

# Characteristic and Competency Measurement Instrument Development for Maintenance Staff of Mechanical Expertise with SECI Method: A Case of Manufacturing Company

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**Abstract.** Human resource is an important factor for a company to gain competitiveness, therefore competencies of each individual in a company is a basic characteristic that is taken into account. The increasing employee's competency will affect directly to the company's performance. The purpose of this research is to improve the quality of human resources of maintenance staff in manufacturing company by designing competency measurement instrument that aims to assess the competency of employees. The focus of this research is the mechanical expertise of maintenance staff. SECI method is used in this research for managing knowledge that is held by senior employees regarding employee competence of mechanical expertise. The SECI method converts the knowledge of a person's tacit knowledge into an explicit knowledge so that the knowledge can be used by others. The knowledge that is gathered from SECI method is converted into a list of competence and break down into the detailed competency. Based on the results of this research, it is known that 11 general competencies, 17 distinctive competencies, 20 indicators, and 20 item list for assessing the competencies are developed. From the result of competency breakdown, the five-level instrument of measurement is designed which can assist in assessing employee's competency for mechanical expertise.

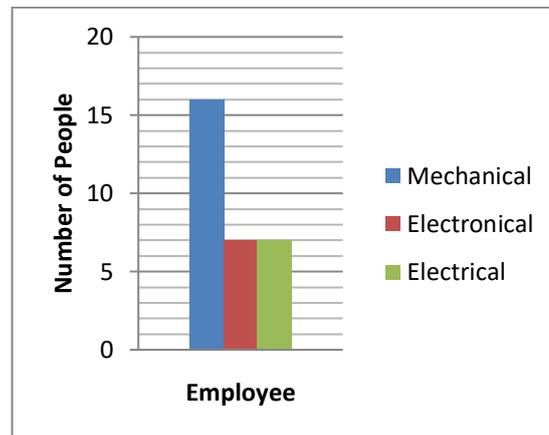
## 1. Introduction

The most important factors in the existence of the company are the competencies within the human resource. The role of human resource in the company is considered as important in order to gain competitive advantage. Thomas [1] stated that with better competencies, an organization can be more effective, efficient, competitive, and easy to achieve high performance. Besides of competencies, knowledge in an organization is considered as important. An organization can obtain great profit if investing in knowledge asset, this can be done because knowledge is one of the un-depreciated assets, on the contrary knowledge, can be increased as long the knowledge is being used by another [2]. According to Nonaka and Takeuchi [3], knowledge can be divided into explicit and tacit knowledge. Explicit knowledge is the knowledge that can be codified and transmitted into the formal and systematic language. Tacit knowledge is the knowledge that consists of a mental model, belief and hard to articulated. In an organization, the tacit knowledge must be converted into explicit knowledge in case the individual in an organization is leaving the organization. Knowledge lies within people, there is a potential problem when the employee in the organization is retired because the form of knowledge in



people usually considered as tacit knowledge. Tacit knowledge can't be transferred completely into formal language, so it is hard to save the tacit knowledge electronically [4].

X company is a manufacturing company that focused on manufacturing part of automotive and aircraft. In order to maintain the productivity in optimum level, there is maintenance department which focused on maintain the machine in the company. Figure 1 shows the number of an employee from maintenance department in company X.



**Figure 1.** Number of Employee in Maintenance Department Company X,

From Figure 1, it is known that the mechanical expertise employee is the largest in the maintenance department. It is important to have good competencies and skill from the maintenance department employee because it is needed a specific set of skill to maintain a machine. According to the head of the maintenance department, it is known that there is enough employee to do the maintenance job, but there is no standardization about how to assess the employee according to the current skill and competencies. The assessment of maintenance operator usually just intuition from the operator supervisor. The standardized assessment and assignment process is considered important because in 5 years from now a lot of maintenance operator retired. It is known that 37% of maintenance department employee will be retired. The needs of measurement for assessing employee competencies is high. The purpose of this research is to improve the quality of human resources of maintenance staff in manufacturing company by designing competency measurement instrument that aims to assess the competency of employees. SECI method developed by Nonaka and Takeuchi [3] is used in this research for managing knowledge that is held by senior employees regarding employee competence of mechanical expertise. SECI model is widely used for extracting knowledge, the research from Nurunisa, Kurnaiwati, Soesanto, and Hedyanto [5] focused on using SECI model for extracting knowledge for machine maintenance process, the research from Atma, Soesanto, Kurniawati, and Hedyanto [6] focused on utilizing the SECI model for corrective maintenance process. Another research that used SECI model is the research from Rehman [7] which focused on using SECI model for human resources.

## 2. Theoretical Background

### 2.1. Knowledge

Knowledge is a main essential for any companies because, in the knowledge-based era, the knowledge itself became the source of competitive advantage [8]. Knowledge is built on individual belief about cause and effect relationship [9]. Knowledge is defined as a fluid mix of experiences, values, information and expert insight that provides some kind of scheme that can evaluate new experience and information [10].

## 2.2. SECI Model

Nonaka and Takeuchi [3] describe the four phase of converting knowledge which is socialization, externalization, combination, and internalization. Socialization is defined as sharing process and creation of tacit knowledge through interaction and direct observation. Externalization is defined as an articulation of tacit knowledge into explicit knowledge through dialogue and reflexion. The combination is defined as conversion process of explicit knowledge into new explicit knowledge through systemization and information. Internalization is defined as a learning process and knowledge acquisition by organization member towards explicit knowledge that spread into the organization through self-experience so it can be tacit knowledge of organization member. Figure 2 shows the SECI method by Nonaka and Takeuchi [3].



**Figure 2.** SECI Method

According to Rehman [7], SECI model can be used for Human Resource (HR) Practice. The difference between general SECI model and the HR based SECI model is in the content of each phase. In socialization phase by applying several HR practices, the sharing knowledge process can be extracted. In externalization phase, The codification is in the form of documents, manuals, procedures, methods, etc., but in HR practices the focused is on the work design. During the internalization phase, the main focus is the internalization of the knowledge gain from the HR practices.

## 3. Research Methodologies

The purpose of this research is to improve the quality of human resources of maintenance staff in manufacturing company by designing competency measurement instrument that aims to assess the competency of employees. The focus of this research is the mechanical expertise of maintenance staff. SECI method is used in this research for managing knowledge that is held by senior employees regarding employee competence of mechanical expertise. The SECI method converts the knowledge of a person's tacit knowledge into an explicit knowledge so that the knowledge can be used by others. The knowledge that is gathered from SECI method is converted into a list of competence and break down into the detailed competency. In socialization phase, tacit knowledge is transformed into another tacit knowledge, in this case, tacit knowledge will be converted into knowledge about the detailed breakdown of general competencies for mechanical expertise. Figure 3 shows the breakdown process for mechanical expertise.



**Figure 3.** Breakdown Process for Mechanical Expertise Characteristic

From Figure 3, it is known that general competencies are the basic competencies that all operator should have in order to maintain the machine. Specific competencies are the detailed competencies from general competencies. Indicators are the detailed breakdown for specific competencies that are used as the basis for assessment. How to measure explained how to measure each indicator. After the process is

break down the next step is to interview the respondent to gain knowledge about the measurement. The data is gathered by interviewing the senior employee. The senior employee will give their tacit knowledge regarding general characteristic of mechanical expertise. During externalization phase, the previous knowledge about the competencies and the interview result is documented. Previous tacit knowledge then converted into explicit knowledge in form of review result. In combination phase, explicit knowledge is converted into new explicit knowledge through a combination of knowledge. From the interview of three respondent, the information will merge into one complete information. All breakdown competencies from the socialization result are merged into one best competencies measurement.

#### 1. Specific Competencies Merge.

The merge of specific competencies is done based on the knowledge of the respondent. Specific competencies are the detailed breakdown of the general competencies.

#### 2. Indicators Merge.

The merge of indicators is done based on the knowledge of the respondent. Indicators are used as a basis to measure the competencies.

During internalization phase, the competencies measurement design is shared through entire department. Focus group discussion is conducted to share the new explicit knowledge.

The selected competencies need a scale that can be used to measure the value of each indicator. The measurement scale can be used to assess the employee competencies. The scale that is used in this research is 5 scale where 5 is the highest score.

## 4. Result and Discussion

### 4.1. Socialization

The breakdown process of competencies measurement is discussed in the methodology section. After the process is break down the next step is to interview the respondent to gain knowledge about the measurement. 3 respondent selected for the interview process, the respondent was selected from maintenance department that is experienced in mechanical expertise for maintenance process. The tacit knowledge from respondent then will be converted into new tacit knowledge through the interview. The problem from interview process is that the respondent not fully aware of the competencies needed and the answer is biased, but this problem is handled by using three respondent to gain a better perspective about the mechanical expertise in machine maintenance.

**Table 1.** Interview Result

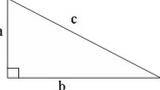
<b>Respondent</b>	<b>Interview Result</b>
A	<ul style="list-style-type: none"> <li>• Explanation about specific competencies</li> <li>• Explanation about indicators of each competency</li> <li>• Explanation about how to measure</li> </ul>
B	<ul style="list-style-type: none"> <li>• Explanation about specific competencies</li> <li>• Explanation about indicators of each competency</li> <li>• Explanation about how to measure</li> </ul>
C	<ul style="list-style-type: none"> <li>• Explanation about specific competencies</li> <li>• Explanation about indicators of each competency</li> <li>• Explanation about how to measure</li> </ul>

### 4.2. Externalization

The previous knowledge about the competencies and the interview result is documented. Previous tacit knowledge then converted into explicit knowledge. Table 2 shows the example of externalized knowledge form respondent. From table 2 it is known that the explicit knowledge is gained from the

previous phase. The general competencies then derived into specific competencies, the specific competencies then derived into the indicator, lastly, the instrument is complete by adding how to measure of each indicator.

**Table 2.** Example of Externalization Process

General Competencies	Specific Competencies	Indicators	How to Measure	Measurement Result
Have basic mathematics skill	Know the concept of trigonometry	Able to calculate great angle of triangle	Ask the employee how to measure great angle of triangle	$\sin A = \frac{\textit{opposite}}{\textit{hypotenuse}} = \frac{a}{c}$ $\cos A = \frac{\textit{adjacent}}{\textit{hypotenuse}} = \frac{b}{c}$ $\tan A = \frac{\textit{opposite}}{\textit{adjacent}} = \frac{a}{b}$
	Know the concept of Pythagoras	Able to calculate the angle of triangle	Ask the employee how to measure the angle of triangle	 $c^2 = a^2 + b^2$

#### 4.3. Combination

In combination phase, the externalized knowledge from 3 respondent merges into one new externalized knowledge. If 2 out of 3 respondent include the item then it will be used in the new competencies measurement breakdown. The externalized knowledge is used for the design of competencies measurement of mechanical expertise, this will help the supervisor or the stakeholder in assigning, evaluating, and developing competencies of each operator. In designing the competencies measurement, 11 general competencies with 17 specific competencies, 20 indicators, and 20 lists of how to measure each indicator is developed. Table 3 shows the example of combination process. From table 3 it is known that the combined process is done by comparing each answer from the respondent.

**Table 3.** Example of Combination Process

Competencies	Respondent A	Respondent B	Respondent C	Combined Specific Competencies	Notes
Able to use the machine's accuracy gauge	Able to use dial indicator	Able to use dial indicator	Able to use dial indicator	Able to use dial indicator	Abilities to use dial indicator and spirit level to measure machine accuracy.
	Able to use spirit level	Able to use spirit level	Able to use spirit level	Able to use spirit level	
English Competencies	Able to understand machine manual book	Able to understand English idiom in machine	Able to understand machine manual book	Able to understand Basic English	This competency related to the ability of the employee to understand the manual book to operate the machine because all machine in the company using English as language.

#### 4.4. Internalization

Focus group discussion (FGD) is conducted in this phase to share the new knowledge with all department employee. FGD is done by discussing the competencies measurement instrument. From FGD result it is known that the explicit knowledge conversion from the previous step is as expected and will be used as basis for evaluating the competencies in the company. Table 4 shows the FGD result. From table 4, it is known that all the instrument that is developed in this research can be used as a basic instrument. The instrument can help the maintenance department to assess current competencies of employee and further can use to improve the skill and competencies of maintenance operators. The knowledge lies within the instrument is rich enough for understanding the basic skill for doing the mechanical task in machine maintenance.

**Table 4.** FGD Result

No.	Focus Group Discussion Result
1	The proposed competencies measurement of mechanical expertise can be implemented in the company, especially maintenance department
2	The proposed measurement can be a basic instrument to assess employee competencies regarding the mechanical expertise in maintenance department
3	The proposed instrument can help the maintenance department to assess current competencies of employee and can be basic step to improve their skill and competencies
4	The knowledge lies within the instrument is enough to be guidance for next generation to understand the basic work of maintenance department, especially the mechanical expertise.

#### 5. Conclusions

The purpose of this research is to improve the quality of human resources of maintenance staff in manufacturing company by designing competency measurement instrument that aims to assess the competency of employees. SECI method is used in this research for managing knowledge that is held by senior employees regarding employee competence of mechanical expertise. The knowledge about the competencies measurement breakdown is well documented in the form of explicit knowledge. The measurement of employee competencies can be done by using the proposed instrument. The competencies for mechanical or in general in maintenance can be different according to the change in technology or method, another research can be done to break down each characteristic according to the company needs,

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