VOL. 11, NO. 17, SEPTEMBER 2016 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences


www.arpnjournals.com

# THE ANALYSIS OF THE LEVEL OF TECHNOLOGY CONTRIBUTION TO DETERMINE THE STRATEGY OF QUALITY STANDARD ACHIEVEMENT IN THE SMALL AND MEDIUM ENTERPRISE OF SHIP COMPONENTS

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**ABSTRACT**

Small and Medium Enterprise (SME) of ship component are manufacturing companies that produce ship components, including the square window, Side scuttle, and weathertight door. The reliability of vessel component quality is a major factor in shipping industry as it involves safety in sailing. As a result, the technology becomes a main requirement that must be mastered by the manufacturer as a determinant of the competitiveness of the products. This study aimed to determine the level of technology contribution in achieving product quality standards in the ship component SME and the strategies to strengthen the technology contribution in achieving product quality standards of ship component SME in Indonesia. Technology components measured include technoware, humanware, infoware, and orgaware. Technology assessment is done by comparing the two types of different ship component SME of ships, namely SME ships component whose some of its products have been certified ($SME_1$) by Biro Klasifikasi Indonesia (BKI) and ship component SMEwhose products have not been certified ($SME_2$); thus technology gap was obtained as the basis for strategy analysis of the quality standard achievement. The results of the data analysis show that of the $SME_1$ the humanware component contribution is the highest (0.623), followed by technoware (0.558), infoware (0.556), and the smallest is orgaware (0.472). Meanwhile, of the $SME_2$ the highest contribution is technoware component (0.261), followed by humanware (0280), orgaware (0.194) and the smallest is infoware (0.167). Successively the grades of TCC (Technology Contribution Coefficient) for $SME_1$ and $SME_2$ are 0.5788 and 0.2393. Therefore, according to the results of this study the humanware component has priority to be upgraded soon, followed by technoware, orgaware and infoware. $SME_1$ has TCC values below 0.7 and above 0.3, being classified as a level of semi-modern technology, while $SME_2$ has TCC values below 0.3, being classified as a level of traditional technology.

**Keywords:** TCC, technology contribution, quality standard,ship component SME.

## 1. INTRODUCTION

At this time international trade has grown rapidly entering the era of free trade. The flow of goods and capital between countries is increasingly heavy [8] [2]. This makes the domestic and international markets have the same challenges as the domestic market is also infiltrated by imported products. Likewise, for products of ship components that has been able to enhance one country and another. One factor that plays an important role in winning the competition is the quality of the product itself. As a result, the product of ship component who is able to meet the requirements of international quality and standard component products meet quality requirements and international standards is the one who will win the competition in the free trade. In this regard, the small and medium enterprise (SME) of ship component in Indonesia as industry supplier on a national shipbuilding industry needs to strengthen the foundations that focus on competitive advantage of products through product certification of ship components, so that the product quality can meet the national standards accepted that is appropriate with quality standard of Biro Klasifikasi Indonesia (BKI). This is in line with the Sutrisno's opinion (2012) that attempts to standardize the products of SME are relevant to SME in Indonesia, which is currently facing a problem of competitiveness.

SME of ship component is manufacturing companies that produce ship components, including the square window, side scuttle, and weathertight door. These ship component products are marketed to the shipping industry throughout Indonesia and partly are exported. One of the keys to success for SME in the ship component in achieving the quality standards is determined by the company's ability to manage technology as part of its business processes since the quality standard is influenced by technology as a tool of transformation of inputs to outputs starting from the selection of raw materials, product planning and production planning, process of maintenance machinery and equipment used, until the delivery of products to consumers as well as the installation process at the site [1].

Technology has an important influence in fostering excellence in competition among companies; therefore it needs to be managed based on the strategic point of view [2]. Planned strategy based on technology assessment should consider the various aspects of the technological capabilities of the company resulting in a betterplanning model strategy in technology development [10] [11]. In addition, the assessment process improves the quality and expands the base of existing technologies as well as enables to identify the strengths and weaknesses of the technology sophistication used by the company, thereby the strategic planning capabilities in technology development increases [12]. The companies should be able to make changes in the technologies necessary to be able to anticipate the competition. One thing to note is that changes in company’s technology should consider the suitability of the company's business needs [4]. Thus technology assessment is an important part of the technology management [5], which involves decision making that is important for the profitability and growth of the company in improving the global competitive scenario [3].

In spite of everything stated, the analysis of technology in the ship component SME becomes important. Technology analysis is conducted to identify and evaluate the strengths and weaknesses of the technology assets of the company aimed to assess the company's relative technology position to competitors and the best technology [7]. The analysis of the technology at the enterprise level is needed as a means to assist management in defining the fundamental problems associated with existing technology in the company and its relationship with productivity [14].

## 2. RESEARCH METHODS

Technology measurement in this study used an econometric model that has been developed by ESCAP. This model was used to assess the four components of technology forming that jointly contribute to contribute to the transformation of inputs into outputs on two different types of ship component SME which are that whose some of its products are certified by Biro Klasifikasi Indonesia ($SME_1$) and the other one whose products are not certified ($SME_2$). The assessment of the technology component is to give value performed by the owners and employees of ship component SME, in a questionnaire that has been prepared. Criterion of technology component analysed refers to the one used by Wiraatmaja and Ma'ruf (2004). Technometric model defined technology contribution coefficient in a transformation facilities.

## 3. RESULTS AND DISCUSSIONS

### 3.1 Transformation process

In general, to obtain the products of ship component which are appropriate to quality standards, the transformation process of ship component SME is as follows:

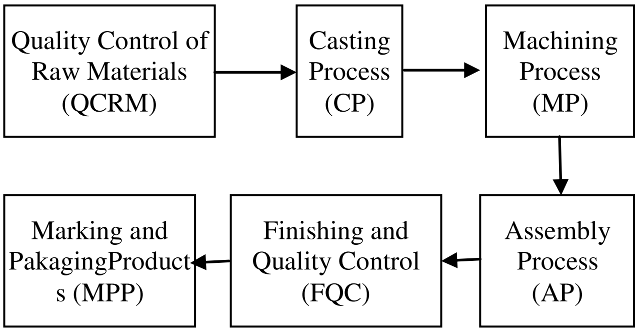


**Figure-1.** Transformation process of ship component SME.

### 3.2 Degree of sophistication

The degree of sophistication demonstrated the sophistication of each technology component in the ship component SME. The level of technology sophistication is based on the lower limit value which is in $SME_1$ Lower Limit ($LL_{1.i}$) and the Upper Limit ($UL_{1.i}$) while on $SME_2$ the Lower Limit ($LL_{2.i}$) and the Upper Limit ($UL_{2.i}$) of each technology component sophistication as seen in Table-1 to Table-4. The lower limit value indicates the lowest (simple) level of sophistication (complexity) of each technology component. Meanwhile, the upper limit value indicates the highest (complex) level of sophistication (complexity) in each technology component.

**Table-1.** Limitation of technoware sophistication.

| Technowarecomponent | Degree of sophistication | | | |
|---|---|---|---|---|
| | $SME_1$ | | $SME_2$ | |
| | $LT_{1.i}$ | $UT_{1.i}$ | $LT_{2.i}$ | $UT_{2.i}$ |
| QCRM | 1 | 8 | 1 | 4 |
| CP | 3 | 6 | 1 | 5 |
| MP | 3 | 7 | 2 | 5 |
| AP | 3 | 6 | 1 | 5 |
| FQC | 2 | 7 | 1 | 4 |
| MPP | 2 | 6 | 1 | 3 |

**Table-2.** Limitation of humanware sophistication.

| Humanwarecomponent | Degree of sophistication | | | |
|---|---|---|---|---|
| | $SME_1$ | | $SME_2$ | |
| | $LH_{1.i}$ | $UH_{1.i}$ | $LH_{2.i}$ | $UH_{2.i}$ |
| Operator | 3 | 5 | 1 | 4 |
| Supervisor | 4 | 7 | 1 | 5 |
| Administration | 3 | 7 | 2 | 5 |
| Manager | 3 | 8 | 1 | 5 |

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**Table-3.** Limitation of infowaresophistication

| Infowarecomponent | Degree of sophistication | | | |
|---|---|---|---|---|
| | $SME_1$ | | $SME_2$ | |
| | $LI_{1.i}$ | $UI_{1.i}$ | $LI_{2.i}$ | $UI_{2.i}$ |
| Infoware | 3 | 7 | 1 | 4 |

**Table-4.** Limitation of orgaware sophistication.

| Orgawarecomponent | Degree of sophistication | | | |
|---|---|---|---|---|
| | $SME_1$ | | $SME_2$ | |
| | $LO_{1.i}$ | $UO_{1.i}$ | $LO_{2.i}$ | $UO_{2.i}$ |
| Orgaware | 3 | 5 | 1 | 4 |

**3.3 State of the Art**

State of the art is the level of complexity of each technology component. Before undergoing the rating assessment of the state of the art for each component, an assessment of each criterion in each technology component was carried out at the first phase. Formulations for calculation of state of the art used the following equation (1) [16]:

$$\text{State of the art} = \frac{1}{10}\left[\frac{\sum_i \text{Tik}}{\text{kt}}\right] \quad (1)$$

The counting result of state of the art shows that the highest level of complexity is in the humanware technology component of 0.75 at the manager level in $SME_1$. The high value indicates that the human resource at manager level is already capable of critical thinking to their work environment and has a high awareness of the work he does because the entrepreneurial spirit that has been formed from businesses hereditary is strengthened to the level of an adequate education in accordance with his competence

**Table-5.** State of the Art of ship component SME.

| Teknologicomponent | State Of The Art | | | |
|---|---|---|---|---|
| | $SME_1$ | | $SME_2$ | |
| Technoware | $ST_{1.1}$ | 0,639 | $ST_{2.1}$ | 0,333 |
| | $ST_{1.2}$ | 0,667 | $ST_{2.2}$ | 0,472 |
| | $ST_{1.3}$ | 0,611 | $ST_{2.3}$ | 0,472 |
| | $ST_{1.4}$ | 0,639 | $ST_{2.4}$ | 0,333 |
| | $ST_{1.5}$ | 0,639 | $ST_{2.5}$ | 0,300 |
| | $ST_{1.6}$ | 0,528 | $ST_{2.6}$ | 0,300 |
| Humanware | $SH_{1.1}$ | 0,611 | $SH_{2.1}$ | 0,333 |
| | $SH_{1.1}$ | 0,667 | $SH_{2.1}$ | 0,361 |
| | $SH_{1.1}$ | 0,611 | $SH_{2.1}$ | 0,250 |
| | $SH_{1.1}$ | 0,750 | $SH_{2.1}$ | 0,472 |
| Infoware | $SI_1$ | 0,500 | $SI_2$ | 0,167 |
| Orgaware | $SO_1$ | 0,625 | $SO_2$ | 0,250 |

**3.4 Contribution of each technology component**

Determining the value of the contribution of each component was done by using the value limitation of the sophistication degree and state of the art rating was by using the formula (2) [16]. The results are demonstrated in Table-6.

$$T_i = \frac{1}{9}\left[LT_i + ST_i\,(UT_i - LT_i)\right] \quad (2)$$

**Table-6.** Calculation of technology component contribution to the ship component SME.

| Teknologicontribution | Component contribution | | Total contribution | |
|---|---|---|---|---|
| | **$T_{1.i}$** | **$T_{2.i}$** | **$T_1$** | **$T_2$** |
| Technoware | 0.608 | 0.222 | 0.558 | 0.262 |
| | 0.556 | 0.321 | | |
| | 0.605 | 0.380 | | |
| | 0.546 | 0.259 | | |
| | 0.577 | 0.211 | | |
| | 0.457 | 0.178 | | |
| | $H_{1.i}$ | $H_{2.i}$ | $H_{1.}$ | $H_{2.}$ |
| Humanware | 0.469 | 0.222 | 0.623 | 0.280 |
| | 0.667 | 0.272 | | |
| | 0.605 | 0.306 | | |
| | 0.750 | 0.321 | | |
| Infoware | $I_1$ | $I_2$ | $I_1$ | $I_2$ |
| | 0.566 | 0.167 | 0.556 | 0.167 |
| Orgaware | $O_1$ | $O_2$ | $O_1$ | $O_2$ |
| | 0.472 | 0.194 | 0.472 | 0.194 |

### 3.5 Intensity of the technology component contributions

To determine the intensity of each technology component,pairwise comparison matrix approach [14] was used. Therefore, the relative importance level based on the data seen in table 7 can be figured out as follows.

Table-7 shows the relative assessment of respondents of ship component companies owners whose products are already certified. The level of significance in the weighting of technology component based on achievement of quality standard objective is that the humanware component is more important (4) than technoware component, infoware component is almost the same but slightly more important (2) as the technoware component, technoware component is more important (5) than orgaware, humanware component is slightly more important than infoware component, humanware component is slightly more important (3) than orgaware component, infoware component is almost the same but slightly more important (2) than the orgaware component.

**Table-7.** Relative assessment among technology components.

| | T | H | I | O |
|---|---|---|---|---|
| T | 1.00 | 0.25 | 0.50 | 5.00 |
| H | 4.00 | 1.00 | 3.00 | 3.00 |
| I | 2.00 | 0.33 | 1.00 | 2.00 |
| O | 0.20 | 0.33 | 0.50 | 1.00 |

Based on the results of the normalization matrix in Table-8, the intensity values of component contribution for each technology component can then be determined. The contribution intensity of each technology component is as follows: $\beta t = 0.2061$; $\beta h = 0.4879$; $\beta i = 0.2081$; $\beta o = 0.0979$. The intensity value of technology component has different value for each component. Humanware component has the largest intensity value of 0.4879 and the lowest intensity value is on orgaware component of 0.0979. The intensity of the technoware and infoware components is respectively 0.2061 and 0.2081.

**Table-8.** Matrix of relative assessment normalization among technology components.

| | T | H | I | O |
|---|---|---|---|---|
| T | 0.1388 | 0.1309 | 0.1000 | 0.4545 |
| H | 0.5556 | 0.5235 | 0.6000 | 0.2728 |
| I | 0.2778 | 0.1728 | 0.2000 | 0.1818 |
| O | 0.0278 | 0.1728 | 0.1000 | 0.0909 |

### 3.6 Technology contribution coefficient

Once known the value of the contribution and the component contribution of THIO, then by using the formula (3) [16] the following formula is obtained:

$$TTC = T^{\beta t} . H^{\beta i} . I^{\beta i} . O^{\beta o} \quad (3)$$

$$TTC_1 = T_1^{\beta t} . H_1^{\beta i} . I_1^{\beta i} . O_1^{\beta o} = 0.5788$$

$$TTC_2 = T_2^{\beta t} . H_2^{\beta i} . I_2^{\beta i} . O_2^{\beta o}$$

= 0.2393

TCC value is in the range of 0-1. The level of company's technology can be assessed based on the value of its TCC, in which the level company's technology is said to be traditional if it has TCC in the range of 0 $<TCC<0.3$. If company's TCC is at a value of 0.3 $<TCC<0.7$, the level of company's technology is at the level of semi-modern. Besides, the company is said to have a level of modern technology if it has TCC at 0.7 $<TCC<1$ [11]. Therefore for the small and medium enterprise of ship component whose some of its products have been certified ($TTC_1$ = 0.5788) is at a semi-modern, while the small and medium enterprise of ship components whose products have not been certified ($TTC_2$ = 0.2393) is a traditional company.

### 3.7 Analysis of diagram radar

The difference of component contributions of technology on small and medium enterprise of ship components whose some of its products have been certified $SME_1$ and small and medium enterprise of ship component whose products have not been certified $SME_2$ can be seen clearly in Figure-2 that contribution gap of technology component provides the direction and magnitude of the value of the technology contribution that must be achieved by the small and medium enterprise of ship components whose products have not reached the quality standard. This technology gap can be used to analyze its technology development strategy [17].

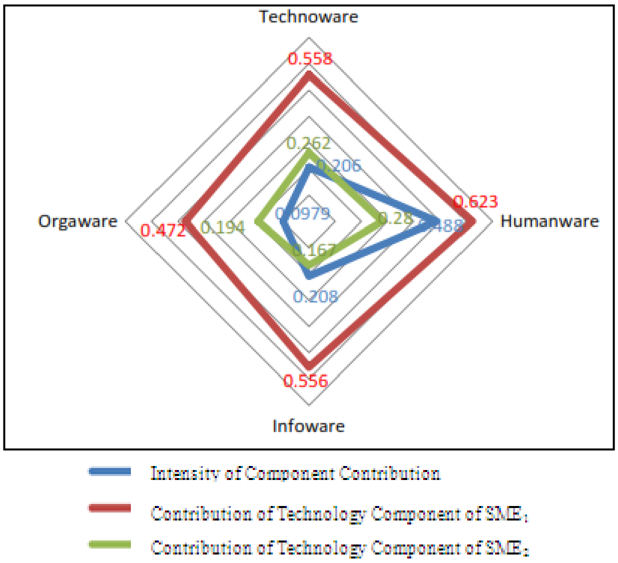


**Figure-2.** Diagram of assessment radar of technology component contribution.

The highest value of the technology contribution to the $SME_1$ is in humanware component amounting to 0.623. It results from the human resource who has a high loyalty to the workplace. The loyalty is shown by sensitivity to work well and to be able to maintain and to takecare the production facilities. In addition, the working atmosphere based on kinship and mutual help makes the worker able to work with both groups. Workers in $SME_1$ are often trained on the techniques of casting, welding techniques, drawing techniques, and management team work.

The trainings provide excellent impact to improve human resource capacity. Compared with the humanware component of $SME_2$ which has very small value of 0.208, this suggests that the quality of its human resources is still very low that is below the average. The contribution of technoware component of $SME_1$ is 0.558 showing that the company's facilities are able to process complex production with relatively small error rate. Meanwhile, the contribution of technoware component of $SME_2$ is 0.262 showing that the company's facilities have no ability to perform complex production processes with low error rate. Infoware component contribution of$SME_1$ is 0.556 meaning the range of information management is comprehensive, there is frequent condition in which the company informs problems and internal conditions to the employees, there is a network of information, procedures for communications are simple, information systems exist to support the company's activities. On the other hand, $SME_2$ which is worth 0.167 meaning the information refinery is still very low.$SME_1$ has orgaware value contribution of 0.472 meaning the company is able to create a favorable environment to conduct quality improvement and enhancement, while $SME_2$ is worth 0.194 meaning there has been no ability to create a favorable environment to conduct quality improvement and enhancement. In many cases the industry is less balanced in ability of technoware aspects such as managerial, human and knowledge aspect detaining the performance improvement in the achievement of quality standards [5].

## 4. CONCLUSIONS

The technological component contribution value is affected by the sophistication limitation, the range of the upper limit and lower limit of level of sophistication, and the cost of state-of-the-art, while the TTC value is determined by the intensity of the component contribution and technology component contribution.

The results of the identification of component contribution of technology to the ship component's small and medium enterprise whose some of its products have been certified and that whose products have not been certified show there exist the gaps of technology contribution which can be used as a reference in the priority of technology development for achieving the quality standards of small and medium enterprise of ship component. The priority of technology development refers to the intensity value that is of component humanware becoming the key priority subsequent to technoware, orgaware and infoware components.

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