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Information Infrastructure Capability and Organizational Competitive Advantage: A Proposed Framework

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ABSTRACT

Background: Knowledge management (KM) development is essential because it is widely accepted that KM is an enabler for the information infrastructure capability (IIC) and organizational competitive advantage (CA). However, the existing KM studies on different research dimensions are unclear and ineffective to organizations and researchers without indicating their strengths, weaknesses, key variables and values contributed into this research domain. Since Malaysia is currently moving towards the era of knowledge (k)-economy, this study is essential in assisting Malaysian government and researchers to establish the most appropriate information infrastructure for effective knowledge management in the organization. The framework proposed by this study can also become an important and useful reference to the governments and researchers in other developing Asian countries in escalating their moves towards the creation of k-economy. **Objective:** This paper aims to propose a research framework to fill up the lacunae of the previous research. **Results:** Based on previous research reviews, this paper surveyed and classified KM frameworks using five categories as: (1) KM foundation studies. (2) Resource-based view (RBV) studies. (3) Information infrastructure capability (IIC) studies. (4) Competitive advantage (CA) studies. (5) Organizational information processing theory (OIPT) studies. A comprehensive research framework was proposed to overcome the lacunae of previous prominent studies in this research domain. **Conclusion:** The framework proposed by this study will assist companies to examine how well their current information infrastructure are promoting effective KM to quickly develop new business processes, techniques and decisions. This study is one of the pioneer studies in Asia that incorporating valuable IICs such as the integrating capability, data management capability, security capability, utility capability and collaborating capability in the research framework to assist knowledge-and-technology-based companies to improve current KM practices and achieve sustainable CA.

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INTRODUCTION

Seeking a clear view of knowledge management (KM) development is essential because it is widely accepted that KM is an enabler for the information infrastructure capability (IIC) and organizational competitive advantage (CA) (Chang and Chuang, 2011; Li, Tarafdar and Rao, 2012). However, there are ambiguous and numerous KM studies on different research dimensions. In this paper, different dimensions of KM researches are reviewed and classified, which leads KM-IIC-CA research in a clearer view by indicating their strengths, weaknesses, key variables and values contributed into this research domain.

This study has remarkable implications for research. It aims to propose a comprehensive knowledge management research model that investigates how IIC affects the sustainable KM and CA of a company based on the research lacunae from previous KM framework. Since Malaysia is currently moving towards the era of k-economy, this study is essential in assisting Malaysian government and researchers to establish the most appropriate information infrastructure for effective knowledge management in the organization. The framework proposed by this study can also become an important and useful reference to the governments and researchers in other developing Asian countries in escalating their moves towards the creation of k-economy.

One of the practical implications of this study is to assist managers to recognise the importance of information infrastructure. This study is one of the pioneer studies in Asia that incorporating valuable IICs such as the integrating capability, data management capability, security capability, utility capability and collaborating capability in the research framework to assist knowledge-and-technology-based companies to improve current

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KM practices and achieve sustainable CA. Without well-developed information infrastructures, companies will not be succeed in developing long-term CA through effective process management, database management, document management and performance management.

The framework proposed by this study will also help senior executives to examine how well their current information infrastructure are promoting effective KM to quickly develop new business processes, techniques and decisions. When a knowledge-and-technology-based company can quickly and easily develop new KM applications and modify existing applications, the organization is on the right track of developing sustainable CA. This study will help companies in developing a relevant, timely and flexible IIC, which will help the companies to manage its resources to respond to customer demands in timely manner.

Review of Theoretical Frameworks:

To better understand how IIC and organizational competitive advantage (CA) are associated, it is crucial that previous related research and their interactions with technology and systems are reviewed and explored. In this section, related and prominent researches as below were reviewed and categorised based on their research nature.

1. Knowledge Management (KM) Foundation Studies (Holsapple and Joshi, 2002; Nonaka, 1994; Zack, 1999).
2. Resource-Based View (RBV) Studies (Bharadwaj, 2000; Foss and Knudsen, 2000; Peteraf and Barney, 2003).
3. Information Infrastructure Capability (IIC) Studies (Sher and Lee, 2004; Tanriverdi, 2001).
4. Competitive Advantage (CA) Studies (Bhatt, *et al.*, 2010; Tallon, 2008; Wang, *et al.*, 2007) and
5. Organizational Information Processing Theory (OIPT) (Galbraith, 1973, 1974).

Methodology:

Systematic literature review (SLR) approach was used in this paper (Kitchenham, 2007) to explore and review the related and prominent studies. SLR consists of six steps as presented in Figure 1. This paper adopted all the six steps as suggested.

Research questions are first identified as (1) What are the Information Infrastructure Capability (IIC) for achieving organizational competitive advantage (CA)? (2) What are the strengths and weaknesses of the existing frameworks of IIC for CA? (3) What are the value(s) retrieved from the existing frameworks that could be incorporated into this present study?

Keyword searching was conducted as a research strategy to select the relevant literature (Wen, *et al.*, 2011). Boolean AND and OR were used to create search strings. The search strings are (Information Infrastructure Capability and competitive advantage) or (Knowledge and management and competitive advantage) or (Knowledge and competitive advantage) or (Knowledge and management and Information Infrastructure Capability).

Research selection criteria and quality assessment are then identified to find relevant studies which adequately address the research questions. Online databases such as Science Direct, Pro Quest and Web of Knowledge were searched to collect the relevant literature.

Finally, a data extraction form was adopted for data extraction and data synthesis (Wen, *et al.*, 2011). These six quality assessment questions are (1) Are the aims of the research clearly defined? (2) Is the estimation context adequately described? (3) Are the estimation methods well-defined and deliberate? (4) Are the findings of study clearly stated and supported by reporting results? (5) Are the limitations of study analyzed explicitly? (6) Does the study add value to academia or industry community?

RESULTS AND DISCUSSION

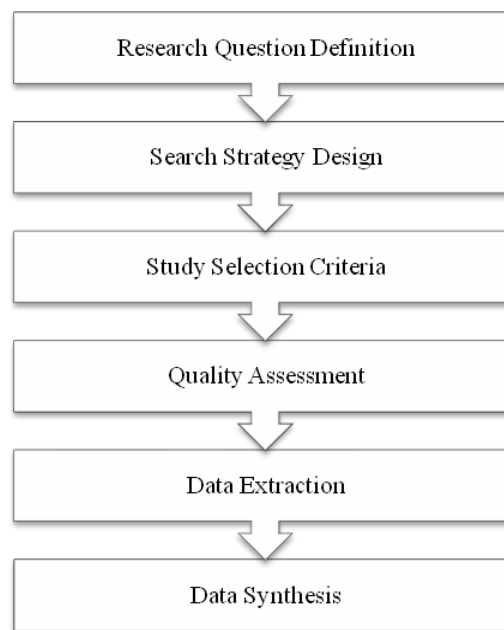
Knowledge Management (KM) Foundation Studies - Organizational Knowledge Creation Model:

Nonaka (1994) developed a theoretical framework which suggested an analytical dimension on knowledge creation. It was implemented in dynamic creation of appropriate organizational knowledge. This framework has been widely adopted by KM researchers specifically on tacit or explicit knowledge (Zack, 1999b).

The central theme of the framework is that organizational knowledge is created through a continuous exchange of ideas between tacit and explicit knowledge. The nature of such exchange of ideas is investigated. There are four modes of relations for tacit and explicit knowledge in "SECI" model (Figure 2). "Socialization" refers to the process of converting knowledge from tacit knowledge into tacit knowledge via shared experience between individuals. "Combination" involves the utility of KM activities to combine different explicit knowledge held by individuals. "Externalization" is the process to make tacit knowledge explicit. This is the ultimate goal of any KM initiatives. "Internalization" is converting explicit knowledge into tacit knowledge. This process is similar to "learning" in the traditional sense. Therefore, in Nonaka's (1994) research, the ICT applications and information infrastructure capability enabled conversion of the tacit and explicit knowledge.

However, when the Nonaka's (1994) framework is re-examined, the concept of the "SECI" model was derived from accounting for product innovation activities in Japanese assembly lines which is not fit for knowledge-intensive organizations. Likewise, this "SECI" approach is not suitable for Malaysia which envisions transforming to knowledge-intensive economy from one which is production-based. The inappropriateness is mainly due to (1) nature of business of accounting production to knowledge-and-technology based organizations and (2) differences of culture and customs between Japan and Malaysia. This current research will create a better way to express information infrastructure capability which underlines competitive advantage (CA) since this current research on MSC Malaysia companies as knowledge-intensive organizations would be better presenting Malaysia's knowledge-intensive initiative.

Moreover, Nonaka's (1994) framework focused merely on dynamic capability of organizational knowledge creation without considering other information infrastructure capability (IIC) components. Organizational competitiveness should not focus only on knowledge creation and dynamic perspective because all the IIC components represent better an organizational CA.



Source: Kitchenham (2007)

Fig. 1: Systematic literature review (SLR)

	Tacit knowledge	To	Explicit knowledge
Tacit knowledge	Socialization		Externalization
Explicit knowledge	Internalization	From	Combination

Source: Nonaka (1994)

Fig. 2: Modes of Knowledge Creation

Knowledge Management (KM) Foundation Studies - Corporate Memories as Knowledge Management (KM) Tool:

Gertjan, Rob and Eelco (1997) defined that knowledge and information in an organization is explicit, disembodied and persistently represented by corporate memory. The main purpose of a corporate memory is to enhance organizational CA by improving the management of organizational knowledge. In this framework, a corporate memory will facilitate and enhance three types of organizational learning: self-learning for individual, direct learning using communication and in-direct learning using a knowledge repository.

The implemented corporate memories such as the knowledge publisher, knowledge pump and knowledge sponge principles for organizing a corporate memory were reviewed and investigated based on the World Wide Web (WWW) scan in this framework. Findings revealed that individual learning contributed to knowledge creation but the knowledge was not consolidated and not disseminated for re-use. Knowledge was further disseminated and possibly consolidated with other departments of the organizations; but the knowledge was not

protected. Hence, in Gertjan, Rob and Eelcos' (1997) framework, corporate memory allows knowledge creation, distribution and protection.

While the research efforts in this framework emphasized knowledge creation and distribution in corporate memory using WWW scan examples, none of the findings was either statistically validated or verified by experts/software developers. This is just an initial step in structuring knowledge in an overall view of corporate memories as information infrastructure capability (IIC) since no other IIC was investigated. There was also no direct relationship of the knowledge learning to organizational CA. Hence, suitable IIC components are needed to resolve the issues in this framework in order to achieve organizational CA.

Knowledge Management (KM) Foundation Studies - Knowledge Strategy Model:

Zack (1999) proposed a framework for describing and evaluating an organization's knowledge strategy based on examples from five organizations representing the spectrum of physical and knowledge-based products and services. He concluded that knowledge is the fundamental resource and capability for organizational CA. Organizations must strategically assess their resources and capabilities which was then called as "knowledge strategy" to achieve organizational CA. The knowledge strategy was developed based on two major components, knowledge gap and strategy gap. The developed knowledge strategy must then be translated into an organizational and technical architecture to support data management and knowledge utilization processes for closing the gaps. Since data management is viewed as capability for closing the gaps, it will be further tested in this research.

In view that knowledge is a resource and must be transformed into the technical architecture for organizational CA, further investigation of the types of information infrastructure capability linking organizational CA is needed. All the components of information infrastructure capability for achieving organizational CA were not addressed in the framework of this particular study of Zack (1999).

Knowledge Management (KM) Foundation Studies - Knowledge Management (KM) and Knowledge Management System (KMS) Model:

Hahn and Subramani (2000) contributed to the knowledge management (KM) research stream by grouping knowledge management system (KMS) based on the focus of prior knowledge research. This framework discovered three phases of deployment issues of KMS: the initial setup, in progress and maintenance and continuing effect. The contingencies discussed were the amount and network diversity, the knowledge maintenance and the continuing effect of the KMS support. They highlighted KM as an emerging powerful source of CA. KMS could be considered analogous to a tool where "a tool is successful if the users of the tools succeed with the tool". These led to their further argument that the utility of KMS may produce positive and negative outcomes in the long run. The dynamic nature of KMS was required to ensure that the final outcome of KMS was positive in a constantly changing KM environment. Hence, dynamic capability was crucial in linking KMS to organizational CA (Tallon, 2008; Wang, *et al.*, 2007). While this research enriched the utility of KMS, the fundamental issues such as how knowledge-driven organizations utilize their KMS and what types of KMS are needed to achieve organizational CA were not addressed in the framework of this particular study though important.

A systematic KM framework was developed by Alavi and Leidner (2001). This research focused on knowledge, knowledge management and knowledge management systems as the basis of discussion. In the framework of this particular study, KMS could play a variety of roles such as: (1) best practices sharing, (2) corporate memories creation and (3) knowledge network creation in support of organizational KM activities. Specific examples of ICT applications for support of KM activities were generated and presented in the framework of this particular study. Corporate intranets were proven to support dynamic capability which enabled speedy decision. Individual social networks and corporate memories also enhanced collaborating capability among organizational units. Furthermore, speedy integrating and data management capability was enabled by workflow automation systems. The systems reduced communications and coordination efforts by having timely, integrated and work-related documents, information, rules and activities in a unified view. The positive role of ICT applications supporting dynamic, collaborating, integrating and data management capabilities in KM activities was confirmed. Nevertheless, there was no insightful measurement of CA to link the findings to the organizational CA.

A threefold framework was proposed and reported by Holsapple and Joshi (2002). The framework indicated that understanding of KM phenomena was essential. Both human and machine participants in an organization were skilful in utilizing the knowledge resources. Basically, there were three components of the framework: (1) knowledge resources; (2) activity; and (3) KM impact. The knowledge resources were organizational knowledge storage; this knowledge was stored, accessible and usable. An organizational user (human or machine) used knowledge handling skills to perform these activities. The KM impact affected the conduct of KM in an organization. These three components laid a foundation in this current research - information infrastructure capability (IIC) executes KM activity to achieve organizational CA. Even though a more complete view of KM

framework was developed - accommodated concepts and features of prior KM frameworks - but the ultimate goal of businesses, organizational CA, was not addressed by this study. The three main components, the sub-components and their relationships were not analyzed in greater detail. Furthermore, there was also no empirical link of the developed KM framework to knowledge-intensive organizations since the framework was only tested using 31 respondents; 13 researchers, 13 practitioners and 5 researchers and practitioners.

Later, a study of early adopters of corporate portal using eight case studies was carried out by Benbya, Passiante and Aissa (2004). Findings revealed that corporate portal could support KM activities. KMS was viewed as technologies that supported KM in organizations, specifically, to generate, codify and transfer knowledge.

There were four categories of KMS:

1. General KMS: Systems that propose an overall solution for a company's knowledge management needs.
2. Knowledge sharing systems: Systems that support sharing knowledge between people or other agents.
3. Content management systems: Systems that offer abilities to integrate, classify and codify knowledge from various sources.
4. Knowledge searching and retrieval systems: Systems that enable search and retrieval and have some knowledge discovery abilities.

Findings revealed that corporate portals presented the highest capability of performing a rich and multifaceted information platform for the knowledge creation, exchange, retention and reutilization among the four categories of KMS. They also reported corporate portal as having integrating capability and collaborating capability. With corporate portal, an integrated view of organizational information was integrated from different organizational departments and databases. Collaboration among organizational participants was allowed by a shared community or online forum of special accesses among group members. With these notations, integrating capability and collaborating capability will be further tested in this current research as IIC.

Benbya *et al.* (2004) categorized functionalities of the corporate portal as benefits. Although the benefits of KMS were well categorized and defined, no further investigation of linking the KMS to organizational CA was conducted. The types of KM activities for achieving organizational CA were not addressed in the framework of this particular study and thus would be accomplished in this current research. A summary of the KM foundation studies were summarized in Table 1.

Table 1: Summary of KM Foundation Studies

Category/ Sources	Constructs/ Variables	Strengths	Weaknesses	Value-added into Present Research
Knowledge Management (KM) Foundation 1. Nonaka 1994 2. Gertjan, Rob, and Eelco 1997 3. Zack 1999 4. Hahn and Subramani 2000 5. Alavi and Leidner 2001	Dynamic capability	"SECI" model involving organizational knowledge conversion from tacit into explicit knowledge was developed.	The "SECI" concept was derived from accounting for product innovation activities in Japanese assembly lines which is unfit to the nature of knowledge-intensive organizations. Merely focused on dynamic capability.	Dynamic capability enables tacit and explicit knowledge conversion.
	Information infrastructure capability (IIC)	Corporate memory was tested to improve the organizational competitive advantage (CA) by improving the way it manages its knowledge.	None of the findings were either statistically validated or experts/software developers verified. Merely focused on corporate memory since no other IIC was investigated.	Information infrastructure capability (IIC) improves organizational CA.
	Data management capability	Knowledge strategy was developed based on knowledge gap and strategy gap.	Detailed types of IIC linking CA was not addressed.	Knowledge is the fundamental source for competitive advantage.
	Dynamic capability Utility capability	Framework was based on knowledge management system (KMS) grouping. Three phases of KMS deployment issues were explored.	How knowledge-driven organizations utilized their KMS and what types of KMS for achieving organizational CA were not discovered.	Knowledge management system (KMS) is a powerful source for CA and analogues to a tool. Dynamic capability is required to link KMS to CA. Utility capability can impact final outcome of KM implementation.
	Dynamic, collaborating,	Detailed examples of IIC in supporting KM	There is no insightful measurement of CA to	The positive role of ICT applications supporting dynamic, collaborating,

	<i>integrating and data management capabilities.</i>	<i>activities were discussed.</i>	<i>link the findings to the organizational CA.</i>	<i>integrating and data management capabilities in KM activities was confirmed.</i>
<i>Category/Sources</i>	<i>Constructs/Variables</i>	<i>Strengths</i>	<i>Weaknesses</i>	<i>Value-added into Present Research</i>
<i>Knowledge Management (KM) Foundation</i> <i>6. Holsapple and Joshi 2002</i>	IIC	A more complete view of Threefold framework of (1) knowledge resources; (2) activity; and (3) KM impact was developed. This framework accommodated concepts and features of prior KM frameworks.	Even though it is more complete, however the ultimate goal of businesses - organizational CA was not addressed. Furthermore, there is also no empirical link of the developed KM framework to knowledge-intensive organizations since the framework was only tested using 31 respondents; 13 researchers, 13 practitioners and 5 researchers and practitioners.	Three components: (1) Knowledge resources; (2) activity; and (3) KM impact laid a foundation in this current research - IIC executes KM activity to achieve organizational CA.
7. Benbya, Passiante, and Aissa 2004	Integrating and collaborating capability. ICT applications	Corporate portal as an example of KMS is well categorized based on its features. The corporate portal's benefits were identified based on the categorized features.	Benefits were identified and examined merely based on corporate portal. No linking of the benefits of KMS to organizational CA. The types of KM activities for achieving organizational CA were not addressed in this framework.	KMS are technologies that support KM activities. Corporate portal is an example of KMS that supports KM activities. Corporate portal enables integrating and collaborating capability.

Resource-Based View (RBV) Studies:

Resource-Based View (RBV) of competitive advantage (CA) was dominant in early 2000s (Bharadwaj, 2000; Foss and Knudsen, 2000; Peteraf and Barney, 2003). Bharadwaj (2000) argues that to possess RBV of IT resources enables organizations to be unique themselves. In this study, a model of IT infrastructure, human IT skills and capability to leverage IT for CA was developed. Superior IT capability was confirmed to be positively associated with significant CA. These empirical findings of RBV indicate that IT capability as a resource that is not easily imitated or substituted by rival organizations. For instance, if an organization can have the IT infrastructure as a platform to execute innovative ICT applications, it will obtain more competitiveness as compared to others who are not. Similar situations applied to other capabilities such as human IT skills and capability to leverage IT. However, this research is limited to the IT capability as IIC and no clear metric to measure the IT capability. These research gaps will be filled in this current research.

Foss and Knudsen (2000) have performed basic RBV analysis. From their analysis, only two conditions exist as determinants of CA. The two conditions are uncertainty and immobility. For instance, demand and supply uncertainties such as market price and value can be leveraged by having the unique product. Hence, without having the uncertainty knowledge, repeated product is created and its uniqueness is ruined completely. Competition will equalize all returns across organizations with the absence of immobility (full mobility). In line with the ideas of uncertainty and immobility, Peteraf and Barney (2003) have identified that imperfectly imitable and heterogeneity could generate CA for an organization.

From RBV studies, CA is measured by organizational success relative to competitors. Relative success does not mean an organization to be the best player in the market (Foss and Knudsen, 2000). Thus, CA could be measured by differences among competitors on indirect impacts between organizations (Becerra-Fernandez, *et al.*, 2004), not focusing on cost and value of an organization. A summary of the RBV studies were summarized in Table 2.

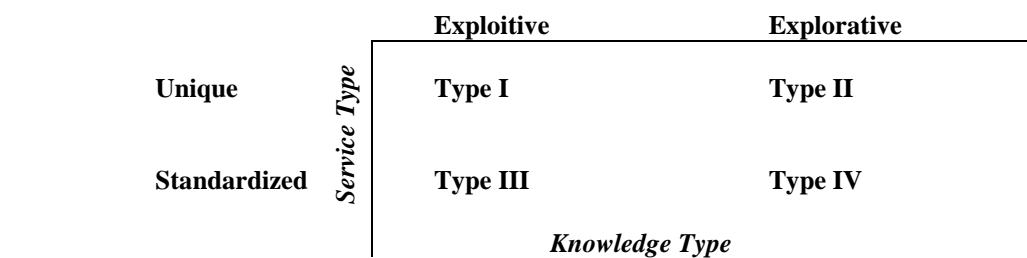
Table 2: Summary of RBV Studies

<i>Category</i>	<i>Constructs/Variables</i>	<i>Strengths</i>	<i>Weaknesses</i>	<i>Value-added into Present Research</i>
Resource-Based View 1. Bharadwaj, 2000 2. Foss and Knudsen, 2000 Peteraf and Barney, 2003	Competitive advantage (CA) CA	A model of IT infrastructure, human IT skills and capability to leverage IT for CA was developed. Determination of two conditions for CA: uncertainty and immobility.	This research is limited to the IT capability as IIC and no clear metric to measure the IT capability. No clear linking of the conditions to IIC and KM activities.	IT capability is positively associated with CA. Imperfectly imitable and heterogeneity could generate CA for an organization.

Information Infrastructure Capability (IIC) Studies:

According to Kim (2001), if an organization can fully understand the types of knowledge and services it uses, it then can select and use the proper ICT applications to support its KM initiatives. Subsequently, it will help the organization to plan and implement KM projects effectively and efficiently. Kim (2001) further recommended that the service and knowledge types used by an organization could be modelled into four distinct types. The principles were clearly identified by the two dimensions of each service and knowledge type.

There are two dimensions for service type: unique and standardized (Figure 3). When an organization provides a service for a unique request in highly personalised, context-dependent and expertise oriented (i.e. strategic consultancy), service type is “unique”. When an organization provides a procedure-oriented service in relatively low context-dependent (i.e. ICT consultancy), the service type is standardized.



Source: Kim (2001)

Fig. 3: Knowledge Management Model

The two dimensions of knowledge type are: exploitive and explorative. Exploitive knowledge is explicit in nature. It can be easily transferable and shared in formal and structured ways (Abdel-Aziz and Kamel, 2012). Declarative knowledge and procedural knowledge are examples of exploitive knowledge which describe something and explain why something occurs accordingly (Zack, 1999). In contrast, explorative knowledge is tacit in nature. Understanding explorative knowledge is difficult. Hence, coaching or apprenticeship is required for the knowledge transfer (Yaghoubi, *et al.*, 2011). Causal knowledge is an example of explorative knowledge. It explains the reason of having something (Zack, 1999).

When an organization captures explicit knowledge and must codify it before using, the knowledge type is “exploitive”. When an organization’s key concern is to create new knowledge from mostly tacit knowledge among collaborators, the knowledge type is “explorative”. Four distinct models were developed using the intersection of the four dimensions defined (Figure 3). These four well-defined models are named as Type I, Type II, Type III and Type IV.

On top of the evaluations of knowledge and service types, the effectiveness of KM implementation depends on information infrastructure capability (IIC) that supports its KM initiatives. The IIC in this framework includes: (1) Integrating capability, (2) Collaborating capability, (3) Data management capability, (4) Security capability and (5) Utility capability.

Although this framework emphasized the critical role of mapping types of organization to IIC, the research did not explore the impact of IIC - organizational competitive advantage (CA) which was the main aim of this current research. The findings of the Kim’s (2001) study were even limited with non-supportive results given to the relationships between KM models and IIC though past research had showed positive results. Therefore, this current study bridges the research gap. All the possible IIC components will be developed in this current research.

To further explore into KM as a major determinant of organizational CA (Benbya, *et al.*, 2004; Gertjan, *et al.*, 1997; Hahn and Subramani, 2000; Lawson and Potter, 2012; Tanriverdi, 2005), a study was carried out by Sher and Lee (2004). The empirical findings were based on results of regression models from a survey of key Taiwanese organizations. They argued accumulating large amounts of knowledge from new knowledge collection; knowledge codification and new and previous knowledge integration often increased dependence on the ICT applications. The findings also demonstrated that management of ICT applications significantly enhanced dynamic capabilities.

Several ICT applications were regarded as moderators in KM’s effect on dynamic capabilities. The most remarkable was enterprise resource planning (ERP). ERP supports integrating capability in customer relationship management and supply chain management. Besides ERP, four other ICT applications were also seen as moderators. First, e-mail was the most frequently utilized tool; however, the findings indicated that e-mail was not really effective for KM implementation. Second, document management was found to be enhancing dynamic capabilities. Synchronization with external entities and document sharing enhanced communication and coordination and induced responsiveness among organizational participants. Third, powerful search engine often encouraged knowledge availability for fast decision making. Finally, data

warehousing was found to enhance dynamic capabilities. Implementation of powerful databases allowed speedy knowledge storage and retrieval. It was also highlighted that, security and accessibility of the entire KMS were critical in achieving organizational CA. From these notations, ICT applications, integrating capability, dynamic capability and security capability will be adopted in developing the current research framework.

Despite the research contributions described above, Sher and Lee (2004)'s framework comprised a few limitations. The findings were just based on 13% of the top 100 Taiwanese organizations, leading to a doubtful generalization to represent the population. Furthermore, the research design only focused on dynamic capability, a narrower scope without other IIC perspectives. The present research will bridge this research gap by having a more comprehensive way by adding the entire IIC from past research.

Echoing Zack's (1999) framework of knowledge strategy, Tanriverdi (2005) derived a better way of understanding knowledge strategies. The framework investigated information infrastructure from multi-business organizational perspective and revealed that ICT applications played a critical role in enhancing organizational CA. There was no direct association of KM shown in this study although past research proven the positive impact of KM to organizational CA (Chang and Chuang, 2011). Mediating role of ICT applications was observed between KM to organizational CA. With this, the role of ICT applications will be investigated in the current research to confirm its contribution in this research stream.

Tanriverdi's (2005) framework focused on large multi-business organizations. The relevance of the framework was doubtful as small and medium enterprises (SMEs) were excluded. As the framework was highly concerned with knowledge and information infrastructure, knowledge-and-technology intensive organizations would be more appropriate instead of multi-business organizations. Moreover, there was still an elusive link between ICT applications and organizational CA. This research will conceptualize the relationship of information infrastructure and organizational CA from knowledge-and-technology intensive organizations in greater detail. A summary of the IIC studies were summarized in Table 3.

Table 3: Summary of IIC Studies

Category	Constructs/ Variables	Strengths	Weaknesses	Value-added into Present Research
Information Infrastructure Capability (IIC) 1. Kim 2001	Integrating, collaborating, data management, security and utility capabilities	Four distinct KM models - termed as Type I, Type II, Type III and Type IV were developed based on the knowledge and service types. Suitable KM model to organization was mapped in order to have effective IIC to support its KM initiatives.	The research did not explore the impact of IIC - organizational competitive advantage (CA) which was the main aim. The findings were non-supportive results of relationships between KM models and IIC while past research shows positive results. Therefore, the KM model developed was insufficient to link IIC to organizational CA.	IIC includes: 1. Integrating capability, 2. Collaborating capability, 3. Data management capability, 4. Security capability and 5. Utility capability.
2. Sher and Lee 2004	ICT applications; Dynamic, integrating and security capabilities	ICT applications were proven in enhancing dynamic capability towards organizational CA. ICT applications were seen as moderators in KM's impact on dynamic capability	The findings were just based on 13% of the top 100 Taiwanese organizations, leading a doubtful generalization to represent the population. The research design was only focused on dynamic capability; a narrower scope without consideration of other IIC perspectives.	ICT applications enhance dynamic, integrating and security capabilities which will then contribute to CA.
3. Tanriverdi 2005	ICT applications	Better way of understanding knowledge strategy was investigated using ICT applications from large multi-business organizations perspective.	The relevancy of the framework is doubtful as small and medium enterprises (SMEs) were excluded. There is still elusive link between ICT applications and organizational CA.	Mediating roles of KM is observed between ICT applications and organizational CA. The roles of ICT applications will need to be investigated to confirm its contribution in this research stream.

Competitive Advantage (CA) Studies:

Bixler (2000) identified the value of KM to an organization in terms of its capability to solve enterprise-wide challenges. In the framework, organizational resources, preconditions for initiating a KMS and the expected benefits of a KMS were investigated. A set of twenty-eight problem areas, fourteen initial conditions and fifteen expected benefits of KMS were subsequently determined by this study. The top three of the expected benefits were "establishing a formalised knowledge transfer system, providing an enhanced transfer of tacit knowledge from one employee to another and an improved ability of an enterprise to sustain a competitive

advantage". The expected benefits in terms of organizational competitive advantage (CA) are adopted in this current research. For instance, the ability to CA is enhanced for organizations with CA as compared to the organizations that are not CA (Evers, 2011).

Bixler's (2000) study served as a validated foundation for a comprehensive and extended research model in achieving organizational CA from implementing IIC. However, there were three shortcomings found in the study. Firstly, the reason why a type of KMS was selected was not highlighted. Secondly, the pre-condition of information infrastructure capability (IIC) – right ICT applications to enable the organizational CA was not investigated. Thirdly, the KMS was not viewed in greater detail in terms of their knowledge process which could result in inappropriate selection of IIC.

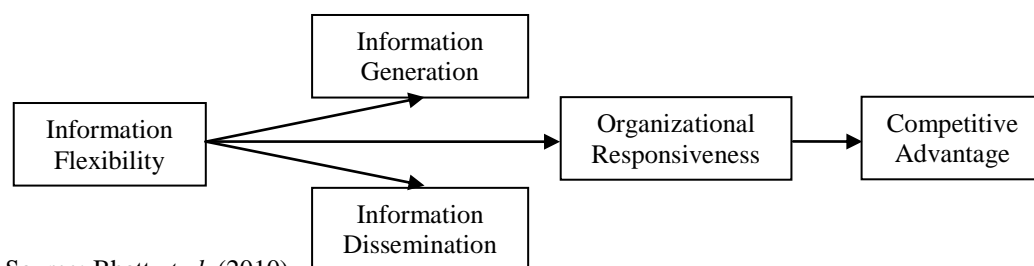
The importance of KM activities for organizational CA using ICT was well recognized by Rajiv and Sanjiv (2005). They sought to have better understanding on the short term effect of KM on organization's value by conducting a study on public announcements of ICT-based KM implementation and used cumulative abnormal return (CAR) integrated with a public announcement as the dependent construct. With better understanding on the effectiveness of KM as the goal, this study focused on the use of ICT and concluded that ICT was able to evaluate the impact of KM and to improve KM effectiveness.

Since the research was based on public announcements and market perceptions of performance, relationships of organizational KM efforts, prior organizational KM practices and private information were not examined. Moreover, the positive impacts were based on the announced KM effort on any of the KM activities: knowledge sharing, creation or utilization. When organizational CA was achieved from right information infrastructure capability (IIC), appropriate ICT applications should be identified instead of the KM activities. A detailed study on how ICT applications supported IIC to achieve organizational CA should therefore be carried out to obtain a more comprehensive framework and thus would be presented in this present research.

Burca, Fynes and Brannick (2006) investigated the relationships among information technology (IT) sophistication, service practices and business performance. With previous studies indicating direct effects of IT sophistication on service performance, this research extended the service practice-performance relationship by positioning the interaction effects of IT sophistication. However, this particular study did not consider how and why the service was provided and how to categorize the need of the service type. The matching of the right service to the right type of organization may be incorrect without the service type information. Hence, to enable concise achievement of organizational CA, the right ICT applications for the right organizations are necessary and would be identified in this research.

An empirical study of how ICT contributed to an organization's CA showed that information infrastructure flexibility could empower organizational information building. Hence, organizations could utilise the organizational information to have quick action to market opportunities, thereby making CA possible (Bhatt, *et al.*, 2010). These results showed the importance of generating information infrastructure flexibility that could be rapidly adopted and adapted by information processing demands in dynamic phenomenon. The research model of this particular study is shown in Figure 4.

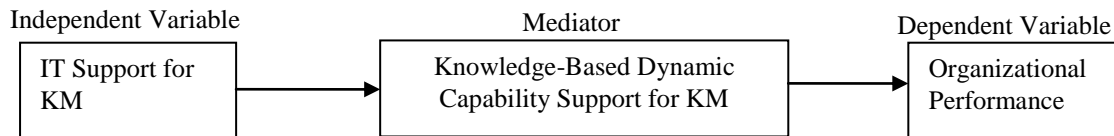
Although the framework indicated that superior information infrastructure capability (IIC) improved organizational CA, the underlying ICT applications were not identified based on KM perspective. The ICT applications were classified as infrastructure resources, human resources and IT-enabled intangibles. Due to the aforementioned shortcomings, in this present research, the right IIC based on KM perspectives will be identified and the relationship among the right ICT applications, IIC and organizational CA will be built in this study.



Source: Bhatt *et al.* (2010)

Fig. 4: IT Infrastructure Flexibility, Organizational Responsiveness and Competitive Advantage

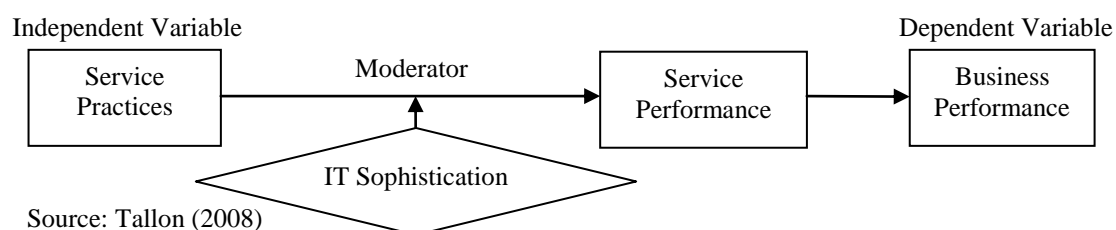
Wang, Klein and Jiang (2007) demonstrated that ICT support of KM benefited manufacturing organizations indirectly. The findings also showed that organizations must carefully align the ICT support for KM to strategic needs. Knowledge-based dynamic capability was tested and proven as a mediator between IT support for KM and performance. The framework is shown in Figure 5 below. However, this study focused on dynamic capability only without considering other prominent information infrastructure capabilities (IICs) discussed so far.



Source: Wang *et al.* (2007)

Fig. 5: IT Support for KM

Another study was carried out by Tallon (2008) to further define the relationship of information infrastructure capability (IIC) and business process agility. Managerial and technical capabilities were found to be essential for organizational dynamic capabilities. Both managerial and technical capabilities were also proven to have positive impact on organizational CA. The framework is shown in Figure 6 below. The findings of this study also confirmed the positive impact of IIC, the types of IIC was based on managerial and technical IT perspectives, not derived from KM perspectives as required by knowledge- and technology intensive organizations.



Source: Tallon (2008)

Fig. 6: Moderating Effects of IT Sophistication

A conceptual model of IIC was also developed and tested by Qi, Lan and Guo (2008). The empirical results of 241 IT executives in the USA showed that IIC provided CA by developing effective IIC. An empirical link could also be drawn from this empirical finding: Better organizational IIC leads to better organizational CA. However, the identification of the right ICT applications for IIC was not carried out. This will be carried out in this current research. A summary of the CA studies were summarized in Table 4.

Table 4: Summary of CA Studies

Category	Constructs/ Variables	Strengths	Weaknesses	Value-added into Present Research
Competitive Advantage (CA) 1. Bixler 2000	CA	A set of fifteen expected benefits of a KMS was determined.	Three major perspectives of organizational competitive advantage were not explored. 1. The reason of a type of KMS being selected was not highlighted. 2. The right IIC to enable the organizational competitive advantage was not investigated. KMS was not viewed in greater details in terms of their knowledge process which can lead to the appropriate selection of IIC.	Fourteen measurements of organizational competitive advantage are adopted.
2. Rajiv and Sanjiv 2005	ICT applications	The use of ICT and the effectiveness of KM implementation were evaluated based on the public announcements and market perceptions of performance.	Relationships of organizational KM efforts, organizational prior KM practices and private information were not examined. The positive impacts were based on the announced KM effort on any of the KM activities: knowledge sharing, creation or	ICT application is able to improve KM effectiveness. When organizational competitive advantage (CA) is achieved from right information infrastructure capability (IIC), appropriate ICT applications should be identified but not the KM activities.

3. Burca, Fynes, and Brannick 2006	ICT applications	This research extended the basic service practice-service performance relationship by incorporating the interaction effects of IT sophistication in a contingency framework which previous studies found mixed support for the direct effects of IT sophistication on service performance.	utilization. However, this study did not consider the context of how the service is provided and how to classify the need of the service type. The matching of the right service to the right type of organization may be mismatched without the service type information.	In order to achieve the organizational CA, the suitable ICT applications for the right organizations are required.
4. Bhatt et al. 2010	Information infrastructure capability	Information infrastructure flexibility can generate information building effects and thus organizations can leverage information to respond to market opportunities, thereby creating CA. The ICT applications were classified as infrastructure resources, human resources and IT-enabled intangibles.	The underlying ICT applications were not identified based on KM perspective.	The right IIC based on KM perspectives and relationship of the right ICT applications to IIC are required to achieve the organizational CA.
5. Wang, Klein, and Jiang 2007	Dynamic capability	ICT support of KM indirectly benefits manufacturing organizations.	This study was focused on dynamic capability only based on manufacturing organizations.	Knowledge-based dynamic capability has positive impact between IT support for KM and organizational performance.

Category	Constructs/ Variables	Strengths	Weaknesses	Value-added into Present Research
6. Tallon 2008	Dynamic capability ICT applications	Relationship of IIC on business process agility was investigated. Managerial and technical capabilities were found to be essential for organizational dynamic capabilities.	The types of IIC was based on managerial and technical IT perspectives; not derived from KM perspectives as required by knowledge-and technology intensive organizations to achieve organizational CA.	Both managerial and technical capabilities were proven to have positive impact on organizational CA.
7. Qi, Lan, and Guo 2008	IIC	The empirical results of 241 IT executives in the USA showed IIC provided CA by developing effective IIC.	The identification of the right ICT applications for IIC was not carried out.	An empirical link drawn from this empirical finding: Better organizational IIC leads to better organizational CA. Suitable ICT applications for IIC will be carried out in this research.

Organizational Information Processing Theory (OIPT):

Galbraith (1973) developed the Organizational Information Processing Theory (OIPT) and identified three important concepts: information processing needs, information processing capability and the information fit to obtain optimal performance. The concern of OIPT includes organizational processing capacity and performance. Organizations need quality information to cope with uncertainties. Uncertainty stems from missing required information and a specified task cannot be performed without the information (Galbraith, 1973, 1974; Premkumar, *et al.*, 2005). Therefore, right amount and quality of information are required in confronting environmental uncertainties.

Typically, there are two strategies for organizations to cope with environmental uncertainties and increased information needs: (1) buffers development and (2) structural mechanisms and information processing capability implementation. With these strategies, the effects of uncertainties will be reduced and the information flow will be enhanced. An example of the buffers development is developing inventory buffers to reduce the effect of unpredictable market demand or supply; another example is building extra safety buffers in designing product for the uncertainty of product working conditions. In the second strategy, generating better information

flow among organizations can reduce uncertainties in the supply chain. Another example is redesign of business processes and integrated information system can enhance information flow and reduce organizational subunits uncertainty internally (Galbraith, 1973, 1974; Nemutanzhela and Tiko, 2011).

The concept of OIPT has a long tradition in organizational research (Galbraith, 1973, 1974; Premkumar, *et al.*, 2005) and has been applied in the field of information technology (Mathiassen and Sorensen, 2008). OIPT recognizes ICT resources as information source. The information processing requirements and capabilities are enabled by people and ICT applications (Nemutanzhela and Tiko, 2011). However, neither earlier nor more recent work has directly examined the information infrastructure capability as information processing capability. With respect to this current research, information infrastructure capability is conceived as organizational capability which will lead to the organizational competitive advantage (CA). The current research would use information infrastructure capability as information processing capability which may not be done by others.

Proposed Research Framework:

From the review of different theoretical approaches and concepts of information infrastructure capability (IIC) and organizational competitive advantage (CA), it is clear that there is still a lack of understanding as to which IIC is specifically important to consistently contribute to CA. Basically, past researches only determined if IIC had positive impact on organizational CA without finding how IIC contributed to organizational CA. Besides, no research specified how and which IIC was important, and also, none of them looked at IIC from the perspective of knowledge management (KM) activities. Thus, it is difficult for ICT and knowledge practitioners to plan their ICT applications effectively for organizational CA.

In order to fill the research gaps of previous literature, a comprehensive framework is developed by this study to investigate how effective IIC and KM measures can contribute to organizational CA.

In the proposed framework of this study, IIC is considered as a group of components, namely dynamic capability (Hipkin, 2001; Rajiv and Sanjiv, 2005; Tallon, 2008; Wang, *et al.*, 2007), integrating capability (Benbya, *et al.*, 2004; Christopher, 2006; Sher and Lee, 2004), data management capability (Alavi and Leidner, 2001; Zack, 1999), security capability (Sher and Lee, 2004), utility capability (Hahn and Subramani, 2000; Kim, 2001) and collaborating capability (Alavi and Leidner, 2001). For instance, individual social networks and corporate memories will enhance collaborating capability among organizational units to support collaborating and dynamic capabilities for speedy decision. Workflow automation systems will enhance speedy integrating and data management capability (Alavi and Leidner, 2001). Furthermore, corporate portal will enable integrating capability and collaborating capabilities from combining different departments and databases (Benbya, *et al.*, 2004). Document management tools which contribute data management capability found to be enhanced by dynamic capabilities. Communication and coordination tools that enhance collaborating capability also induce dynamic capability among organizational participants (Sher and Lee, 2004). Therefore, in this research, IIC are considered as the foundation for knowledge-and-technology-based organizations in achieving organizational CA (Figure 7). Each component of the IIC is distinct but they greatly facilitate, reinforce and interconnect with each other.

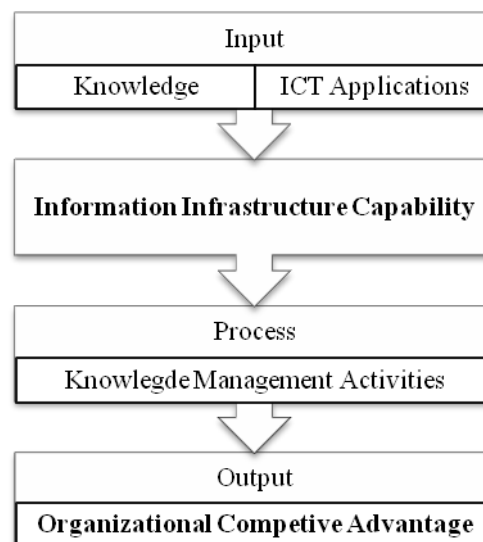


Fig. 7: Proposed Framework

Conclusion:

Strengths, weaknesses and added values were identified from five perspectives of articles (1) KM studies (Holsapple and Joshi, 2002; Nonaka, 1994; Zack, 1999), (2) Resource-Based View (RBV) Studies (Bharadwaj, 2000; Foss and Knudsen, 2000; Peteraf and Barney, 2003), (3) Information Infrastructure Capability (IIC) Studies (Sher and Lee, 2004; Tanriverdi, 2001), (4) Competitive Advantage (CA) Studies (Bhatt, *et al.*, 2010; Tallon, 2008; Wang, *et al.*, 2007) and (5) Organizational Information Processing Theory (OIPT) (Galbraith, 1973, 1974). With these findings, a new research framework was proposed (Figure 7). This framework could provide KM researchers and practitioners who are currently moving towards the era of k-economy to obtain the most appropriate information infrastructure for effective KM in their organizations. This study could also serve as pioneer study in Asia that introducing valuable IICs such as the integrating capability, data management capability, security capability, utility capability and collaborating capability in this research context.

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