

Effects of sustaining innovation and knowledge integration ability on innovation performance

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Abstract

Along with the changes in economic environment and upgrading industries, medical industry has become the lifeline of current economic survival. The added value of products is promoted through the sustaining innovation of knowledge-based production and the proper application of information technology to make the growth and advance of enterprises. The samples of this study are mainly employees of medical industry in southern Taiwan. The questionnaires are distributed and collected by email. A total of 322 valid samples were received, and the sample retrieval rate in this study was 64%. The research results conclude significantly positive effects of 1.sustaining innovation on knowledge integration ability, 2.knowledge integration ability on innovation performance, and 3.sustaining innovation on innovation performance. According to the results, suggestions are proposed, expecting to assist medical industry in promoting the external knowledge resource absorptive power and integration ability to create the sustaining innovation and competitiveness in medical industry.

Subject Classification: 62P25.

Keywords: Medical industry, Sustaining innovation, Knowledge integration ability, Innovation performance.

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1. Introduction

The changes in economic environment and upgrading industries have medical industry become the lifeline of current economic survival. Being an emerging service industry, medical industry is internationally regarded as the new wellness revolution, after IT industry. Medical industry is closely correlated with life. By integrating molecular and cellular biology, nano & engineering technology, and preventive medicine into life, the linked huge market is extended. Similar to the certification of medical units being able to promote the healthcare quality, certification mechanisms should be implemented in medical industry to benefit the public, as health industries aim at health and LOHAS of people. For this reason, medical industry is the economic field engaging in product production and management, service provision, and message spread for maintaining health and enhancing health of the society.

Modern enterprises are in the era of knowledge economy in which knowledge and information technology are stimulated, expanded and applied, and they pay attention to the added value of knowledge creation. The added value of products is promoted through knowledge-based sustaining innovation of production and proper application of information technology for the growth and advance of enterprises. To promote international competitiveness, the development of knowledge and technology with highly intensive added value becomes the future direction for medical industry. Innovation is not simply important for enterprises, but would also influence the development of the entire economic system. Innovation could enhance economic growth and promote national productivity and overall competitiveness. However, investment in research and development activities will facilitate the creation of new products, further enhancing the overall added value of the industry; it would be the key source for establishing sustained competitive advantage in medical industry. The effects of sustaining innovation and knowledge integration ability on innovation performance in medical industry are therefore discussed in this study, expecting to support in the external knowledge resource absorptive power and integration ability as well as create the sustaining innovation and competitiveness in medical industry.

Literature review

I. *Sustaining innovation*

Chen et. al. (2017) proposed the sustaining innovation management model and considered that an enterprise, which could combine the

common innovation of external partners, utilize external power for the innovation, or transfer internal research and development outcomes to other enterprises for innovation activities, could acquire better innovation outcomes. For instance, an enterprise could better understand customer needs and create products with better market competitiveness through external strategic partners. Haffar et. al. (2017) also indicated that an enterprise, in the sustaining innovation, should be able to utilize internal and external innovation ideas to approach the market and connect with new technology by formal contracts with academic units. Ahmed & Ali (2016) revealed that a lot of enterprises were moving towards sustaining innovation strategies, depended more on external technologies, and commercialized the technological assets in the market. Malik et. al. (2017) further explained the idea of sustaining innovation and considered that sustaining innovation, through systematic methods, explored internal/ external innovation opportunities, objectively integrated exploring ability and resources, and acquired the opportunities to utilize external resources.

Referring to Chen et. al. (2018), organizational sustaining innovation contains the following dimensions in this study.

- (1) External technology network: To cope with global competition and external environment changes, an enterprise gradually understand and emphasize the importance of external knowledge resources in the innovation practice process. In the open innovation era, the acquisition of external knowledge and technology present certain effects on the innovation performance of an enterprise.
- (2) Absorptive power: It is the ability to form commercialization by evaluating, assimilating, and applying external new information. Absorptive power is the combination of skills, including learning ability and problem-solving ability, mainly for dealing with tacit knowledge in the technology transfer.

II. *Knowledge integration ability*

Cui & Wu (2017) regarded knowledge integration as combining existing knowledge as the basis to develop potential knowledge. Nevertheless, corporate information systems could be the knowledge oriented process to integrate the knowledge of specific related persons. Amin et. al. (2017) further explained that knowledge integration covered customers' knowledge integration and the technological knowledge integration under the environment with technology uncertainty. In order

to integrate knowledge, Imran et. al. (2016) mentioned that the organization pattern of an enterprise should conform to the proper combination ability, and the integration of knowledge with different patterns was the key ability of managers in enterprises. Giannakis & Bullivant (2016) described the process of an enterprise selecting required knowledge from existing knowledge banks and reconstructing and transforming external new knowledge to become the new knowledge of the organization; and, effective knowledge creation should be linked with external knowledge sources. For this reason, an enterprise must not only integrate internal knowledge resources, but also absorb knowledge from rich external knowledge resources in order to give full play to the value of knowledge.

Referring to Lu & Wu (2018), knowledge integration could reinforce the consistency of internal culture and value of an enterprise to promote the work efficiency and system operation. To achieve all coordination activities, two dimensions are required for knowledge integration.

- (1) Systematic ability: the ability to integrate existing knowledge into new knowledge through symbols, plans, and processes.
- (2) Coordination social ability: the ability to integrate existing knowledge into new knowledge through interaction, communication, and education & training so that members would coordinate with and adapt to each other with the belief in value and principles or understanding without clear specifications.

III. *Innovation performance*

Gu et. al. (2016) pointed out the importance of innovation to help enterprises develop and establish several profit acquisition strategies. All management activities and strategic planning of an enterprise aimed to promote the organizational management performance, as the achievement of specific goal. Nonetheless, Belias et. al. (2017) indicated that innovation performance of an enterprise would be affected by internal and external resources of the organization. Internal indicators contained R&D personnel's professional background, personal capability, supportive management ability, internal improvement capability of technology, technical scanning, technical permeation, and innovation culture. External resource indicators included the close advantage in the network connection, the strength of network connection, and the acceptance of institutional support. Karageorgos et. al. (2016) measured innovation performance and particularly stressed on the achievement rate of

integrated goal, including financial performance indicators of market share, achievement rate of cost goal, and listing speed. In this case, it would be an important challenge for academic circle and industries to properly measure the innovation performance of an organization.

Referring to Lai (2017), organization innovation is divided into technological innovation and management innovation in this study.

- (1) Technological innovation: referring to the innovation performance among operators, e.g. introduction of new concepts to new products or new service, introduction of new elements to operation processes.
- (2) Management innovation: referring to the innovation among management teams. It does not appear direct relationship with the provision of new products, but would indirectly affect the production process of new products.

Methodology

I. Research hypothesis

Chen et. al. (2018) indicated that the value of external knowledge would increase with the diversity of network members, which could benefit enterprises acquiring knowledge and experience with distinct value to benefit the organization comprehensively integrating knowledge resources. Bendermacher et. al. (2017) proposed that an enterprise with stronger absorptive power would increase the experience and knowledge, through learning by doing, accumulate the knowledge basis, digest newly acquired knowledge, and further integrate internal/external knowledge of the organization. Laureani & Antony (2017) also considered that the higher density between enterprises and networks would enhance more knowledge exchange to ensure a knowledge searcher fully comprehending and using the newly acquired knowledge. From the aspect of knowledge basis, Steinhardt et. al. (2017) stated that an organization with diverse knowledge could better rely on the common language to achieve communication and interaction among organizational members or internal/external groups and further integrate the knowledge skills. Therefore, this study establishes the following hypothesis.

Hypothesis 1: Sustaining innovation shows significantly positive effects on knowledge integration ability.

Lu & Wu (2018) regarded the internal learning process of an organization as knowledge integration, indicating that a parent company acquired new knowledge from joint-stock companies and preceded digestion, absorption, and application in the organization. Manatos et. al. (2017) pointed out the positive effect of organizational learning on innovation. Assuming that an enterprise was capable of acquiring new knowledge and integrating existing knowledge in the organization with various methods, the enterprise would present favorable performance on the product and process innovation, i.e. the better organizational learning ability, the better innovation ability. Chatterjee et. al. (2016) regarded knowledge advantage as the knowledge created by an organization being able to construct the core competitiveness of the organization; and, it was realized on the promotion of competition performance. It revealed that knowledge advantage created by knowledge exchange and combination would reflect on value creation related activities of an organization; and, such value creation activities would be realized in the innovation performance. Tasopoulou et. al. (2017) indicated that alliance members should pay attention to the needs of other partners and the entire system for executing duties and considered that merely the full coordination among team members could have the team grasp the innovation opportunity. This study further constructs the following hypotheses.

Hypothesis 2: Knowledge integration ability shows remarkably positive effects on innovation performance.

Lai (2017) mentioned that when facing internal resources and complicated unsolvable technology problems, a lot of innovation enterprises would search for useful knowledge through the interaction with other enterprises or the cooperation with external organizations. Chawla & Lenka (2017) revealed that an enterprise could expand the technological knowledge and reinforce the innovation performance through mergers and acquisitions. Furthermore, the learning technique of alliance partners could be utilized for expanding existing technological knowledge bases and implement higher innovation outcomes. Psomas et. al. (2017) regarded the higher absorptive power, the better ability to grasp information and environmental changes as well as to identify useful knowledge to create valuable performance for the organization. Zwain et. al. (2017) mentioned that the diversity of knowledge sources would accelerate the processing and shorten the product development cycle. An organization with higher absorptive power could better manage the new

knowledge from other organizations to enhance the innovation activity, successfully commercialize new products, and enhance the innovation performance. Therefore, this study establishes the following Hypothesis.

Hypothesis 3: Sustaining innovation reveals notably positive effects on innovation performance.

II. Research subject

The samples of this study are mainly employees of medical industry in southern Taiwan. The questionnaires are distributed and collected by email. A total of 322 valid samples were received, and the sample retrieval rate in this study was 64%.

III. Statistics analysis method

Apply regression analysis to understand the relations among sustaining innovation, knowledge integration ability, and innovation performance.

Result and discussion

I. Reliability and validity analysis

Sustaining innovation, through factor analysis, is extracted two factors of “external technology network” (eigenvalue=2.736, $\alpha=0.81$) and “absorptive power” (eigenvalue=2.25, $\alpha=0.86$). The accumulative covariance explained achievement 78.522%.

Knowledge integration ability, through factor analysis, two factors were extracted “systematic ability” (eigenvalue = 3.255, $\alpha = 0.84$) and “coordination social ability” (eigenvalue = 2.527, $\alpha = 0.87$). The accumulative covariance explained achievement 80.615%.

Innovation performance, through factor analysis, two factors were extracted “technological innovation” (eigenvalue = 4.233, $\alpha = 0.88$) and “management innovation” (eigenvalue = 3.942, $\alpha = 0.90$). The accumulative covariance explained achievement 86.773%.

II. Analysis of sustaining innovation and knowledge integration ability

Table 1, reveal significant effects of external technology network ($t = 2.126^{**}$) and absorptive power ($t = 2.342^{**}$) on systematic ability and significance effects of external technology network ($t = 2.035^{**}$) and

Table 1
Analysis of sustaining innovation to knowledge integration ability

Dependent variable→	Knowledge integration ability			
Independent variable↓	Systematic ability		Coordination social ability	
Sustaining innovation	β	t	β	t
External technology network	0.204	2.126**	0.198	2.035**
Absorptive power	0.227	2.342**	0.213	2.211**
F	31.451		36.732	
Significance test	0.000***		0.000***	
R ²	0.283		0.335	
Adjusted R ²	0.276		0.321	

Note: ** stands for $p < 0.01$, *** for $p < 0.001$.

absorptive power ($t = 2.211^{**}$) on coordination social ability. H1 is therefore valid.

III. *Analysis of sustaining innovation, innovation performance, and knowledge integration ability*

(1) Analysis of sustaining innovation and innovation performance

Table 2, show significance effects of external technology network ($t = 2.245^{**}$) and absorptive power ($t = 2.346^{**}$) on technological innovation and significant effects of external technology network ($t = 2.285^{**}$) and absorptive power ($t = 2.368^{**}$) on management innovation. As a result, H3 is therefore valid.

(2) Analysis of knowledge integration ability and innovation performance

Table 2, appear notable effects of systematic ability ($t = 2.422^{**}$) and coordination social ability ($t = 2.536^{**}$) on technological innovation and notable effects of systematic ability ($t = 2.493^{**}$) and coordination social ability ($t = 2.587^{**}$) on management innovation. In this case, H2 is therefore valid.

Table 2
Analysis of sustaining innovation and knowledge integration ability to innovation performance

Dependent variable → Independent variable ↓	Innovation performance							
	Technological innovation		Management innovation		Technological innovation		Management innovation	
Sustaining innovation	β	t	β	t	β	t	β	t
External technology network	0.211	2.245**	0.216	2.285**				
Absorptive power	0.224	2.346**	0.231	2.368**				
Knowledge integration ability								
Systematic ability					0.232	2.422**	0.238	2.493**
Coordination social ability					0.241	2.536**	0.247	2.587**
F	26.943		31.753		34.527		41.694	
Significance test	0.000***		0.000***		0.000***		0.000***	
R ²	0.257		0.292		0.337		0.398	
Adjusted R ²	0.238		0.279		0.314		0.382	

Note: ** stands for p<0.01, *** for p<0.001.

Conclusions

The results of this study reveal that sustaining innovation is the key path to acquire and integrate knowledge resources in the external technology network in medical industry. The connection in the network shows the exchange of resources or knowledge between both parties and the network members present the same belief in value for mutual imitation and learning. For this reason, an organization in medical industry appears the higher ability to integrate and transform knowledge into more useful technological knowledge. The high ability to identify external knowledge value and acquire knowledge would assist in the promotion of systematic ability. In other words, an organization in medical industry should acquire and integrate knowledge as well as systematically confirm and acquire organizational knowledge. An organization with richer knowledge could better comprehend the explicit knowledge of technical document, operation processes, and information systems provided by partners, present high possibilities of successful system integration, and establish stronger knowledge integration ability. An employee in medical industry with higher ability of integrating tacit knowledge to new knowledge through belief in value, observation, imitation, and mutual adaption and coordination could assist in the innovation performance of the organization.

Suggestions

In view of the above research results, this study makes the following suggestions.

1. The innovation R&D strategies in medical industry could head multinational technology licensing and establish technology transaction platforms, match with the policies of governmental sectors, activate the R&D outcomes and intellectual property of public sectors, and develop sustaining innovation with a network organization.
2. The absorptive power of external knowledge and technology should be reinforced in medical industry to cultivate the ability of identifying and utilizing valuable external knowledge for the organization. For instance, employees' abilities could be enhanced through internal education and training; professional talents with rich experience, knowledge, and technology could be selected when recruiting new employees; and, the R&D investment could be increased to facilitate the effective acquisition of knowledge. Effective absorption

of external knowledge and the application to internal research and development in medical industry could significantly promote internal R&D ability and enhance innovation performance.

3. The medical industry needs to cultivate internal knowledge integration capabilities. Knowledge is power, especially in the era of knowledge economy. Relying on the establishment and promotion of the knowledge management mechanism in the medical industry, strengthen the storage of knowledge and enhance the competitive advantage, such as appointment of chief knowledge officers, establishment of knowledge management departments, enhancement of circulation and expansion of internal knowledge, development of knowledge integration beneficial to the organization in medical industry, promotion of overall knowledge integration ability of the organization, and creation of better innovation performance.

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