Knowledge Management Evaluation in Oil and Gas Company Using Analytic Hierarchy Process

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Abstract

In today's competitive business environment, competition between organizations has become strict and more competitive. Oil and Gas Company is a learning organization that manages knowledge for implementing Knowledge Management (KM) as company intangible asset in order to reach higher competitive advantage. The investment in KM needs to be evaluated to assure the advantage obtained from the investment. The objective of this study is to evaluate knowledge management performance by comparing and ranking each division to find division that represents the most desirable performance to the least performance. The methodology used to evaluate is Analytic Hierarchy Process (AHP). The AHP arranges the decision problem into a hierarchy of more easily comprehended. This research adopts SECI model as a criteria that correlated to KM performance. In order to identify the area for improvements by means of determine the differences between division, gap analysis was conducted. Prioritize of criteria socialization (37.68%), internalization (23.63%), combination (23.61%), and externalization (15.08%). The result of division with highest weight of KM performance is planning and the lowest is financial. Financial division needs to improve the overall SECI process by increasing interaction between team members, routine progress reports and also verbalizing knowledge based on documents. A case study in an oil and gas company was conducted to demonstrate how to evaluate KM using AHP.

Keywords: analytic hierarchy process, knowledge management performance, knowledge management process, SECI model

1. Introduction

In this globalization era, competition between organizations has become strict and more competitive. This organizations are required to have a solid strategy and able to make right decisions in this competitive situation. Organization's competitive advantages depend on the organization ability to learn faster than its competitors. The organizational learning process depends on the ability of the organization to collect and use knowledge, skills and behaviors which have the potential to enhance learning of its members and improve the organizational future performance (KLICON, 1999).

Knowledge Management (KM) recognizes that organizations are a complex system made up of both the people that work for the organization, and the processes, procedures and information systems that drive our actions. Organizations that have started to try to measure intangible assets have cited several benefits which could help to provide competitive advantage (Forstenlechner, Roth, & Lettice, 2006).

The concept of knowledge management involves managing the learning processes of individual and collective members of an organization. Therefore, it includes organizational learning (related to the creation of new knowledge), and most processes related to the acquisition of knowledge from outside, dissemination, storage and exploitation of knowledge at the firm (García, Lloréns, & Verdú, 2009).

The oil and gas industry has taken advantage of knowledge management (KM) developments for more than a decade. Throughout the rapid advance of technology, an extension of offshore drilling, numerous acquisitions, the growing reliance on foreign oil

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sources, and a focus on environmental issues, KM initiatives have played a part in making operations more efficient and effective (Leavitt, 2002).

Between 2000 and 2010, the Society for Petroleum Engineers (SPE) estimated that 231,000 years of cumulative experience and knowledge will be lost to the industry in the next 10 years due to retirement of petroleum engineers and other technical staff. Knowledge management offers a means of limiting the potentially devastating effects of the continuous knowledge loss due to retirement & downsizing (Drain, 2001).

PT. XYZ has realized the importance of implementing Knowledge Management in order to have better performance than other organizations by having the capacity to learn and act quickly. Unfortunately, the problem with knowledge management is that most companies struggle to make it work. Knowledge management promises much, but often delivers very little (Julian, 2001).

Based on managers opinion, KM implementation is not implemented properly yet. One manager state that KM in PT. XYZ is better known as business training provider, not managing knowledge in each department. The training provided by knowledge management has too many focal objects in business instead of corporate (which is the core of the company). And other said that KM needs stable and conducive state of company to grow. Because the company's priority is still on how to make operations efficient, then KM initiatives will be assumed as spending money activities.

Due to the fact of the imbalance of employee quality of knowledge and satisfaction throughout employees and manager opinion of ineffectiveness of KM implementation, then by considering the importance of knowledge creation process as organizational learning that uses knowledge as their intangible asset, therefore the aim of this research is to evaluate the performance of knowledge management in the organization to improve knowledge management implementation.

2. Literature Review

2.1. Knowledge Management

Knowledge management is defined as a tool, technique, and strategy to retain, analyze, organize, improve, and share business expertise (Jennex, 2005). Knowledge management also defined as a systematic and integrative process of coordinating organization-wide activities of acquiring, creating, storing, sharing, diffusing, developing, and deploying knowledge by individuals and groups in pursuit of major organizational goals. It is the process through which organizations create and use their institutional and collective knowledge (Rastogi, 2000). And Jennex (2005) consider knowledge management is the practice of selectively applying knowledge from previous experiences of decision making to current and future decision making activities with the express purpose of improving the organization's effectiveness. Arora (2002) found three knowledge management purposes, which are the improvement of organization knowledge, the creation of new knowledge or innovation, and improved employee job based on extended collaboration.

2.2. Categories of Knowledge

Based on Clark, there are two categories of knowledge tacit knowledge and explicit knowledge:
1. Tacit Knowledge (Clark, 2004)
    Tacit knowledge is defined as a personal knowledge embedded in individual experience and involves intangible factors, such as personal beliefs, perspective, and the value system. Tacit knowledge is hard to articulate with formal language (hard, but not impossible). It contains subjective insights, intuitions, and hunches. Before tacit knowledge can be communicated, it must be converted into words, models, or numbers that can be understand. In addition, there are two dimensions to tacit knowledge:

- Technical Dimension (procedural): This encompasses the kind of informal and skills often captured in the term know-how. For example, a craftsperson develops a wealth of expertise after years of experience. But a craftsperson often has difficulty articulating the technical or scientific principles of his or her craft. Highly subjective and personal insights, intuitions, hunches and inspirations derived from bodily experience fall into this dimension.
- Cognitive Dimension: This consists of beliefs, perceptions, ideals, values, emotions and mental models so ingrained in us that we take them for granted. Though they cannot be articulated very easily, this dimension of tacit knowledge shapes the way we perceive the world around us.

2. Explicit Knowledge (Clark, 2004)

Explicit knowledge can be articulated into formal language, including grammatical statements (words and numbers), mathematical expressions, specifications, manuals, etc. Explicit knowledge can be readily transmitted others. Also, it can easily be processed by a computer, transmitted electronically, or stored in databases.

2.3. Components of Knowledge Management

Components of Knowledge Management are the important part to construct KM. Bhatt (2000) states that components of Knowledge Management consist of people, process, and technology.

1. People

A person is the one who keeps and apply the knowledge. The concern is about how to increase the ability of an individual in the organization to influence others with their knowledge.

2. Process

The process is how which people create, capture, store, organize, and distribute knowledge. Its approach varies from organization to organization. There is no limit on the number of processes.

3. Technology

Technology allows people to easily access and applies knowledge. It needs to be chosen only after all the requirements of a knowledge management initiative have been established.

2.4. Importance of Knowledge Management Implementation

Knowledge Management is linked to the organization's goal which is to reach a higher output or result such as overall knowledge, performance, competitive advantage or innovation. In order to survive in this era of knowledge competition, an enterprise should have an efficient knowledge management system which can facilitate knowledge innovation and sharing and repetition. This knowledge that always increased and improved is making knowledge management increasingly more important. Three key reasons why actively managing knowledge is important to a company's success are (Quast, 2012):

1. Facilitates decision-making capabilities

Data can offer managers a wealth of information but processing overwhelming amounts can get in the way of achieving high-quality decisions. While information overload or needing knowledge from people in other parts of the company for decision-making can handicap managers, putting in place knowledge management systems can facilitate better, more informed decisions.

2. Builds learning organizations by making learning routine

To move ahead, one must often first look behind. KM builds a learning organization by making learning routine. This has created a culture where everyone continuously assesses themselves, their units, and their organization, looking for ways to improve. After every important activity or event, each teams review assignments, identify successes and failures,

and seek ways to perform better the next time. This approach to capturing learning from experience builds knowledge that can then be used to streamline operations and improve processes.

3. Stimulates cultural change and innovation
    Actively managing organizational knowledge can also stimulate cultural change and innovation by encouraging the free flow of ideas. KM programs can help managers embrace change and encourage ideas and insight, which often lead to innovation.

2.5. Knowledge Management Process

Functional process of KM process can be considered as a cycle of input-output as any other system. The process clearly indicates that knowledge management takes information, knowledge, and people as its basic inputs, and applied knowledge and intellectual capital as its desired outputs. KM emphasizes knowledge creation, transfer and embedding to serve different organizational purposes (Rahimi, Arbabisarjou, & Mohse, 2011).

A number of studies have addressed knowledge management processes; they divide knowledge management into several processes (Lee & Lee, 2007). And Lee and Choi (2003) focused on the knowledge creation process, and they adopt the SECI (socialization, externalization, combination, internalization) process model by Nonaka and Takeuchi (1995) to explore knowledge creation. Nonaka and Takeuchi's model (1995) of the four modes of KM process or knowledge creation that are derived from the two kinds of knowledge:

1. Socialization (tacit to tacit)
    Socialization is a process of sharing and creating tacit knowledge through direct experience. It is the same event that occurs during the dynamics of effective teams or between colleagues with common ideas. In this phase, the members discuss about what is more important and use the other's thoughts. The socialization is also known as converting new knowledge through shared experiences. Organizations gain new knowledge from outside their boundaries such as interacting with customers, suppliers and stack holders. Meetings and brainstorm can support interaction of tacit knowledge transfer, sharing tacit knowledge through face-to-face or share knowledge through experiences.

2. Externalization (tacit to explicit)
    Externalization is a process of articulating tacit knowledge through dialogue and reflection. This process requires the expression of tacit knowledge and its translation into comprehensible forms that can be understood by others. In a team climate, metaphors and allegories assist the individuals to externalize their own tacit knowledge (personal experiences, ideas, beliefs, and so on) and imagine a clear picture of other's ideas. It helps in creating new knowledge as tacit knowledge comes out of its boundary and becomes collective group knowledge. In this process can be said that knowledge is crystallized. The process of externalization is often driven by metaphor analogy and models.

3. Combination (explicit to explicit)
    Combination is a process of systemizing and applying explicit knowledge and information. The form of different collections of knowledge has exchanged, distributed, and documented or discussed during meetings and sessions. The collections of knowledge are processed and categorized in order to create new knowledge. The new explicit knowledge is then transferred among the members of the organization through presentations, meetings or emails, and processing by documents, plans, reports and market data. The creative use of computerized communication networks and large-scale databases can support this mode of knowledge conversion.

4. Internalization (explicit to tacit)

Internalization is a process of learning and acquiring new tacit knowledge in practice. It is very similar to learning through practice. Internalization is also a process of continuous individual and collective reflection and the ability to see connections and recognize patterns and the capacity to make sense between fields, ideas, and concepts. When this tacit knowledge is read or practiced by individuals then it broadens the learning spiral of knowledge creation. The organization tries to innovate or learn when this new knowledge is shared in socialization process. Organizations provide training programs for their employees at different stages of their working with the company. By reading these training manuals and documents employees internalize the tacit knowledge and try to create new knowledge after the internalization process.

2.6. Knowledge Management Performance

While the ultimate goal of knowledge management is the improvement of organizational performance, such linkage is obscure and difficult to be empirically validated due to an extremely large number of internal and external factors affecting organizational performance. Fernandez & Sabherwal (1991) measured end user satisfaction with knowledge management implementation. These indicators can be considered as immediate outcomes of knowledge management and more direct measures of knowledge management performance (Yu, Kim, & Kim, 2004).

When your knowledge repository gets filled with irrelevant, inaccurate, and unreliable pile of low quality knowledge, it will make your knowledge search more time-consuming and unproductive, ultimately driving away end users from your knowledge management system. Thus, creating and gathering high quality knowledge should be one of the most important objectives of knowledge management and is at the same time certainly related to organizational performance (Yu, Kim, & Kim, 2004).

When satisfied with their organization's knowledge management initiatives, organizational members will voluntarily participate in diverse knowledge management activities such as knowledge creation, sharing, and utilization. In the knowledge management context, we measure user's satisfaction with quality and quantity of knowledge, knowledge search capability, knowledge management system functionalities, incentives for knowledge contribution, and overall organizational management of knowledge (Yu, Kim, & Kim, 2004).

2.7. Correlation of KM process and KM performance

Successful knowledge management depends on processes that enhance individual and organizational ability, motivations, and opportunities to learn, gain knowledge, and perform in a manner that delivers positive business results. Organizational processes that focus on these three attributes will lead to an effective management of knowledge (Argote, McEvily, & Reagans, 2003). Previous study provides sufficient evidence knowledge process can encourage the creation of organizational knowledge, which in turn leads to greater performance (Lee & Choi, 2003).

2.8. Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP), introduced by Thomas Saaty (1980), is an effective tool for dealing with complex decision making, and may aid the decision maker to set priorities and make the best decision. By reducing complex decisions to a series of pairwise comparisons, and then synthesizing the results, the AHP helps to capture both subjective and objective aspects of a decision. In addition, the AHP incorporates a useful technique for checking the consistency of the decision maker's evaluations, thus reducing the bias in the decision making process (Saaty T. , 1980). The process of AHP that defined by Saaty T.L (2008) are:

1. Model the problem as a hierarchy containing the decision goal, the alternatives for reaching it, and the criteria for evaluating the alternatives.
2. Establish priorities among the elements of the hierarchy by making a series of judgments based on pairwise comparisons of the elements. For example, when comparing potential

purchases of commercial real estate, the investors might say they prefer location over price and price over timing.

3. Synthesize these judgments to yield a set of overall priorities for the hierarchy. This would combine the investors' judgments about location, price and timing for properties A, B, C, and D into overall priorities for each property.

4. Check the consistency of the judgments.

5. Come to a final decision based on the results of this process

To make comparisons, we need a scale of numbers that indicates how many times more important or dominant one element is over another element with respect to the criterion or property with respect to which they are compared. The priorities comparison is measured using Pairwise Comparisons. The comparison is sequence from bottom to top, which is from choices to factors and factors to goal.

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Table 1 Fundamental Scale for Pairwise Comparisons

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two elements contribute equally to the objective
3	Moderate Importance	Experience and Judgment moderately favour one element over another
5	Strong Importance	Experience and Judgment strongly favour one element over another
7	Very Strong Importance	One element is favoured very strongly over another; its dominance is demonstrated in practice
9	Extreme Importance	The evidence favouring one element over another is of the highest possible order of affirmation

Intensities of 2, 4, 6 and 8 can be used to express intermediate values. Intensities of 1.1, 1.2, 1.3, etc. can be used for elements that very close in importance.

Source: Saaty T., 1980.

Based on Saaty's (1980) opinion, the AHP considers a set of evaluation criteria, and a set of alternative options which the best decision is to be made. It is important to note that, since some of the criteria could be contrasting, it is not true in general that the best option is the one which optimizes each single criterion, rather the one which achieves the most suitable trade-off among the different criteria.

The AHP generates a weight for each evaluation criterion according to the decision maker's pairwise comparisons of the criteria. The higher the weight, the more important the corresponding criterion. Next, for a fixed criterion, the AHP assigns a score to each option according to the decision maker's pairwise comparisons of the options based on that criterion. The higher the score, the better the performance of the option with respect to the considered criterion. Finally, the AHP combines the criteria weights and the options scores, thus determining a global score for each option, and a consequent ranking. The global score for a given option is a weighted sum of the scores it obtained with respect to all the criteria (Saaty T., 1980).

3.   Methodology

In this research, knowledge management performance will be evaluated by comparing and ranking each division. By comparing and ranking, the weakness of each division could be revealed, because both processes increase the efficiency of selecting the better one. So that the company could clearly define the right improvement needed and to develop the perspective on how employee contributes to the organizational process. The expert judgment is used to prioritize the criteria that influencing knowledge management performance, which is in this case knowledge creation process. The criteria in this research are Socialization, Externalization, Combination and Internalization (SECI) that adopted from study of Nonaka and Takeuchi about knowledge creation process (Nonaka & Takeuchi, 1995).

3.1.   Measurement Framework Development

Knowledge is created when there is the transformation of tacit knowledge of individuals into explicit knowledge at group and organizational level (Nonaka & Takeuchi, 1995) Knowledge management process is requirement that absolutely has to be delivered for the KM to gain its objectives which is improving organization performance. To describe knowledge process, this research adopts the Nonaka and Takeuchi study of knowledge. The research measurement framework describes the relationship between variables of this research is described in Figure 1. The Figure shows that KM process that focuses on knowledge creation process is correlated to KM performance. The reasons of choosing Nonaka and Takeuchi KM process (SECI model) as describes by are:

1.   Chang, Hsu, & Yen (2012) find out that KM processes (socialization, externalization, combination, and internalization) can improve KM performance. Their study results reveal that there is significantly affects knowledge satisfaction and knowledge quality for subunits performing focused, process-oriented and broad, process-oriented tasks.
2.   Based on Ramírez, Morales, & Rojas (2011) analysis, SECI model of knowledge creation influences organizational learning as an essential part of KM.
3.   Their work has become widely accepted in the variety of management fields such as organizational learning, joint ventures, new product development, and information technology (Lee & Choi, 2003).
4.   It includes not only knowledge creation but also knowledge transfer. Because transfer of existing knowledge and creation of new knowledge have become two major management tasks, both should be considered together (Lee & Choi, 2003).
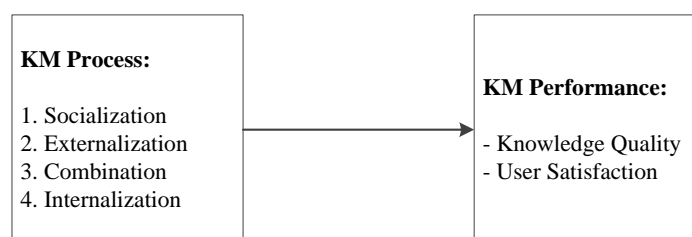

Fig. 1. Research Measurement Diagram

3.2.   Questionnaire Development

In this research, there are two questionnaires developed. The first questionnaire is for employee in every division to measure the level of performance as object of ranking process. In this questionnaire every respondent is asked for their perception of a question based on five Likert scale from strongly disagree (1) to strongly agree (5).

The second questionnaire is developed for weighting process to define knowledge management process factors priorities based on experts judgment. This questionnaire is distributed to eight experts or managers in PT. XYZ. Managers were chosen to give judgments because in PT. XYZ training of KM is programmed for leader and managers. And also strengthened by clarification from Lee and Choi (2003) that middle managers tend to play key roles in knowledge management, top managers may be eager to highlight their roles in

organizational success, line managers are incapable of understanding the characteristics of the overall organization. The judgment is used to generate a weight for each evaluation criterion according to the decision maker's Pairwise Comparisons of the criteria. The higher the weight means the more important the corresponding criterion.

3.3. Questionnaire Design

The first questionnaire is adopted from Huang and Wang's journal about knowledge conversion abilities and knowledge creation and innovation. Their study conceptualized the four knowledge conversion patterns, including socialization, externalization, combination, and internalization. Measure and formula of each item of question is developed in order to clarify the correlation of each question to KM process. The development of measure and formula is based on Nonaka & Takeuchi's (1995) SECI model theory.

Table 2 Questionnaire Design

Cate-gory	No	Measure	Formula	Questions
Socialization	S1	Member sharing experience	Level of employee shares experience	In team discussion, I will actively share my experience with others.
	S2	Group sharing experience	Level of group sharing experience	In my work team, my team mates and I will share life or work experience with each other.
	S3	Meeting and discussion	Level of information gathered through discussion	During group discussion, I try to find out others' opinions, thoughts and other information.
	S4	Tacit knowledge creation	Level of creating tacit knowledge	During discussion, I will bring out some concepts, thoughts or ideas.
	S5	Sharing knowledge	Level of knowledge expressed	I often encourage others to express their thoughts.
	S6	Creating knowledge	Level of employee data collection ability	Before team discussion, I will collect necessary information and show it to my teammates.
Externalization	E1	Translating tacit knowledge	Level of employee able to translate their knowledge through reflection	When others can't understand me, I am usually able to give him/her examples to help explaining.
	E2	Developing ideas	Level of employee able to developing ideas	Most of the time, I can transcribe some of the unorganized thoughts into concrete ideas.
	E3	Knowledge communication	Level of communication ability	I can describe professional or technical terms with conversational language to help communication in a team.
	E4	Developing concepts	Level of reflecting their knowledge ability	I tend to use analogy when expressing abstract concepts.
	E5	Crystalizing knowledge	Level of crystalizing dialogue ability	I will help others to clearly expressing what he/she has in mind by encouraging them to continue what they are saying.
	E6	Articulating tacit knowledge	Level of articulating thought ability	When others cannot express themselves clearly, I usually help them clarify their points.

Combination	C1	Organizing and integrating knowledge	Level of information organized and integrated	During the discussion, I tend to help organize ideas and make conclusion to facilitate the discussion.
	C2	Integrating knowledge	Level of problems processed and integrated	When coming across problems, I tend to use my experience to help solving problems.
	C3	Gathering explicit knowledge	Level of situation organized and integrated	After every event, I have the habit of organizing and making summary of what happened.
	C4	Systemizing knowledge and information	Level of systemization information	During discussion, I will organize everyone's thoughts in my mind
	C5	Breaking down and finding relationship among concepts	Level of adding and categorizing information	I like to collect new information, and making connection of new and old knowledge to work up new concepts.
	C6	Organizing concepts	Level of categorizing knowledge ability	I like to organize ambiguous concepts into structure.
Internalization	I1	The ability to see connections	Level ability to see connections	After hearing a new idea or concept, I tend to compare it with my experience to help me comprehend the meaning.
	I2	The capacity to make sense between concepts	Level ability to make sense the concepts	I understand others' thoughts better by repeating what they said and asking them "Is this what you mean?"
	I3	Embodying explicit knowledge through reflection	Level of same concept reflected	I will tell others what I think to make sure my understanding is the same as theirs.
	I4	Recognize patterns	Level of patterns communicated	When I have finished saying something, I will ask the other person if it is necessary to repeat to make sure he/she understands exactly what I mean.
	I5	Learning tacit knowledge in practice	Level of thoughts acquired	When communicating with others, I will give others time to think about what we just discussed.

3.4. Data Validation and Reliability

Testing the reliability and validity of the questionnaire results is important before conducting any further analysis. Validity tests aim at evaluating the extent to which a measure is testing what is intended to be measured. The validity testing in this study is performed on variables that include multiple items of question or statement using factor analysis and the loading factor. Factor analysis with varimax was applied to reduce the collected data into certain factors. Varimax is an orthogonal rotation to minimize the complexity of the components by making the large loadings larger and the small loadings smaller within each component.

Reliability tests are used to provide an indication of the degree to which the measures used to evaluate the same thing are homogeneous and consistent. Item-to-total correlation and internal consistency method was adopted for this research. Item-to-total correlation confirms the reliability of each research factors. The internal consistency method estimates the degree to which items in a set are homogeneous by calculating a reliability coefficient called Cronbach's alpha (Pallant, 2002).

3.5. Analysis

This research uses analytic hierarchy process (AHP) to evaluate KM performance by quantifying importance of KM process and analysing weight scores of division's ability in socialization, externalization, combination, and internalization. The reason of using AHP is because as remarked by Chan and Lynn (1991), AHP provides a systematic approach for weighting performance criteria to provide a comprehensive performance measure. And also Islam and Rasad (2005) discussed that AHP can help managers to assess and compare the overall contribution provided by each division to achieve the company objective, by linking the competitive priorities to performance measure at every level of the organizational structure, and by addressing trade-offs among them. Furthermore, due to the goal of this research to find out division that represents the most desirable performance, AHP able measure and compare the overall performance of different divisions within the same company. So because AHP is a method of making decisions between alternatives, the comparison among divisions is able to be conducted.

In AHP, the problem analysis is be set in hierarchy that consists of goal, criteria and alternatives. Hierarchy indicates a relationship between elements of one level with those of the level immediately below. The hierarchy is shown in Figure 2. After the hierarchy has been constructed, analysis will be conducted using pairwise comparisons that derive numerical scales of measurement. Then priorities are established that represent the weights of each alternatives. The higher the weight refers to higher KM performance.
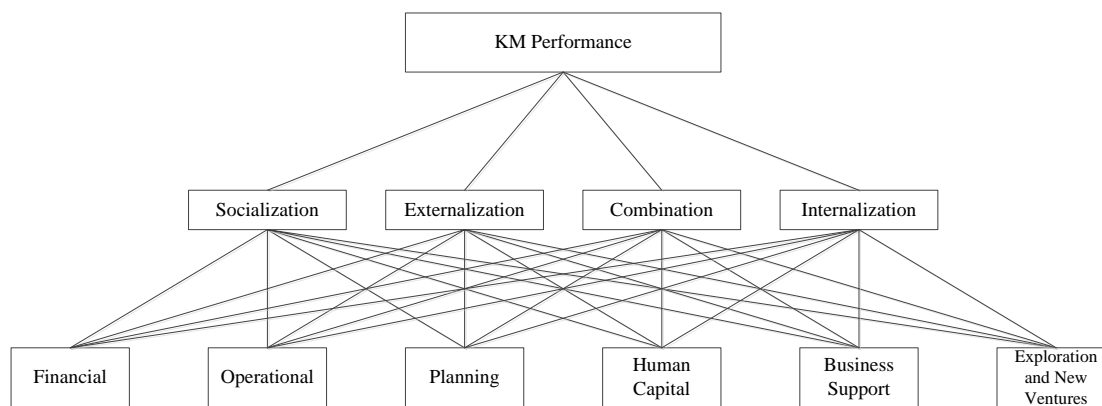

Fig. 2. Research Ranking Process Hierarchy

In the ranking step, there are four criteria of KM process that has a positive correlation to knowledge management performance (socialization, externalization, combination, and internalization). Then there are six alternatives choices or in this case the divisions. This group of options will be ranked based to find the division with the highest weight of knowledge management performance, which means the division with the best performance in compared with other divisions to find out the gap among divisions.

3.6. Performance Evaluation (Pairwise Comparisons)

A pair-wise comparison in expert judgment is the process of comparing the relative importance with respect to another element in the level above. Data collected from experts or decision-makers corresponding to the hierarchy structure. The pairwise comparisons of criteria generated were organized into a square matrix. After the matrix is set, the next process is Synthesization. Synthesization is a process of calculating the priority of each criterion in terms of its contribution to the overall goal of achieving KM performance. The steps of Synthesization are:

1. Calculate average in each column of pairwise comparison matrix

    The computations made by the AHP are always guided by the decision maker's experience, and the AHP can thus be considered as a tool that is able to translate the evaluations into a multi criteria ranking. In addition, the AHP is simple because there is

no need of building a complex expert system with the decision maker's knowledge embedded in it (Saaty T., 1980). The average was calculated based on numerical value that organized into a square matrix A that shown in Table 3. ajk represents the importance of matrix A of the jth creation relative to the kth criterion. If two criteria have the same importance, then the entry ajk is 1. If ajk is greater than 1, then the jth criterion is more important than the kth criterion, while if ajk is less than 1, then the jth criterion is less important than the kth criterion. Criteria that have difference importance can be described in Equation 1:

$$a_{jk} = \frac{1}{a_{kj}} \; ; \text{For j} \neq \text{k} \qquad (1)$$

2. Divide each element by its column total (gives normalized pairwise comparison matrix)
   The comparisons are processed mathematically, and priorities are derived for each node. After evaluation based on weight of each factor is built, sum normalization is needed since smaller weight value is more preferable than higher weight. The normalization derives by making the sum of the entries on each column is equal to one. The formula of normalized score shows in Equation 2 (Saaty T. , 1980):

$$\text{Normalized score} = \frac{A_{jk}}{\sum_{l=1}^{m} A_{lk}} \qquad (2)$$

3. Compute average of elements in each row (gives estimate of relative priorities of elements being compared)
   This step finds the largest weight of the maximum Eigen value, the principal Eigen value is obtained from the summation of products between each element of Eigen vector and the sum of columns of the reciprocal matrix. Under condition the total of weight is equal to one. The formula of Eigen value of n size of comparison matrix is in Equation 3 about weight of criteria:

$$w_j = \frac{\sum_{l=1}^{m} A_{jk}}{n} \qquad (3)$$

The maximum eigenvector is calculated according to the Equation 4:

$$\lambda_{\max} = \frac{1}{n} \sum_{i=j}^{n} \frac{(Aw)_j}{w_j} \qquad (4)$$

The calculation of eigenvector and eigenvalue gives good results when there is high consistency in the pairwise comparisons. The result obtained is an approximation, but the more precise the result then the more consistent the evaluations (Saaty T. , 1980).

3.7. Evaluation of The Comparison's Consistency

In this step, individual elements are evaluated and the consistency of the evaluation is checked. The evaluation works by comparing all pairs of elements at a given level from the point of view of each element located a level higher in the previously constructed hierarchical structure.

A slight inconsistency might be arises if the decision maker evaluates that one criterion is also slightly more important than the other criterion. Then evaluation of decision maker should be by gave a measure of consistency, called Consistency Index as deviation or degree of consistency using the equation 5:

$$CI = \frac{\lambda \max - n}{n-1} \qquad (5)$$

Random Consistency Index (RI) is used index by comparing it with the appropriate one. Random Index (RI) is the average consistency index of 100 randomly generated (inconsistent)

pairwise comparisons matrices. The values of RI for small problems where the size of comparison matrix is less than 10 are shown in Table 3.

Table 3 Value of Random Index (RI) for small problem

n	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

Source: Saaty T., 1980.

Consistency Ratio is a comparison between Consistency Index and Random Consistency Index which is used to find weather small values of inconsistency may be tolerated or not. The formula of Consistency Ratio (CR) shows in Equation 6:

$$CR = \frac{CI}{RI} \qquad (6)$$

If the value of Consistency Ratio is smaller or equal to 10%, the inconsistency is acceptable. If the Consistency Ratio is greater than 10%, we need to revise the subjective judgment.

The result of the comparisons is a set of matrices which, after normalization and examination of consistency, form the basis for the final evaluation of the system (Cabala, 2010).

3.8. Weight Calculation

The weights of criteria are aggregated in order to determine a compromise weight for group decision making that minimizes conflict among the different individual preferences. Barzilai and Lootsma (1997) use an aggregation procedure based on geometric means to calculate the global scores for a group of participants. Alfares found that if different individuals rank different subsets of the criteria, the recommended method is the aggregate weights that proposed by Barzilai and Lootsma, which converts individual ranks into individual weights, and then calculates aggregate weights as averages of individual weights. The equation, where m is number of individual, is in Equation 7:

$$W_j = \sqrt[m]{w_{1,j} \; x \; w_{2,j} x \ldots x \; w_{m,j}} \; ; \quad j = 1, \ldots, n$$

The results of the factor analysis have served as weight for division. The weight is decided from all variables that accepted based on factor analysis. The weight is calculated from the average of each value of the first questionnaire survey result that was distributed to employee in six divisions in PT. XYZ. Employee ability was decided to measure KM process because according to many authors including Nonaka (1998), generating new knowledge is a way of behavior or a mindset of every single person in the organization. Divisions weight was calculated by dividing total average score to average score. The calculation is using Ms. Excel as a tool. Next the overall weight pf each alternative with regards to the goal is calculated. This can be obtained by sum up the multiplication weight of criteria with weight of alternatives with respect of each criterion.

3.9. Gap Analysis

Gap analysis is conducted by comparing the difference between divisions to find out the potential criteria of divisions with less performance of KM in compared to divisions with highest weight of KM performance to be improved. The result of gap analysis was used to find area to be concerned. From the gap, company can determine what steps need to be taken in order to move from its current KM performance to future better performance. The analysis was performed by interpret the average of score each division with respect to KM process based on the measure of questionnaire result.

4. Results

4.1. Data Validation and Reliability

To verify the validation and reliability of this study, factor analysis, item to total correlation analysis, and coefficient alpha analysis were conducted. Factor analysis examined the basic structure of the data. Correlation analysis assessed the degree of psychometrics among variables. The internal consistency of each identified dimension is measured by Cronbach's alpha.

Table 4 KMO and Bartlett's Test Result

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.738
Bartlett's Test of Sphericity Significance	0.000

Form Table 4, the result of Kaiser-Meyer-Olkin (KMO) is 0.738 which means greater than 0.50 and Bartlett's Test is 0.00 which is less than 0.05. The result indicates the data were suitable for the implementation of factor analysis and the relationship among variables is strong.

The result of item to total correlation and Cronbach's alpha are shown in Table 6. Item to total correlation and coefficient alpha were assessed to identify the internal consistency and reliability of the construct. Cronbach's alpha for each factor used in this study is 0.60. And item to total correlation coefficients used is 0.30.

Table 5 Results of Validity and Analysis

No.	Dimension	Loading Factor	Item to Total Correlation	Cronbach's Alpha
1	Socialization 1	0.815	0.437	
2	Socialization 2	0.532	0.516	
3	Socialization 3	0.488	0.618	
4	Socialization 5	0.866	0.479	
5	Socialization 6	0.552	0.582	0.754
7	Externalization 3	0.764	0.496	
8	Externalization 5	0.488	0.461	
9	Externalization 6	0.647	0.355	
10	Combination 1	0.722	0.521	
11	Combination 2	0.473	0.514	
12	Combination 3	0.720	0.456	
13	Combination 4	0.633	0.578	0.756
14	Combination 5	0.546	0.351	
15	Combination 6	0.574	0.560	
16	Internalization 1	0.574	0.495	
17	Internalization 2	0.802	0.353	
18	Internalization 3	0.666	0.489	0.716
19	Internalization 4	0.579	0.573	
20	Internalization 5	0.731	0.495	

Table 5 shows the result of validity and reliability of questionnaire that the measures of each question are explained in Table 2. From the Table 6, the loading factor of each dimension is greater than 0.40 and item to total correlation is greater than 0.30 means that the questionnaire

is valid. The dimension that has value less than those values mentioned has been deleted. The dimension deleted was socialization 4, externalization 2 and externalization 4. It means those dimensions have a lower variation then more difficult to be used as a latent construct. And also if the item to total correlation was deleted means that item is not as good as the other ones. It is not as closely associated with the rest of the scale as the other items are. All the Cronbach's alpha is greater than 0.6 means internal consistency is acceptable. Thus, it is apparent that the measurement scale of this study is reliable.

4.2. Weight Calculation

The criteria weights are calculated by AHP. And the alternatives weights are decided from percentage of each average value of the first questionnaire result. From the comparison that evidently consistence from previous analysis, then the weight of criteria were averaged geometrically in order to obtain definite results of priorities of criteria. Table 6 shows the final weight of each creation. The final weight of criteria is aggregated using geometric mean to find out the weight based on the judgment of 4 experts, about importance comparison of each element in SECI model, into one absolute weight. Then the final weight of criteria is multiplied by the weight of each division in order to find the overall weight of each division with respect to KM process.

Table 6 Aggregating Weights from Criteria Ranks

Aggregated Weights	Member 1	Member 2	Member 3	Member 4	Geometric Mean	Normalized Geometric Mean	Rank
Socialization	0.074	0.501	0.526	0.526	31.78%	37.68%	1
Externalization	0.171	0.077	0.141	0.141	12.71%	15.08%	4
Combination	0.284	0.263	0.085	0.249	19.91%	23.61%	3
Internalization	0.471	0.159	0.249	0.085	19.93%	23.63%	2
	Sum				84.33%	100.00%	

For evaluation of each division was conducted based on scores from the result of 1st survey. The result of the KM process activity of 44 respondents throughout the 6 divisions that measured based on scale was resulting the average score that then normalized in order to gain the weight is equal to 1. The overall composite weight of each alternative choice based on the weight of level 1 and level 2 in the hierarchy, which can be seen in Table 7. The overall weight is the multiplication between weight of alternatives and priority vector of criteria.

Table 7 Overall Weights

Overall Weight		Rank
Financial	14.69%	6
Operational	17.26%	3
Planning	17.55%	1
Human Capital	16.79%	4
Business Support	17.45%	2
Exploration & New Ventures	16.26%	5

4.3. Gap Analysis

From the gap analysis, can be concluded that human capital, exploration and new ventures, and financial division are the area should be focused to increase the KM performance. The weight in range of 3 - 3.9 means fair KM process ability and range of 4 - 4.9 means good KM process ability. Human capital division is good in socialization, externalization, and internalization process, especially in socialization with weight of KM process ability of 4.38. But they are not optimal combination process, it can be seen by their weight is only 3.93. If they

want to have a good process, they have to have at least score of 4.00. Exploration and new ventures division is good in socialization, externalization and internalization process because they have a weight higher than 4.00. To increase their KM performance, they have to improve combination process from score of 3.94 to at least 4.00. The main concern in KM process that influences its performance is in financial division, because their overall KM process ability weight is below 4.00. That is 3.67 for socialization, 3.63 for externalization, 3.61 for combination, and 3.57 for internalization. Therefore financial division needs more attention in order to improve KM performance.

5. Conclusion

In today's competitive business environment, knowledge is important to provide the foundation for organizational sustainable competitive advantages. Therefore, implementation of knowledge management is essential for oil and gas industry in order to prevent a knowledge gap in the industry. However the company is still struggle with their KM implementations. It can be viewed from the problem of imbalance of employee knowledge quality of and user satisfaction (KM performance drivers) and inefficient of KM implementation. Based on that reason, this research was evaluating KM implementation in PT. XYZ using Analytic Hierarchy Process (AHP) comparison method as the evaluation.

This research adopts SECI model as criteria or factor that correlated to knowledge management performance to evaluate divisions in the company. Because many researchers have been proved that SECI model can encourage the creation of organizational knowledge, which in turn leads to greater performance.

The result of the analysis is the priorities of KM process elements that affect KM performance from highest to lowest order are socialization (37.68%), internalization (23.63%), combination (23.61%), and externalization (15.08%). Furthermore, the division with the highest weight of KM performance is planning (17.55%), business support (17.45%), operational (17.26%), human capital (16.79%), exploration and new ventures (16.26%), and financial (14.69%).

In order to identify the area for improvement by means of determine the differences between division with the highest KM performance and the other divisions, gap analysis is conducted. The gap analysis explains the current situation of KM process in each division and used the planning KM process as a comparison with other division. The results of gap analysis are financial division should be the main concern because they are performed the least KM process and also combination process in exploration & new ventures division and human capital division is need to be the focus as improvement of KM process.

Human capital division needs to improve the combination process by organizing and integrating knowledge, sorting and categorizing knowledge, embodying explicit knowledge through reflection, and recognize patterns. Exploration & new ventures division group sharing experience, sharing knowledge, gathering explicit knowledge, systemizing knowledge and information, breaking down the concept and finding relationship among concepts, and embodying explicit knowledge through reflection. For financial division, they have to improve the overall of SECI process.

6. Future Research

Some recommendations proposed for future research of this study are:
1. Develop a method that can be proposed for improving KM performance through knowledge creation process
2. A study of KM mature level in company that describes some steps of growth that can be expected to reach its knowledge management development
3. The exploration of other factors that may influence KM performance

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