead to increase management's awareness about security-enhancing measures and promote their security-related investment.

Study limitation

One major limitation of this study is the sample size of 79 which is much lower than the generally required level, 150-200. A caution in research methodology when applying TAM is that you have to assure that respondents are expected to know about the target innovation which has never been explored yet. Therefore, with TAM, we are recommended to take a field study. In this sense, we have decided a public seminar event as the field site. While "sample size requirements remain a vexing question in SEM based studies" [Westland, 2010], the lower sample size might be an inevitable consequence of our decision. As a matter of fact, we could not forecast accurately the total number of attendees in advance.

When it comes to managerial or social support, a variety of support can be employed. With this study, only support programs such as direct investment, guidelines set-up, and training programs, are covered. An integrated view of combining these various types of support programs could have provided a deeper understanding about determinants of developers' beliefs about secure coding methods.

Conclusion

This study proposed an extended model based on TAM to investigate the impact of two specific constructs of support programs on software developers' intention to adopt secure coding methods. Given the finding of social and organizational support being able to increase developers' beliefs about methods adoption, all the interested parties such as policy makers, professional groups, and top managers of firm should take a lesson that more support programs

to assist software developers' adoption of secure coding are well worth. For further studies, one may evaluate the hypothesized model with a larger sample. Also, extension of support can be made in future studies to include other antecedents such as managers' attitudinal aspects and social awareness

References

- [1] Ajzen, I., "The theory of planned behavior," *Organizational Behavior and Human Decision Processes*, vol. 50, no. 2, 1991, pp. 179-211.
- [2] Bhattacharjee, A., "Understanding information systems continuance: An expectation-confirmation model", *MIS Quarterly*, vol. 25, no. 3, 2001, pp. 351-370.
- [3] Chess, B. & West, J., *Security Programming with Static Analysis*, Addison-Wesley, 2007.
- [4] Gefen, D. & Mark, K., "The impact of developer responsiveness on perceptions of usefulness and ease of use: An extension of the technology acceptance model", *The DATA BASE for Advances in Information Systems*, vol. 29, no. 2, Spring, 1998.
- [5] Graff, M. & van Wyk, K., *Secure Coding: Principles & Practices*, O'Reilly, 2003.
- [6] Halfond, W. & Orso, A., "Combining static analysis and runtime monitoring to counter SQL-injection attacks", *ACM SIGSOFT Software Engineering Notes*, vol. 30, no. 4, July 2005, pp. 1-7.
- [7] Igbaria, M., Sinatelli, N., Cragg, P. & Cavaye, A., "Personal computing acceptance factors in small firms: A structural equation model," *MIS Quarterly*, vol. 21, no. 3, 1997, pp.279-305.
- [8] Jones, R. & Rastogi, A., "Secure coding: Building security into the software development cycle", *Information Systems Security*, vol. 13, no. 5, 2004.
- [9] Kozar, K., "Adopting systems development methods: An exploratory study", *Journal of Management Information Systems*, vol. 5, no. 4, pp. 73-86, 1989.
- [10] Kumar, R., Pandey, S. & Ahson, S., "Security in Coding Phase of SDLC", *Third International Conference on Wireless Communications and Sensor Networks*, 2007, Dec. 13-15, pp. 118-120.
- [11] Lederer, A., Manpin, D., Sena, M. & Zhuang, Y., "The technology acceptance model and the World Wide Web," *Decision Support Systems*, vol. 29, no. 3, 2000, pp. 269-282.
- [12] Lee, H., Lee, Y. & Kwon, D., "The intention to use computerized reservation systems: the moderating effects of organizational support and supplier incentive", *Journal of Business Research*, vol. 58, 2005, pp. 1552-1561.
- [13] Lewis, W., Agarwal, R. & Sambamurthy, V., "Sources of influence on beliefs about information technology use: An empirical study of knowledge workers", *MIS Quarterly*, vol. 27, no. 4, 2003, pp. 657-678.
- [14] Lucas, H. & Spittler, V., "Technology use and performance: A field study of broker workstations," *Decision Sciences*, vol. 30, n. 2, Spring 1999, pp. 291-311.
- [15] Mahmood, M., Burn, J., Gemoets, L. & Jacquez, C., "Variables affecting information technology end-user satisfaction: a meta-analysis of the empirical literature", *International Journal of Human-Computer Studies*, vol. 52, 2000, pp. 751-771.
- [16] Pfleeger, S., "Understanding and Improving Technology Transfer in Software Engineering", *Journal of Systems and Software*, vol. 47, no. 2-3, July 1999, pp. 111-124.
- [17] Recker, J., "Explaining usage of process modeling grammars: Comparing three theoretical models in the study of two grammars", *Information & Management*, vol. 47, no. ?, 2010a, pp. 316-324.
- [18] Recker, J., "Continued use of process grammars: The impact of individual difference factors", *European Journal of Information Systems*, vol. 19, 2010b, pp. 76-92.
- [19] Riemenschneider, C., Hardgrave, B. & Davis, F., "Explaining software developer acceptance of methodologies: A comparison of five theoretical models", *IEEE Transactions on Software Engineering*, vol. 28, no. 12, December 2002, pp. 1135-1144.
- [20] Riemenschneider, C., Harrison, D. & Mykytyn, P., "Understanding IT adoption decisions in small business: Integrating current theories", *Information & Management*, vol. 40, 2003, pp. 269-285.
- [21] Roberts, T., Gibson, M., Fields, K. & Rainer, R., "Factors that impact implementing a system development methodology", *IEEE Transaction on Software Engineering*, vol. 24, no. 8, Aug. 1988, pp. 640-649.
- [22] Seacord, R., "Secure coding in C and C++ of strings and integers," *IEEE Security & Privacy*,

- vol. 4, no. 1, 2006, pp. 74-76.
- [23] Tan, X., Understanding Information Systems Developers' Modeling Method Continuance: A Theoretical Model and an Empirical Test, Ph.D. Thesis, University of Nebraska, 2006.
- [24] Taylor, B. & Kaza, S., "Security Injections: Modules to help students remember, understand, and apply secure coding techniques", ITiCSE, June 27-29, 2011.
- [25] Venkatesh, V. & Davis, F., "A theoretical extension of the technology acceptance model: Four longitudinal field studies", Management Science, vol. 46, no.2, 2000, pp. 186-204.
- [26] Venkatesh, V., Morris, M., Davis, G. & Davis, F., "User acceptance of information technology: Toward a unified view", MIS Quarterly, vol. 27, no. 3, 2003, pp. 425-478.
- [27] Westland, J., "Lower bounds on sample size in structural equation modeling", Journal of Electronic Commerce Research and Applications, vol. 9, no. 6, Nov. 2010, pp. 476-487.
- [28] Whittaker, J., "Why secure applications are difficult to write", IEEE Security & Privacy, March/April, 2003, pp. 81-83.
- [29] Woon, I. & Kankanhalli, A., "Investigation of IS professional s' intention to practice secure development of applications," International Journal of Human-Computer Studies, vol. 65, 2007, pp. 29-41.
- [30] Zhao, H., Yang, J. & Wang, X., "Research on antecedent of adoption intentions of collaborative commerce based on TOE and TAM," 2010 International Conference on E-Business and E-Government, 2010, pp. 332-335.

Appendix A: Constructs and measurement items

Perceived Usefulness	PU1 Following secure coding practices would improve the robustness of software I develop. PU2 Following secure coding practices would reduce the total development cost of software I develop. PU3 Following secure coding practices would reduce the maintenance cost of software I develop.
Perceived Ease Of Use	PEOU1 I would easily acquire knowledge needed for secure coding. PEOU2 I would easily apply secure coding-related knowledge to my work practice.
Social Support Program	SSP1 I am provided with a list of software vulnerabilities, which are identified in real hacking incidents and released by professional communities on a regular basis. SSP2 If I want, I would not have any problem in finding and taking secure coding-related training programs opened by public agencies.
Organizational Support Program	OSP1 I would get assistance from secure coding specialists within the organization, if needed. OSP2 I would be able to use secure coding analysis tools within the organization, if needed.
Intention to Adopt	INT1 I have an intention to follow secure coding practices. INT2 I have an intention to comply with secure coding standards and guidelines.

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