



# APPLICATION OF KNOWLEDGE MANAGEMENT IN R&D INSTITUTIONS: A SYSTEMATIC REVIEW

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## ABSTRACT

*In an effort to understand the application of Knowledge Management in Research and Development (R&D) Institutions, we conducted a systematic review of relevant literature. This method involves searching and analyzing various literature sources, such as articles, books and reports, with a focus on the application of Knowledge Management in the R&D context. The results of the literature review identified four key components that support the implementation of Knowledge Management in R&D: technoware (equipment and technology), humanware (human resources), infoware (information resources), and orgaware (organizational structure). Five stages of Knowledge Management implementation were also identified, including creating a knowledge map, planning, strategizing, implementing, and measuring activities. Success indicators are explained as Knowledge Inventory and Knowledge Activity. This review presents a conceptual framework that can be used as a guide for R&D in implementing Knowledge Management. The application of Knowledge Management in R&D can support economic growth, innovation and advancement of knowledge in Indonesia. With the knowledge gained from this review, R&D can more effectively manage and utilize knowledge in order to achieve their goals.*

**KEYWORDS:** *Systematic Review, Knowledge Management, R&D, Economic Growth, Innovation.*

## INTRODUCTION

Research and Development Institutes (R&D) have an important role in developing knowledge, innovation and economic growth in Indonesia. Along with dynamic global changes, increasing competitiveness is the key to achieving better results in terms of research and development. In an effort to achieve better competitiveness, the business paradigm has changed from resource-based competitiveness to knowledge-based competitiveness (Akbar, SA, 2018). This includes improving production techniques, marketing methods, human resource management, as well as optimizing the use of equipment and machines in the research and development process.

*Knowledge Management* has emerged as one of the key approaches in encouraging knowledge-based competition. However, the implementation of Knowledge Management in R&D has unique and complex characteristics. In this context, this research aims to identify an appropriate conceptual framework for the implementation of Knowledge Management in R&D. The application of Knowledge Management in R&D will not only support economic growth through more innovative research, but will also advance the knowledge and innovation sector in Indonesia.

In order to achieve this aim, we used the Systematic Review method to analyze and summarize the relevant literature. We identify key components, implementation stages, and indicators of success of Knowledge Management in R&D. The results of this research can provide useful guidance for R&D in managing and utilizing knowledge effectively in an effort to realize sustainable economic growth and improvements in research and development. Muslihudin (Oktafianto et al, 2016).

## LITERATURE REVIEW

The literature review that we have presented provides a deep understanding of the concept of Knowledge Management in the context of Research and Development Institutions (R&D). This understanding can be applied to various R&D in Indonesia.

Nonaka and Takeuchi (1995) highlight the distinction between tacit and explicit knowledge, which is relevant in the R&D context. It is concerned with knowledge management which involves aspects of researchers' individual knowledge, their skills, and experience which may not always be easily expressed in written form.



Knowledge Management (Knowledge Management) Knowledge Management was developed by Karl-Erick Svelby who emphasized an attitude of openness and readiness for new information. Every knowledge starts from the individual, when that individual knowledge can be transferred into organizational knowledge, then that knowledge will be very valuable for increasing the productivity of the company or organization. To be able to transform individual knowledge into organizational knowledge, continuous efforts must be made at all levels in the organization. Some definitions of KM by experts are as follows:

1. According to Beijerise (1999): KM is an effort to achieve organizational goals, through strategies to motivate and facilitate knowledge workers to develop, as well as improve their ability to interpret data and information using available information sources, experience, expertise, culture, character, personality, feelings and so on so that they can provide meaning to others.
2. Wiig (1998): KM is a systematic, firm and deliberate effort to build, update and apply knowledge in order to maximize the effectiveness of knowledge linkages in the company and store it as knowledge assets to be renewed continuously to create creation and innovation.
3. Bassi (1997): KM is the process of creating, capturing, and using knowledge to improve organizational performance. KM is often associated with two types of activities. The first activity is to document and determine appropriate individual knowledge, and then disseminate it through the company database. KM also includes activities to facilitate the exchange of human knowledge via groupware, e-mail and the internet. From the various opinions above, it can be concluded that knowledge management is:
  - Strategies to facilitate knowledge workers to transfer knowledge.
  - Systematic efforts to build, update, and apply knowledge to achieve organizational effectiveness.
  - With current technological developments, to achieve effective knowledge transfer, it is necessary to build a company database.
  - KM must be carried out continuously and sustainably. Nonaka introduced four forms of knowledge creation processes in organizations, namely: as shown in the following picture:

The Knowledge Management framework proposed by Hansen et al. (1999) brought the understanding that technology, organizational culture, and knowledge strategy must work together. This can be a very useful guide for R&D in Indonesia to integrate appropriate technologies, create a collaborative work culture, and design knowledge strategies that support their research goals.

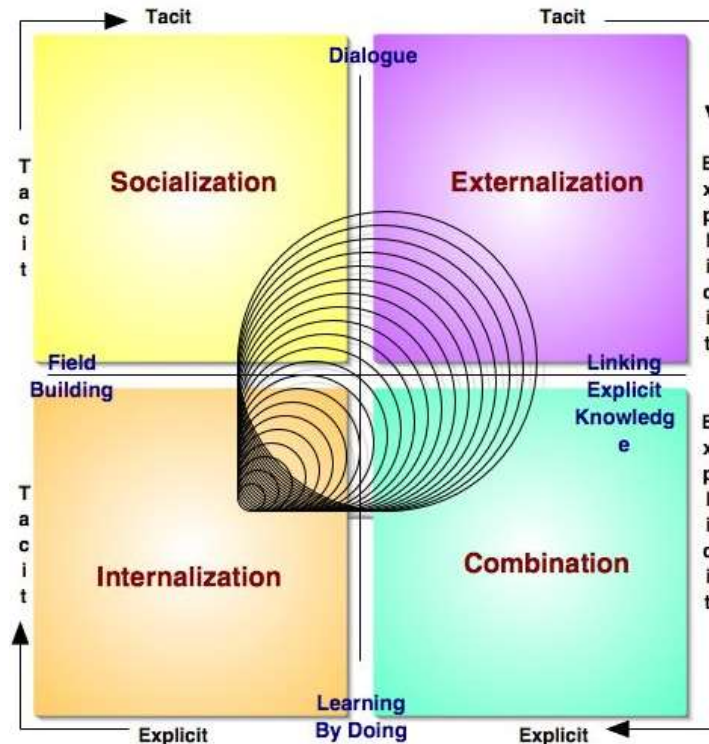
The challenges of implementing Knowledge Management, as explained by Zack (1999), are another important aspect for R&D in Indonesia to consider. Resistance to change, especially when it comes to sharing knowledge, can be a barrier. Researchers may need encouragement and incentives to overcome these challenges.

Leonard et al. (2001) identified four pillars of Knowledge Management, namely technology, organization, culture and methods. In the context of R&D in Indonesia, this highlights the importance of selecting appropriate technologies, creating a collaborative culture within the organization, and implementing effective methods to measure progress in knowledge management.

Knowledge Management measurement, as highlighted by Ruggles (1997), can be a very effective tool for R&D in Indonesia. The use of metrics such as Knowledge Inventory and knowledge activity can help R&D to monitor their progress in terms of knowledge management and knowledge utilization in their research.

Lastly, Santos et al. (2020) discusses the application of Knowledge Management in R&D, which is also relevant for R&D in Indonesia. A focus on innovation in research through collaboration platforms and the exchange of ideas can provide an important impetus for R&D to be more creative and productive.

As an assessment of R&D in Indonesia, the Knowledge Management concept obtained from this literature review can be a valuable guide. In an increasingly competitive context, R&D needs to consider effective knowledge management to advance research, innovation and knowledge growth in Indonesia. By applying these concepts, R&D can become more efficient in achieving their goals.



**Fig.1 Spiral Evolution Of Knowledge Conversion**

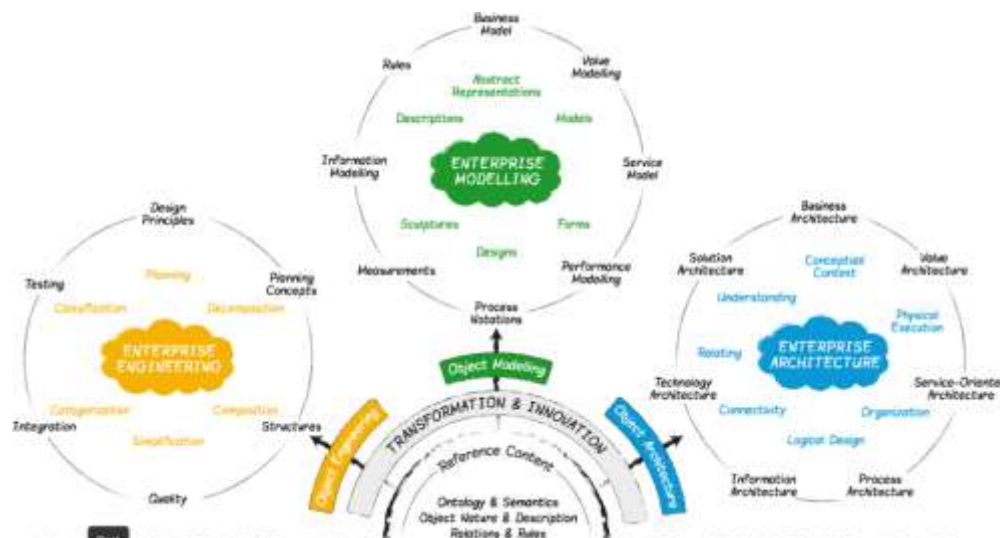
From this picture it can be explained as follows:

1. Socialization (tacit to tacit), which is a process of transferring individual tacit knowledge to other individuals through direct observation, repetition and practice. The knowledge that is socialized is in the form of skills obtained from experience, and this knowledge will never become explicit so it is not easy for someone to transfer this knowledge widely within the organization.
2. Externalization (from tacit to explicit), which is the process of articulating tacit knowledge into explicit knowledge, so that this knowledge can be shared and transferred to other individuals in an organization.
3. Combination (explicit to explicit), which is a process that combines various explicit knowledge in an organization and then processes it into a new, explicit experience so that it is easy to understand and transfer to other individuals in the organization.
4. Internalization (from explicit to tacit), which is the absorption of new explicit knowledge which is then transferred widely within the organization through a learning process so that it becomes tacit for individuals in the organization, provided that each individual is willing to learn new knowledge and is willing to internalize it. in itself will expand and enrich the tacit knowledge concerned.

## DISCUSSION

Implementation of Knowledge Management is a process for creating, documenting, sharing and updating knowledge in an organization. This is supported by the company's main pillars, including leadership and technology, with the aim of creating a culture of knowledge sharing within the company. Nonaka (1991), Alavi & Leidner (2001), and Newman & Conrad (2000) have discussed the importance of implementing Knowledge Management in this context.

1. In the context of R&D, the first stage of implementing Knowledge Management is to create a "knowledge" map in the organization. This is done to ensure that the knowledge potential of each employee can be identified and utilized effectively. To achieve this goal, companies need comprehensive information about the knowledge assets they own. Various research and developments by world experts have been carried out to understand the potential of this knowledge and learn lessons from other organizations and companies that have successfully implemented Knowledge Management. This stage is an important first step in building the foundation for effective knowledge management in R&D. One of the concepts developed by American universities, namely the University of George Washington, published the title University Research the Architecture of Enterprise Engineering which is depicted in the following picture:



**Figure 2. the Architecture of Enterprise Engineering**

The Multi Disciplinary Concept is an important foundation in an organization or company. Modern organizations often consist of many different disciplines, and this gives rise to the need to collaborate and share knowledge across these disciplines. The four main pillars that support the implementation of Knowledge Management concepts and systems are leadership, organization, technology and learning.

- **Leadership (Leadership/Management)** : The first pillar is leadership which involves strategy, values, decision-making processes, resource allocation, and the promotion of systemic thinking. Effective leadership can establish a culture of knowledge sharing and promote an integrative management role in the organization.
- **Organization (Organization)** : The second pillar is organization, which includes operational aspects such as functions, processes, structures, controls and measurements that support system technology, and their use. A good organization must support efficient knowledge management.
- **Technology (Technology)** : The third pillar is technology, which includes various information technology products that support collaboration and codification of knowledge. Technology is a tool that can facilitate knowledge management and information exchange.
- **Learning** : The fourth pillar is learning, which includes various learning forums, principles and behaviors that support a collaborative learning environment. Learning is key to knowledge development and organizational growth.

Overall, these four pillars are interrelated and contribute to the successful implementation of Knowledge Management in an organization. Strong leadership, an efficient organization, appropriate technology, and a supported learning culture can form a solid foundation for effective knowledge management.

2. Planning for implementing knowledge management which includes three components in value creation, namely quality, efficiency and growth, with the aim of an internal strategy has been created.
3. The Knowledge Management Map strategy for Research and Development (R&D) Institutions is that knowledge management is a key aspect in utilizing intangible assets, including human capital (knowledge, skills and training) as well as organizational capital (culture, leadership, teamwork). The importance of integrating human and organizational capital into R&D operations, such as operational management, marketing, HR, efficiency, and resource management, shows its essentiality in achieving the research and development mission. Alignment in all aspects of the organization is the main foundation for achieving the R&D vision and mission. To evaluate the success of Knowledge Management implementation, measuring organizational performance using the Balance Scorecard approach is very important, which includes financial aspects, customer satisfaction, internal processes, as well as learning and growth perspectives. With this approach, R&D can efficiently manage knowledge to achieve more established and effective research goals.

4. The five levels of Knowledge Management (KM) implementation in R&D institutions are as follows:  
 Level 1 - Initiate: KM implementation must start from actors in R&D supported by related parties, and must then be expanded to reach all communities within the organization. This initiation is an important first step to introduce the KM concept in the R&D environment.



Level 2 - Develop: At this stage, KM development is initiated by R&D member groups. They can lead initiatives using groupware or collaboration tools to facilitate knowledge sharing. This step underscores the importance of collaboration and knowledge exchange between R&D members.

Level 3 - Standardize: This stage involves developing the processes and approaches necessary for consistent knowledge development. Standardization will help R&D to manage knowledge in a more structured and efficient manner.

Level 4 - Optimize: At this stage, the success of KM implementation is measured in terms of effectiveness. Evaluation and measurement of organizational performance is carried out to ensure that knowledge management has provided appropriate benefits.

Level 5 - Innovate: The final stage shows that the organization has reached a level where the implementation of KM has become the culture and way of acting for every member. This is marked by the emergence of many products and innovations. Organizations are able to utilize knowledge effectively to create added value.

This underlines that to achieve the level of innovation and successful implementation of KM, R&D needs to go through a series of stages starting from initiation to innovation. This is a step that can help R&D optimize their knowledge management and become productive innovation centers.

5. Measuring KM Activities The parameters used as indicators of the success of KM implementation are:
  - a. Knowledge inventory & acquisition, which includes: knowledge capturing, library, E-Library, Knowledge center.
  - b. Knowledge activities, which include: creative industry forums, innovation forums, sharing-problem solving-collaboration discussion forums.

## CONCLUSION

1. The successful implementation of knowledge management in the creative industry needs to be supported by four components which include: technoware, humanware, infoware, and orgaware.
2. There are five stages of Knowledge Management implementation, namely:
  - (1) create a knowledge map in the organization;
  - (2) make a plan for implementing knowledge management;
  - (3) develop a knowledge management strategy map;
  - (4) implementation of knowledge management; And
  - (5) Measuring knowledge management activities.
3. Indicators of successful KM implementation are:
  - a. Knowledge inventory and acquisition, which includes: knowledge capturing, library, E-Library, Knowledge center.
  - b. Knowledge activity, which includes: creative R&D forum, innovation forum, sharing-problem solving-collaboration discussion forum.

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