

# A Proposed Clustered knowledge Management Development Framework (CKMD)

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**Abstract**— Knowledge Management (KM) is a paradigm that seeks to improve the organization performance by maintaining and leveraging the present and future value of knowledge assets. Knowledge management is not a single paradigm but it is an integration of fields of study. This paper provides a framework for enhancing knowledge management performance using clustered knowledge base. This clustered knowledge management framework (CKMD) may help in the development of KM as we divided the framework into five main phases, each phase consists of sub modules explaining the entire processes in the module. This partitioning is useful for increasing the specificity of the framework as each module will have its separate tasks and algorithms. In addition this framework has the ability to cluster the knowledge extracted, which will help in knowledge utilization process to make decisions.

**Index Terms**— Knowledge management, DIKW pyramids, Knowledge management processes, Clustered Knowledge management framework, KDD, data mining, Knowledge discovery

## 1 INTRODUCTION

Knowledge management is recognized as an urgent step for sustaining competitive advantage and improving performance as it has a strong impact on IT. It has been an integration of numerous fields of study [1]. Frameworks define the relevant objects and their coherences as well as providing a scaffold for aspects that have to be considered during the design and implementation process[2].

Knowledge management has many advantages in that it enhances the effectiveness business processes, brings consistency in all activities and operations, improves the communication internally and externally and saves cost and time and helps in taking more reliable decisions due to storing the experience of people in systems instead of brains.

Decision makers must consider the knowledge management because it is important for organizational survival and competitiveness (Goodman and Chinowsky, 1997).

Knowledge making/building is an unstoppable process which has several elements including the idea generation, grasping new models and mixing the theories/concepts for new processes [3].

Enormous researchers introduced different frameworks investigating the knowledge management infrastructures and its processes as will be shown in section 3.

In spite of this effort that had been dedicated in these researches, no one had spoken about the entire processes in each phase, also they all deals with normal un-clustered knowledge base which lead to long processing time.

The main goal of this paper is to introduce Clustered Knowledge Management Development framework (CKMD) that consists of 5 main phases: Knowledge Acquisition, Knowledge Formalization, Knowledge organization,

Knowledge utilization and knowledge sharing. This framework differs from other frameworks in illustrating the entire processes in the various processes of knowledge management [2,4,5,6,7,32]. Phases are subdivided into modules illustrating the task of each one. The remainder of this paper is organized as follows:

Section 2 presents a literature review. Section 3 presents related work about Knowledge management framework. Section 4 presents proposed clustered knowledge management framework (CKMD). Finally; section 5 presents conclusions and future work.

## 2 KNOWLEDGE MANAGEMENT OVERVIEW

This section gives an overview of different contribution in literature which includes the Data Information Knowledge Wisdom (DIKW) pyramid, various definitions of knowledge management and finally the infrastructure elements of knowledge management.

### 2.1 DIKW pyramid and Knowledge Management infrastructure

The DIKW pyramid composes of 4 main items data, information, knowledge and wisdom, as illustrated in fig. 1.

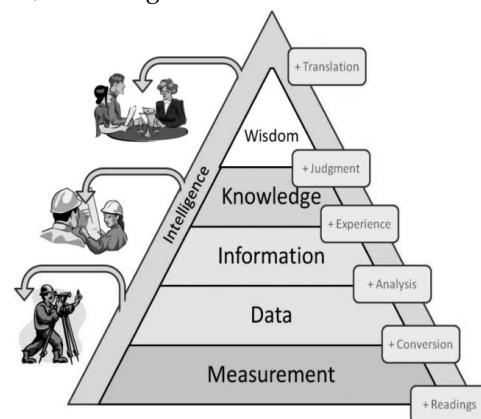


Fig.1:DIKW pyramid

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Knowledge management has been defined differently [4] as shown:

Wigg (1995)[8] defined it as a group of clearly defined process or methods used to search important knowledge among different knowledge management operations. Gupta (2002)[9], Knowledge management is a process that helps organizations identify, select, organize, disseminate and transfer important information and expertise that are a part of the organizational memory that typically resides within an organization in an unstructured manner.

Snowden (2000) defines knowledge management as process of identification, optimization, and active management of intellectual assets, either in the form of explicit knowledge held in artifacts or as tacit knowledge possessed by individuals or communities. Davenport et al. (1998) describes knowledge management systems should fulfill the following objectives:

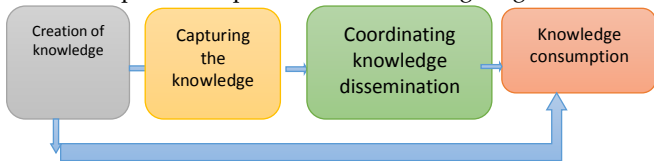
- To create knowledge repository
- To improve knowledge assets
- To enhance the knowledge environment
- To manage knowledge as an asset

Ellen knapp (1999), PriceWaterhouseCoopers defines knowledge management as an art of transforming information and intellectual assets into enduring value for an organization's clients and its people.

According to Gartneriii, knowledge management consists of four key processes. These key processes can be coined as 4 C's of Knowledge Management

1. Creation of knowledge,
2. Capturing the knowledge,
3. Coordinating knowledge dissemination process (Organizing the knowledge sharing)
4. Consumption of knowledge (Access and usage of information assets, including the tacit, uncaptured knowledge of people).

This process depicted in the following diagram:



**Fig:2 Four C's of Knowledge Management**

Satish Joshi, Senior VP, Patni Computer Systems Limited says "For us, KM is a set of processes and tools which give us the ability to leverage and combine the collective abilities of our knowledge work.

Recently, Filemon and Uriarte (2008)[10] defined KM as the broad process of locating, organizing, transferring, and using the information and expertise within an organization.[1,4]

The knowledge management infrastructures are the mechanism for the organization to develop its knowledge and also stimulate the creation of knowledge within the organization as well as the sharing and protection of it. Many researchers discussed the knowledge management infrastructure capabilities through the following elements: technology; structure; culture and human resources [1].

## 2.2 Knowledge Management Framework

Knowledge management and organizational learning are one amongst the foremost hotter areas in study as results of the organizations development and knowledge revolution [11]. Also due to the relation between KM and IT; IT plays important role in supporting KM as in creating organizational knowledge bases and knowledge networks [12]. This relation is studied in large enterprises and in small medium enterprises (SME). There are many topics regarding knowledge management which are:

1. Performance of knowledge management success factors [11].
2. Way to secure and defend organizations practices [13].
3. Designing and Deploying advanced knowledge systems [14].
4. Creation of knowledge in organizations and its relation with IT [13, 15, 16, 17]
5. Knowledge discovery and data mining [18, 19, 20].
6. Knowledge with decision [21, 22].
7. Knowledge with ontology [23, 24].

The knowledge management processes is defined as the degree to which the firm creates, shares and utilizes knowledge resources across functional boundaries.

There are several KM cycles exists: Meyer and Zack (1996), Bukowitz and Williams (2000), McElroy (2003), and Wiig (1993). Knowledge management process consists of four processes including capturing, arranging, refining and shifting (Awad and Ghaziri, 2004). The stages of knowledge transfer are parallel to the stages of the knowledge management process: arranging, distribution, adapting, using, generating, defining, and gathering (O'dell, Grayson and Essaides, 2003). KM process contains phases: make/create, store/retrieve, shift and use (Alavi and Leidner, 2001 [3].

Gupta et al. (2000) stated that KM is a process that deals with development, storage, retrieval, and dissemination of information and expertise within an organization to support and improve its business performance. (Ramachandran et al., 2009) identified six common KM processes for Higher Educational Institutions in Malaysia setting as a systematic process of knowledge creation, capture, organization, storage, dissemination, and application. Albers (2009) stated six factors that influence KM which include culture, leadership, organizational intent, knowledge processes, organizational structure and technology infrastructure. Sharma et al. (2010) indicate six similar knowledge management processes which are create, capture, organize, store, search, and transfer[8]

Many researches talked about knowledge management processes but they differ in describing knowledge management life cycle as discussed in table 1[2, 4, 5, 6, 7, 25]

**TABLE 1**  
A REVIEW OF KNOWLEDGE MANAGEMENT CYCLES

Framework	Descriptions
<b>Nonaka 1996,2012</b>	1.Socialization 2.Internalization [25] 3.combination 4.Externalization
<b>Alavi 1997</b>	1.Acquisition(Knowledge creation development) 2.Indexing 3.Filtering

	4. Linking 5. Distribution 6. Application
<b>Van der spek and Spijkervet 1997</b>	1. Develop 2. Distribute 3. Combine 4. Hold
<b>CEN 2004</b>	1. Identify knowledge 2. create knowledge 3. store knowledge 5. share knowledge 6. use knowledge
<b>Maier 2007</b>	1. Identify knowledge 2. create knowledge 3. storing 4. sharing 5. Application (use of knowledge)
<b>Global Knowledge framework 2012</b>	1. Knowledge identification 2. Knowledge acquisition 3. Knowledge development 4. Knowledge distribution/sharing 5. Knowledge preservation 6. Knowledge use
<b>SnehlataBhat, Dr.Abdulwahid 2012</b>	1. create 2. formalize 3. organize 4. distribute 5. apply 6. evolve
<b>Waikoloa et al. 2014</b>	1. creation 2. conversion [16] 3. sharing

### 3 THE PROPOSED CLUSTERED KNOWLEDGE MANAGEMENT DEVELOPMENT FRAMEWORK (CKMD)

The proposed clustered knowledge management development framework (CKMD) consists of 5 main phases: Knowledge Acquisition, knowledge formalization, knowledge organization, knowledge utilization and knowledge sharing as shown in figure 3. This is made to help in knowledge utilization process that uses the clustered knowledge to achieve goals and make decisions using decision support.

#### 3.1 knowledge Acquisition Phase

In this phase, information and knowledge is either created within organization or acquired from internal and/or external sources. This phase consists of two main sub modules:

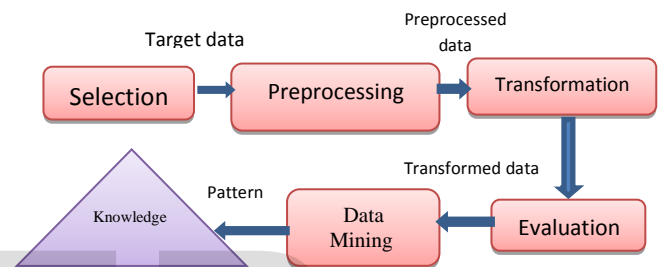
- **Knowledge Mining Sub Module:** is responsible for searching for knowledge by using one of two different ways: (1) Knowledge discovery: Searching the knowledge either in internal or external sources. (2) Knowledge Retrieval: used for knowledge extraction of a predefined knowledge base. The knowledge extracted from this step will be the input to the next sub module.
- **Knowledge Creator Sub Module:** this sub module takes the knowledge extracted from previous sub module. And its main goal that it is responsible for

knowledge creation.

#### 3.1.1 Knowledge discovery

Knowledge discovery is responsible for digging information from datasets (databases, data warehouse, digital library, human resources) and finding internal knowledge within organization or external sources.

Knowledge discovery and data mining goal is to turn data into knowledge. KDD refers to the overall process of discovering useful knowledge from data. It evaluates and possibly interprets the patterns to make the decision of what qualifies as knowledge. It also includes the choice of encoding schemes, preprocessing, sampling, and projections of the data prior to the data mining step while Data mining refers to the application of algorithms for extracting patterns from data without the additional steps of the KDD process. Data mining is the core part of (KDD) process [7] as shown in figure 4.



**Fig 4: knowledge discovery phase**

The KDD process consists of the following steps: [26]

1. **Data selection:** is the process where data relevant to the analysis is decided on and retrieved from data collection. It creates target data set by selecting a data set, or focusing on a subset of variables, or data samples, on which discovery is to be performed.
2. **Data cleaning (preprocessing):** is the process of removing noise data and irrelevant data from collection. It removes noise or outliers, Collects necessary information to model or account for noise, gives strategies for handling missing data fields and account for time sequence information and known changes.
3. **Data transformation (data consolidation):** is the process where selected data is transformed into forms appropriate for mining procedure.
4. **Pattern searching (data mining):** is the process where clever techniques are applied to extract patterns potentially useful. It chooses the data mining task by deciding whether the goal of the KDD process is classification, regression, clustering, etc. it selects methods to search for patterns in data and decide which model is appropriate. It Searches for patterns of interest in a particular representational form or a set of such representations as classification rules or trees, regression, clustering, and so forth.
5. **Evaluation:** is the process that Consolidates discovered knowledge.

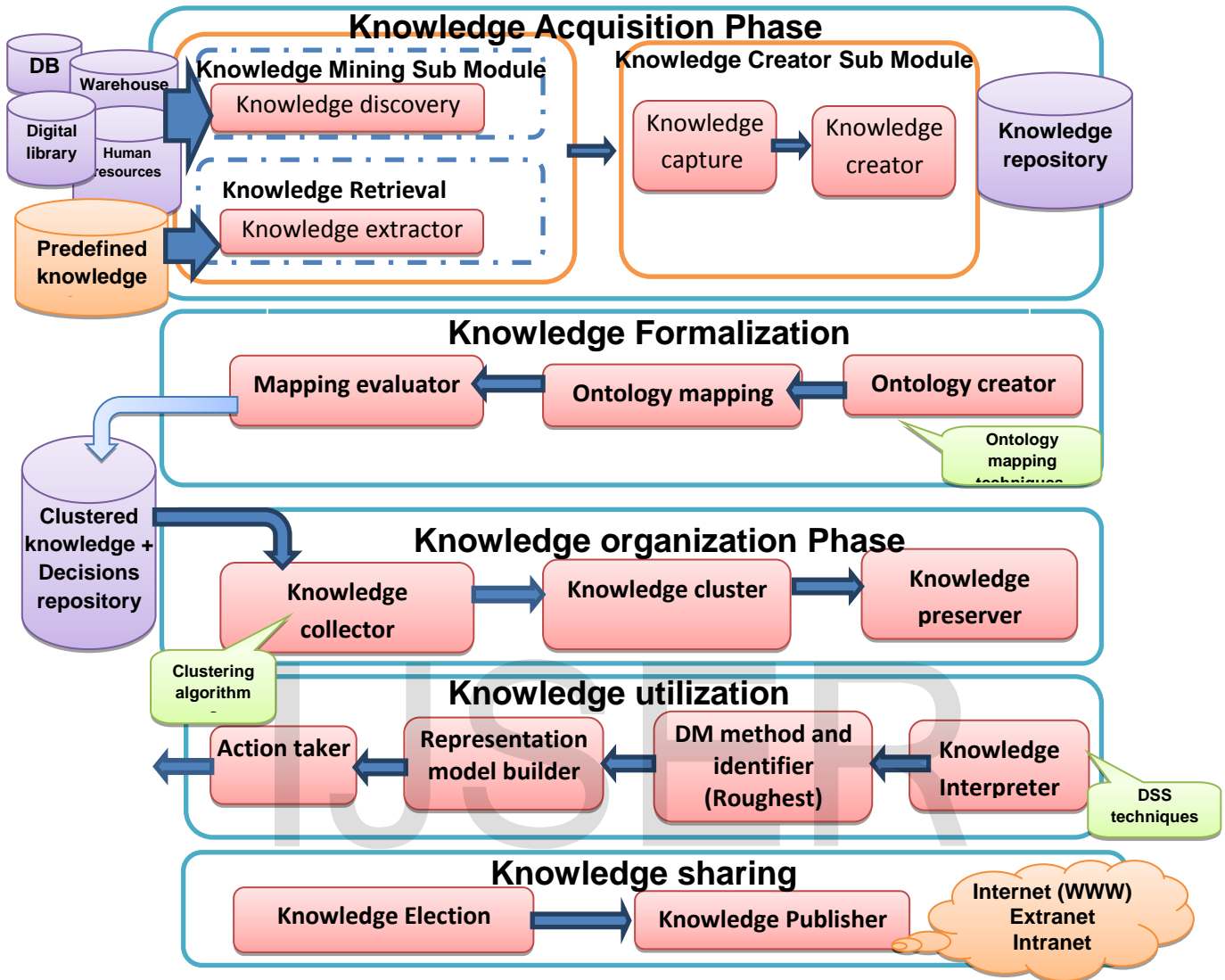


Fig 3: Proposed Clustered knowledge management development framework

### 3.1.2 Knowledge creation

This step is responsible for capturing and creation of new knowledge.

- Knowledge capture: (old knowledge)
- Gaining of knowledge with an essential experience for the creation and updating selected knowledge areas.
- Confines knowledge using matching technologies.
- Knowledge creation:(new knowledge)
- Creating new knowledge through combining internal knowledge with another and analyzes information to create new knowledge.
- Use technological components: Brainstorming - Data mining and knowledge discovery tools.

### 3.2knowledge formalization phase (Conceptualization)

This phase main goal is to formalize knowledge using ontology. Formally represents knowledge as a set of concepts within a domain and relationship between pairs of concepts. It puts knowledge in the form of formal taxonomic or ontologies. The formalization phase consists of the following sub modules:

- **Ontology creator**: it creates ontology for the knowledge output from acquisition and creation phase. it provides a shared vocabulary about a definition of a world as Ontology is the philosophical study of the nature of being, becoming, existence, or reality, as well as the basic categories of being and their relations.
- **Ontology Mapping**: it is also known as ontology matching or ontology alignment. Its main goal is to map concepts in the various ontologies to each other so that a concept in one ontology corresponds to a query (view) over other ontologies. Given 2 ontologies o1, o2. Mapping one ontology onto another. Means that for each entity (concept C, relation R or instance I) in o1, searching for a corresponding entity which has intended meaning in ontology o2.[ 27]
- **Mapping Evaluator**: Evaluates mapping process.

### 3.3 Knowledge organization Phase:

This phase main interests is the activities about organizing and preserving knowledge as labeling, indexing, sorting, abstracting,



categorizing and clustering.

The output of this phase is the clustered knowledge assets which can be used in the knowledge retrieval source in knowledge acquisition phase or can be published/shared in knowledge sharing phase. Knowledge organization consists of sub Modules which are:

**Knowledge collector:** it collects information discovered, captured

**Knowledge cluster:** clustering of knowledge in clusters. It is a task of grouping a set of knowledge in such a way that knowledge in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups. Cluster analysis itself is not one specific algorithm, It can be achieved by various algorithms that differ significantly in their notion of what constitutes a cluster and how to efficiently find them. The appropriate clustering algorithm and parameter settings (including values such as the distance function to use, a density threshold or the number of expected clusters) are used.

**Knowledge preserver:** it is responsible for storage of knowledge collected. It is viewed as organizer of memory and retention of knowledge assets.

The knowledge repository is storage for knowledge collected. It is viewed as organized memory and retention of knowledge assets. There are 2 types of memory; structured (storing explicit knowledge) and memorized memory (tacit knowledge in people's brain). The knowledge repository consists of both storing the content and structure.

### 3.4 knowledge utilization (use) Phase:

Knowledge utilization process uses knowledge to achieve goals and make decisions using decision support system. The performance of KM framework depends on making right decisions at right time. Knowledge utilization consists of several sub modules which are:

- **Knowledge interpreter:** responsible for gathering and interpreting relevant collected knowledge.
- **Decision making method and identifier:** determines method used in decision making process. Since decision is a difficult process as it is about incomplete information, decision making can be best take place in a fuzzy environment using fuzzy or rough sets. Rough set is chosen for its importance in AI, multi-agents system, data mining, decision making and granular computing. one of the tools that have been proven to be a soft computing tool that provides robustness, low cost solution, low computation time and powerful in decision making application is implementing rough set theory (RST) with granular computation (GRC) which is known as Granular Rough Model (GRM). [28,29]
- **Representation model builder:** implementing the GRM model and generates rules that aid in decision making process as illustrated in ref [30]
- **Action taker:** responsible for taking actions and making decisions.

### 3.5 Knowledge sharing Phase:

This phase is responsible for transferring and sharing knowledge among the individuals in same organization or different organization. Activities associated with flow of knowledge

from one part to another via communication technologies as internet (www), intranet and extranet. Knowledge sharing consists of 2 sub modules:

- **Knowledge election:** choose suitable knowledge to be published.
- **Knowledge publisher:** publish data via communication technologies in order to be used by other organizations for creation again of new data and so on.

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