Can Knowledge Management Be Appropriate for Shipbuilding?: Based on Typology and the Seven C's Model

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I use typology to find the divisions of knowledge management by literature review, then I use the seven C's model to evaluate knowledge management in shipbuilding. The research aims to promote the knowledge management practice in shipbuilding. In the meantime, the research method can be a reference for future research on knowledge management in other fields. From the evaluation of the seven C's model, we can see that six aspects of the implementation of knowledge management are suitable for shipbuilding. But in the connection part, we realize that if we want to keep a strong connection with all the people in shipbuilding, it is very difficult. The limitation of our research is that we rely on the literature review and our own experience to evaluate. It will be meaningful to conduct empirical research in the future to fill up the gap between the academic part and the practice part. This article can help shipbuilding organizations realize that conducting knowledge management is appropriate for shipbuilding. In the meantime, it reminds us what we need to do if we want to have effective knowledge management in shipbuilding.

Keywords: knowledge management, shipbuilding, typology, seven C's model

INTRODUCTION

What is knowledge management (KM)? It is a vague conception. When we start to give a precise definition of KM, it is not simple. From my point of view, combining the features of KM, the general definition is that it is the process of managing massive knowledge in organizations.

KM has been introduced to many sectors. And the research of KM has been a fashion. As Anders Örtenblad said, KM has become increasingly popular, you can find researches among organizational actors and scholars, therefore, a fashion (for example, Raub and Rüling 2001; Scarbrough et al.2005; Perkmann and Spicer 2008). In the meantime, according to Anders Örtenblad, There is much literature that states that KM is claimed to be something relevant to all organizations (see, for example, Wiig 1997; Ichijo and Nonaka 2007). Anders Örtenblad shows us the possibility to explore KM in different professions((Örtenblad,A., 2014). Shipbuilding, as labour-hungry organizations, need to pay more attention to KM. The industry 4.0 brings more opportunities, in the meantime, it emphasizes the necessity of conducting KM. However, is KM appropriate for shipbuilding? That is why we researched to reveal whether KM is appropriate for shipbuilding, based on typology of KM and the seven C's model.

The research aims to promote the KM practice in shipbuilding. In the meantime, the method in the research can be a reference for future research on KM in other fields.

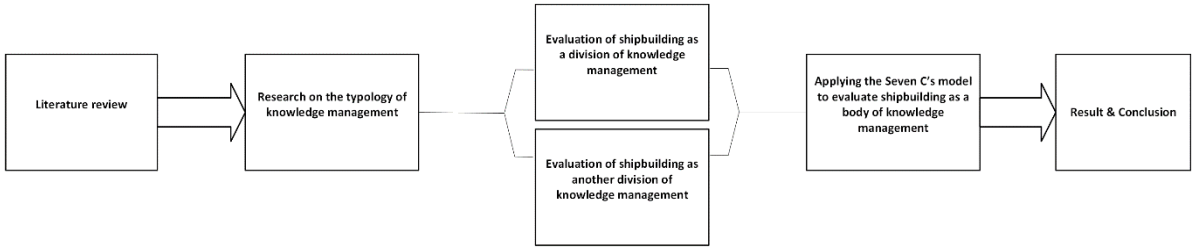
METHODOLOGY

First, we use the "Web of Science" and "Scopus" to collect the related literature on KM. There are plenty of papers that talk about KM. We narrow the scale of KM by professions and era. Then we analyze these articles. This is the first typology of KM. After analyzing the first typology, we generate the second general typology of KM, in the meantime, we also give the general definition of KM. Then we apply the concept in the shipbuilding field. We analyze shipbuilding which is the body of conducting KM from three aspects (i.e. market, employer, employee and management) We use the seven C's model to analyze the feasibility of KM in shipbuilding. We apply the Model called "seven C's model", which can examine the research systematically. This method is based on the key aspects of KM. The method is general and suitable for KM effectiveness analysis in many fields, which has been identified. Regarding this, we decide to apply the seven C's Model to our research. The Seven C's model is based on seven key aspects of KM. It contains connection, competencies, contacts, communication, catalysts, culture and capability, which have been described and applied in the article from Paul S. Myers (Myers, P.S.,2014) The seven C's model here is for testing the effectiveness of KM in shipbuilding from seven key aspects.

We not only cannot find the discussion on the meaning of conducting KM in shipbuilding but also cannot find the research that is conducted systematically about this topic. Our research will fill this gap. To deepen the research in KM related to shipbuilding.

This paper makes the extensive definitions of KM as a foundation to develop our research, which differs from the other papers based on shipbuilding.

FIGURE 1
A MODEL OF EVALUATING THE FEASIBILITY OF KM IN SHIPBUILDING



TYPOLOGY OF KNOWLEDGE MANAGEMENT

KM involves different fields. The number of publications on KM is also huge. When we use "Scopus" to search the publications related to the theme by searching within keywords, titles, and abstracts. Currently, it gives us 95770 publications of KM. Obviously, the number of KM research will increase.

The drawback is manifest. The huge number of publications brings the researchers challenges. According to Fteimi & Lehner, the keywords, knowledge activity and knowledge process, are used interchangeably to express the same concept. Furthermore, a single keyword may be interpreted differently according to different persons (Fteimi & Lehner, 2018). The overlap and interaction in KM remind us to conduct the classification before doing research related to KM. Also, KM concepts are involved in splicing. you can find the discussion among technology, economy, management, and so on. In our paper, we focus on KM in shipbuilding. As Fernandes showed, KM includes a list of procedures (i.e., systematic, explicit, updates, and application of knowledge) to maximize the knowledge embedded in the organization, which can improve its effectiveness (Fernandes, 2018). Based on Fernandes and van Den Hooff &De Ridder, I think that the core of KM, as a process of reciprocity to generate new knowledge, is dissemination that can only be done in an openly conversational place (Van Den Hooff & De Ridder, 2004). Openly conversational places can be considered as culture or environment. The suitable environment to cultivate new knowledge is becoming more and more pivotal in modern organizational activities. However, the aspects of KM are

multiple dimensions. This point can be identified by previous research. According to Rošulj et al., KM is a multifaceted discipline encompassing a spectrum of factors, which is crucial for harnessing, sharing, and leveraging organizational knowledge (Rošulj et al., 2024). As Bencsik & Speiser said, the method of change is defined by the abilities of persons. It reminds us that personal abilities play a pivotal role in KM. In the meantime, He states that to obtain the more modern and higher-level cognitions behind the operational realization of all new systems, learning, and knowledge are essential (Bencsik&Speiser,2010). Ignoring the human-centric thoughts in understanding KM is unrealistic. Hislop also states that: the success of KM initiatives is fundamentally predicated on having workers who are prepared to share their knowledge (Hislop, 2003). He emphasizes the importance of focusing on the core of KM, which is considered a human being.

According to the corresponding analysis based on the structural equation modeling (SEM) method from Fernandes, we can see that knowledge assets can affect KM directly, but technology and organizational culture can affect KM indirectly (Fernandes, 2018).

The shipbuilding cannot avoid dealing with the issues related to knowledge. A plenty of information must cause the issue of KM. The workflow of a knowledge management system (KMS) (i.e., acquire, create, update, use, preserve, and disseminate knowledge) is embedded in a complex environment that focuses on the KM process(Ni & Kantola, 2024). All these steps rely on strong leadership in the organization to generate the closed loop. We can find some opinions to identify this point. e.g., the leader controls the knowledge-processing environment tremendously and the role of leadership has a broader influence than the resolution of knowledge gaps (Martin & Marion, 2005).

According to the summarization of different conceptions of KM from Fayda-kinik & Cetin (Fayda-Kinik & Cetin, 2023), we can give the following typology of KM. We define three aspects of KM based on infrastructure capabilities. Infrastructure is the foundation of KM in organizations. We define KM from three aspects (i.e., technology, organizational structure, and organizational culture) initially.

The aforementioned discussion connects KM with different factors (e.g., technology, culture structure, etc.). Different definitions are also developed. We summarize the following major definitions from different literature.

TABLE 1
THE SUMMARY OF DEFINITIONS OF KM BY DIFFERENT PHRASES

Authors	Year	Description
Henry (Henry, 1974)	1974	KM is the public policy for the production, dissemination, accessibility, and use of information as it applies to public policy formulation
(O'Dell & Grayson, 1998) O'Dell & Grayson	1998	KM is therefore a conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that can create value.
Nonaka&Takeuchi (Nonaka et al., 2000)	2000	KM is about creating, sharing, and applying knowledge within organizations. It emphasizes the tacit-to-explicit knowledge conversion process.

Karl M. Wiig (Wiig, 2000)	2000	KM is the approach and activities throughout the organization. It emphasizes the aim which is supporting objectives in organizations and understanding the underlying process
Horwitch&Armacost (Horwitch & Armacost, 2002)	2002	KM involves the practice of creating, capturing, transferring, and accessing of right knowledge and information when needed to make better decisions and support business strategies
(Mertins et al., 2003) Mertins	2003	KM includes all the methods, instruments, and tools that contribute to the promotion of a core knowledge process (i.e., generate, store, distribute, and apply knowledge)
(Groff & Jones, 2012) Groff&Jones	2012	KM is considered the tools, techniques, and strategies to retain, analyze, organize, improve, and share business expertise.
(Edwards, 2019) Edwards	2019	A broad definition of KM includes people, processes, and technology working together to perform KM within an organization. This holistic view recognizes the multifaceted nature of KM.

The definition of KM has changed since the 1970s. Different eras bring new explanations for KM. However, the core of KM does not change. It uses all the feasible ways to manage knowledge and information. In the meantime, it is meaningful to figure out definitions of KM in different professions. KM has been applied in many fields, as the handbook of research on knowledge management written by Anders Örtenblad (Örtenblad, 2014). We summarize the following definitions of KM in different fields.

TABLE 2
THE SUMMARY OF DEFINITIONS OF KM BY DIFFERENT PROFESSIONS

Authors	Fields	Description
Cathrine Filstad & Petter Gottschalk (Filstad,C.,&Gottschalk,P.,2014)	Law	KM is to help companies create, share, and use knowledge effectively, including the seven C's which are connection, competencies, contracts, communication, catalysts, culture, and capability.
Cathrine Filstad & Petter Gottschalk(Filstad,C.,&Gottschalk,P.,2014)	Police	KM is the knowledge work that is about creating new knowledge and sharing existing knowledge, it is dependent on organizational structure and organizational culture under the seven C's KM framework.

Denise McDowall, Anita Rynne &Steven Talbot (McDowall,D., Rynne,A.,&Talbot,S.,2014)	Amy	It is an ongoing process of managing organizational intellectual assets to provide leaders with current, valid, and reliable knowledge under two broad domains which are technology-oriented aspects and social and human factors.
Carina Abrahamson Löfström (Abrahamson Löfström, C.,2014)	Elderly Care	KM is setting out new policy aims and directives or bureaucratic and hierarchical structure, to contribute to the activities in elderly care.
John S. Edwards (Edwards,J.S.,2014)	Energy Sector organizations	It is the process of making the best of capabilities and IT infrastructure, involving in recruiting, developing, and socializing the right people, under the assistance of well-crafted IT infrastructure.
Eduardo Tomé & Gaby Neumann (Tomé, E. & Neumann, G., 2014)	Logistics industry	KM is the science of managing chaos.
Thomas Garavan, Fergal O'Brien& Eamonn Murphy (Garavan, T., O'Brien, F.& Murphy, E., 2014)	Small and medium-sized enterprises (SMEs)	KM is the activities that are associated with the introduction of new information and communications technology systems, the creation of KM structures, and new organizational roles (cited from Hutchinson&Quintas,2008)

By combining the literature and our point of view, we think that there are the following types of KM which cover all the types of KM research. The second typology of KM contains two general parts:

1. Technology-oriented knowledge management (TOKM). It focuses on the various KM systems that support KM (e.g., Document Management Systems (DMS)). The system forms the foundation of KM by organizing and storing documents efficiently. We also use collaboration tools to improve the effectiveness of KM (e.g. Decision support system (DSS). Product lifecycle system (PLM), etc.).
2. Knowledge management of Human and social factors (KMHSF): A suitable solution of organizational management can lead to successful KM. KM is defined as the combination of people, processes, and technology. An effective organizational structure can contribute to KM.

As Santoro al. cited in his paper (Santoro et al., 2018), Firms are becoming more intelligent in developing adopting, and adapting disruptive technologies in their business, which can increase their efficiency and innovativeness through knowledge flows and data/information gathering (Malhotra, 2000). This identifies the trend of technology-oriented KM. Technology-oriented KM has been used widely in many companies and public organizations. Intranet is one of the best examples. All in all, the TOKM can be considered an IT-based knowledge-supporting system. KMHSF is the core of KM. The KM is embedded in the organization. Organizational structure plays a pivotal role in KM. e.g. A flat organizational structure may lead to the success of KM. Furthermore, some other enablers can influence the development of KM. As Ibarra-Cisneros et al. state, the organizational culture and leadership significantly influence the process of KM (Ibarra-Cisneros et al., 2023). This type of KM focuses on human and social factors.

Before analyzing the KM in shipbuilding, we give the general concept based on the aforesaid content.

KM in shipbuilding is the approaches and activities, which include managing tacit and explicit knowledge throughout the shipbuilding organization by thinking of technology, human, and social factors.

KNOWLEDGE MANAGEMENT IN SHIPBUILDING

Shipbuilding as the Technology-oriented Knowledge Management

KM, as a technology-oriented subject, can effectively improve the performance of. Mainly, computer science and information technology have been introduced into KM. Since the last century, the KM has been developed. It has been over for decades. The way of managing knowledge is being diverse. It gives us more possibilities of managing mass knowledge. This field has been flourishing, decision-making systems, databases, AI… They improve the efficiency and effectiveness of knowledge sharing, storage, creation, updating…

From a marketing perspective, there are some benefits of turning shipbuilding into an organization that focuses on technology-oriented KM. As Cheng & Shaw write in their paper, the shipowner's demands are modified in the shipbuilding process. In the meantime, a lot of information concerning ship design or construction increases and changes constantly (Cheng & Shaw, 2015). If we apply KM properly, a mass of new knowledge can be created during the construction. This will be a win-win result. On the one hand, shipbuilding can absorb much knowledge from the market by using KM effectively, identifying knowledge, and creating new knowledge. On the other hand, the stakeholders can apply the advanced knowledge to promote effective KM.

From the Employer's perspective, Due to the requirement of knowledge socialization, we have to rely on computer science and information technology. According to Galgotia & Lakshmi, Implementing Artificial Intelligence in KM can let speedy and efficient decision-making with better accuracy and quality (Galgotia & Lakshmi, 2022).

From a managerial and employee perspective, shipbuilding, as the body of technology-oriented KM, can promote the development of personal knowledge, and then it will be beneficial for the managerial stage. However, we have to realize the defects of conducting technology-oriented KM, according to Budur et al., computer science technology may also restrict KM (Budur et al., 2024).

Shipbuilding as the Knowledge Management of Human and Social Factors

Liu et al. state that KM aims at combining advanced information technology with human learning and innovating ability, which is involved in the knowledge economy age, improving enterprise knowledge creation, capturing, transforming, sharing, and utilization among individual, group, and organization levels. Finally, it contributes to improving the performance of enterprise management (Liu et al., 2009). Human and social factors play a pivotal role in KM.

Plenty of academic papers talk about conducting KM based on organizational management. According to Adhikari & Shrestha, rules and regulation is the way to optimize the KM performance in HEIs (Adhikari & Shrestha, 2023). The process of KM is a list of activities involving humans, technology, and resources. Obviously, it is highly related to management.

From a market perspective, effective KM can promote the excellent performance of shipyards in markets. Tacit Knowledge assets, being the core of competitiveness, can help control the broader conversation in the global market. As proposed the concept of clusters in maritime (Stavroulakis et al., 2020). Clusters can contribute to the KM especially for the tacit knowledge part in KM, in the meantime the development of tacit knowledge can contribute to new business initiatives and excelled performance in the market ((Zhou et al., 2021) A plenty of current cases show that clusters is being tendency in shipbuilding throughout the world nowadays. It means that KM will play a more and more important role in shipbuilding in the future. And we will also need to think of creating clusters to develop KM.

From the employer's perspective, KM can promote KM development can improve the organizational performance, decreasing the cost of operation.

From a managerial and employee perspective, the effective KM can gather all the resources in the organization, and then facilitate the management. It can also improve the commitment of employees to organizations.

Shipbuilding in the View of the Seven C's Model

We generated this Table to evaluate the feasibility of implementing KM in shipbuilding, which is based on the aforesaid analysis and our experience in shipbuilding projects.

TABLE 3
SHIPBUILDING IN THE VIEW OF THE SEVEN C'S MODEL

Key concepts	The context of implement of KM	Can it fit in current shipbuilding
Connection	Based on transparency, It gives all the stakeholders the necessary information, then it can be transferred into knowledge.	No (The shipbuilding industry is in a complex environment, and it is very hard to keep transparency with all the stakeholders)
Competencies	Employees can collect professional knowledge and exploit new knowledge	Yes (The HR department can select suitable candidates, this is always connected with HR strategy)
Contacts	Promote effective contacts among individuals, groups, and organizations	Yes (Managers in shipbuilding organizations can promote effective contacts. This always involves leadership in shipbuilding)
Communication	Use effective IT to enhance communication	Yes (Deploy the effective IT tools to enhance communications in shipbuilding organizations)
Catalysts	Organizational motivation is positive for promoting learning	Yes (Create a positive organizational atmosphere for sharing and creating knowledge)
Culture	Create aligning value and organization practice	Yes (Improve the commitment of employees in shipbuilding organizations)
Capability	Create effective knowledge management system	Yes (Develop and apply the KM system to manage the lifecycle of knowledge activities in shipbuilding organizations)

RESULTS

From the seven C's model evaluation, we can see that six aspects of the implementation of KM are suitable for shipbuilding. But in the connection part, we realize that if we want to keep a strong connection with all the people in shipbuilding, it is very difficult. The technical documents and sales documents always make the shipyard have strong competitiveness in the markets. Keeping high transparency means the risk of losing interest. On the one hand, we need to keep an open attitude to accept and give access to stakeholders all the necessary information. This can promote stable and long-term cooperation, in the meantime, it can be beneficial for creating new knowledge. On the other hand, we need to think of the loss of knowledge assets. When we implement KM, we need to think of balancing this issue.

CONCLUSIONS

KM is playing a pivotal role in shipbuilding. From our point of view, we think that it is very appropriate to implement KM in shipbuilding. And it is also necessary. KM can improve the competitiveness of shipyards, in order to achieve the greatest benefits. However, it is not easy to create the perfect KM for shipbuilding. In the connection part, we can see that balancing transparency and knowledge sharing is an important issue. If we do not keep transparency with stakeholders, the knowledge sharing will not be done well. Finally, the KM does not work well in organizations. However, if we keep open access to all the stakeholders in the organizations or projects, it can cause the loss of knowledge assets. Our research displays whether shipbuilding, as the body of KM, is a good idea or not. We conduct the literature review to find the general divisions of KM, then we analyze the working of shipbuilding in each of them, Finally, we evaluate the shipbuilding in the view of key aspects of implementing KM. Shipbuilding fits most of the items. So, we think that it is suitable to conduct KM in shipbuilding. The future research is very clear. We need to think about how to adapt KM to shipbuilding when considering the connection. The limitation of our research is that we rely on the literature review and our own experience to evaluate. It will be meaningful to conduct empirical research in the future to fill up the gap between the academic part and the practice part.

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