PROPOSED MODELS OF ADAPTIVE KNOWLEDGE AGGREGATOR

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ABSTRACT

Knowledge is considered as an important and valuable source for organizations. The right knowledge contributes to better decision making and thus, improves competitiveness and organizational performance. Thus, it is essential for organizations to manage their knowledge properly through knowledge management processes as to sustain in the competitive industry. Tacit knowledge, which is stored in employees' minds and is hard to manage, has been considered as a crucial factor affecting the performance of organisations. Therefore, knowledge management enables the tacit knowledge of employees be converted to explicit knowledge to enable the retrieval of knowledge by other organizational members so that they can use that knowledge to be more innovative. Retrieving the right knowledge is important to enable the employees to perform better in their work; however, it poses a major challenge especially when retrieving knowledge from a large and variety of sources. The traditional knowledge retrieval methods share the explicit knowledge without a proper evaluation of the quality of knowledge (for example, without a proper editing). Thus, the aim of this paper is to develop efficient knowledge management methods that are able to; (1) to retrieve the right explicit knowledge from tacit knowledge based on responsible measurement variables; and (2) to aggregate and formulate the retrieved knowledge effectively for sharing valuable and focused knowledge. These methods will enable the organizational members to share the right explicit knowledge to the right employees at the right time.

Keywords: *Explicit Knowledge; Knowledge Aggregation; Knowledge Management; Knowledge Measuring; Knowledge Retrieving; Tacit Knowledge.*

1. INTRODUCTION

Knowledge is a complex term that has various definitions and types [1]. Thus, the researchers are trying to standardize the knowledge concept into more understandable forms to clarify the knowledge styles, types and implementations. [2] Defined knowledge based on the relationship between knowledge contents and the systematic processes to ensure that high quality of knowledge can be provided to support the organizations' activities. The knowledge is strong relationship between data or objects in the working environment such that it can develop competitive advantages for the organization. [3] Defined the knowledge as a deeper and richer layer that can represent the objects more than data and information layers. [4] Defined the knowledge as the results of linking the organization's information and the working services and activities. The concept of knowledge is shown in figure 1.
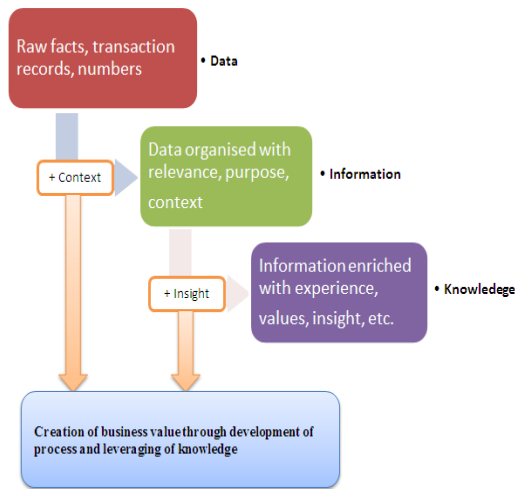
Figure 1: Concept of Knowledge (Shankar et al. 2003)

[5, 6] classified the knowledge to:

- Explicit Knowledge: the kind of knowledge that can be documented as written information based on people and systems expertise (i.e. experiments' reports).

- Tacit Knowledge: the kind of knowledge that the people gain through their personal experiences (i.e. personal skills).

[7, 8] argued that the transfer of explicit knowledge to tacit knowledge is easier than the transfer of tacit knowledge to explicit. However, the explicit knowledge can be codified and processed simply compared to the tacit knowledge. The methods that can be used to transfer the knowledge from one form to another are shown in figure 2.
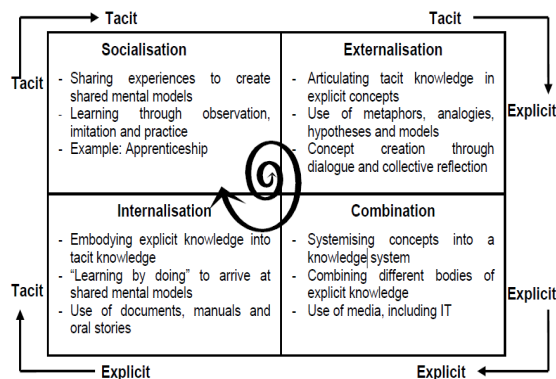

Figure 2: Kinds of Knowledge Transferring (Nonaka and

Takeuchi, 1995)

Nowadays, knowledge is considered as one of the most important factors that can guarantee the accuracy of the organizations activities and meet the high quality standards [9]. Therefore, organizations try to improve their competitive advantages by having the accurate knowledge through good strategies of managing tacit and explicit knowledge. One way is to encourage knowledge sharing among employees so that employees can share their tacit knowledge and be stored as explicit for reuse by other organizational members. This activity can be efficient through knowledge management (KM).

Knowledge Management (KM) is defined as a series of processes that collect, manage, design and share knowledge efficiently to maximize the performance of organizations [10]. On the other hand, [11] defined the KM as a sequence of processes of knowledge collecting, creating, capturing, retrieving, designing and sharing to support the organization activities. [6] Explained that KM is the processes of managing tacit and explicit knowledge inside organizations to maximize the profits of businesses. The main goal of Knowledge Management (KM) is to promote the cultural factor within the organization in order to achieve the most efficient outcomes through sharing the right knowledge to the right employee at the right time [12].

The implementations of KM face different changes: (1) Markets are continuously evolving; hence, organizations should reflect their internal operations accordingly and this will increase the complexity of building the knowledge and providing it appropriately [13]. Developing tacit knowledge is based on explicit knowledge, which requires continuous updating to the knowledge sources to be more consistency with the changes of organization's context; (2) there are variations in the employees' skills and capabilities. Therefore, it is important to ensure that knowledge provided is shaped accurately to meet the targeted person characteristics. Matching the knowledge depends on factors like culture, skills, context, experiences, and positions, which increase the complexity of providing an individualized knowledge [14, 15]. Accordingly, the inability of providing the required knowledge will decrease the performance of the organization and increase the chances of working mistakes. (3) Due to high number of factors that contribute to building the knowledge, the knowledge creating and introducing are complex tasks; consequently, the difficulty in providing

focused and valuable knowledge will increase [16,17].

In this paper, the current knowledge measurement and retrieving approaches will be reviewed accordingly, and the knowledge measurement model is proposed. The aim is to provide accurate explicit knowledge, which is based on employees' tacit knowledge and the knowledge retrieving model based on knowledge aggregation approach that can help in retrieving focused and valuable knowledge in real time.

2. RELATED WORKS

[18,19] Discussed two perspectives of KM : (i) Information Management (IM), which is concerned of managing explicit knowledge and knowledge sources (i.e. internet source); and (ii) People Management (PM), which focuses on tacit knowledge and is based on managing people inside the organization depending on their personal knowledge. Both IM and PM are very important for the organization, because it enables the organization to achieve two outcomes, which are: increasing the organization productivity and discovering new opportunities through using knowledge such as enhancing the human behaviors.

2.1 Knowledge Measurement

[20, 21, 22] explained that there are three main methods to measure the explicit knowledge quality; (1) Intuitive method through evaluating the shared knowledge by the employees themselves; (2) A systematic method through tracking the employees' behaviors using information systems to evaluate their added value of explicit knowledge; and (3) an empirical method which evaluate the knowledge based on the empirical variables such as trust of source and age of contents. [23, 24] There are four main variables that affect the quality of information: (i) essential variable that ensures that the information will maximize the performance of individuals' skills (i.e. tacit knowledge); (ii) a contextual variable that is focused on compatibility between information and organizational strategies and the organization's contexts; (iii) performance variable that represents the structure of the information and the writing styles; and (iv) a conductivity variable that provides the systematic accessing of information.

[25, 26, and 27] the quality of explicit knowledge measured through the extent of the actual enrichment that is a result of enhancing the tacit knowledge. Thus, the real experiments of tacit knowledge after gaining the explicit knowledge are considered as an efficient measurement method of the documented knowledge quality. There are three main methods of measuring the tacit knowledge quality: (1) formal methods, based on tests and quizzes; (2) informal method, based on observing the explicit knowledge effects on employees' skills; and (3) general characteristics of employee, (i.e. qualifications, development, and years of experiences). Table 1 shows the measurement methods of tacit and explicit knowledge.

Table 1: Analysis of Measurement Methods

Tacit Knowledge	Explicit Knowledge
Formal	Systematically; Contents Compatibility with organizational strategies.
Informal.	Empirical; Sources and contents characteristics
Employees' Characteristics	Intuitive

2.2 Knowledge Retrieval

The knowledge is retrieved in an abstract form - without editing or formatting - before it is shared to users' [28]. Knowledge should be processed such that it is compatible with the users' needs is success factor of KM inside any organization in order to provide accurate and focused explicit knowledge to develop the tacit knowledge [29]. The organization is responsible to provide focused and valuable explicit knowledge for its employees through the processes of knowledge systems [30].

Knowledge management processes focus on storing and retrieving knowledge based on the sources evaluations rather than contents evaluations [31]. However, to retrieve accurate explicit knowledge the knowledge contents need to be classified effectively to retrieve exact and compatible explicit in order to support the tacit knowledge. Thus, the knowledge management processes and techniques should work on variables that agree with knowledge contents levels more than general variables which deal with knowledge sources level. The Retrieving and designing methods do not processes the explicit knowledge,

i.e. articles retrieved without editing or reformatting [32, 33]. Thus, the explicit knowledge retrieved and shared to persons as lists of articles. Therefore, the shared knowledge may have a lot of inaccurate contents. However, the explicit knowledge editing and reformulation is necessary to share accurate, focused and valuable knowledge to save the employees searching time and efforts. Figure 3 illustrates the current knowledge retrieving and designing methods.
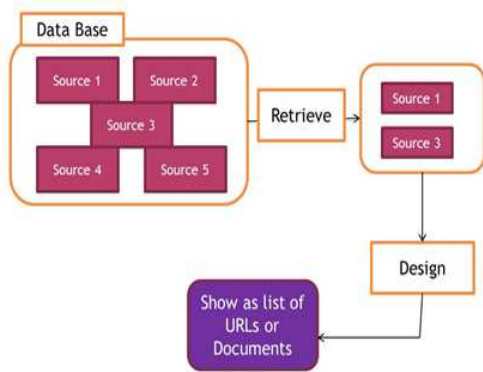

Figure 3: Current Retrieving And Designing Method

3. GAPS OF RELATED WORKS

In general, KM aims to share the right knowledge to the right person at the right time in order to develop and support tacit knowledge (skills and expertise) and maximize the accuracy and efficiency of organizations' services and activities, which, eventually, maximize the organizations profits and customers' satisfactions. However, there are three main gaps that limit the efficiency of current KM implementations:

(1) Knowledge Measurements: in the literature there are no accurate methods to measure tacit and explicit knowledge, based on clear and structured dimensions. Besides that, there are not specific methods to retrieve accurate explicit knowledge based on current tacit needs; accordingly, the retrieved explicit knowledge may not be efficient to improve the tacit knowledge.

(2) Retrieving and designing methods: the literature focuses on retrieving the explicit knowledge (i.e. articles without editing or reformatting); hence, the explicit knowledge retrieved and shared to persons as lists of articles. Therefore, the shared knowledge

contents might be inaccurate. Accordingly, the explicit knowledge editing and formatting is necessary to share accurate, focused and valuable knowledge to save the employees searching time and efforts.

(3) Validity and quality of explicit knowledge, there are many factors that control the explicit knowledge validity and quality, such as organizations' strategies and explicit sources variables (i.e. source ranking and contents age). In the literature, there are no efficient and applicable methods to validate and qualify the explicit knowledge contents based on knowledge sources' variables and the organization strategies to prepare accurate knowledge infrastructure to support the tacit knowledge efficiently.

4. RESEARCH METHOD

The construction of the proposed model is based on the feedback from the experts in Jordanian universities. The experts were chosen based on their working experiences and the position held in Jordanian universities and who frequently access their employees' tacit knowledge. The interview was conducted to identify the most effective variables and processes of knowledge measurement and retrieving model. Table 2 illustrates the panel profiles.

Table 2: profiles of Expert Panel

Name	Position	Experience Years
Prof. Saleh Irshed	Vice president of Alblqaa university	30 years
Dr. Hyam Nesor	IT college member in applied science technology	8 years
Associate prof. Farid Alqwasmeh	Chairperson of business department in Jadara University	6 years

5. DATA ANALYSIS

According to expert panel, the most effective variables of tacit knowledge measurement are as the following:
Based on the interview, the variables for tacit knowledge measurement are identified:

- **Qualification Levels**: The qualification levels of employees i.e. PhD, master, Bachelor and diploma reflect are significant attributes of tacit knowledge levels. Tacit knowledge of an individual is expected to be improved with better qualification.

- **Years of working experience**: this variable is another significant variable to measure the employees' tacit knowledge. It is expected that tacit knowledge can be improved through longer working experiences.

- **Supervisors Assessment**: the tacit knowledge assessment through working supervisors is efficient variables to measure the current tacit levels of employees.

- **Quick Assessment**: It is expected that the tacit levels of employees can be evaluated using written tests. The quiz is effective approach due to low requirements i.e. time and cost.

On the other hand, the levels of explicit knowledge can be measured using two effective variables which are:

- **Managers' Ranking:** the managers can evaluate the levels of explicit knowledge based on the compatibility between the knowledge contents and businesses strategies of organizations.

- **Employees' Ranking:** the employees can evaluate the levels of explicit knowledge based on the gained value of the knowledge contents i.e. added value to tacit knowledge.

On the other side, the expert panel mentioned that the retrieved contents could be more focused than the current knowledge retrieving methods i.e. retrieve all contents of articles. The parts of knowledge that satisfy the employees needs of knowledge can be retrieved rather than all parts of explicit knowledge i.e. all parts of articles. The articles can be classified based on 5 main sections; (1) problem statement, (2) objective, (3) methodology, (4) findings, and (5) general knowledge such as introduction and conclusions. The knowledge retrieving based on these classifications can help the employees to retrieve focused sections of knowledge rather than large knowledge contents and the employee can refer to most useful knowledge articles rather than read all articles.

6. PROPOSED MODELS

The main aim of this paper is to retrieve right knowledge to right employee at real time through develop two main methods which are: (1) Adaptive knowledge matching method to measure the tacit and explicit knowledge based on practical variables in order to retrieve the right explicit knowledge based on current tacit level of employees. (2) Aggregation method to retrieve and aggregate valuable parts of knowledge from various recourses i.e. articles rather than retrieve the whole knowledge of recourses in order to minimize the knowledge searching efforts and time.

6.1 Adaptive Knowledge Matching
The adaptive knowledge retrieving is based on tacit and explicit knowledge evaluation. Figure 4 shows the proposed method. The proposed method incorporates a measurement algorithm that is implemented to address the following points:

1. Measure the explicit knowledge levels: the explicit knowledge measured through two important variables which are: (1) top management evaluation to ensure the knowledge compatibility with organizations strategies. (2) Employees' ranking to reflect the benefits that gained from the shared knowledge. Both of these variables represent overall explicit knowledge level measurement.

2. Measure the tacit knowledge levels: the tacit knowledge measured through four main variables; (1) experience years of employee, (2) qualification levels of employees, (3) observing feedback from supervisors based on employees working performance, and (4) the assessments after retrieve the explicit knowledge i.e. quiz. All variables represent overall tacit knowledge level measurement.

3. Matching between tacit and explicit knowledge: There are dependencies between the measurement of tacit and explicit variables. The employees evaluate the explicit knowledge levels based on their tacit knowledge levels and the managers evaluate the explicit knowledge levels based on their businesses strategies that are developed using tacit knowledge of employees. The explicit and tacit knowledge levels: the matching between the explicit and tacit levels calculated based on the integration between tacit and explicit knowledge measurement. The levels of tacit and explicit knowledge need to be evaluated depend on same measurement scale i.e. 0-10 scale.

Therefore, the matched knowledge of tacit and explicit levels will be aggregated using through the aggregation model. The next sections will explain the aggregation model processes.
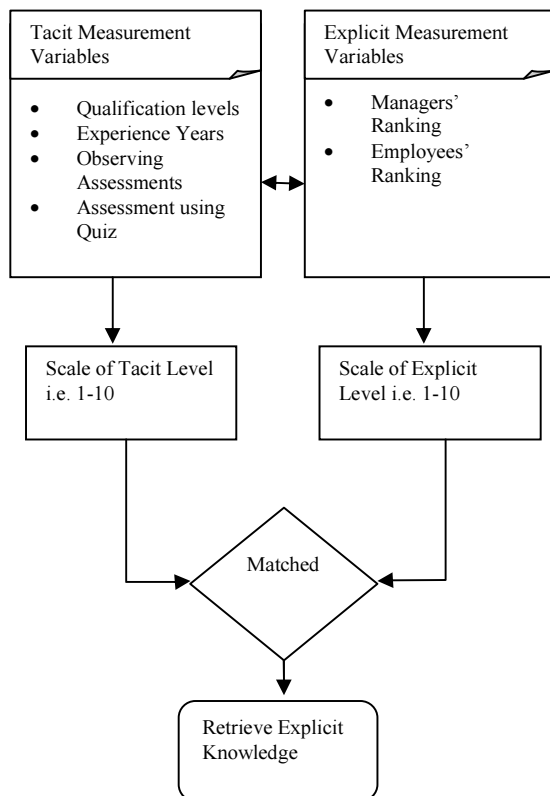

Figure 4: Knowledge Matching Model

6.2 Knowledge Aggregation Model

To the best knowledge of the authors, the current retrieving techniques are retrieving Knowledge that is not sufficient to satisfy the individual's needs at a particular time and context [12]. Aggregation technique is proposed to generate more valuable and trusted knowledge by combining the retrieval knowledge from diverse sources. The retrieved knowledge is selected from categorized sources in a database; which are ranked according to different factors; finally the suitable parts are combined together in one file as a result of aggregation technique. Figure 5 shows the proposed aggregation method.
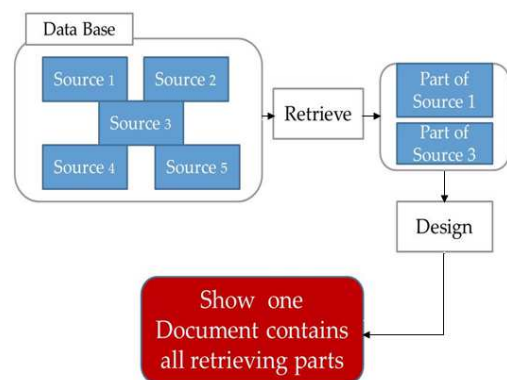

Figure 5: Knowledge Aggregation

Figure 6 shows the proposed classification of articles contents. Every article classify as many parts; general information such as introduction, literature review and conclusion, problem statement, methodology, and findings.
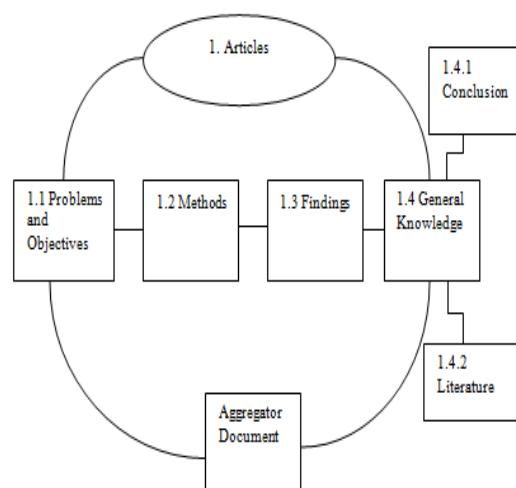

Figure 6: Article Classification Support Knowledge Aggregation Model

The following are the process that represents the integration between knowledge measurement and retrieving models.

1. The employee type the searching keywords and the searching scope that could be retrieved i.e. problem statement or objectives.

2. The measurement model responsible about measure the current tacit level of employees and the articles level.

3. The matched articles with employees searching keys will be retrieved.

4. The matching articles with employees' tacit levels will be retrieved.

5. The scope the selected by employees' will be aggregated from all candidates articles in one file.

6. CONCLUSION

Explicit and tacit knowledge measurement is important to share accurate explicit knowledge according to levels of tacit knowledge within the context of organizations activities. Sharing the right knowledge to the right employee can increase the performance of the working tasks; eventually this will increase the overall performance of the organization. There are different methods that are proposed to measure the explicit knowledge accuracy and tacit knowledge levels. This paper proposed a novel approach to measure the tacit and explicit knowledge in order to improve sharing the knowledge adaptively. A knowledge retrieving and designing method is developed in order to retrieve more focused and valuable explicit knowledge to support the tacit knowledge based on internal contents evaluation rather than general knowledge evaluation. The proposed knowledge aggregation method focuses on retrieving the exact knowledge by managing, designing, and retrieving the explicit knowledge based on knowledge contents level.

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