

A Study of Knowledge From Closed and Open System That Affect the Innovation Capability of Employees in the Thai Automotive Industry

Poramet Eamurai¹, Napaporn Khantanapha¹ & Rapeepun Piriyaikul²

¹ Graduate School of Business Administration, Southeast Asia University, Thailand

² Faculty of Science, Ramkhamhaeng University, Thailand

Correspondence: Poramet Eamurai, Graduate School of Business Administration, Southeast Asia University, 19/1 Phetkasem Road, Khwaeng Nong Khang Phlu, Bangkok 10160, Thailand.

Received: March 10, 2019

Accepted: March 25, 2019

Online Published: March 28, 2019

doi:10.5430/ijba.v10n3p13

URL: <https://doi.org/10.5430/ijba.v10n3p13>

Abstract

The objective of this research was to investigate the knowledge from closed and open systems that affect the innovation capability of employees in the Thai automotive industry. The study was conducted by reviewing related literature and theories and holding a small group meeting with experts in the automotive industry to review the research model and factors obtained from this study. This research is only part of the main research that we are currently studying. The results from this research have led to the research model. According to the research results, knowledge from a closed system can be divided into two types: 1) Knowledge from on-the-job training that consists of six factors; i.e. Coaching, Mentoring, Job rotation, Job instruction, Apprenticeship, and Understudy, and 2) Knowledge from off-the-job training that consist of one factor, i.e. Conference and seminar. In addition, knowledge from an open system can be divided into five factors, i.e. Free open software, Business partnership, Customer knowledge, Supplier knowledge, and University knowledge. The results obtained from this research will be used to additionally expand the development of research model in order to study the population, collect data, and extend results of the next research.

Keywords: knowledge from a closed system, knowledge from an open system, innovation capability, automotive industry

1. Introduction

The innovation of an organization is part of the success and performance of such organization. With a rapid change in technology and innovation, if any organization is unable to develop and change themselves by developing their innovation capability continuously, it will be difficult to succeed in the long term. Driving innovation must rely on knowledge, ability, creativity, and supportive resources, both tangible and intangible, such as technology and communication. Human capital development in all dimensions will be able to help drive the organization to become an innovation-oriented organization. The importance of innovation capability in terms of human capital is that employees have obtained knowledge, experience, and leaning that can be used to improve and develop their talents and skills leading to outstanding uniqueness and innovation. A fact that employees can develop their own innovation capability is not only dependent on creating learning activities for them, but it also relies on observing the different capabilities of each employee. These different capabilities of employees can be used to create the organization's capability, which is the beginning of innovation for the organization. Again, it can be said that the innovation of an organization is part of the success and performance of such organization because the innovation requires knowledge base within the employees, which will be used to create innovation called as innovation capability of employees. Some organizations focus on developing this innovation capability among employees while some organizations aim to gain innovation through various ways, such as by doing research, buying or acquiring knowledge from employees who have learnt through their work called "Best Practices."

Currently, the number of innovations in the industries and businesses in Thailand is much less than those in other countries. The proportion of investment in research and development of the Thai manufacturing industry that focuses on developing product innovation is 75% while those that focuses on developing process innovation is only 25%. The investment in research and development of the Thai automotive industry in 2016 was ranked in the third place compared to those of other industries, but it was an investment in product research and development rather than in process development (National Science, Technology and Innovation Policy Center, 2017). The Thai manufacturing industry plays an

important role in the national economy development and is a main branch that has driven the economy of the country (Department of Industrial Promotion, 2015). The Thai automotive industry is considered one of the main industries supported by the government. In addition, the Thai auto parts manufacturers are seen as being strongest due to the highest number of business operators, or around 2,500 operators (Thailand Automotive Institute, 2016). With the current change, the organizations need to be competitive to survive. At present, the car assembly companies (OEMs) are looking to find car parts manufacturers with innovation capability in order to increase efficiency and reduce production costs. Moreover, with the trend of energy conservation, energy-saving cars and clean technologies have occurred (Department of Industrial Promotion, 2015). The car assembly companies are therefore required to change and develop vehicles together with automotive parts manufacturers and suppliers of raw materials used in car production. They are thus looking for automotive parts manufacturers with innovation capability and ability to respond to current uncertainties (Antonio & Yam, 2007).

Therefore, the automotive parts manufacturers are affected and required to adapt themselves to keep up with the rapidly changing technology development because most of them are small with low capital and use of technology. However, with the largest number, these companies are therefore an important part of driving the Thai automotive industry (Damanpou, Walker & Avellaneda, 2009). At the same time, importing automotive parts from ASEAN countries is a problem that will affect the Thai auto parts manufacturers due to their lower costs and advantage in tax restrictions (Thailand Automotive Institute, 2012). From the importance of such problem, there is an urgent need for automotive parts manufacturers to develop the innovation capability of employees in their organization by allowing employees to receive knowledge from organizational support where the organization is responsible for providing various sources of knowledge for employees to learn both the knowledge from closed and open systems in order to absorb and apply knowledge in their organization as well as from self-support where the employees can acquire knowledge from their work. They have the opportunity to practice solving the problems in their work so that they achieve learning and gain experience from repeated trials and errors until it becomes new knowledge and innovation capability. In addition, they are allowed to search for new knowledge by themselves outside their organization through the use of various media, such as the Internet, and from external organizations in order to absorb and apply knowledge in their work. Moreover, the organization must encourage employees to use creativity and find new ideas on a regular basis (Van De Vrande et al., 2008). This can lead to the development of innovation capability in terms of production, which is an important part of driving the organization, by increasing production efficiency, using low costs with high flexibility, and minimizing waste from production. Therefore, this research was aimed to study of knowledge from closed and open system that affect the innovation capability of employees in the Thai automotive industry.

2. Research Objectives

To obtain a research model of knowledge from closed and open systems that affects the innovation capability of employees in the Thai automotive industry; and

To know the factors of knowledge from closed and open systems that affects the innovation capability of employees in the Thai automotive industry.

3. Literature Review

3.1 Knowledge From a Closed System

Knowledge from a closed system means allowing employees to gain knowledge from on-the-job and off-the-job trainings and to apply their knowledge to develop their innovation capability and meet the goals of their organization (Sallis & Jones, 2002). The employees can integrate knowledge within their organization by collecting knowledge that has been passed on and exchanged until it becomes a new knowledge that can be used by employees in the organization to increase their work efficiency (World Bank, 2002). As a result, a new product can be developed due to the introduction of new knowledge (Seng, 1990). Moreover, there is a knowledge sharing network created in the organization (Dyer & Nobeoka, 2002) as well as an accumulation of knowledge in the organization enabling employees to use their knowledge and create new knowledge (Lin & Lee, 2005).

Knowledge from a closed system is divided into two types. (1) Knowledge obtained from on-the-job training is the knowledge transmitted within an organization through different activities. On-the-job training is intended to allow employees to learn through training in their work and most knowledge is in the persons and is mainly based on the experience of employees within the organization. Typically, it focuses on the practice so that employees apply knowledge in their work as well as on enhances the skills needed to develop the employee's innovation capability, upgrading the working capability in the desired direction, and increasing the productivity resulting in an achievement of the organization's goals (Maria & Ramos, 2012); and (2) Knowledge obtained from off-the-job training is the

knowledge supported by the organization where employees are allowed to learn and receive new knowledge in addition to those obtained from on-the-job training (Bankole, 2000). An organization may arrange for employees to attend a meeting or seminar on topics relating to their work and the knowledge from these topics is not disclosed or published (Landy & Conte, 2007). Therefore, the organization will provide an off-the-job training course and support all expenses to employees in order to provide employees with new knowledge that is in line with current changes (Olakunle & Ehi, 2008) as well as to apply knowledge in their work and develop the innovation capability of employees.

According to Kanu (2015), the factors of knowledge from a closed system by means of on-the-job training can be divided into five methods of proving knowledge to employees as follows:

Method 1: Coaching is to provide knowledge by on-the-job training in a face-to-face manner. The organization will support and select those who will teach work for the employees. This method of training will allow employees to receive knowledge and experience from the coaches directly. It is a continuous coaching throughout the working period that can reduce learning time and mistakes from trial and error and the employees can apply the gained knowledge to their work immediately (Peterson & Hicks, 1996). In addition, the coaches can know the weak points quickly from employee actions and therefore focus on correcting such weak points directly by giving advices and suggestions to employees (Burdett, 1998). Moreover, it can also enhance and develop employees in the organization to have more knowledge and skills in a way that they are motivated to know how to solve problems and do challenging tasks (Hamlin, Ellinger & Beattie, 2009). It not only focuses on improving the current performance of employees, but it also focuses on improving the capability of employees (Kirwan, 2000).

Method 2: Mentoring is to provide knowledge by on-the-job training by means of mentoring for employees. The organization will support and select those who have the accepted ability or management members to give advices and suggestions to less experienced employees in matters that are beneficial to their work (Mavuso, 2007). These mentors will provide assistance when employees have working, mental, and social problems (Karkoulian, Halawi & McCarthy, 2008) as well as convey various information within the organization to new employees who will be guided on how to behave and adapt to the corporate culture. In addition, there will be an examination and monitoring of understanding and knowledge gained by new employees (Swap, Leonard, Shields & Abrams, 2001).

Method 3: Job rotation is to provide knowledge by on-the-job training in which the organization will encourage employees to gain new knowledge by rotating them to work in or across various related functions in the organization (Torrington & Hall, 1991). This allows employees to integrate knowledge in many functions together to develop new knowledge that will lead to the development of innovation capability (Arnold & Felderman, 1986) as well as to help reduce boredom and develop their harmony with other personnel (Jerris, 1999). In addition, it results in greater collaboration between departments (Geet & Deshpande, 2008). It also allows employees to face new challenges and opportunities that they will improve themselves to have higher capability (Saiyadain, 2009).

Method 4: Job instruction technique is to provide knowledge by on-the-job training in which the organization will support and provide those will train employees who will learn through the correct work procedures that are specific techniques of work in the organization (Rao, 2010). The training provider will prepare for the trainees to be informed about the overall information, purposes, and expected results of the work (Blandchard & Thacker, 1999) as well as provide a demonstration of work or related skills for the employees. In addition, the trainees will be allowed to try such work by themselves. The results will be followed up and informed to the trainees who will be assisted in case of any problem (Olakunle & Ehi, 2008). In this training, the trainees will receive written learning materials or may learn from a variety of teaching materials. This method of training will help employees to work correctly and properly in accordance with the organization's work processes (Blandchard & Thacker, 1999).

Method 5: Apprenticeship is to provide knowledge by on-the-job training in which the organization will support employees to receive training to gain knowledge and work skills. This training method will take longer training period than other types of on-the-job training (Olakunle & Ehi, 2008). To change from a trainee to a person who is knowledgeable in the work, the employees must work with a trainer under supervision throughout the apprenticeship period (McNamara, 2000).

Method 6: Understudy is to provide knowledge by on-the-job training in which the superior will educate the subordinate employees in the form of an internship so that they act as an alternate assistant to the managers in the organization (Olakunle & Ehi, 2008). In this way, subordinates will learn through real experiences and observations because they will be involved in solving various problems that occur each day. It is intended to prepare for the development of employee capability in advance for receiving complete duties and responsibilities in the future (Steinmetz & Lawrence, 1996).

According to the study knowledge from off-the-job training, most organizations use conferences and seminars. The organization will support and provide knowledge topics in conferences and seminars to be held in various locations suitable for the work of each employee. Since this knowledge is not disclosed or published, the organization will support the cost for employee participation in order for employees to receive new knowledge (Thiagarajan, 2005). This type of off-the-job training is interactive and encourages the participation of all employees who attend the conferences and seminars, which allows them to gain new knowledge and perspectives from each participant and apply the acquired knowledge to their organization in order to meet the goals and needs of the organization (Olakunle & Ehi, 2008).

From the literature review about factors of knowledge from a closed system by means of on-the-job training and off-the-job training, it can be summarized as follows:

Table 1. Factors of knowledge from a closed system

Method	Description	Source
1. Coaching	<ul style="list-style-type: none"> - Learn in a face-to-face manner - Give advices and suggestions - Motivate to solve problems and do challenging tasks - Continuous coaching throughout the working period - Two-way communication 	Hamlin, Ellinger and Beattie (2009) Gregory and Levy (2010) Garman; Whiston and Zlatoper (2000) Kilburg (2001)
2. Mentoring	<ul style="list-style-type: none"> - Provide mental and social assistance - Provide work assistance 	Zerzan, Hess, Schur, Phillips and Rigotti (2009) Vincent and Seymour (1994) Andrews and Chilton (2000)
3. Job rotation	<ul style="list-style-type: none"> - Learn various functions - Learn across departments 	Saiyadain (2009) Geet and Deshpande (2008) Torrington and Hall (1991); Parker (2002)
4. Job instruction technique	<ul style="list-style-type: none"> - Learn from work-related documents and manuals - Learn from demonstrations - Learn from real actions 	Rao (2010) Blandchard and Thacker (1999) Olakunle and Ehi (2008)
5. Apprenticeship	<ul style="list-style-type: none"> - Provide knowledge in orientation - Supervision throughout the apprenticeship period 	Olakunle and Ehi (2008) McNamara 2000
6. Understudy	<ul style="list-style-type: none"> - Learn from real experiences - Learn from observations - Learn from participation in solving problems a 	Olakunle and Ehi (2008)
7. Conference and Seminar	<ul style="list-style-type: none"> - Learn from conferences - Learn from seminars 	Thiagarajan (2005) Olakunle and Ehi (2008)

3.2 Knowledge From an Open System

Knowledge from an open system means allowing employees to learn from the shared knowledge sources free of charge from outside their organization and to apply such knowledge in their organization in various ways, such as by conducting experiments until being expert in working and becoming a new knowledge that is beneficial to the organization (Townley, 1993), which creates value for the organization (Sallis & Jones, 2002) in the form of product innovation or production innovation (Seng, 1990; World Bank, 2002). In addition, the use of such knowledge can be done in various ways; for example, the knowledge can be instantly used, the data within the organization must be taken via the cloud system or the knowledge is processed by free software. Moreover, it can help create knowledge in the organization (Lin & Lee, 2005). Some organizations may allow disseminating or sharing this new knowledge to external organizations widely that will be beneficial to various industries and that will form a knowledge sharing network between organizations leading to cost reduction, partnership, and collaborative advantage (Martelo & Cegarra, 2014).

Factors of knowledge from an open system can be divided based on the following knowledge sources:

Knowledge source 1: Open knowledge gained from free use, such as “Free open software”, is knowledge from free programs, such as a program for design of car parts. The organization will determine, select, and allow employees to bring free software to use in the organization (Searls, 2003) so that they learn and research through the use of such software in their work by running and processing the data via software to become a new and better knowledge (Maria & Ramos et Al., 2012).

Knowledge source 2: Open knowledge gained from free knowledge sharing from external organizations or business partners, such as site visit, is knowledge from seeing the production processes in successful organizations. For example, Toyota’s production system is a continuous production process from the beginning to the end until obtaining a finished product that thus eliminates the need for work piece storage space during production and reduces time and production costs (Dyer & Nobeoka, 2002). The experts in the organization will share their knowledge and experiences. The organization will support and select successful companies with the objective of allowing employees to gain new experiences from visiting the factories as well as to learn and apply knowledge to meet the goals and needs of the organization, including further development of employee capability (Michael, 2016).

Knowledge source 3: Open knowledge gained from customers free of charge is knowledge from customers in the modern marketing dimension based on the concepts of customer co-creator and knowledge sharing with employees (Smith & McKeen, 2005), which is derived from customer complaints and experiences. For example, a complaint about the function to adjust the car seats inconveniently has been improved to make it more convenient and easier to use (Claycomb & Germain, 2005). This type of knowledge is intended to allow employees to learn and develop their thinking as well as to analyze and find ways to improve products that meet customer needs and develop employees’ innovation capability (Rowley, 2002).

Knowledge source 4: Open knowledge gained from suppliers free of charge is knowledge from suppliers of quality raw materials for use in the production and assembly of products. Raw material suppliers are part of the supply chain system of the manufacturing industry (Oghazi & Fakhrei, 2016). This knowledge source is intended to allow employees to gain knowledge from quality raw material suppliers. Since the organization sees the importance of these suppliers of raw materials that have specialized knowledge, the employees are encouraged to learn and apply knowledge. For example, it allows employees to know the properties of each type of raw material and be able to consider selection for use in the production process for maximum efficiency according to the needs of the organization (Steiner & Hartmann, 2006).

Knowledge source 5: Open knowledge gained from universities free of charge is knowledge from universities both in the form of research that has been experimented and proven and that is being investigated in a laboratory. There will be experts in research and development to educate employees with the objective for employees to apply such research in their organization that helps reduce the time of invention, research, and development of new products on their own from the beginning (Maral & Ekaterina, 2016). In addition, it can also help save money on research and development and develop the capability of employees in terms of innovation research and development in order to cope with the current rapid changes (Gunasekara, 2006).

From the literature review about factors of knowledge from an open system, it can be summarized as follows:

Table 2. Factors of knowledge from an open system

Knowledge	Description	Source
1. Free open software	- Learn from use, system analysis, and processing to become new knowledge - Learn from system improvement to become new knowledge	Voth (2003); Proctor (2003); Searls (2004); Fitzgerald and Kenny (2004); Rossi (2005); Matthews et al. (2008)
2. Business partnership	- Learn from on-site visit - Learn from interviews with those with knowledge and experience - Learn from case studies in successful organizations	Abeba and Mesele (2015) Ahmad and Mustabsar (2016)
3. Customer knowledge	- Learn from customer complaints - Learn from customer experiences	Smith and McKeen (2005) Claycomb and Germain (2005) Rowley (2002)
4. Supplier knowledge	- Learn from material properties - Learn from material testing	Steiner and Hartmann (2006) Maarten and Arjan (2015) Oghazi and Fakhrei (2016)
5. University knowledge	- Learn from research - Learn from research and development experts	Gunasekara (2006) Maral and Ekaterina (2016)

Knowledge from closed and open system to knowledge absorption

According to the review of literature supporting the influence line of Knowledge from closed and open system to knowledge absorption and application of employees, Wu & Chiang (2006) suggested that knowledge from closed and open system by sharing through on-the-job and off-the-job trainings has a direct influence on the ability to absorb knowledge. McAdam & Miller (2010) found that knowledge from closed system from work instructors at various levels has a direct impact on knowledge absorption of employees. If an organization uses different tools and techniques in the teaching, the employees will be motivated to learn and help increase their ability to absorb knowledge. Similarly, Nikolas & Wuryaningrat (2013) said that knowledge from closed and open system can affect the ability to absorb knowledge. There is empirical evidence that new knowledge arising from employee learning can be transformed into innovation capability if it is supported by the organization along with higher knowledge absorption. Vasylieva & Anatoliivna (2013) agreed that learning from on-the-job and off-the-job trainings influences the ability of knowledge absorption among employees in the organization. If an organization provides more knowledge to employees, it will help increase their ability to absorb knowledge. In addition, Esha, Warda & Qasim (2017) also cited that knowledge from closed and open system by allowing employees to learn can affect their ability to absorb knowledge, which is directly important to increase their capability.

3.3 Knowledge Absorption

According to Cohen and Levinthal (1990), knowledge absorption means the employee's ability to absorb and retain knowledge through the learning process by various ways, including organizational support and self-support from various sources of knowledge in both closed and open systems. The absorbed and retained knowledge is then taken through the process of thinking, analysis, and adaptation in work in order to develop the employee's innovation capability and respond to the organization's goals. Minbaeva et al. (2003) said that knowledge absorption is one of the processes to retain knowledge of employees by learning from various knowledge sources and such knowledge can be self-accessed for commercial benefits and response to the goal of becoming an innovation organization. At a later time, Lane et al. (2010) stated that the employee's ability to absorb knowledge is different based on their previous experience, education level, and accessibility to knowledge resources. Knowledge absorption consists of two related parts: (1) Ability to understand knowledge and (2) Ability to retain knowledge, but it does not relate to the ability to apply knowledge. According to Zahra and George (2002), the ability to search and apply knowledge can be divided into four elements: (1) Acquisition; (2) Absorption; (3) Conversion; and (4) Utilization. If personnel or employees can complete all four elements, their innovation capability can be improved.

The importance of the employee's ability to absorb knowledge will help result in the introduction or application of new knowledge in their work based on the ability to absorb and retain knowledge of each employee. This is the result of understanding of the knowledge gained from learning by various methods. As the retained knowledge is correctly and

effectively used in their own work, the employee's innovation capability can be improved and the organization's goals can be met (Mahnke & Venzin, 2003; Kautz & Mahnke, 2003).

Knowledge absorption to innovation capability of employees

According to the review of literature supporting the influence line from knowledge absorption to innovation capability of employees, Massa and Testa (2004) concluded that the ability to absorb knowledge can affect the innovation capability of employees and lead to the application of knowledge to create innovation for commercial purposes of the organization. Thomas & Ralf (2012) reported that knowledge absorption is essential to the development of employee's innovation capability resulting in the ability to invent innovation within the organization. Similarly, Huseyin & Salih (2016) suggested that the ability to absorb knowledge influences the innovation capability of employees, creates new ideas for innovation within the organization, and leads to competitive advantages. In addition, the ability to absorb knowledge can also positively influence the employee's innovation capability and also enhance the innovation capability of the organization (Patricia & Alberto, 2016).

3.4 Innovation Capability

Innovation capability is the employee's ability to learn and absorb the knowledge. The retained knowledge can be applied to create innovation within the organization in the forms of product innovation, process innovation, service innovation, and management innovation leading to the development of the employee's innovation capability and the achievement of the organization's goals. According to Goldsmith & Hofacker (1991), innovation capability is both attitude and behavior of employees in learning and absorbing knowledge for use in innovation. Avlonitis et al. (1994) said that innovation capability is both ability to learn technology and intention, which can affect the ability to absorb knowledge and strive to change knowledge into the development of innovation in the organization. Later, according to Hurley & Hult (1998), innovation capability is the employee's ability to learn and retain knowledge that can be commercially utilized. Nybakk et al. (2009) defined innovation capability as a creation or development of a new product, process, idea or method to do things based on creativity. Wutthirong (2015) stated that innovation capability is the ability to change the management system throughout an organization to develop new things in terms of new products, services, work processes, and business models.

The importance of innovation capability is involved with knowledge absorption and retention of employees. As an organization encourages employees to use their retained knowledge in inventing or creating innovation continuously, there will be new knowledge that helps create innovation within the organization. In addition, when employees are motivated by their organization by giving various rewards, they will be more encouraged to apply their retained knowledge to create more innovation in the organization. As the organization has its own innovation, it will have greater innovation capability as a result of the employee's innovation capability.

4. Results

The results of the study and the literature review mentioned above can be synthesized as research model and can reveal the factors of knowledge from closed and open systems that affects the innovation capability of employees in the Thai automotive industry as shown in Figure 1.

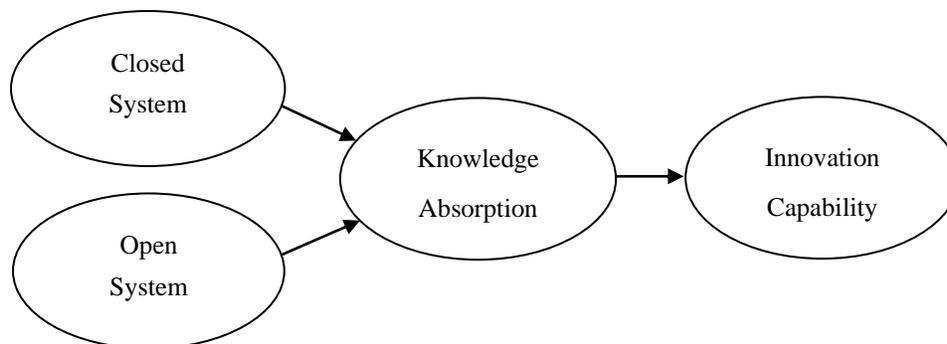


Figure 1. The research model

5. Conclusions and Future Research

From the results of the study and the literature review mentioned above, the knowledge from a closed system can be divided into two types: 1) Knowledge from on-the-job training that consists of six factors; i.e. Coaching, Mentoring, Job rotation, Job instruction, Apprenticeship, and Understudy, and 2) Knowledge from off-the-job training that consist of one factor, i.e. Conference and seminar. In addition, knowledge from an open system can be divided into five factors, i.e. Free open software, Business partnership, Customer knowledge, Supplier knowledge, and University knowledge. These factors can also affect the knowledge absorption of employees in the automotive industry.

Therefore, in the next research, we will use the research model from this study to investigate population and collect and analyze sample data in the Thai automotive industry in order to obtain results that can be extended as a policy to lead to the development of the innovation capability of employees in the Thai automotive industry.

References

- Abeba, M., & Mesele, D. (2015). The Impact of training and development on employee performance and effectiveness: A Case study of district five administration office. *Journal of Human Resource and Sustainability Studies*, 3, 188-202. <https://doi.org/10.4236/jhrss.2015.34025>
- Ahmad, T., & Mustabsar, A. (2016). Impact of ethical leadership on employee performance: Moderating role of organizational values. *International Review of Management and Marketing*, 6(3), 590-595.
- Andrews, M., & Chilton, F. (2000). Student and mentor perceptions of mentoring effectiveness. *Nurse Education Today*, 20, 555-562. <https://doi.org/10.1054/nedt.2000.0464>
- Antonio, K.W.L., & Yam, R.C.M. (2007). Supply chain product co-development, product modularity and product performance. *Journal of Industrial Management and Data System*, 107, 1036-1065. <https://doi.org/10.1108/02635570710816739>
- Automotive Institute. (2012). Automotive industry master plan 2012-2016.
- Blanchard, P.N., & Thacker, J.W. (1998). *Effective Training: System, Strategies and Practices*. Prentice Hall, New Jersey.
- Bureau of Science Policy Committee National Technology and Innovation. (2560). *Report of the research and development survey and innovation activities in the industrial sector of Thailand*. Science Information Center Technology and innovation.
- Candy, P.C. (1991). *Self-direction for lifelong learning*. Jossey-Bass Publishers, San Francisco, California
- Claycomb, C., & Germain, R. (2005). Predicting the level of B2B e-commerce in industrial organizations. *Industrial Marketing Management*, 34, 221-234. <https://doi.org/10.1016/j.indmarman.2004.01.009>
- Cohen, W.M., & Levinthal, D.A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, 35, 128-152. <https://doi.org/10.2307/2393553>
- Damanpour, F., Walker, R.M., & Avellaneda, C.N. (2009). Combinative effects of innovation types and organizational performance: a longitudinal study of service organizations. *Journal of Management Studies*, 46(4), 650-75. <https://doi.org/10.1111/j.1467-6486.2008.00814.x>
- Department of Industrial Promotion. (2015). Creating and developing industrial businesses to grow and compete. Retrieved 10 March 2016, from <https://www.dip.go.th>
- Dyer, J., & Nobeoka, K. (2000). Creating and managing a high-performance knowledge-sharing network: the toyota case. *Strategic Management Journal*, 21(3), 345-367. [https://doi.org/10.1002/\(SICI\)1097-0266\(200003\)21:3<345::AID-SMJ96>3.0.CO;2-N](https://doi.org/10.1002/(SICI)1097-0266(200003)21:3<345::AID-SMJ96>3.0.CO;2-N)
- Esha, K. (2017). Does organization learning capacity influence the organization effectiveness? Moderating role of absorptive capacity. *International Journal of Engineering and Information Systems*, 1(7), 28-35.
- Fitzgerald, B., & Kenny, T. (2004). Open source software in the trenches: lessons from a large-scale OSS implementation. In *24th International Conference on Information Systems* (pp. 316-326).
- Garman, A.N., Whiston, D.L., & Zlatoper, K.W. (2000). Media perceptions of executive coaching and the formal preparation of coaches. *Consulting Psychology Journal: Practice and Research*, 52(3), 201-205. <https://doi.org/10.1037/1061-4087.52.3.201>
- Geet, S.D., & Deshpande, A.A. (2008). *Elements of human resource management*. Pune, Mumbai: Pragati Book

Centre.

- Gregory, J.B., & Levy, P.E. (2010). Coaching in a performance management context: A review and research agenda. *Poster presented at the 25th Annual Meeting of the Society for Industrial/Organizational Psychology*. New Orleans, LA.
- Gunasekara, C. (2006). The generative and developmental roles of universities in regional innovation systems. *Science and Public Policy*, 33(2), 137-50. <https://doi.org/10.3152/147154306781779118>
- Hamlin, E., & Beattie. (2009). Toward a profession of coaching? a definitional examination of 'coaching,' 'organization development,' and 'human resource development'. *International Journal of Evidence Based Coaching and Mentoring*, 7(1), 13.
- Hiemstra, R., & Burns, J. (1997). Self-directed learning: present and future a paper delivered at the first world. *Conference on Self-Directed Learning*. Montreal, Canada.
- Hirumi, A., & Bermudez, A. (1996). Interactivity distance education and instructional systems design converge on the super information highway. *Journal of Research on Computing in Education*, 24(1), 1-16. <https://doi.org/10.1080/08886504.1996.10782183>
- Kilburg, R.R. (2001). Facilitating intervention adherence in executive coaching: A model and methods. *Consulting Psychology Journal: Practice and Research*, 53(4), 251-267. <https://doi.org/10.1037/1061-4087.53.4.251>
- Landy, F.J., & Conte, J.M. (2007). *Work in 21st Century: An Introduction to Industrial Organizational Psychology*. New York: McGraw Hill.
- Maarten, S., & Arjan, J. (2015). Managing supplier relationships in a new product development context. *Journal of Purchasing & Supply Management*, 21, 192-203. <https://doi.org/10.1016/j.pursup.2015.05.002>
- Maral, M., & Ekaterina, A. (2016). *Specific examples on fostering open innovation at the industry level*. University-Industry Collaboration.
- Matthews, D., Wilson, G., & Easterbrook, S. (2008). Configuration management for large-scale scientific computing at the UK met office. *Computing in Science and Engineering*, 10, 56-64. <https://doi.org/10.1109/MCSE.2008.144>
- Mcadam, R., Miller, K., McMacken, N., & Davies, J. (2010). The development of absorptive capacity-based innovation in a construction SME. *Entrepreneurship and Innovation*, 11(3), 231-244. <https://doi.org/10.5367/000000010792217308>
- McNamara, C. (2000). Various Ideas for learning activities and documentation results. Retrieved from www.mapnp.com
- Minbaeva, D., Pedersen, T., Bjorkman, I., Fey, C., & Park, H.J. (2003). MNC Knowledge transfer, subsidiary absorptive capacity, and HRM. *Journal of International Business Studies*, 34(6), 586-599. <https://doi.org/10.1057/palgrave.jibs.8400056>
- National Innovation Agency. (2014). *Thailand Innovation Capability Survey Report*. Ministry of Science and Technology.
- Nikolas, F. (2013). Knowledge sharing, absorptive capacity and innovation capabilities: An empirical study on small and medium enterprises in North Sulawesi, Indonesia Gadjah Mada. *International Journal of Business*, 15(1), 61-78.
- Oghazi, P., Fakhrei, R.F., & Zaefarian, G. (2016). Unity is strength: A study of supplier relationship management integration. *Journal of Business Research*, 69(11), 4804-4810. <https://doi.org/10.1016/j.jbusres.2016.04.034>
- Olakunle, A.O., & Ehi, P.O. (2008). *Industrial sociology. ibadan: penthouse Publications Rao, V.S.P (2010). Human resource management: Text and Cases*. New Delhi: Anurag Jain Publishers.
- Proctor, P., Deussen, P.C., Heath, L.S., & Gove, J.H. (2003). The open-source movement: an introduction for forestry professionals. In *5th Annual Forest Inventory and Analysis Symposium* (pp.203-208).
- Rao, A.K. (2010). Management's responsibility for training. *Personnel Today*, 26(1), 22.
- Rogers, E.M., & Shoemaker, F.F. (1971). *Communication of innovations: A cross cultural approach*. New York, NY: The Free Press.
- Rossi, B., Russo, B., Zuliani, P., & Succi, G. (2005). On the transition to an open source solution for desktop office automation. *International Federation for Information Processing*, 277-285.

https://doi.org/10.1007/978-3-540-32257-3_26

- Rowley, J. (2002). *Customer knowledge management*. Bangor, University of Wales. Retrieved from http://www.aom-iaom.org/pdfs/jms/JSM-18-06_rowley.pdf
- Royal Academy Dictionary. (2009). *The definition of innovation*. Bangkok.
- Saiyadain. (2009). *Human resource management*. New Delhi: Tata McGraw-Hill Publishing Company Limited.
- Sallis, E., & Jones, G. (2002). *Knowledge management in education*. London.
- Searls, D. (2004). DIY-IT: How Linux and open source are bringing do-it-yourself to information technology. *Linux Journal*, 4.
- Senge, P.M. (1990). *The fifth discipline: The art and practice of the learning organization*. New York: Doubleday.
- Smith, H.A., & McKeen, J.D. (2005). Developments in practice customer knowledge management: Adding value for our customers. *Communications of the Association for Information Systems*, 16, 744-755. <https://doi.org/10.17705/1CAIS.01636>
- Stefanie, L.B., Diane, R.E., Andrew, B.A., & David, F. (2014). Self-directed learning: A tool for lifelong learning, *Journal of Marketing Education*, 36(1), 20-32. <https://doi.org/10.1177/0273475313494010>
- Steiner, M., & Hartmann, C. (2006). Organizational learning in clusters: A case study on material and immaterial dimensions of cooperation. *Regional Studies*, 40(5), 493-506. <https://doi.org/10.1080/00343400600757494>
- Thiagarajan, S. (2005). *Thiagi's interactive lectures: Power up your training with interactive games and exercises*. Alexandria, VA: ASTD Press.
- Todd, M., & Douglas, B. (2012). Self-directed learning: A cognitive and computational perspective. *Perspectives on Psychological Science*, 7(5), 464-481. <https://doi.org/10.1177/1745691612454304>
- Torrington, D., & Hall, L. (1995). *Personnel Management: HRM in Action* (3rd ed.). Hemel Hempstead, England: Prentice Hall.
- Townley, B. (1993). Performance appraisal and the emergence of management. *Journal of Management Studies*, 30, 0022-2380. <https://doi.org/10.1111/j.1467-6486.1993.tb00302.x>
- Van de Vrande, V., Jong de J., & Vanhaverbeke, W. (2008). Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, 29, 423-437. <https://doi.org/10.1016/j.technovation.2008.10.001>
- Vincent, A., & Seymour, J. (1994). Mentoring among female executives. *Women in Management Review*, 9(7), 15-20. <https://doi.org/10.1108/09649429410069935>
- Voth, D. (2003). Open source in the US government. *IEEE Software*, 20, 73-L. <https://doi.org/10.1109/MS.2003.1159033>
- Wimmer, M.A. (2006). *E-Government: towards electronic democracy lecture notes in artificial intelligence*. Springer Berlin, Heidelberg. <https://doi.org/10.1007/11823100>
- Zahra, S., & George, G. (2002). Absorptive Capacity: a review, reconceptualization, and extension. *Academy of Management Review*, 27(2), 185-203. <https://doi.org/10.5465/amr.2002.6587995>
- Zerzan, J., Hess, R., Schur, E., Phillips, R., & Rigotti, N. (2009). Making the most of mentors: A guide for mentees. *Academic Medicine*, 84, 140-144. <https://doi.org/10.1097/ACM.0b013e3181906e8f>