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Competency Measurement Instrument Design for Maintenance Staff of Electronic Expertise with SECI Method

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Abstract. To gain competitive advantages, companies must combine and collaborate with the tangible and intangible assets. The most important intangible assets in companies are people because people have the knowledge to run the companies. Competencies of each individual in a company is a basic characteristic that must be taken into account. The purpose of this research is to improve the quality of human resources of maintenance staff in the 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 in electronic 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. The result of this paper is the competency measurement instrument that aims to assess the competency of employees. Future research can be done to test the instrument and add more specific criteria.

Keywords: Competency Measurement, Maintenance, SECI Method

1. Introduction

Nowadays, companies are a set of the collaboration of tangible and intangible assets to achieve companies objective. The example of tangible assets in companies are land, labor, and capital. Tangible assets are easy to develop by increasing the number of such assets. The intangible assets in companies usually embedded in people, which come in a form of knowledge. People as an asset is considered as the important factors to gain a competitive advantage [1]. Type of knowledge in people can be divided into two category, which is explicit and tacit knowledge [2]. Explicit knowledge is defined as the knowledge that is easy to articulate and in form of formal and systematic language, where tacit knowledge is defined as the knowledge within the people that forge through experience in form of the mental model. The competitiveness of industry comes with the concept of the needs of bringing the availability of knowledge worker into an industry. The knowledge worker in the industry will bring value-added and increase the productivity of companies to gain a competitive advantage.

Knowledge lies within a people, there is a risk of losing the resource when the people in the organization is retired or resign from the organization. As stated by Alwis, Hartmann, and Gemunden [3], the most important knowledge in people is tacit knowledge and it is hard to be completely transferred into formal language. Company Z 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. There is different education background within the maintenance department staff, the difference can be used by the supervisor to establish the work assignment by understanding each competency needed for each specific job. There are three specific competencies that are set by the companies, which is mechanical, electrical, and mechanical. Figure 1 shows the number of an employee from the maintenance department in company X.

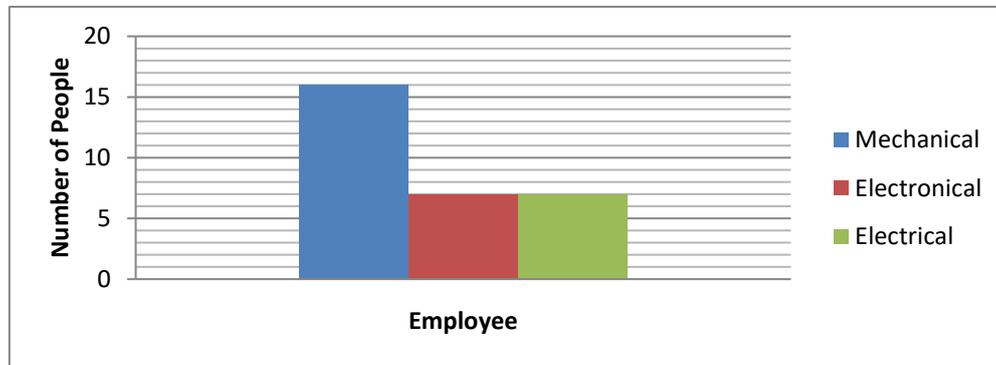


Figure 1. Number of Employee in Maintenance Department Company X,

From figure 1, it is known that the mechanical expertise employee is the largest in the maintenance department and the others are a smaller size than the mechanical expertise employee. 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 the 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. The needs of measurement for assessing employee competencies is high. The purpose of this research is to design a competency measurement instrument that aims to assess the competency of employees. Previous research about the knowledge conversion practice is the research from Mahatmavidya, Soesanto, Kurniawati, and Andrawina [1] that focused on converting the expertise of maintenance staff. The study from Lis [4] focused on knowledge conversion in military organizations. Another research of knowledge conversion application is the research from Nugraha, Kurniawati, and Hedyanto [5] that focused on knowledge conversion in a research institution. Research from Gao and Nee [6] focused on converted knowledge for the product development process. Research from Kalogeraki, Apostolou, Polemi, and Papastergiou [7] focused on converting knowledge for maritime and logistics supply chain using SECI and semantic web technologies.

2. Methods

The purpose of this research is to improve the quality of human resources of maintenance staff in the manufacturing company by designing competency measurement instrument that aims to assess the competency of employees. Nonaka and Takeuchi [2] describe the four phase of converting knowledge which is socialization, externalization, combination, and internalization. Socialization consists of sharing process and creation of tacit knowledge through interaction and direct observation. Externalization consists of an articulation of tacit knowledge into explicit knowledge through dialogue and reflexion. Combination consists of the conversion process of explicit knowledge into new explicit knowledge through systemization and information. Internalization consists of the 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 Phase.



Figure 2. SECI Phase

In the socialization phase, tacit knowledge is transformed into another tacit knowledge, knowledge about job title, expertise, and etc. General competencies for electronic competencies such as specific skills, indicator, how to measure such an indicator and the result is gained from the interview with the supervisor and senior staff. In the 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 the 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. In internalization phase, the competencies measurement design is shared through the entire department. Focus group discussion is conducted to share the new explicit knowledge.

3. Result and Discussions

3.1. Socialization

Socialization is a sharing process and the creation of tacit knowledge through interaction and live experience. In the socialization phase, there is knowledge capturing process from the respondent. Figure 3 shows the socialization phase scheme. The result of this phase is tacit knowledge about job title, employee expertise, specific skills, indicators, how to measure indicators, and the result needed to asses and evaluate the competencies for electronic expertise in the maintenance department. Figure 3 shows the scheme of the socialization phase.

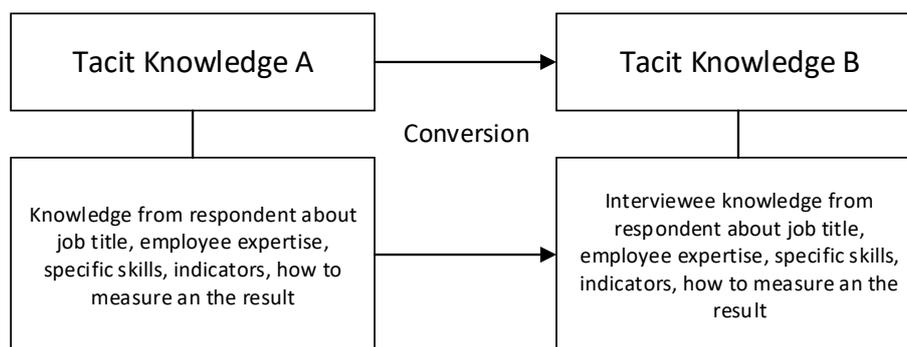


Figure 3. Socialization Phase Scheme

The electronic expertise is a skill that needed for repairing the component of the machine. According to the supervisor, all electronic expertise staff must have all general competencies for repairing the electronics part of the machine. Table 1 shows the competencies needed for electronic competencies,

Table 1. Electronic Expertise Competencies List

No.	Competencies	Specific Competencies
1	Able to use measurement tools for electric devices	Able to use a digital multimeter
2	Have basic mathematical knowledge	Able to understand the number system
3	Have basic mathematical knowledge	Able to understand the number conversion system
4	Understand the maintenance procedure philosophy	Able to understand the preventive maintenance procedure
5	Understand the maintenance procedure philosophy	Able to understand the corrective maintenance procedure
6	Understand the machine diagram	Able to understand block diagram of a machine
7	Have basic English skill	Able to understand the content of the manual book
8	Have basic electronic skills	Able to understand the type of electricity and electric lines.
9	Have machine calibrating system skills	Able to understand tools for calibrating a machine
10	Have machine calibrating system skills	Able to calibrate a machine
11	Have machine work system knowledge	Able to understand how machine work
12	Have the ability to use CMMS application	Able to understand general terms in CMMS
13	Have the ability to use CMMS application	Able to operate the CMMS
14	Have Human Safety and Environment knowledge	Understand basic HSE
15	Have the ability to operate Microsoft office application	Able to use all kind of Microsoft office software

After understanding the job title, employee expertise, specific skills, indicators, how to measure indicators, and the result needed to asses and evaluate the competencies then the next step is to design the scale for assessing the competencies. The socialization process is done by interviewing and explore previous knowledge from the supervisor and the senior staff.

3.2. Externalization

The externalization phase articulate the previous tacit knowledge gain in the socialization phase into explicit knowledge in the form of a business process. In the externalization phase, knowledge will be documented informal ways. Figure 4 shows the externalization phase scheme

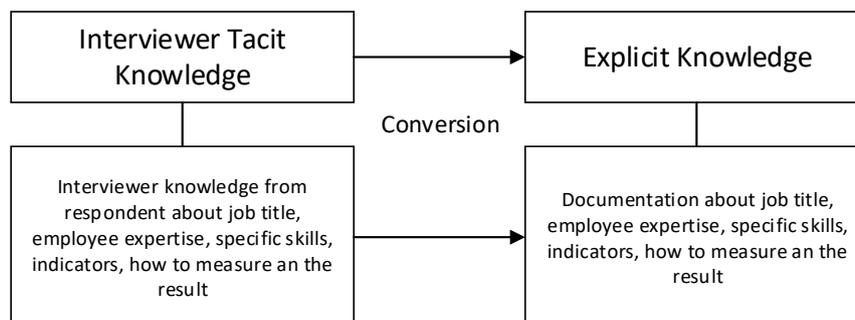


Figure 4. Externalization Phase Scheme

The job title is a brief description of what is the main task of the job and is used to categorize the position of the employee in the organization. A job title can describe the responsibilities. Every staff in the maintenance department have different basic skills. With specific categorization for each job, the line of work for each staff is clear. Table 2 shows the example of externalized knowledge from the respondent.

Table 2. Example of Externalization Process

General Competencies	Specific Competencies	Indicators	How to Measure	Measurement Result
Have basic electronic skill	Know how to use a digital multimeter	Knows part of a digital multimeter	The employee is asked to show each part and the function of a digital multimeter	In general, there are a digital display, pushbuttons, rotary switch, and input terminals in a digital multimeter,



3.3. Combination

In the combination phase, the previous explicit knowledge from each respondent is combined and merged into one new knowledge. In the externalization phase, the knowledge from respondent is gathered, but there is a possibility that there is a difference between respondent in deciding what is competencies needed for electronic expertise. 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. Figure 5 shows the combination phase scheme.

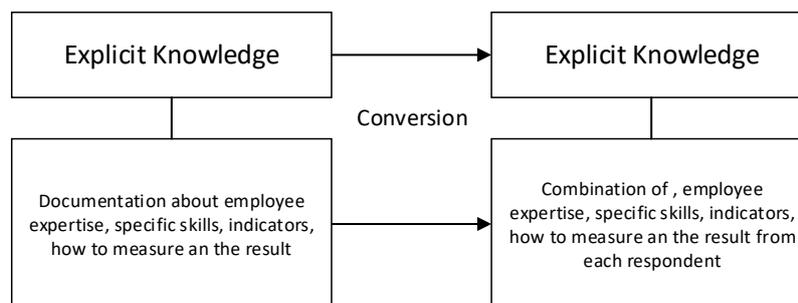


Figure 5. Combination Phase Scheme

The merging process of specific competencies is done based on the knowledge of each respondent. Specific competencies are the detail explanation about the general competencies, therefore all electronically expertise staff must have all the competencies. In deciding which competencies are needed, knowledge exploration is conducted to gain the brief knowledge about the job of maintaining the machine in electronic point of view. Indicators represent the variable that indicates or as a guide to measure about an event or activity. The indicator is used as a base for assessing the staff competencies. How to measure explain how to measure the competencies according to each indicator. The measurement result is a measurement standard that is used for measuring competencies. Table 3 shows the example of the combination process.

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	
Basic Electronic skills	Able to understand the type of electricity and electric lines.	Able to understand the type of electricity and electric components	Able to understand the type of electricity and electric components	Able to understand the type of electricity, electric lines, and electric components	Basic competency for electronic expertise that focused on the knowledge of basic electric skills.

3.4. Internalization

Internalization phase is the last step in knowledge conversion. Internalization is a learning process and knowledge acquisition that is done by the member of the organization. In this phase, the explicit knowledge which is the best practice is to disseminate into tacit knowledge. Focus group discussion (FGD) is conducted in this phase to share the new knowledge into all department employee. FGD is done by discussing the competencies measurement instrument. The purpose of the FGD are (1) to convert the knowledge from explicit to tacit about the competencies, indicators, how to measure and the measurement result, (2) to discuss the competencies and etc. to the employee for sharing process, (3) to understand the willingness of the stakeholder implementing the competencies measurement. From the FGD result, it is known that with the proposed competencies measurement design all electronic expertise staff competencies can be measured so the assignment, evaluation, and recruitment activities can be exactly as needed.

4. Conclusions

This research tends to improve the quality of human resources of maintenance staff in the manufacturing company by designing competency measurement instrument that aims to assess the competency of employees. In the socialization phase, there is knowledge capturing process from the respondent. In the externalization phase, knowledge will be documented informal ways. In the combination phase, the previous explicit knowledge from each respondent is combined and merged into one new knowledge. In the Internalization phase, the explicit knowledge which is the best practice is to disseminate into tacit knowledge. 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. Future research can be done to test the instrument and add more specific criteria.

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