The combination of diffusion model and learning effect model to evaluate the policy impact of Cancer Control Act

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Abstract

Considering the social high incidence and mortality rate of cervix cancer, the government provides a free medical service of Pap smear test based on the Cancer Control Act regulated in 2003. This paper attempts to understand the impact of policy implementation for Pap smear test and employs the diffusion model, learning model and integrating model respectively to examine the diffusion of Pap smear test promotion. The results show that all the three models are statistically fitted, i.e. diffusion effects, learning effects, and interaction effects exists and may explain the trend of Pap smear test. The policy of the Cancer Control Act is also found to significantly affect the adoption of Pap smear test.

Keywords: Diffusion Model, Learning Model, Integrating Model, Cancer Control Act

1. Introduction

With the rapid economic development of society, the lifestyles change fast and also bring many serious public health problems in Taiwan. Since 1982, malignant neoplasm has become the first leading cause of mortality rate in Taiwan. In order to retard the high mortality causing from cancer, Department of Health, Executive Yuan implements serious countermeasures and regulates the "Cancer Control Act" as a guideline to enhance the rate of cancer screening that is believed to be an effective and

preventive method for and the reduction in the incidence of cancer. According to Cancer Control Act, some cancer-control programs are adopted to improve the medical behavior of population for improving the cancer problem (Bureau of Health Promotion Annual Report, 2012). The strategy of cancer-control programs is to increase the amount of cancer screening to detect the cancer in the early stage. Chen et al. (2007) propose that cancer screening is a powerful tool to detect cancer and may provide a highly effective medical treatment for curing cancer in the early stage. Bharel et al. (2009) indicate that surveillance of cancer screening may detect cancers at an early stage when they can be treated most effectively. Yang et al. (2011) indicate that the incidence and mortality rate of cervical cancer may decrease dramatically by using the Papanicolaou (Pap) smear test. Therefore, Department of Health devotes to increase the rate of cancer screening for retarding the impact from cancer.

Figure 1 indicates that the mortality rate of cervical cancer trend during 1995-2008. In contrast, the incidence rate of cervical cancer had an increasing trend from 1995 and reached a peak during the period of 1996-2000, after 2000 it almost declined except 2004. The incidence rate of cervix uteri cancer ranks the top among cancers in Taiwan, increasing from 32% in 1995 to 52% in 2002 (Department of Health, 2012), and then drop to 44% in 2008. Currently, the incidence rate still remains at high ends and causes the high mortality to women in Taiwan. In the meantime, Department of Health has set a well-established guideline

for routine screening to help patients and physicians make decisions for screening.

The National Health Insurance (NHI) program offers the free service of Pap smear test for every female aged 30 and above, and the government also offers some service that may minimize the financial barrier for every female in Taiwan. However, the rate of Pap smear test is not satisfied and does not match the goal set by government, increasing from 9.7 % in 1997 to 29.7 % in 2010 (Department of Health, 2012) .The promotion of the NHI program depends on many factors. At first, the government has to understand the barriers that cause females to refuse the service of Pap smear test. In order to eliminate the barriers, we analysis the risk factors of Pap smear test that may affect the service of cancer screening spreading in the social network.

Figure 1. The incidence and mortality rate of cervical cancer

The free Pap smear test is treated as a new service provided by government in this paper. In practice, the main participants of Pap smear test promotion require the integration of the government, non-government organizations and individual stakeholders. Government dominates Pap smear test promotion government by implementing policies while individual stakeholders are regarded as adopters of such new service. The government has to keep continuous efforts to enhance the performance of organization by expanding the employee capacity through the reform of management system and the improved organizational learning.

In this paper, the performance of Pap smear test promotion may attribute to diffusion effect and organizational learning effect. Redmond (2004) proposes that diffusion effect describe the new service spread in the social network and transfer the information of new service by social network. Diffusion is defined as an phenomenon that an innovation service communicates through certain

channels among the members in the social network over time (Rogers, 2003). Montalvo and Kemp (2008) propose that diffusion can be treated as an adoption process of new technology by population in social networks overtime and the process implies that the potential may adopt the new innovative product by learning the existence information through the direct relationship between a potential adopter and a user. In society networks, the information of technology can be exchanged and continue the process of experimentation with them, are the essential element in the diffusion of innovation. Therefore, the performance of Pap smear test promotion is regarded as the result that females adopt the innovative service of Pap smear test provided by government.

The performance of organization can be improved by experience and the activity of organizational learning that includes the acquisition of explicit and tacit knowledge, knowledge sharing, and knowledge use (Chen and Chang, 2010). Organizational learning is the capability “within an organization to maintain or improve performance based on experience. This activity involves knowledge acquisition (the development or creation of skills, insights, and relationships), knowledge sharing (the dissemination to others of what has been acquired by some), and knowledge utilization (integration of learning so that it is assimilated and broadly available and can be generalized to new situations)” (DiBella et al., 1996, p. 363). Organizational learning plays an important rule to enhance the competitive advantage and improve the organizational performance (García-Morales et al., 2012).

The communication between users and potential adopters is the main factor as technology diffusion. The diffusion effect will occur while personal contacts and imitations have interaction between users and adopters potentials in the social network. In contrast, an activity within the organized and developed process in the organization by the interaction between employees will bring the learning effect that can be treated as an intra-firm diffusion process. Therefore, we treated females as adopter population for Pap smear test when learning effect takes place within the organizational structure of Department of Health.

In this paper, we analyze diffusion effect, organizational learning effect and interaction effect by developing three mathematical models in term of the model proposed by Chen and Chang (2010). We also discuss the policy and other factors that may affect the diffusion process by incorporating these factors into model. In

addition, we discuss the interaction effect between the diffusion effect and organizational learning effect and analyze the role of interaction effect that affect the promotion of Pap smear test. We propose that interaction effect may influence the promotion of Pap smear test by integrating system including National Department of Health and females, and bring about the success management in National Department of Health.

2. Methods

2.1 Diffusion model

The diffusion process implies a communication process that spreads the information between the users and potential adopters over time in the social networks, and thus the process may change the behaviors and perception of potential adopters by imitation and learning (Chen and Chang, 2010; Rogers, 2003). The Bass model is, in general, employed to describe the diffusion pattern for the analysis of innovation diffusion (Montalvo and Kemp, 2008; Bayus, 1993), expressed below:

$$\frac{dn(t)}{dt} = p [M - n(t)] + q \frac{n(t)}{M} [M - n(t)] \quad (1)$$

where $n(t)$ is the accumulated adopters, t represents time, p and q are coefficients of external and internal influence respectively, and M is the ceiling of adopters. In Bass model, potential adopters may be influenced by two types of communication channels: mass media and interpersonal factors. The information is spread through mass media to attract the number of nonadopters in the system. The interpersonal factor is the way of information transformation between users and potential adopters through the word of mouth interaction. In this paper, the factor of mass media is assumed to be negligible and thus the term of $p [M - n(t)]$ on the right-hand side of Eq. (1) is removed. Hence, a logistic model describing the process of innovation adoption is employed and expressed in Eq. (2) (Chen and Chang, 2010). Eq. (2) describes that the amount of innovation adoption grows firstly, then accelerates rapidly, and finally slows to reach some asymptotic saturation level. The S-shaped pattern describes the amount change of innovation adoption over time as dynamic of an epidemic through a population. Chen and Chang (2010), Rogers (2003) and Sohn and Ahn (2003) have used the logistic model to capture the spread of various innovations and knowledge in a social network. In practice, the Pap smear test provided by government can be treated as an

innovative service, and thus we treat the number of Pap smear test as the adopters for the service of Pap smear in a society. Females who adopt the service of Pap smear test may increase gradually by observation and imitation through the process of diffusion in a social network.

$$\frac{dx}{dt} = \alpha x \left(1 - \frac{x}{F} \right) \quad (2)$$

where x is the number of Pap smear test, α is the natural growth rate of diffusion process with $\alpha > 0$, t treats as the time, and F is the potential carrying capacity, defined by the amount of female in a society. We assume that F is given and fixed, treated as a parameter. Pap smear test service provided for females and our government looks forward to promote the service for all females aged over 30 in Taiwan. Therefore, all female aged over 30 can be treated as the number of the adopters and potential adopters for the service of Pap smear test. Converting Eq. (2) yields a difference equation, expressed below:

$$(x_t - x_{t-1}) = \alpha x_{t-1} \left(1 - \frac{x_{t-1}}{F} \right) \quad (3)$$

Chen and Chang (2010) adopt a time-varying parameter α that may bring substantially better fits and lower forecasting errors. Since policy implementation may bring a positive impact on the process of diffusion, it is employed as a factor to affect parameter α . In order to increase the amount of Pap smear test, our government implements the policy of Cancer Control Act by integrating and utilizing health and medical care resources for the effective promotion of cancer prevention in 2003. Thus, parameter α is defined as time varying and influenced by the policy implementation of Cancer Control Act, i.e.

$$\alpha = \alpha_0 + \alpha_1 I_1(t) \quad (4)$$

where $I_1(t)$ represent the policy of Cancer Control Act and $I_1(t)=1$ for the year after year 2003, otherwise $I_1(t)=0$.

Kivistik et al. (2011) propose that age is an important factor affecting females to adopt the service of Pap smear test, and thus we assume that the amount of Pap smear test is linearly proportion to the age of female in Taiwan. Substituting Eq. (4) into Eq. (3) yields Eq. (5), listed below:

$$x_t = \beta_1 x_{t-1} + \beta_2 I_1(t) x_{t-1} + \beta_3 x_{t-1}^2 + \beta_4 I_1(t) x_{t-1}^2 + \beta_5 I_2(t) + u_t \quad (5)$$

where β_i is the coefficient of variables, $I_2(t)$

represents the event of SARS occurred in 2003, because of the temporary influence from SARS, we set $I_2(2003, 2004)=1$, otherwise $I_2(t)=0$, and u_t is the error term distributed by a normal distribution function with zero mean and variance of ε_1^2 .

2.2 Organizational learning model

In recent years, the research that focuses on the relationship between organizational learning and organizational performance has grown exponentially and the positive effect of organizational learning on effect performance has also been proved (Bolívar-Ramos et al., 2012; Bontis et al., 2002; Real et al., 2006). Chen and Chang (2010) propose that organizational learning is a kind of collective capability based on the experience accumulation and cognitive process, and the basic element of the process of organizational learning includes knowledge acquisition, knowledge sharing and knowledge utilization. Therefore, the organizational learning model can be expressed as follows:

$$x_t = A \left(\sum_{s=0}^{t-1} x_s \right)^k \quad (6)$$

where k represents learning coefficient. We take a logarithm on both sides of Eq. (6) yields:

$$\ln x_t = h_0 + h_1 \ln \sum_{s=0}^{t-1} x_s + v_t \quad (7)$$

where h_0 refers to $\ln A$ and v_t represents an error term,

distributed over a normal distribution with zero mean and variance of ε_2^2 .

2.3 Interaction model

Meyer and Ausbel (1999) propose that some factors of diffusion path may use to promote the diffusion. Cohen and Levinthal (1990) indicate cumulative learning effect is an important factor that can stimulate the assimilation of spillover knowledge, and the major factors are information exchange and learning effect that may influence the process of diffusion. Kemp (1998) proposes that learning is an endogenous factor that affects the process of diffusion. In other words, consumers may obtain the information of innovative product by learning and imitating each other and spread the innovative technology by exchanging information between adopters in a social network. Relatively, organizational learning effect refers to the cumulative effort through experience or information exchange among employees. According to this view, this paper proposes that diffusion effect may affect learning

effect. In practice, learning effect may bring the influence to the performance of International Health Department (the amount of Pap smear test) and affect the perception of female to accept the new service of Pap smear test (innovative product). In order to increase the adoption of Pap smear test, International Health Department is encouraged to improve organizational learning program so we use the interaction model propose by Chen and Chang (2010) to describe the interactive relationship between the adopters and organization. Interaction model is resulted from rearranging the Eq. (1) and integrating diffusion effect and organizational learning effect. The rearrangement of Eq. (1) can be represented as following:

$$\ln x_t - \ln x_{t-1} = \alpha \left(1 - \frac{x_{t-1}}{F} \right) \quad (8)$$

We integrate Eq. (8) with (7) can obtain the interaction effect model.

$$z_t = \gamma_0 + \gamma_1 x_{t-1} + \gamma_2 I(t) x_{t-1} + \gamma_3 \ln \sum_{s=0}^{t-1} x_s + \gamma_4 I(t) \ln \sum_{s=0}^{t-1} x_s + \gamma_5 x_{t-1} \ln \sum_{s=0}^{t-1} x_s + \gamma_6 I(t) x_{t-1} \ln \sum_{s=0}^{t-1} x_s + \gamma_7 \ln Tr_t + w_t \quad (9)$$

where $z_t = \ln x_t - \ln x_{t-1}$, $\ln Tr_t$ is the expense of public

health promotion, and w_t is error term with zero mean and

variance of ε_3^2 .

3. The data

The rate of Pap smear test is collected from Pap Smear Screening Registry System Annual Report, covering the period of 1995-2009 (Bureau of Health Promotion, 2012). The rate of Pap smear test is defined as the amount of female aged 30 and above who adopt the screening. Figure 2 shows that the acceptance rate of Pap smear test grew sharply before 2001, increasing from 9.7% in 1995 to 30.2% in 2001. After 2001, it kept fluctuatingly flat. The decreased acceptance rate of Pap smear test in 2002 may be explained by the SARS event that discourages people to attend in the hospital and avoid using public medical service, even though the medical service is free. After the SARS event, the acceptance rate of Pap smear test started to increase, but was still low and not satisfied by the government. And thus, the government set the Cancer Control Act to promote the Pap smear test.

Figure 2 The rate of Pap smear test

4. Results and discussion

Table 1 indicates that diffusion effect affects the Pap smear test promotion significant and plays an important role to stimulate the information exchange in a social network. Therefore, diffusion effect may accelerate the velocity of the innovative product spread. In the meantime, the organization learning effect that exists in Department of Health may enhance the performance of organization and employees will also obtain the superior ability by the accumulation of experience. In this article, Department of Health and all the female in the social network can be seen as a system and we find that the interactive relationship between Department of Health and females is existed. The interactive relationship may explain how the organization learning effect affects the diffusion of Pap smear test. The Durbin Watson test rejects the hypothesis of autocorrelation for the three models that show the specification of the models with appropriate explanation.

Table 1 The estimation of diffusion model, organizational learning model, and interaction model

	Diffusion model		Organizational learning model	
	Coefficient	p-value	Coefficient	p-value
β_1	0.8162**	0.027		
β_2	0.8117**	0.033		
β_3	2.61E-06	0.393		
β_4	-9.1E-6**	0.015		
β_5	-4.5366*	0.094		
h_0			8.9328**	≤ 0.001
h_1			0.3353**	≤ 0.001
R^2	0.7981		0.8295	
A- R^2	0.6973		0.8243	
DW	2.4968		1.5459	
Interaction model				
γ_0	-92.33	0.291		
γ_1	0.0002**	0.029		
γ_2	0.0648**	0.027		
γ_3	5.8786**	≤ 0.001		

γ_4	-1.2379**	0.002	
γ_5	0.0062	0.212	
γ_6	-0.0033**	0.038	
γ_7	1.5455	0.873	
R^2	0.7895		
A- R^2	0.7791		
DW	2.4297		

4.1 Diffusion effect

The estimation of Eq. (5) in Table 1 reveals that the amount of adopters in the earlier stage has a positive impact to the amount of adopters in the current stage. In the other words, the amount of adopters in the earlier stage can be seen as the imitation object that the potential adopter may obtain the information of innovative product from them. If the amount of adopters in the earlier stage increases, then the information spread will be rapid. The estimation result also reveals the diffusion effect significantly and affects the promotion of Pap smear test. The coefficient of variable I_2 indicates that SARS have a significant negative impact to the diffusion of Pap smear test because of the reduction of females perspective that accept the service of Pap smear test. However, the rate of Pap smear test shows the increasing trend since 1995, but decreases from 2003 to 2004. As the famous public health event of SARS was occurred in 2003, most people avoided to use the medical service or get into the medical center. However, the impact of SARS is temporary and the rate of Pap smear test still maintains the increasing trend after 2004.

In practice, Department of Health provides the bus to offer the medical service included cancer screening and prevention medical education to people who live in the rural area, and the bus also provides the customization service that includes reservation system and House-Call service. This service may not only offer the convenient cancer screening but also provide the guideline of cancer screening. Under this system, the range of medical service providing can be extended and there may have more opportunities to receive and exchange information between adopters and potential adopters. This result indicates that an individual's awareness of Pap smear test can affect other potential adopters to adopt the service of Pap smear test. Under this kind of state, Pap smear test promotion is beneficiary to sustainable development and individuals can be enhanced the awareness of cervix uteri cancer prevention sustainable.

4.2 Organizational learning effect

Table 1 shows that Eq. (7) is an appropriate model to

describe the organizational learning effect and we can compute the organizational learning rate by using $LR = \exp(h_1)$ as 1.3983. In an organization system, organizational learning may be generated and applied by the interaction of employee and the ability of employee will be enhanced through the system designed for increasing the collective competencies. Knowledge transfer is the process of information and skills that are systematically exchanged and individuals may assimilate the knowledge through the process (Chua and Pan, 2008). Therefore, the institution factors included the process of information exchange and experience accumulation that will effectively improve the performance of employee may imply the high learning rate. Bolívar-Ramos et al. (2012) propose that the interactive activities are carried the learning and obtain the acquisition of new knowledge within the organization. Chua and Pan (2008) indicate that personnel movement, communication, observation, replicating routines, interaction between employees may promote the knowledge transfer that will cause the occurrence of learning effect. Martín-Rojas et al. (2011) indicate that organizational learning may maintain a system of knowledge creation and enhance the performance of organization. In practice, Department of Health has taken into the consideration of investment on learning system including employee education, cancer screening promotion program, on-job training, cancer screening knowledge promotion programs, etc. Under the organizational system, knowledge transfer may happen and promote the appearance of learning effect that improves the ability of employee. Due to promote Pap smear test for a long time, the organizational system may promote the interaction between employees and cause the experience accumulation and information exchange that can offer the learning opportunity for employee. In the meantime, cancer prevention is the most important work of Department of Health who urgent to spread the idea of cancer screening by the integration of medical resource after the implementation of Cancer Control Act. Under such a circumstance, organizational learning effect may the result of the performance enhancement and will promote the cancer screening more efficiency.

4.3 Interaction effect

The estimation of Eq. (9) in Table 1 reveals that the diffusion of Pap smear test interacts with the organizational learning and it also indicates that the interaction between diffusion effect and organizational learning effect is a determinant factor to affect the promotion of Pap smear test in the long run. In the social network, the interaction between diffusion effect and organizational learning effect can be observed significantly. The performance of employee can be seen as the result of organization learning effect and the females may be the adopters or potential adopters that will decide the diffusion effect. The main task of employee is to promote female accepting the service of Pap smear test and the amount of female who decide to adopt the service will affect the diffusion effect. In the contrary, the relationship between the Department of Health and females in the society network can be described as interaction effect. As the performance of employee is enhanced by learning effect in Department of Health, the skill of Pap smear test promotion may also be enhanced that will provide more opportunity for female to assimilate the

education and information about the Pap smear test. Due to the increment of the opportunity for assimilating the information and education about Pap smear test, the amount of female who decide to accept the service of Pap smear test will be affected. Barreto and Kemp (2008) propose that requirements and opportunities from the early adopters is an important factor to affect the process of diffusion and the rate of innovation adoption decided by the number of adopters. Through the support of the empirical results and observation in this paper, we conclude that the promotion of Pap smear test may attribute to the diffusion effect, the organizational effect and the interaction effect.

The policies that set for the prevention of cancer are focused on eliminating the barrier including economic, geography, cognition etc. In order to achieve the goal of high rate of Pap smear test, Department of Health devote the integration of medical resource included the connection of medical network that collect all the patient information and can be transfer between Division of Disease Control and Prevention, Health Promotion Division, distinct health center, hospitals, and public health service center. In the other word, the integration of medical resource can be treated as a system that will transfer the information of patients between each other. If the female who aged 30 or above and has not received Pap smear test in this system, the information will transfer between the medical network and inform you to accept Pap smear test. The creation of "system" arrangement with females in fact works effectively and enhances the opportunity of the assimilation of cancer prevention for female.

According to the performance of Pap smear test promotion in Taiwan, we propose three models to describe the promotion of Pap smear test and the results of three models are listed in Table 1. Information about the innovative products (Pap smear test) will be exchanged in the social network and accepted by the public in a society. In practice, females (the users and the potential adopters) may assimilate the information about the Pap smear test by personal contacts. On the other hand, organizational learning effect occurs in Department of Health is encouraged to be designed a better mechanism for provision of the information about Pap smear test in the social network. The results by the estimation of interaction effect model show that the positive relationship between organizational learning effect and diffusion effect, and imply the performance of Department of Health may affect the females' adoption of Pap smear test service provided by this system.

5. Conclusion

In this article, we integrate the diffusion effect and the organizational learning effect to describe the integrative relationship between the Department of Health and females. The results also show that the diffusion effect, organizational learning effect and interaction effect play an important role to affect the promotion of Pap smear test and

explain the rapid growth of the rate of Pap smear test. In practice, it is an appropriate way to promote the Pap smear test by integrating the diffusion effect associated with the females' support and organizational learning determined by Department of Health. According to the results, it is important to improve the interlinking of Department of Health and female for participating the cancer prevention. Therefore, Department of Health needs to design a strategy for integrating the medical resource that may improve the process of information dissemination.

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References

- [1] Aragón-Correa, J. A., Sharma, S. (2003). A contingent resource-based view of proactive corporate environmental strategy, *Academy of Management Review*, 28 (1), 71–88.
- [2] Aragón-Correa, J.A., García Morales, V.J., Cordón Pozo, E. (2007). Leadership and organizational learning's role on innovation and performance: lessons from Spain, *Industrial Marketing Management*, 36 (3), 349–359.
- [3] Barreto, L., Kemp, R. (2008). Inclusion of technology diffusion in energy-systems models: some gaps and needs, *Journal of Cleaner Production*, 16(S1), S95–S101.
- [4] Bayus, B. L. (1993). High-definition television: assessing demand forecasts for a next generation consumer durable, *Management Science*, 39 (11), 1569–1585.
- [5] Biskup, D. (2008). A state-of-the-art review on scheduling with learning effects, *European Journal of Operational Research*, 188, 315–329.
- [6] Bharel, M., Casey, C., Wittenberg, E. (2009). Disparities in Cancer screening: Acceptance of Pap smears among Homeless women, *Journal of Women's Health*, 18(12), 2011–2016.
- [7] Bolívar-Ramos, M. T., García-Morales, V.J., García-Sánchez, E. (2012). Technological distinctive competencies and organizational learning: Effects on organizational innovation to improve firm performance. *J. Eng. Technol. Manage*, 29, 331–357.
- [8] Bolívar-Ramos, M. T., García-Morales, V. J., García Sánchez, E. (2012). Technological distinctive competencies and organizational learning: Effects on organizational innovation to improve firm performance, *Journal of Engineering and Technology Management*, 29, 331–357.
- [9] Bontis, N., Crossan, M. M., Hulland, J. (2002). Managing an organizational learning system by aligning stocks and flows, *Journal of Management Studies*, 39(4), 437–469.
- [10] Bureau of Health Promotion (2012). Pap smear screening registry system annual report. Department of Health, Executive Yuan. <http://www.bhp.doh.gov.tw>
- [11] Bharel, M., Casey, C., Wittenberg, E. (2009). "Disparities in Cancer Screening: Acceptance of Pap Smears among Homeless Women." *Journal of Women's Health*, 18(12), 2011–2016.
- [12] Chen, L. S., Huang, N., Tsay, J. H., Wang, P. J., Chou, Y. J., Chou, P., Lee, C. H. (2007). Screening for cervical cancer among female physicians and their relatives in Taiwan – A population-based comparative study, *Preventive Medicine*, 44, 531–535.
- [13] Chen, B., Wang, M., Moormann, J., Olaniran, B. A., Chen, N. S. (2012). The effects of organizational learning environment factors on e-learning Acceptance, *Computers & Education*, 58, 885–899.
- [14] Chen, Y. T. Chang, D. S. (2010). Diffusion effect and learning effect: an examination on MSW recycling, *Journal of Cleaner Production*, 18, 496–503.
- [15] Chiang, C. J., Chen, Y. C., Chen, C. J., You, S. L., Lai, M. S., (2010). Cancer trends in Taiwan, *Japanese Journal of Clinical Oncology*, 40(10), 897–904.
- [16] Chua, A. L., Pan, S. L. (2008). Knowledge transfer and organizational learning in IS offshore sourcing, *Omega*, 36, 267–281.
- [17] Cohen, W. M., Levinthal, D. A. (1990). Absorptive capacity: a new perspective of learning and innovation, *Administrative Science Quarterly*, 35 (1), 128–153.
- [18] Department of Health (2012). The incidence and mortality of cervix uteri cancer. Executive Yuan. <http://www.ey.gov.tw/default.aspx>.
- [19] DiBella, A., Nevis, E., Gould, J. (1996). Understanding organizational learning capability, *Journal of Management Studies*, 33, 361–379.
- [20] Doornbos, A. J., Simons, R. J., & Denessen, E. (2008). Relations between characteristics of workplace practices and types of informal work-related learning: a survey study among Dutch police, *Human Resource Development Quarterly*, 19(2), 129–151.
- [21] García-Morales, V. J., Jiménez-Barrionuevo, M. M., Gutiérrez-Gutiérrez, L. (2012). Transformational leadership influence on organizational performance through organizational learning and innovation, *Journal of Business Research*, 65, 1040–1050.
- [22] Garvin, D. (1993). Building a learning organization, *Harvard Business Review*, 71, 78–91.
- [23] Holland-Barkis, P., Forjuoh, S. N., Couchman, G. R., Capen, C., Rascoe, T. G., Reis M. D. (2006). Primary care physicians' awareness and adherence to cervical cancer screening guidelines in Texas, *Preventive Medicine*, 42, 140–145.
- [24] Hsia, J., Kemper, E., Kiefe, C. (2001). The importance of health insurance as a determinant of cancer screening: Evidence from the women's health initiative, *Preventive Medicine*, 31(2), 61–70.
- [25] Kadiyala, S. (2009). Are U.S. cancer screening test patterns consistent with guideline recommendations with respect to the age of screening initiation? *BMC Health Services Research*, 9, 185.
- [26] Kemp, R., Volpi, M. (2008). The diffusion of clean technologies: A review with suggestions for future diffusion analysis, *Journal of Cleaner Production*, 16 (S1), S14–S21.
- [27] Kemp, R. (1998). The diffusion of biological waste-water treatment plants in the Dutch food and Beverage industry, *Environmental and Resource Economics*, 12, 113–136.
- [28] Kivistik, A., Lang, K., Baili, P., Anttila, A., Veerus, P. (2011). Women's knowledge about cervical cancer risk factors, screening, and reasons for nonparticipation in cervical cancer screening programme in Estonia, *Bio Med Central Women's Health*, 11.
- [29] Krogh, G. V., Nonaka, I., Aben, M. (2001). Making the most of your company's knowledge: A strategic framework, *Long Range Planning*, 34, 421–439.
- [30] Madhavan, R., Grover, R. (1998). From embedded knowledge to embodied knowledge: New product development as knowledge management, *Journal of Marketing*, 62 (4), 1–12.

- [31] Meyer, P. S., Ausbel, J. H. (1999). Carrying capacity: a model with logistically varying limits, *Technological Forecasting and Social Change*, 61 (3), 209–214.
- [32] Meyer, P. S. (1994). Bi-logistic growth, *Technological Forecasting and Social Change*, 47 (1), 89–102.
- [33] Martín-Rojas, R., García-Morales, V. J., García-Sánchez, E. (2011). The influence on corporate entrepreneurship of technological variables, *Industrial Management & Data Systems*, 111 (7), 984–1005.
- [34] Montalvo, C., Kemp, R., (2008). Cleaner technology diffusion: Case studies, modeling and policy, *Journal of Cleaner Production*, 16 (S1), S1–S6.
- [35] Radiation Protection of Patients (2012). “Mammography Screening.” International Atomic Energy Agency, <http://www.iaea.org/>.
- [36] Real, J. C., Leal, A., Roldán, J. L. (2006). Information Technology as a determinant of organizational learning and technological distinctive competencies, *Industrial Marketing Management*, 35 (4), 505–521.
- [37] Redmond, William H., (2004). Interconnectivity in diffusion of innovations and market competition, *Journal of Business Research*, 57, 1295–1302.
- [38] Rogers, E. M. (2003). Diffusion of Innovation, 4th ed., *The Free Press*, New York. Sohn, S. Y., Ahn, B. J. (2003). Multigeneration diffusion model for economic assessment of new technology, *Technological Forecasting & Social Change*, 70, 251–264.
- [39] Yang, T. C., Matthews, S. A., & Hillemerier, M. M. (2011). Effect of health care system distrust on breast and cervical cancer screening in Philadelphia, Pennsylvania, *American Journal of Public Health*, 101(7), 1297-1305.
- [40] Zollo, M., Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities, *Organization Science*, 13, 339– 351.