

# **Synthesis of Criteria for Knowledge Management Strategy in an Aircraft Maintenance Company to Increase the Employee Capability**

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## **Abstract**

In this research we want to searching the factor in the knowledge management strategy that is suitable and can be used in MRO industry. This research is focusing on searching the most important factor in knowledge management that can increase employee capability. Often, we find out in organization that they did not have a good knowledge management system, the effect of that is there's a huge possibility of losing knowledge when the employee gone. The research will try to answer question "what a criterion for a knowledge management system to be considered good for increasing employee capability". Our research method will be using literature study about knowledge management criteria, and using structural model to knew which part of knowledge management that can increase employee capability. The result of this research that, we can identify a good criterion for knowledge management for a company that works in MRO industry, that can also increase their employee capability.

## **Keywords**

Knowledge Management, Knowledge Enabler, Knowledge Criteria, Knowledge Creation, Knowledge System

## **1. Introduction**

Airplane industry is one of the industry that hit hard during the covid pandemic. Since the airplane industry is affected cause of covid, it also makes the other industry related to airplane got the same effect. One of it is MRO (Maintenance, Repair, and Overhaul) industry for airplane. When Covid-19 hit the world, all the company that moves in MRO industry had to limit their operational. They had to limit their operational because the airplane industry as their main customer is also halting their operation. Because of that many airplane company replanned their maintenance schedule or shut-down completely leave the MRO industry had a decrease in customer. Due to the airplane industry that hit hard during pandemic, the MRO industry need to adapt to their new economic condition. One of the adaptation they had to do is to adapt to the human resource they have. During pandemic the company need to do some things to make the company operates optimal, some of it are; contract restructurization with vendor, partner, creditour or even customer, readjusment of price that already been agreed on, and other things. The effect of the adaptation were there are 134 employee affected with the company policy to reorganize from the company during 2020 – 2021. The condition around airplane industry also force the employee to resign, or go to another company, due to that the company lose their precious employee, and the precious knowledge they had in their self.

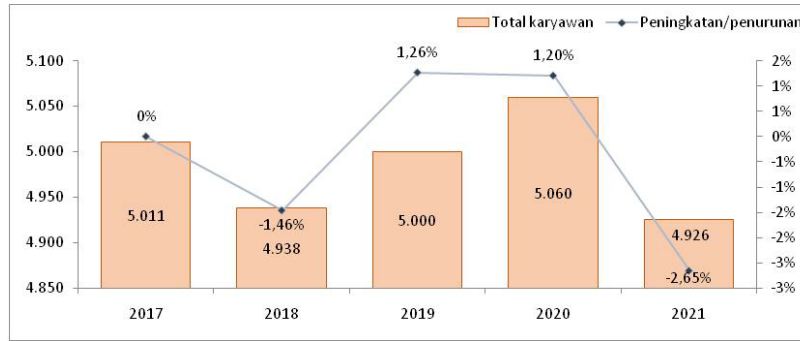


Figure 1. Employee growth from 2017 - 2021

A good company need to have a good knowledge management system, a good management system will help the company to retain all the knowledge their employee had. According to the Jeffrey (2020) where they research found that they still found a lot of construction company in Malaysia still use manual methods in their knowledge management implementation (books, notes, etc), another research done by Kokkaew (2021) states that it needed a strong role from Human Resource if the company want to implement a good knowledge management system, also the use of IoT in operational of the company is one of the strong factor, where IoT can helps the company to gather data needed and use to decrease the value loss during company operational (Wang 2021).

One way the company can do in order to increase employee capability is by facilitated the employee with a training program that can increase employee capability, or even help the employee to achieve some sort of degree or certification for their life. As an MRO industry that moves in a very high standard and detail-oriented, preventing the loss of knowledge in the organization becoming important.

## 1.1 Objectives

This research objective is to analyze what are the criteria needed to implement a knowledge management in order to increase the employee capability, and create a strategy based on that criteria.

## 2. Literature Review

### 2.1 Knowledge Management

Knowledge or in this area means that a group of information that already been processed, where the processed information is come from group of data that gather from company/place/organization. Generally, there's two type of knowledge: Tacit knowledge that means a knowledge that stored in someone mind, and explicit knowledge that means type of knowledge in forms of document or other forms, outside from person mind/thought.

The management of knowledge is one of the important factor to increase the efficiency and effectivity of a company. Designing the right knowledge management can help company to organized, storing, and sharing the information that had by the company so it could increase employee productivity dan the performance of the employee itself. Management knowledge itself is defined as a process to capture, distribute, and using the knowledge as effective as it can be (Davenport 2004).

### 2.2 Knowledge Management Aspect

There are two main aspect in knowledge management (information management, and people management). Information management is associated as how to handling the information (in this case knowledge) that connect with object that usually been used. In the practice of it knowledge management it include the identification and mapping all the intellectual asset in company. This included things like identification of the capable personel that knew important things in the company. If it been seen by this step, knowledge management can be seen as process to do audit of intellectual asset that focusing on the unique resource dan crucial function.

Second aspect of knowledge management is people management. It included is to do the management of tacit knowledge that inside of people head. In practice, it include to adjust existing knowledge inside of the organization process that include set of complex skill and unique ability in someone.

### 2.3 Knowledge management infrastructure

In a good knowledge management system there's are 3 main principal that needed; First is the technological infrastructure to organize content; second, technological infrastructure for searching information after being organized; the third is technological infrastructure to find someone with unique skill. Here are the table that explain the tecnology on knowledge management

Table 1. Knowledge Management Infrastructure

Type	Knowledge management infrastructure
Repository model	<ul style="list-style-type: none"> <li>• Internet, HTML, XML</li> <li>• Search engine full-text</li> <li>• Document management system</li> </ul>
Comunity for training	<ul style="list-style-type: none"> <li>• Web conference</li> <li>• Discussion group</li> <li>• Automatic work-sheet</li> <li>• Expert directory</li> </ul>
Continous learning	<ul style="list-style-type: none"> <li>• Learning management systems</li> <li>• Electronic Performance Support System (EPSS)</li> <li>• Performance management</li> </ul>
Business intelgence	<ul style="list-style-type: none"> <li>• Database</li> <li>• Tools for data mining</li> <li>• Enterpirse database</li> <li>• Decision support tools</li> </ul>

### 2.4 Knowledge Sharing

Usually when the knowledge sharing activity, there are added value from the knowledge that been shared on. The knowledge was collected by shared through the organization by the employee, and knowledge sharing happen between employee in organization (internal) or outside of the organization (external).

- Community training  
Training is one of the method of sharing knowledge that good to use for sharing knowledge between individual. As a result of interaction between individual that happen during training, that enriched their self with new knowledge and experience that they got from training.

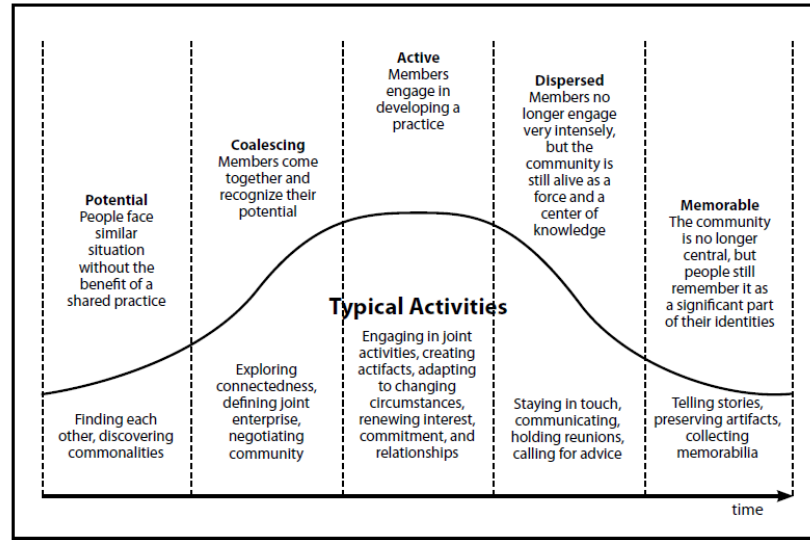


Figure 2. Development Step during Training

- Incentif scheme  
For increasing the rate of knowledge sharing. Some incentiv scheme is needed to help motivate the worker. In some cases, worker maybe feel afraid to sharing knowledge, where some other might be feel not motivated enough to do some knowledge sharing. Many person do also think that knowledge sharing process is hard, and need time and effort to do so. So by using incentiv scheme, it can be increasing worker motivation to sharing knowledge

## 2.5 Knowledge Management Tools

The application of specific tools can help the application of a good knowledge management system, that will help the company operational. Like a good access to internal knowledge of the company, will resulting in faster organizational process. The usage of knowledge mapping to show employee competency will help supervisor to put a personel with the competency equal to their ability. For a knowledge management can operate well and get a maximum benefit, it needed two element; First, technology infrastructure, second is application in the form of software that can be installed in the organization environment. Some of it are :

- Document management system  
Document is one of the form of informaton storing and the most general form in organization. Document management has two main function: first, to provide content, second is to facilitate the management of content and access, depend on the scale of the organization. Document management has 4 basic element: First, to record discussion, email, and document; Second, to organize electronic document in hierarchy; Third, provide the search engine to take the prepered document; Fourth, to provide security for the content itself.
- Knowledge portal  
Portal can be defined as a main point of access to knowledge. Portal is one of a tool that important in knowledge management because having a portal will make the information sharing process is easier. Through the portal the user can contribute to the information sharing in the company. Portal can be an access point for the employee to search the information they needed, as for addition portal is also becoming a tool for worker to updating their knowledge. The main benefit of having a knowledge portal is that some section, can be free from administrative task that they handle.
- Knowledge mapping and skill management  
A skill management system is a tool to help distribute skill and knowledge in an organization. All of the worker can update their skill (increase or change their skill level), and using that tool to help find people with special skill. Tool like this can help the HR division to identify person with unique and special skill in an organization. Knowledge mapping will help HR to navigate through all the document in the company. Knowledge mapping is standard tool that has a function to organize employee hierarchy that has an access to company portal ad access all of the document according to the skill that they had.

- Collaboration tool  
Other than document management, collaboration is one of the important aspect in knowledge management. Collaboration is like a group of employee where they all working together. An environment that good, will be the trigger for the employee to sharing information to help solving problem. Software or special tool need to help the employee to gather around and discuss as the collaboration functionality. The use of application can help gathering employee to discussion (Ex : Zoom, Skype, Teams, etc) will help the company to fastering the spread of information in the organization.

### **3. Methods**

This research contain 3 main method in use, the first is literature review to determine the criteria needed to applied knowledge management system in MRO industry, the second is to search the hierarchy of the criteria using ISM (Interpretative Structural Model) analysis, and last to search the correlation between criteria using MICMAC method.

#### **3.1 Literature Review**

The literature review step is divided by three main step :

- Step 1  
The existing literature about knowledge management is being reviewed, especially the one that focusing on knowledge management and the application. All of the supporting factor that can help or support the application of knowledge management being studied from all of the existing publication. The keyword for searching the literature are “Knowledge management”, “Capability”, and “industry”.
- Step 2  
From all the paper that we had, we choose several paper to studied more extensively, to determine what are the factors that determine the application of knowledge management that can increase the employee capability. After we got the determining factor, we continue to review it with an expert in the industry to determine what factor that can be applied to the MRO industry.
- Step 3  
After all of the existing factor is identified and eliminated we then use the ISM analysis method, and MICMAC analysis to determine the hierarchy of the criteria and to searching the correlation between each criteria.

#### **3.2 Interpretative Structural Model (ISM) Method**

ISM Method is an interpretive method because there are connection that happening between each element in the problem that being research on. ISM method is also considered structural because in this method they depicting complex problem from a system using pattern that already being designed using graphic. Using ISM technique, a model that not clear enough, can be change to be more visible.

Step to create ISM method are :

1. Identification of the element  
Element that will be used in the designing of knowledge management system, is being identified and listed.
2. Create Strucutural Self Interaction Matrix (SSIM)  
SSIM is a matrix that containt the connection between element. The connection between element is listed with the code V, A, X, O
  - a. V : There is a connection between element  $E_i$  to  $E_j$ , not vice versa
  - b. A : There is a connection between element  $E_j$  to  $E_i$ , not vice versa
  - c. X : There is an inter-relaton between  $E_i$  and  $E_j$ , vice versa
  - d. O : There is no connection between  $E_i$  and  $E_j$
3. Create Reachability Matrix (RM)  
This matrix is used to change the code obtain in SSIM step to become binary number. The reachability matrix is done with the purpose to get which factor became driving power and which one become dependance power. Code obtain then convert to this number :
  - a. If the connection in SSIM,  $E_i$  to  $E_j = V$ , then the score of element  $E_{ij} = 1$  and  $E_{ji} = 0$
  - b. If the connection in SSIM,  $E_i$  to  $E_j = A$ , then the score of element  $E_{ij} = 0$  and  $E_{ji} = 1$
  - c. If the connection in SSIM,  $E_i$  to  $E_j = X$ , then the score of element  $E_{ij} = 1$  and  $E_{ji} = 1$
  - d. If the connection in SSIM,  $E_i$  to  $E_j = O$ , then the score of element  $E_{ij} = 0$  and  $E_{ji} = 0$

4. Do transitive analysis  
Transitive analysis is done with the purpose to do correction in SSIM and calculate the number using transitivity. Reachability matrix that already fulfill the transitive analysis can be continued in partition level step
5. Divided existing element to the level  
The element need to be divided into level with the purpose to creating the diagraph. This process could be done with seeing the reachability set and antecedent set The reachability set is a set that come from all of the score that get by the element  $E_i$ , Antecedent set is all of the element score from element  $E_j$ . Intersection set will be got by seeing the connection between reachability and antecedent set
6. Create canonical matrix  
This matrix is created by organized all the existing variabel with their current level that already been created on the step before, in the form on final reachability matrix
7. Create directional graph  
Diagraph is a structural model used to give ilustation of all of the element that connected one to each other in the hierarchy level. Diagraph is created based on the canonical matrix, all the components in transitive diagram will be moved to created the final diagraph.

### **3.3 MICMAC Analysis**

MICMAC method or Cross-Impact Matrix Multiplication Applied to Qualification, is one of the analysis method that being used for analyze the driver power, and dependance power from the researched variabels. So the result of MICMAC analysis that we can do identification from all of the variabels which variabels is has a driven power, and which variabels has dependance power. In MICMAC analysis, all of the variabels will be classified in to 4 sector, which is :

- Sector 1 - Autonomous factor (Weak driven power, weak dependant power)  
All the element in sector 1, is an element that had weak driving power and weak dependance power. The element in sector 1 did not had connection with the system, so element in this sector could be throw out.
- Sector 2 - Dependant factor (Weak driven power, strong dependant power)  
Elements in sector 2 is an element that considered to had a weak driving power but had a strong dependance power. The element in sector 2 is considered as an element that did not free.
- Sector 3 – Linkage factor (Strong driven power, strong dependant power)  
Elements in sector 3 is an element that considered to had a strong driving power and also strong dependance power. Elements in this sector need to be analyzed further, because the connection between each element is unstable.
- Sector 4 – Independent factor (Strong driven power, weak dependant power)  
Elements in sector 4 is an elements that considered to has a strong driving power but weak dependance power, elements in this sector is the key element in order to create or building a model.

## **4. Data Collection**

The data collection phase is divided into 3 main step :

- First step – Searching the knowledge management criteria through literature review  
This step purpose is to find what criteria that affecting the application of knowledge management in order to increasing employee capability through literature review. The literature is search on SCOPUS with the keyword “Knowledge management, Capability, Industry, Enabler, MRO, Application, and Criteria”. All the paper that been found in our search in SCOPUS, we then continue to eliminate the paper we find so that only a paper that had the similar topic can be used for literature. There are three level of paper elimination that being used in this paper :
  - a. Elimination through paper tittle  
In this step, we only use the paper that the tittle is simillar of the topic that we researched on.
  - b. Elimination through paper abstract  
All the paper that passed the first level, then we will be reviewed the paper abstract so that only the paper that has an abstract simillar for what we research on that can be passed to the final stage of paper elimination.
  - c. Elimination through the content of the paper

All the paper that passed the abstract elimination then will be reviewed by the paper content, the paper that research the similar topic that we take will be considered can be used for literature review, the remaining paper will not be used in further research

- Second step – Choosing applicable criteria using the paper content.  
After all of the elimination paper step already done, we than proceed to continue to the second step, which is the choosing of applicable criteria for creating a knowledge management system for increasing employee capability through literature review by viewing the paper content. As a result of this step, we found 27 criteria that we think can be applied in MRO industry

Table 2. Criteria got from literature review

No	Criteria	No	Criteria
1	Infrastructure for knowledge management	16	Worker education level
2	IT for knowledge management system	17	Informal learning (training, certification, etc)
3	Company culture	18	Ways of knowledge capturing
4	User emotional	19	Ways of updating knowledge
5	Competent worker	20	Ways of sharing knowledge
6	Sharing knowledge culture	21	Company policy
7	Leadership and support	22	Top management instruction
8	Software for knowledge sharing	23	Worker motivation
9	Compensation for worker	24	Information filtering process
10	Ability to sharing knowledge	25	Commitment from top management
11	Helping partner	26	Knowledge management visualization
12	Help from external	27	Ways of searching information
13	Space for discussion		
14	Reward for contribution		
15	Knowledge storage		

- Third step – Choosing applicable criteria through expert opinion  
After we got 27 criteria, we then go to eliminate the unnecessary criteria using expert opinion, the criteria of expert for the discussion is someone that already had 5 years or more experience as an HR practition in MRO company. The discussion is started using this question “Which criteria that can be used in MRO industry for creating knowledge management system for increasing employee capability?” The result was there are 17 criteria that seems fit to use in MRO industry for creating knowledge management system to increasing employee capability.

Table 3. Criteria after eliminated by expert

No	Criteria	No	Criteria
1	Infrastructure for knowledge management	10	Ways of updating knowledge
2	IT for knowledge management system	11	Ways of sharing knowledge
3	Company culture	12	Company policy
4	Sharing knowledge culture	13	Top management instruction
5	Leadership and support	14	Worker motivation
6	Compensation for worker	15	Commitment from top management
7	Space for discussion	16	Knowledge management visualization
8	Knowledge storing	17	Ways of searching information
9	Informal learning (training, certification, etc)		

## 5. Results and Discussion

### 5.1 ISM Analysis Result

Using the criteria we got from discussion with expert, we then continue to make an ISM diagraph, first by creating the Self Structural-Interaction Matrix (SSIM) using discussion by expert.

Table 4. Structural Self-Interaction Matrix (SSIM)

Structural Self-Interaction Matrix (SSIM)																		
Enabler (Yi)	Enablers	Enabler (Xj)																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Knowledge management infrastructure		V	O	O	O	O	V	X	V	V	V	A	V	V	V	X	V
2	IT Technology for knowledge management			X	X	O	O	V	V	V	V	V	A	A	V	A	V	V
3	Company culture				X	X	A	X	O	X	O	X	X	X	X	X	X	O
4	Sharing culture					X	A	X	O	X	O	X	X	X	X	X	X	O
5	Leadership and support							O	V	O	V	V	A	A	V	A	V	O
6	Compensation / reward for contributor								O	O	O	O	A	A	V	A	O	O
7	Space for discussion									O	X	X	A	A	X	A	A	V
8	Knowledge storing										A	X	X	A	A	V	A	V
9	Informal learning											V	V	A	A	X	A	V
10	Ways of updating knowledge												X	A	A	X	A	X
11	Ways of sharing knowledge													A	A	V	A	X
12	Company policy														X	V	X	V
13	Top management instruction															V	X	V
14	Worker motivation																A	A
15	Top management commitment																	V
16	Ways of searching information																	
17	Knowledge management visualization																	A

After we got the SSIM, we then create a scoring base by the connection we got :

Table 5. Final Reachability Matrix (FRM)

Final Reachability Matrix (FRM)																		Driving power
Enabler	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1	1	1	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	12
2	0	1	1	1	0	0	1	1	1	1	1	0	0	1	0	1	1	11
3	0	1	1	1	1	0	1	0	1	0	1	1	1	1	1	1	0	12
4	0	1	1	1	1	0	1	0	1	0	1	1	1	1	1	1	0	12
5	0	0	1	1	1	0	1	0	1	1	1	0	0	1	0	1	0	9
6	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	4
7	0	0	1	1	0	0	1	0	1	1	0	0	0	1	0	0	1	7
8	1	0	0	0	0	0	0	1	0	1	1	0	0	1	0	1	1	7
9	0	0	1	1	0	0	1	1	1	1	1	0	0	1	0	1	0	9
10	0	0	0	0	0	0	1	1	0	1	1	0	0	1	0	1	0	6
11	0	0	1	1	0	0	1	1	0	1	1	0	0	1	0	1	0	8
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17
13	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
14	0	0	1	1	1	0	1	0	1	1	0	0	0	1	0	0	0	7
15	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
16	1	0	1	1	1	0	1	0	0	1	1	0	0	1	0	1	0	9
17	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	3
Dependance	4	7	13	13	8	4	14	9	11	13	13	5	6	17	6	14	8	

Using Final Reachability Matrix, we then got the score for the driving power of each enabler, and dependance power of each enabler. After we got the driving power and dependance power of each enabler, we then continue to make the level partition of each enabler



Table 6. Level Partition

Level Partition							
Enablers	Reachability set	Antecedent set	Intersection	Intersect	Driving power	Dependance	Level
6	3,4,6,14	6,12,13,15	6	1	4	4	1
17	14,16,17	1,2,7,8,12,13,15,17	17	1	3	8	1
1	1,2,7,8,9,10,11,13,14,15,16,17	1,8,12,16	1,8,16	3	12	4	2
2	2,3,4,7,8,9,10,11,14,16,17	1,2,3,4,12,13,15	2,3,4	3	11	7	2
8	1,8,10,11,14,16,17	1,2,8,9,10,11,12,13,15	1,8,10,11	4	7	9	3
5	3,4,5,7,9,10,11,14,16	3,4,5,12,13,14,15,16	3,4,5,14,16	5	9	8	4
9	3,4,7,8,9,10,11,14,16	1,2,3,4,5,7,9,12,13,14,15	3,4,7,9,14	5	9	11	4
11	3,4,7,8,10,14,16	1,2,3,4,5,8,9,10,11,12,13,15,16	3,4,8,10,16	5	8	13	4
12	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	3,4,12,13,15	3,4,12,13,15	5	17	5	5
13	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	1,3,4,12,13,15	3,4,12,13,15	5	16	6	5
15	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	1,3,4,12,13,15	3,4,12,13,15	5	16	6	5
7	3,4,7,9,10,14,17	1,2,3,4,5,7,9,10,11,12,13,14,15,16	3,4,7,9,10,14	6	7	14	6
10	7,8,10,11,14,16	1,2,5,7,8,9,10,11,12,13,14,15,16	7,8,10,11,14,16	6	6	13	6
14	3,4,5,7,9,10,14	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17	3,4,5,7,9,10,14	7	7	17	7
16	1,3,4,5,7,10,11,14,16	1,2,3,4,5,8,9,10,11,12,13,15,16,17	1,3,4,5,10,11,16	7	9	14	7
3	2,3,4,5,7,9,11,12,13,14,15,16	2,3,4,5,6,7,9,11,12,13,14,15,16	2,3,4,5,7,9,11,12,13,14,15,16	12	12	13	8
4	2,3,4,5,7,9,11,12,13,14,15,16	2,3,4,5,6,7,9,11,12,13,14,15,16	2,3,4,5,7,9,11,12,13,14,15,16	12	12	13	8

Using the level partition result, we can now create the ISM structure :

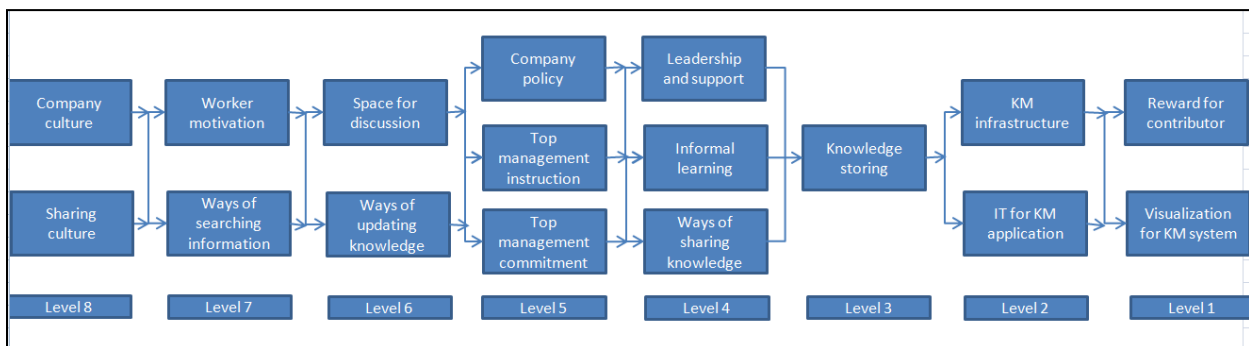


Figure 3. ISM Structure of Knowledge Management System

From the ISM structure above we can see that the most important factor for creating knowledge management in MRO industry to increase employee capability is company culture and sharing culture due to the fact that factor is placed on highest level (level 8) in ISM structure, meanwhile reward for contributor, and knowledge management system visualization is considered as not an important factor due to the fact that the factor is on lowest level in ISM structure (Level 1). This means, any change on the factor on level 1, will not affected the system too much, meanwhile any change on the factor on level 8, will affected the system being created.

## 5.2 MICMAC Analysis

Using result we got in ISM analysis, we can make the graphic for MICMAC analysis.

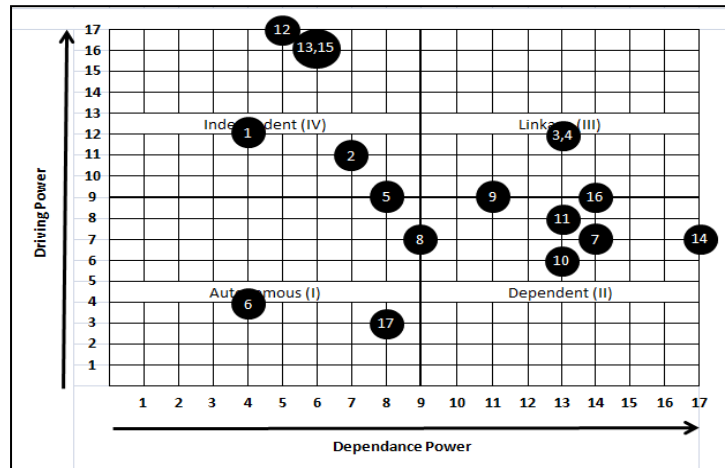


Figure 4. MICMAC Analysis of Knowledge Management System

Based on the MICMAC analysis, we then can group all of this enabler into quadrant as follows :

- Sector I – Autonomous Factor (Weak driving power, weak dependant power)  
Leadership and support (5), reward from contribution (6), knowledge storing (8), knowledge management system visualization (17).
- Sector II – Dependant Factor (Weak driving power, strong dependant power)  
Ways of storing knowledge (7), informal learning (9), ways of updating knowledge (10), ways of sharing knowledge (11), worker motivation (14), ways of searching information (16).
- Sector III – Linkage Factor (Strong driving power, strong dependant power)  
Company culture (3), sharing culture (4).
- Sector IV – Independent Factor (Strong driving power, weak dependant power)  
Knowledge management infrastructure (1), IT for knowledge management (2), company policy (12), top management instruction (13), top management commitment (15).

## 5.3 Proposed Improvements

Using result we got from ISM and MICMAC analysis we than proposed the improvement for designing knowledge management in MRO industry to increasing employee capability as follows :

1. The company need to support or increase their infrastructure for applying knowledge management system in the organization
2. The company need to increase the usage of IT technology in the application of their knowledge management system
3. The company need to promote or create a policy that based on their knowledge management system, and show commitment to run the policy they create
4. The top management need to create an instruction to be followed by the whole company about the application of knowledge management
5. The top management need to show commitment that they also will support and do the policy they create about the knowledge management system
6. The company needed to create a whole knowledge culture around daily operational as a whole system

## 6. Conclusion

Based on our research we can conclude that it took a whole layer of people in organization/company to might be created a good knowledge management system in MRO company with the purpose of increasing employee capability. From this research we learn that the most important thing when creating a knowledge management system is to had a company culture that support the implemmentation of knowledge management system and to have

a sharing culture already implied. For the knowledge management system to work, the company need to build the company culture around it, and make the sharing culture between employee growth stronger.

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