

Enhancing Innovation through Knowledge Management: A Systematic Literature Review on Empirical Findings

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Abstract—To develop innovation initiative, an organization will highly rely and depends on the knowledge. By managing knowledge, an organization will increase its creativity that will bring positive impact on organizational performance and innovation. Since knowledge is considered as the determinant of innovation, this study is aimed to provide more comprehensive identification towards the relationship between knowledge management and innovation using systematic literature review on empirical findings. In the systematic literature review, 30 primary articles were obtained. According to 30 articles that were selected as the primary study, various knowledge management constructs, types of innovation, and mediating variable between knowledge management and innovation were identified.

Index Terms—Innovation, knowledge, knowledge management, systematic literature review.

I. INTRODUCTION

Innovation is defined as production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and the establishment of new management systems [1]. Firms with greater innovation capacity are considered greater in new product introduction and new market entry [2]. Moreover, innovation enables an organization to improve performance, solve problems, add value, and create the competitive advantage for the organization [3] and is considered as a key prerequisite for achieving sustained long-term wealth in today's business environment [4]. Thus, innovation is considered as necessary and critical components for an organization to create value, survive, and sustain competitive advantage [2], [5]. This need comes from increasing competition and customer demands, the emerging of new market areas [6] and rapid technological development [7]. To develop innovation initiative, an organization will highly rely and depends on the knowledge [2], [3]. Knowledge is considered as one of aspect that influences successful innovation [8]. By managing knowledge, an organization will increase its creativity that will bring positive impact on organizational performance and innovation [9]. Managing knowledge, basically involves the acquisition, creation, and use of information that can lead to

innovation [10]. Therefore, knowledge management is considered as an effective means for increasing the innovation performance in an organization [11] and frequently cited as the antecedent of innovation [12]. Since knowledge management is considered as an important determinant of innovation, the comprehensive understanding towards the link between knowledge management and innovation is needed. An attempt to bring a clearer understanding of the linkage between these two constructs had been done by Costa & Monteiro [13]. In their study, Costa & Monteiro [13] identified the relationship between knowledge management process, namely knowledge acquisition, knowledge sharing, knowledge codification, and knowledge creation towards various type of innovation such as product/service and process innovation, radical and incremental innovation, technical and administrative innovation, innovation capability, and innovation performance. Other than that, the constructs in the study from Costa & Monteiro [13] were obtained from 41 empirical articles and 4 theoretical articles. This study is aimed to provide more comprehensive identification towards the relationship between knowledge management and innovation using systematic literature review. The articles used as the primary study is limited to study that have empirical evidence regarding the relationship between knowledge management and innovation.

II. METHODOLOGY

This study aims to identify the comprehensive relationship of knowledge management on innovation. The systematic literature review protocols were adopted in this study to obtain the previous literature that discussed knowledge management and innovation. The literature review process followed five main steps in conducting the review on the study from Kitchenham & Charters [14] namely, the identification of potential study, study selection, quality assessment, data extraction, and data analysis, as seen in Fig.1. In step 1, the potential literature to be reviewed were identified. It contains the process of initial search in the electronic database, internet, specific conference and journal, and any other sources. In this study, two electronic databases were used which are science direct and emerald insight. The search strategy was generated to obtain studies that only discuss specific issue of knowledge and innovation. The search was performed using Boolean AND towards the words "Knowledge" and "Innovation". In step 2, the literature that was obtained from step 1 was reviewed based on the specific criteria. There are four criteria used in this step. First, all of the studies must be written in the English language. Second, all of the studies must show and discuss

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the relationship between knowledge and innovation. Third, the unit analysis is an organization, and finally, the literature obtained should perform empirical evidence towards the relationship between knowledge and innovation. In step 3, the literature that passes step 2 will be further reviewed to check its quality. In step 4, the primary studies were selected. Finally, in step 5, the primary studies were further review and analyzed.

III. RESULT AND DISCUSSION

The literature review process in this study is presented in Fig. 2. The number of articles obtained from Science Direct and Emerald Insight database in initial search based on the abstract is 4216 and 936 respectively. The further identification of the appropriate articles that were obtained in the previous step was performed. From 936 articles found in Emerald Insight, 861 articles were excluded. Those articles were removed because the title of the articles did not specifically mention or discuss knowledge and innovation. Using the same reason, 3802 articles from Science Direct were also excluded for further reviewed.

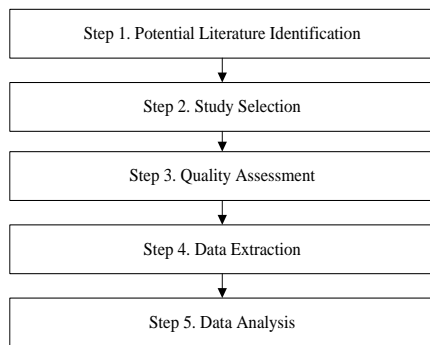


Fig. 1. Systematic literature review steps.

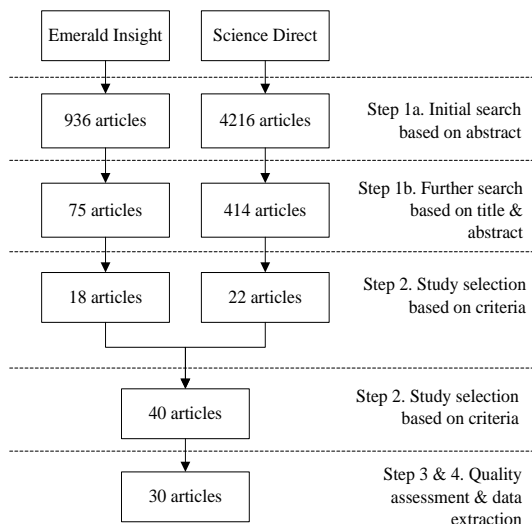


Fig. 2. Literature review process.

The remaining 75 and 414 articles from Emerald Insight and Science Direct were examined whether they met the criteria or not based on the existence of relationship between knowledge and innovation, empirical evidence of the

relationship, whether they were written using English language or not, and the unit analysis of the study must be in organizational level. From 75 remaining articles in Emerald Insight, only 18 articles that met all the criteria, while in Science Direct only 22 articles that met all the criteria. Therefore, there are 40 articles in total from both databases to be further reviewed and screened to obtain primary articles. Finally, 30 articles were selected as primary articles to be analyzed in this study. According to 30 articles that were selected as the primary study, various knowledge management constructs, types of innovation, and mediating variable between knowledge management and innovation were identified. The summary of the primary articles obtained in this study can be seen in Table I.

A. Knowledge Management

There are three categories of knowledge management construct obtained in this study, namely knowledge management process and capabilities, knowledge management implementation approach, and knowledge characteristic. Knowledge management process and capabilities consist of knowledge exploration, knowledge acquisition, knowledge creation, knowledge dissemination, knowledge storage, and knowledge application. In addition to knowledge management capabilities, Darroch [15] considered responsiveness to knowledge as a construct that measures knowledge management capabilities. The term of knowledge management process and capabilities that was between one primary article to another article might differ. Knowledge acquisition construct has similar meaning with knowledge collecting and knowledge exploitation. Knowledge dissemination construct has similar meaning with knowledge sharing, knowledge transfer, knowledge distribution, and knowledge donating. Knowledge creation is considered has similar meaning with knowledge conversion. Knowledge application is considered has similar meaning with knowledge interpretation and knowledge utilization.

The next knowledge management category is knowledge management implementation approach [16]. According to López-Nicolás & Meroño-Cerdán [17], there are two types of knowledge management implementation approach, namely personalization and codification, while Obeidat, Al-Suradi, Masa'deh, and Tarhini [16], identified three approaches, namely personalization, codification, and social network.

The last knowledge management category is knowledge characteristic. There are four knowledge categories identified, which are knowledge complexity [18], [19], knowledge tacitness [18]. Knowledge explicit [19], and modularity [19].

B. Innovation

This study identified various types of innovation variables to measure the existence of innovation improvement in an organization. Innovation variables used in one article might differ with another article. Innovation can be measured in different ways depending on the interest of the researcher [10]. According to literature study, there are 12 types of innovation that are related to knowledge management.

TABLE I: THE SUMMARY OF PRIMARY ARTICLES

Reference	Object	KM Manifest	Innovation Manifest	Proven Relationship
[20]	companies operating within the district of this city	-Knowledge collecting -knowledge donating	- Innovation capability - Innovation performance	-knowledge donation --> innovation capability -innovation capability --> innovation performance
[21]	3 organization in Turkey	- knowledge donating - knowledge collecting	Innovation Capability	- knowledge collecting --> innovation capability
[22]	Service firm in Bahrain	- Knowledge acquisition - knowledge transfer - knowledge application	- product innovation - process innovation	- KM acquisition --> process innovation - Knowledge transfer --> process innovation - knowledge application --> process & product innovation
[23]	three main kinds of parks that make up the industrial cluster index in Taiwan	- knowledge creation & acquisition - knowledge dissemination & storage	- Market innovation performance - product innovation performance	- KM --> Innovation - Knowledge creation & acquisition --> Innovation - knowledge dissemination & storage --> Innovation
[24]	Spanish Industrial Firms	-Internal knowledge creation capacity - Absorptive capacity	-Incremental innovation - Radical Innovation	- internal knowledge creation capacity --> incremental innovation - Absorptive capacity --> Incremental Innovation - Absorptive capacity --> Radical Innovation - internal knowledge creation capacity --> absorptive capacity - absorptive capacity mediated internal knowledge creation and radical innovation
[25]	4 mobile telecommunication companies	Knowledge Sharing	Innovation performance	-Innovation Technology Capability --> Innovation - Innovation technology Support --> Innovation - Knowledge Sharing --> Innovation - Innovation Technology Capability --> Knowledge Sharing - Innovation technology Support --> Knowledge Sharing
[26]	Online Technology firms (Weibo, Wechat, LinkedIn, etc)	Knowledge Acquisition	-Innovation strategy	- Knowledge acquisition --> innovation
[27]	Technology firms	-KM Transfer - KM Storage - KM Application -KM Creation	- Innovation performance	- KM creation --> innovation - KM application practice --> innovation
[28]	Business units in Taiwanese Firms	- Knowledge acquisition capability - knowledge sharing capability	Radical Innovation	-Knowledge acquisition capabilities --> radical innovation - Knowledge sharing capabilities --> radical innovation
[29]	Italian Firms	- Knowledge management system - Knowledge management capacity	- Open Innovation - Innovation Capacity	- KMS --> KMC through open innovation - Open Innovation --> KM Capacity - Open innovation --> innovation capacity - KMC --> Innovation capacity
[18]	Manufacturing firms	- Knowledge tacitness - Knowledge complexity	- Radical Innovation	- Social capital; --> Radical innovation - Knowledge complexity --> Radical Innovation - Knowledge tacitness --> Radical Innovation
[17]	310 Organization in Spanish	- Codification KM strategy - Personalisation KM Strategy	- Radical Innovation	- Codification KM Strategy --> Innovation - Personalisation KM Strategy -->Innovation
[30]	150 firms	-knowledge management capacity (acquisition, sharing, application)	-innovation performance	-knowledge management capacity --> firm innovation performance
[31]	Manufacturing & Financial firms	Organizational Capabilities - Knowledge acquisition - Knowledge conversion - Knowledge Application	Organizational Innovation	- Knowledge management --> Organizational Innovation - Knowledge management --> organizational learning - Organizational learning --> Organizational innovation
[32]	218 project by 144 firms	- Knowledge Acquisition	- Product Innovation	- Knowledge Acquisition --> Product Innovation
[33]	firms in Turkey	- Knowledge management skill	- Innovation performance	- KM Skill --> Innovation performance
[34]	Manufacturing Firms	Knowledge Management Process - Knowledge acquisition - Knowledge sharing - Knowledge application	- Product Innovation - Process Innovation	- KM Process --> Product Innovation - KM Process --> Process Innovation
[35]	Manufacturing SME	- Knowledge management capability	- Open Innovation	- KM Capabilities --> Open Innovation

TABLE I: THE SUMMARY OF PRIMARY ARTICLES (CONTINUED)

Reference	Object	KM Manifest	Innovation Manifest	Proven Relationship
[36]	Manufacturing firms	- Knowledge acquisition - Knowledge sharing - Knowledge application - Knowledge storage	- Technological Innovation	- Knowledge sharing --> Technological Innovation - Knowledge Storage --> Technological Innovation - Knowledge Application --> Technological Innovation - Knowledge Acquisition --> knowledge application - Knowledge Acquisition --> Knowledge sharing - Knowledge sharing --> knowledge application
[37]	High tech firms in Taiwan	Cust. Knowledge management - Knowledge acquisition - Knowledge Sharing - Knowledge Application	- Product Innovation Performance	- Cust Knowledge Management --> Product Innovation Performance
[7]	Malaysian Manufacturing Sector	KM Process - Knowledge Acquisition - Knowledge dissemination - Knowledge application	- Innovation performance	- KM Process --> Innovation - Knowledge Application --> Innovation - Knowledge dissemination --> Innovation
[38]	111 Spanish companies	- Knowledge exploration - Knowledge exploitation		- Knowledge exploration --> Innovation - Knowledge exploitation --> Innovation - All of the mediators are proven
[2]	176 firms in Taiwan	- Knowledge acquisition - Knowledge sharing - Knowledge application	Innovation - Administrative Innovation - Technical Innovation	- Knowledge management --> Innovation
[12]	Spanish Companies	- Knowledge Acquisition - Knowledge distribution - Knowledge Interpretation	- Product innovation - Process innovation	- KM --> Product Innovation - KM --> Process Innovation
[19]	KM Managers	KM Capability - Acquisition - Conversion - Application Knowledge Characteristic - Modularity - Complexity - Explicit Knowledge Integration - Efficiency - Flexibility	- Product innovation - Process innovation	- Knowledge integration --> Innovation - K Char --> KM Capability - KM Capabilities --> Innovation - Org Learning --> Innovation
[15]	CEO from cross-section Industries in New Zealand	- knowledge acquisition - Knowledge dissemination - knowledge responsiveness	Innovation	- Knowledge acquisition --> Innovation - Knowledge dissemination --> innovation - Knowledge responsiveness --> Innovation
[39]	Manufacturing Company	- Knowledge management	- Technical Innovation Innovation	- Knowledge management --> technical innovation
[16]	Jordanian Consulting Firms	Knowledge management process - Acquisition - Sharing - Utilization KM Approach - Social network - Codification - Personalization		- KM Process (Acquisition, sharing, utilization) --> Innovation - KM Approach (codification, social network, personalization) --> Innovation
[40]	French Firms	Knowledge management - Knowledge sharing - Knowledge capture and acquisition - Policies and Strategy - Training and Mentoring	environmental innovation	- KM --> Environmental innovation
[10]	Parastatals Organization in Uganda	Knowledge management	Organizational innovation	- KM --> Organizational Innovation

C. Innovation Performance

In this study, eight articles used innovation performance variable to empirically test the relationship between knowledge management and innovation. Innovation performance was defined as the performance of the implementation new and improved method in the terms of marketing, business practice, workplace organization or external relation, and also the implementation of the new and improved product (goods or service) or process [20].

According to the literature review, knowledge exploration, acquisition, creation, sharing, storage, application, responsiveness to knowledge, and knowledge management implementation approach, as listed in Table II, are related to innovation performance.

As an addition, the study of Kamasak, Yavuz, Karagulle, & Agca [33] provides empiric evidence that knowledge management skill has positive relationship towards innovation performance, where it can be argued that

knowledge management skill is similar to knowledge management capability. Knowledge management capability consists of capability in knowledge management processes such as knowledge exploration, acquisition, creation, sharing, storage, and application.

TABLE II: KM AND INNOVATION PERFORMANCE

Knowledge management variable from literature	Reference
Knowledge exploration	[38]
Knowledge acquisition	[15], [16], [20], [30], [38]
Knowledge creation	[27]
Knowledge dissemination	[15], [16], [20], [25], [30],
Knowledge storage	[27]
Knowledge Application	[16], [27], [30]
Responsiveness to knowledge	[15]
Knowledge management implementation approach	[16]

D. Product and Process Innovation

Based on primary articles used in this study, seven articles used either process innovation, product innovation, or both process and product innovation variable to empirically test the relationship between knowledge management and innovation. Product innovation is related to both introducing new products and improving existing ones [34]. It consists of the introduction of a new-to-the-world product, product modification and improvement, as well as the production of the product that is new to the customer through the extending the existing product line in the organization [22]. Process innovation is defined as the introduction of new changes in the way of producing the product or service to improve efficiency [22] through the adoption of new or improved methods [12]. The knowledge management variables that positively influence product and process innovation can be seen in Table III.

TABLE III: KM AND PRODUCT & PROCESS INNOVATION

Knowledge management variable from literature	Innovation Type	Reference
Knowledge creation	Product Innovation	[19], [23]
	Process Innovation	[19]
Knowledge acquisition	Product Innovation	[23], [32], [34], [37], [12], [19]
	Process Innovation	[22], [12], [19]
Knowledge dissemination	Product Innovation	[34], [37], [12]
	Process Innovation	[22], [12]
Knowledge Storage	Product Innovation	[23]
	Process Innovation	[23]
Knowledge Application	Product Innovation	[22], [34], [37]
	Process Innovation	[12], [19]
	Process Innovation	[22], [12], [19]

E. Market Innovation

Based on primary articles used in this study, there is only one article that used market innovation variable to empirically test the relationship between knowledge management and innovation. Market innovation is defined as the performance of the organization related to high customer's demand, satisfaction, the increasing market share, and profit [23]. Moreover, according to the empirical study, knowledge creation and acquisition, and knowledge storage

and dissemination influence innovation performance including market innovation [23].

F. Incremental and Radical Innovation

Based on primary articles used in this study, four articles used radical innovation, incremental innovation, or both radical and incremental innovation variable to empirically test the relationship between knowledge management and innovation. Incremental innovation consists of the refinement and reinforcement of current products, processes, technologies, methods, and organizational structure in the organization, while radical innovation related the innovation that produces fundamental changes towards products, processes, technologies, methods, or organizational structure in the organization [24]. The knowledge management variables that positively influence radical and incremental innovation are presented in Table IV.

TABLE IV: KM AND RADICAL & INCREMENTAL INNOVATION

Knowledge management variable from literature	Innovation Type	Reference
Knowledge creation	Incremental Innovation	[24]
Knowledge acquisition	Radical Innovation	[24], [28]
	Incremental Innovation	[24]
Knowledge dissemination	Radical Innovation	[24], [28]
Knowledge application	Radical Innovation	[24]
Knowledge Characteristic		
- Tacitness	Radical Innovation	[18]
- Complexity	Radical Innovation	[18]
Knowledge Implementation Approach		
- Codification	Radical Innovation	[17]
- Personalization	Radical Innovation	[17]

G. Administrative and Technical Innovation

Three articles used administrative innovation, technical innovation, or both administrative and technical innovation variable to empirically test the relationship between knowledge management and innovation. Administrative innovation measure the innovation in planning procedure, process control, and integrated mechanism [2]. Technical or technological innovation is defined as the innovation that encompasses innovation in products and processes [39]. Ayoub, Abdallah, & Suifan [39] proved the relationship between knowledge management in general, which is represented by knowledge acquisition, dissemination, and application, toward technical innovation, but not specifically breakdown knowledge management variable and test each dimension towards innovation. The knowledge management variables that positively influence administrative and technical innovation are listed in Table V.

TABLE V: KM AND ADMINISTRATIVE & TECHNICAL INNOVATION

Knowledge management variable from literature	Innovation Type	Reference
Knowledge acquisition	Administrative Innovation	[2]
	Technical Innovation	[36], [2]
Knowledge dissemination	Administrative Innovation	[2]
	Technical Innovation	[36], [2]
Knowledge storage	Technical Innovation	[36]
Knowledge application	Administrative Innovation	[2]
	Technical Innovation	[36], [2]

H. Open Innovation

Based on primary articles used in this study, there are two articles that used open innovation variable to empirically test the relationship between knowledge management and innovation. Open innovation is an innovation where organization tends to build up collaborations with the external partner to access and benefit from their new technologies, skills, and expertise [35]. Knowledge management capability has positive a relationship with open innovation [29], [35].

I. Organizational Innovation

Based on primary articles used in this study, two articles used organizational innovation variable to empirically test the relationship between knowledge management and innovation. Organizational innovation is defined as the application of the new idea in the organization, where it is embodied in products, processes, and management marketing system [31]. Both articles provide empirical evidence of the relationship of knowledge management in general towards organizational innovation. Mafabi, Muene, & Ntayi [10] consider knowledge management as a system that consists of knowledge capture and acquisition, creation, dissemination, and storage where Liao and Wu [31] consider knowledge acquisition, knowledge creation, and knowledge application as the dimension of knowledge management.

J. Environmental Innovation

Based on primary articles used in this study, only one article used environmental innovation variable to empirically test the relationship between knowledge management and innovation [26]. Environmental or green innovation has been defined as the new or modified practices, methods, system, and products that decrease environmental harm through the replacement of inefficient business activities [26]. Stanovcic, Pekovic, & Bouziri [26] examine three constructs of knowledge management, namely knowledge management in general (including knowledge capture and acquisition, knowledge sharing or dissemination, policies and strategy, and training and mentoring), knowledge management policies, and knowledge sharing culture. All three constructs have positive relationship towards environmental innovation.

K. Mediation Variable

According to the literature review, there are some articles that analyze the mediation effect. Below is the further explanation regarding the mediation effect obtained from primary articles. According to the study developed by Yeşil, Koska, & Büyükbese [20], knowledge donating, which in this study is referred to knowledge dissemination have an indirect effect towards innovation performance. Innovation capability mediates the effect of knowledge dissemination towards innovation performance. The study from Forez & Camison [24], found that the effect of knowledge creation towards radical innovation was mediated by absorptive capacity.

IV. CONCLUSION

In conclusion, this study performed a systematic literature review to obtain more insight regarding the relationship between knowledge and innovation. There are thirty articles

were selected as primary articles for further review. According to the primary articles, there are three categories of knowledge management that influence innovation, namely knowledge management process, knowledge management implementation approach, and knowledge characteristic. Moreover, various types of innovation were also obtained namely, innovation performance, product and process innovation, technical and administrative innovation, radical and incremental innovation, market innovation, open innovation, and organizational innovation. For further research, the effect of knowledge management on innovation might be categorized based on the category of the organization such as SME, the non-profit organization, government, etc. Moreover, according to this literature study, most of the innovation still limited to closed innovation that utilizes internal resource which is difficult to be implemented in small industries due to the limited resource. Therefore, small industries tend to adopt collaborative or open innovation method that enables the use of the external resource. The role of knowledge management in open innovation needs further investigation because it is possible that open innovation requires both intra-organizational and inter-organizational knowledge management.

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