



CAPABILITIES OF R&D: LITERATURE ANALYSIS

Zeeshan Asim

Faculty of Industrial Management,
Universiti Malaysia Pahang, Malaysia

Shahryar Sorooshian

Faculty of Industrial Management & Centre for Earth Resources Research and Management,
Universiti Malaysia Pahang, Malaysia

Muzamir Hasan

Centre for Earth Resources Research and Management,
Universiti Malaysia Pahang, Malaysia

ABSTRACT

The establishment of new research idea as a path to narrow the literature gap and added studies in the field of Technology, Innovation, and Knowledge management capabilities and their interrelation impact on Research and development (R&D) has had become a significant challenge for R&D policy-makers. The study was a library search to highlight interrelationships of the R&D dominance (knowledge management, innovation management and technology management) and their subfields. The basic source material to construct academic yield was a one decade publications from 2006 to 2016.

Key words: Technology management capabilities; Knowledge management capabilities; Innovation management capabilities; Research and development.

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1. INTRODUCTION

To understand and allow the comprehensive capabilities related to knowledge management (KM) and innovation management (IM) with technological features have been recognizing as a prominent source to tackle industrial issues at a global extent [1]. Majority of the R&D related firms act as an aggressive observer on the drastic progression in the area of science and innovation due to extreme growth in procuring new capabilities related to KM to navigate their innovation procedures [1]. Due to new trading policies, most of the big corporate giants more focus on their R&D equip with technical advancement as a tool for a strategic benefit to

confronting uncertain market dynamics. In order to sustain firms overall industrial competencies and remain progressive under uncertain market condition majority of firms substantially relied upon the transformation, acquisition, and creation capabilities related to KM [2], such metamorphic attributes deemed as critical element to any R&D firms in order to deal with any uncertain innovative or technological trends.

On the other hand, being consistently innovative and retained the maximum competitive abilities as vigorous for escalating business situation: For the stable and persisting business aim, capabilities associated to IM allows R&D firms to characterize fluctuation among products categories that involve the conventional means of altering the innovation practices [3]. Majority of the R&D driven firms was consistently looking to adopted and organizing capabilities related to IM as the capacity to hold their current market position by inhaling external knowledge and developed an innovative product that targets the consumer demand [3]. Similarly, to boost the technological development, the potential impact of capabilities related to technology management (TM) that permits R&D driven forms to absorb more transparent knowledge to handle composite responsibilities [4]. Therefore, to attained capabilities related to TM by most innovation-driven firms enables R&D capabilities with technical know-how to allows experimental knowledge based on their technological strength [4].

Based on an outline of literature, the main aim of this manuscript is to achieve and evaluate the research articles, not to illustrate it, but fairly to figure out the primary research trends. Based on the literature, the primary objective of this research article is to illustrate primary trends. The publication trends from existing literature also analyzed in this research article but more focus on assessing relationship in among capabilities related to knowledge, innovation and TM. In this article more attention has been made on the possible discussion on towards the current scope of available literature that justifies explicitly the relationship among as an overall view to the R&D capabilities, capabilities related to KM, IM and TM.

Therefore, this research studies describe the possibilities of different narratives by assessing the capabilities related to KM, IM and TM, also known as R&D supporting management discipline, with varying configurations of R&D. Then underlines the arguments on the data retrieve from the systematic search, thirdly a comprehensive debate on results and finally draw a conclusion with further Research Avenue for future research.

2. METHOD

The research can be categorized as quantitative and investigative. The logical and systematic assessment of research literature generated through a preliminary screening and search of scientific database (Web of Science) by linking the key phrase to research papers, and journals related to the topic within the suggested time range from years 2006-2016.

A total of ten journals titles was analyzed which includes articles from the international studies with significant impact rating specifically on the topic of KM, IM and TM capabilities. A preliminary sample size around 3000 articles was obtained and specifically concentrated on the vital areas of the study: Knowledge management capabilities (KMC), Technology management capabilities(TMC), Innovation management capabilities (IMC).

From 3000 research studies, only 1039 fulfill the desired specifications and established further opportunity for the assessment which allow preferred articles logically represent the connectivity of at least one of the relationships suggested for our discussion: Between KMC and IMC, IMC and TMC, KMC and TMC.

3. LITERATURE

To deal with R&D within a bigger picture the capabilities related to KM to some level shares boundaries with capabilities related to IM explicitly coping with uncertain market trends. Some current studies reveal specific restriction for R&D executives to counter market dynamism [5]. In some cases, R&D firms face complicated situation specifically during the process of retainable policy making which is turn out to be critical issues during the selection of essential criteria's utilize for capabilities related to KM that associate to R&D to enhance under inadequate resources [5].

Most R&D driven firms were looking to enhance their innovational capacity frequently was looking to rectifying and addresses the complex issues related to new prospects in case of creating innovation, include potential values and limiting business competencies [6]. In a holistic view, these innovation abilities recognized to harvest the firm's suitable R&D performance by gaining external KMC [6]. A range of preliminary theories on capabilities related to IM enormously correlates with the fundamental theories of KM and significantly be precise when handling with core concepts of intellectual property [7].

The extensive impact on employing the significant drivers for KM practices become primary source for creating capabilities associated with IM in the context of KM [8]. To respond market demands most R&D firms enabling significant drives associated to KM that in majority cases turn out to be a critical source for creating capabilities that belong to IM [8].

In general narrative, the majority of cases firms' KMC were interpreted as a dynamic feature to stimulate the currents capabilities as a tool to compete for their business rivals and to organize their existing innovational strength in a way that firm react practically before their competitors [9]. On the other hand, existing literature unable to draws as much decision guideline for crucial criteria belongs to IM capabilities which exert an impact on R&D [10]. Over the period, various theories and narrative facing critical apprehension regarding extending the value of the effectiveness of selecting the relevant technical know-how for absorbing new knowledge [11]

Many firms over a period have made a little attention to incorporating new capabilities related to TM due to fluctuating technological trends. Some experts identified various un-explore research studies that facilitate R&D executives to highlights on criteria related to TM to create a flexible algorithm for sustainable R&D growth [12]. To confront uncertain technological trends, accessible compatibility of KM capabilities needs complete reconfigurations in the shape of transferring knowledge within and beyond the organizational barriers [15, 16]. This reconfiguration includes all the functional features along with a synchronized approach [13, 14]. Accorsi and Costa [17] indicates the range of technological tools that can be utilized for reconfiguring the capabilities related to KM for instance: a KM system.

Over the period there have been following technological achievements that push organizations towards technical makeover which gives many firms to enhance their existing innovative capabilities [13, 14]. As the process of creating new opportunities related to new product or services has arrived at the market, Majority of the organizations carry forward such approach to industrial scale. Such criteria utilized by many organizations to retain their operational pattern remain flexible concerning fluctuating market trends [13, 14].

4. RESULTS

To observe the research articles that reserved the connectivity, ten-year periods, range from 2006-2016, was studied supporting the completeness of the proposed zone of research. The range of each relationship was contemplated by summing up the quantity of publications

selected for each diverse association with reverence to publication year. Therefore, figure 1 displays specific distribution of article publication over the targeted ten years particularly belongs in research area of management.

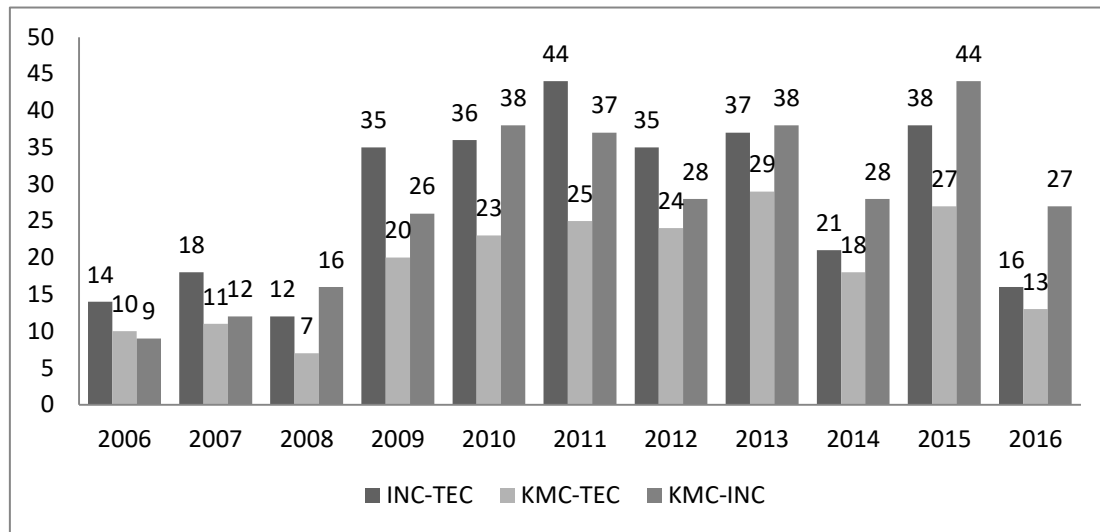


Figure 1 Analysis on the logical relationship on the basis of publication per years
(Source: https://apps.webofknowledge.com/WOS_GeneralSearch_input)

It can be observed that a fascinating progress in the attention among the theoretical concept that correspond to the interrelationship among the IM, TM, and KM in journal publications based on WoS. During the time of 2006 to 2008, limited numbers of published articles has been found that correspond to the logical interrelationship in between the management capabilities especially their influence on the R&D activities. While, the initial emphasis were transform from years 2009 to 2015 as majority of the published studies quantitative in nature with more stress on creating firm advance innovation capacity by acquiring technological capability in order to retain firms competitive proficiency. More researchers over the period of 6 year starting from 2009 to 2015 their comprehensive focus were towards transformation of radical innovation to product and services with extensive support to acquire advance capabilities related to TM in order to retain the maximum competitive advantageous.

Table 1 Publication on relationships between R&D capabilities

Years	IMC-TMC	Years	KMC-TMC	Years	KMC-IMC
2006	14	2006	10	2006	09
2007	18	2007	11	2007	12
2008	12	2008	07	2008	16
2009	35	2009	20	2009	26
2010	36	2010	23	2010	38
2011	44	2011	25	2011	37
2012	35	2012	24	2012	28
2013	37	2013	29	2013	38
2014	21	2014	18	2014	28
2015	38	2015	27	2015	44
2016	16	2016	13	2016	27
A- innovation and technology		B- knowledge and technology		C- knowldge and innovation	

(Source: https://apps.webofknowledge.com/WOS_GeneralSearch_input)

As from Table 1, part A, highlights the particular distribution of the 306 research publications assessed with respect to number of years of publication, approximately 403 articles were primarily analyzed around 306 research article describe connection in between innovation and technological capabilities.

Ten journals were filter out according to the specification that represent frequent publications regarding proposed relationship in between capabilities related to IM and TM over the period of ten years. The observed analysis initially emphasizing on validating research domain a list of publication journal were selected to publish the concerned area of interest. During the period from 2006 -2016 most of papers were published in ‘Research policy’ journal under the range of environmental management, policy management, and some other contests. ‘R&D management’ journal reflects as next in list to published about 19 article under linking scope of TM and IM. R&D Management journal more specific on publication of full range study topics in R&D, innovation related to strategic human resource, also examine some of topics related to innovation and technological capabilities underneath economic and social domain. ‘Technovation’ is the third among publication list with almost 15 articles related to selected domain concentrating on linking technological and innovation capabilities under social innovation. Major trends associated to the mentioned journal are “managing technological innovation capabilities”, and “Investment strategies for technological intense entrepreneurial ventures”. There were few other journals in list like ‘Technology Management and strategic Analysis’ and ‘Journal Product and IM’ which producing publication with a consisting linking analysis of science, technology and innovation for strategic policy making and highlighting knowledge and practice of new product development and IM

Table 1, part B, represents the particular distribution of 207 research publication assessed with respect to number of years, approximately 265 articles were primarily analyzed around 207 research article describe connection in between capabilities related to KM and TM. The existing information from the duration 2006 to 2008 describes the nature of studies from the number of international journals shows limited interest related to logical connectivity in between technological advancement and transforms the knowledge across the organizational function. But, from year’s 2009 to 2015 drastic increase of publication were observe related to technological advancement that demands new capabilities related to KM for effective R&D operations. During the period from 2006 -2016 most of papers were published in ‘Research policy’ journal covering the scope research issue related to developing policy for regional and national level, knowledge diffusion, and some other research issues related to organizational learning, and R&D management in term of Research policy. The journal ‘Technovation’ considers as second in list to published around 14 article covering range of issues related to developing technology involvement in organizational structure. R&D Management journal more specific on publishing full range research topics in research and development, innovation related to social and environmental implication, also examine some of topics capabilities relevant for KM and TM under social and economic domain. ‘Technology Management and strategic Analysis’ is the fourth highest among publication list with almost 11 articles related to selected research domain more focusing on resolving the technological issue at corporate and organizational level through acquiring national and international capabilities. Major trends related to this journal are related to promote strategic thinking regarding science and technology that can be exploited industrially. There were few other journals in list like ‘Product and Innovation Management’ and ‘International Journal of Technology Management’ which producing publication with a consisting linking analysis of KM and TM for strategic policy making and highlighting KM and IM for techno-innovational purposes.

Approximately 371 articles were primarily analyzed around 303 illustrate connection in between knowledge and innovation capabilities associated to R&D, as shown in part C of Table 1. The publication data from the duration 2006 to 2008, describes the nature of studies from the number of international journals have draw a significant attention among technological advancement in order to transform the knowledge across the organizational function. During the period from 2006 -2016 most of papers were published in ‘R&D Management’ journal address issues based on exploratory science to commercial exploitation with major focus on R&D Management. The journal ‘International Journal of Technology Management’ considers as second in list to publish around 9 articles addressing some of the covering scope of Technology Monitoring Audit and Evaluation. The ‘Technology Management and strategic Analysis’ journal more specific on publishing full range research topics in research and development, solving the technological challenges at corporate and governmental level through adopting domestic and international capabilities. ‘Technovation’ is the fourth highest among publication list with almost 09 articles related to selected research domain more focusing on under connecting scope used for developing technology involvement in organizational structure. Major trends belongs to this journal are management capabilities related to technological innovation, Investment strategies for technological intense entrepreneurial ventures. There were few other journals in list like ‘knowledge Management’ and ‘Research Policy’ which producing publication with a consisting linking analysis of KM and IM for policy making and highlighting KM and IM for developing new knowledge capability in order to confront market **dynamism**

5. DISCUSSION

It is observed that over the period of time number of publication link with IM and TM is more emphases acquiring on technological innovation capability. While, limited interest were emphases in creating ability to develop innovational capability by advance on technological change. At initial stages during period in between 2006-2008 the publication trend among capabilities related to IM and TM were focus on interrelating capabilities among IM and TM. During initial stage the most dominant research trends were ‘capabilities’ that used to connect strategies among IM and TM. Similarly, the term like ‘productivity’ and technical change were consider over a long period of time these term used for competitive intelligence to develop new product and process. There were few other research domains appears under same research scope such as innovative performance and technology transfer used to relate as potential capabilities among IM and TM. Research and development, knowledge management and absorptive capacity are the most occurring within capability context. Technological innovation was considering as most attractive research domain among researchers that used as potential instrument in enhance organizational innovation. There were few other research terms that associate with innovation and technological capabilities such as knowledge creation, strategic alliance and product innovation that were utilizes for innovative policy development

Similarly, It has been noticed that with the passage of time number of publication associated with KM and TM were more emphases on efficient work practice. At initial stages the publication trend among knowledge and technological capabilities were focus on interrelation in between technologies and work practice. Over the period of time effective work practice used to transform into new knowledge. The term like efficient practice and technologies consider being inseparable over a period of long time. Other areas of interest are some of digital tools used for transformation of knowledge. There is many other interesting research areas are appear over the period of times with boundaries of interest. Since over the period of time consistent advancement in technologies, therefore the research trend over the period of time consistently emphases on new technologies. Later on, the major research

interest connected to innovation. Above all, it was the most often occurring term among the publications. Innovation was considering as most attractive research domain among the researchers in context of a strategic management, new process and product development and technology acquisitions. Nevertheless, this term also co-occurred with the majority of other area of interest. Such research domains linked with Absorptive capacity in context of IM or referring new technology and new knowledge capability. Another research trends observed during those periods were organizational performance and competitive advantage in context of acquiring new knowledge, and strategic alliance to confront dynamic capability in case of deal with R&D Management

Lastly, it has been analyzed that core association in between KM and IM remain debatable over a period of 2006 to 2016. From 2006 to 2008 initially was emphasis on acquiring innovation capability with economic prospects. There were many other trends published during that period but researchers are more emphases on finding the areas of new discoveries. They were more focus on developing innovational abilities through creating advancement in KM practices. At initial stages were more dominant to 'knowledge' that used to link with technologies that enable the comprehensive KM infrastructure to interface with firms' existing cultures and structures. Similarly, terms like 'People, organizational culture, organizational structure, community of practices, and employees' these trends mainly stressed upon certain general perspectives of firms' existing capabilities. After 2008 significant growth were recognized in context of their Impact on the firms R&D. Further research was conducted using an in-depth focus on the strategic aspect of KM in addition to internal and external organizational dimensions. In between 2011 and 2012 trends were, shifted to due to growing concerned on sustaining innovational ability. This was rectifying by enabling networks creating new knowledge. After 2012 till the end of this research domain, the researchers are consistent focusing on strategic knowledge capability to avoid the potential risks involved with (Externalization, external knowledge source, and joint learning externally)

6. CONCLUSIONS

By observing the logical interaction over the period of ten years, as well as observing the publications from international journals, it was discovered that the relationship in between capabilities related to KM and IM appears in superior numbers over ten years of publications. It was significant that the overlapping connectivity in between capabilities related to KM and IM appears over a period of time, but from the studies, limited publication observed as compare to other two relationships. From 2009 to 2013 frequent publication were observed, but these numbers shrink from 2014. In contrast, the capabilities related to KM and IM were observed an overwhelming number of publications in between 2009 to 2016. It can be still predictable, as a further opportunity of research to fill the literature gap regarding capabilities related to KM, IM, and TM and causal interdependence influence on R&D. The rising growth of scientific production among relationship in between capabilities related KM and IM translates current deficiencies in between knowledge and innovation management. These deficiencies occurred due to the demand of creating new knowledge for the purpose of new product and service because of rising fluctuation in business climate. Similarly, the relationship in between capabilities related to KM and TM required further improvement in order to share new knowledge across organizational boundaries. Limited number research studies related to the relationship among capabilities related to IM and TM with their direct and indirect influence on organizational R&D in order to achieve the competitive advantageous for long term business goal.

Last but not the least, such as past attempt in project management [18], future studies could model R&D based on KM, IM, and TM. The result and observations highlights in this

article offers a contemporary sketch of certain modern trends associated with KM, IM, and TM that influences R&D. The analysis highlights some new trends, which previously unexplored. These unidentified trends help future researchers to construct new area of research interest by interrelating capabilities among knowledge, innovation and technology management. This analysis focusing R&D as main unit of analyses where capabilities influence where observe. The current analysis may suggest that the behavior of these capabilities many influence some other organizational functions. This analysis allows other researcher to enable systematic approach that how to search a new ideas and its relevant solution in the next few years is needed. In last, this analysis pointing out that R&D or managing R&D consider as growing field of study, quantifying by interdisciplinary issues with high research potential.

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