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**PROCEEDING OF  
CONFERENCE ON  
MANAGEMENT AND  
ENGINEERING IN  
INDUSTRY (CMEI) 2021**

**CURRENT PERSPECTIVE AND FUTURE DIRECTIONS OF  
INDUSTRY 4.0 IN ENGINEERING & MANAGEMENT**

**TANGERANG, 23<sup>rd</sup> - 24<sup>th</sup> MARCH 2021**



**MASTER OF MECHANICAL ENGINEERING  
SWISS GERMAN UNIVERSITY**

## **Preface from the Chairman of the Conference on Management and Engineering in Industry (CMEI)**

**Dena Hendriana, B.Sc., S.M., Sc.D.**

*Head Department of Master of Mechanical Engineering, Faculty of Engineering and Information Technology, Swiss German University*

Welcome to the third Conference on Management and Engineering in Industry (CMEI). This conference is conducted by Master of Mechanical Engineering in the Swiss German University at Alam Sutera, Tangerang, Indonesia. The conference is open for all academic community to share the knowledge in the areas of management and engineering which are applicable in the industry. It is held on Tuesday and Wednesday, 23 - 24 March 2021 in the campus of Swiss German University at Prominence Tower, Alam Sutera. The theme of this conference is "Current Perspective and Future Directions of Industry 4.0 in Engineering & Management". This theme is aligned with Master of Mechanical Engineering vision and mission to prepare our students for the era of Industry 4.0 in the global economic.

There are forty-nine papers presented in this event with the topics related to the theme. We thank reviewers who have been working hard to improve the quality of the papers until this conference proceeding ready to be published on time. We thank all the members of the committee who prepare and run the event. We thank Rector, Vice Rectors, and Dean of Faculty of Engineering and Information Technology for their support on this event.

We thank God that we have run the event of the conference smoothly and published the conference proceeding on time. We hope that this event is beneficial for everybody and also the proceeding to be beneficial for the readers.

Best Wishes,

Dena Hendriana, B.Sc., S.M., Sc.D.



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Conference on Management and Engineering in Industry

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## CMEI 2021 PROGRAM

23 – 24 March 2021

Date: 24 March 2021

Time	Location	Activities
08.00 – 09.00		Zoom Preparation
<b>Keynote Session (Moderator: Dr. Gembong Baskoro)</b>		
09.00 – 09.30	Zoom Meeting Room	<b>Keynote Speaker 3: Ir. Reni Yanita, M.Si*</b> <b>(Arah dan Kebijakan Kementerian Perindustrian dalam Pelaksanaan Transformasi Industri 4.0)</b> <b>*Staf Ahli Menteri Bidang Percepatan Transformasi Industri 4.0</b>
09.30 – 09.45		<b>Question &amp; Answer</b>
09.50 – 15.00		<b>Parallel Session</b>
15.20 – 15.40	Zoom Meeting Room	<b>Announcement of the Best Paper (Head of Master Mechanical Engineering)</b>
15.40 – 16.00	Zoom Meeting Room	<b>Closing of the Seminar (Head of Master Mechanical Engineering)</b>

## CMEI 2021 Parallel Session

**Date: 24 March 2021**

**Room: Meeting Room (Emerging Areas of Engineering Management)**

**Moderator: Dr. Ir. Henry Nasution, M. T.**

Time	Presenter	Title
09.50 – 10.10	Ahmad Anwari, Edi Sofyan, Sumarsono Sudarto, Gembong Baskoro, Dena Hendriana	Improving Talent Performances by Using Integrated Learning Development Program in Indonesia Leading Heavy Equipment Distributor
10.10 – 10.30	Bakhtiar Burhan, Hanny J. Berchmans, Dena Hendriana, Henry Nasution, Gembong Baskoro	Green Building Analysis of PT United Tractors on Existing Building Based on the Latest Rating Tools Green Building Council Indonesia
10.30 – 10.50	Daniela Dea Hapsari, Sumarsono Sudarto, Gembong Baskoro	Improving Concrete Waste Rate Generation of Structure Projects in Leading Construction Firm in Indonesia
10.50 – 11.10	Dedi Emawan, Aditya Tirta Pratama, Henry Nasution	Application of Analytic Hierarchy Process (AHP) to Develop the Weighting of Key Performance Indicators on Gas Engine Power Plants
11.10 – 11.30	Iwan Kendarwan Kaldjat, Aditya Tirta Pratama, Dena Hendriana	A Study on Sensible Excise Policy by Considering Acceptable Industry Volume, Government Revenue and Employment for Hand Made Kretek Cigarettes
11.30 – 11.50	Mohammad Yoga Baskoro, Sumarsono, Gembong Baskoro	Availability Improvement by Implementing Customize Maintenance Strategy in Rental Operation of Indonesian Forklift Distributor Company
11.50 – 13.00	<b>LUNCH BREAK</b>	
13.00 – 13.20	Egi Gumilar, Dena Hendriana, Hanny J Berchmans, Gembong Baskoro, Henry Nasution	Study of Rooftop Solar PV Policies that Have an Impact on Techno- Economic, and Socio-Environment in a Leading Heavy Equipment Company in Indonesia

13.20 – 13.40	Satriyo Widy Prasetyo, Gembong Baskoro, Dena Hendriana, Henry Nasution, Hanny J. Berchmans	Integrating Audit System Of AGC, ISO14001, ISO45001 to Improve Implementation of the Management Systems in Leading Heavy Equipment Companies
13.40 – 14.00	Yonta Wasfadhita, Gembong Baskoro, Eka Budiarto, Dena Hendriana, Henry Nasution	Assessing Sustainability Impact of Autonomous Haul System in Indonesian Open Pit Coal Mining Company
14.00 – 14.20	Baladi, Dena Hendriana, Edi Sofyan	Improving of the Mechanic Qualification Standard Related to Customer Satisfaction at Leading Heavy Equipment Distributor Company in Indonesia

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# Improving of the Mechanic Qualification Standard Related to Customer Satisfaction at Leading Heavy Equipment Distributor Company in Indonesia

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**Abstract**—Product support services have an important role in the heavy equipment business because they are long-term relationship builder with customers which affects sales of heavy equipment. In product support services, mechanic has a dominant influence because apart from being a service provider, mechanic is also front liner who shapes customer perceptions regarding product support services. It makes mechanic as a top priority in the company's competency development programs. The main problem is how to align the mechanic development program with customer satisfaction. This study aims to arrange a competency development framework in the form of qualification standard which confirmed with customer satisfaction using the Quality Function Deployment (QFD). The correlation between qualification standard with customer satisfaction is analyzed by regression analysis on the Structural Equation Model (SEM) using the *SmartPLS* software. The finding of this research is the qualification standard with comprehensive requirements in Technical Operating Competency (TOC), Business Management Competency (BMC) and Behavior Competency (BC) has better and consistent impact on customer satisfaction.

**Keywords**—competency development program, customer satisfaction, heavy equipment business, mechanic qualification standard, product support services.

## I. INTRODUCTION

### A. Background

Heavy equipment supports economic activities in the upstream industrial activities such as mineral and coal mining, forestry (logging) and agricultural business. Heavy equipment is also the main equipment in large-scale construction projects, such as the construction of highways, railroad tracks, dams or skyscrapers. Its condition makes heavy equipment have an important function in a vital project of the country. The majority of heavy equipment that circulate in Indonesia are foreign brands, even though several brands of heavy equipment have a production bases in Indonesia. Meanwhile, sales and distribution are held by local companies which are partners of the heavy equipment manufacturer. The company being studied is a heavy equipment distributor company from 5 leading brands. To deliver value to customers, the company has two main services, consisting of heavy equipment sales and product support services. Product support services consists of two

activities, namely: spare parts sales and heavy equipment maintenance services. Apart from providing value to customers, a product support service is also a revenue generator for the company.

In recent years, the product support service business has become more important to the company's business. This condition is a result of fluctuations in coal prices which causes customers to optimize production costs. The optimization of production costs is carried out by extending the life time of the heavy equipment by better maintaining the heavy equipment. The best machine maintenance process held by mechanics will ensure customers get the best performance and life time from their heavy equipment during the production process, therefore the production costs are optimal. Mechanics are also indirect sales man for parts, with reliable parts recommendations bundled with quality installation work will make customers willing to buy parts because they are confident their parts and heavy equipment are handled properly. The important role of mechanics in the product support service business makes the development of mechanic competency become a top priority in company strategy [1]. The Competent mechanics will improve the quality of product support services so that customer expectations can be met and increase customer satisfaction and customer loyalty which has an impact to the company's competitiveness. The company runs a special program for the development of mechanic competency with a fund of IDR 30 million/mechanic/year and 7% of the mechanic's working time as a means of getting a competent mechanic.

### B. Research Problem

The company has spent a lot of money and time on mechanical competency development programs, thus the results of this program must be evaluated to ensure the mechanical competency development can meet customer needs as indicated by the level of customer satisfaction. The competency development program of a mechanic is successful if the increase in the qualification level of the mechanic has a consistent and significant positive impact on increasing the level of customer satisfaction. Current conditions, increasing the qualification level of mechanics (Fig. 1.) does not have a positive impact on increasing the level of customer satisfaction (Fig. 2.) because in 2017 to 2019 the qualification level of mechanics has increased but

the level of customer satisfaction related to mechanics has decreased 2.7 points.

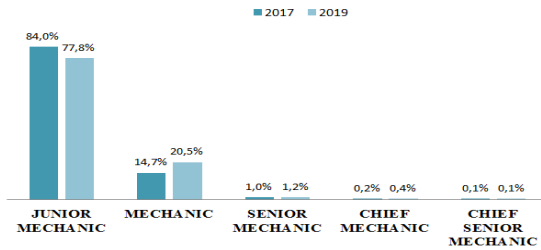


Fig.1. Mechanic qualification level movement



Fig.2. Service division's customer satisfaction index

The mismatch between the actual conditions and the theory raises the question: How to improve the qualification standards of mechanics align with customer needs, therefore the competency development program of the mechanics will have a positive impact on increasing customer satisfaction?

### C. Research Objectives

To make improvement of the mechanic qualification standard which has the greatest impact on customer satisfaction.

### D. Research Questions

- How to improve the mechanic qualification standard related with customer satisfaction?
- How do the improvement of the mechanic qualification standard impact to the customer satisfaction?

### E. Hypothesis

The improvement of the mechanic qualification standard that refers to the customer need has positive impact on the customer satisfaction consistently.

## II. LITERATURE REVIEW AND RESEARCH METHODS

### A. Qualification Standard

The Presidential regulation number 8 of 2012 states that qualifications are mastery of learning outcomes. The qualification standard in Indonesia is the Kualifikasi Kerja Nasional Indonesia (KKNI) or also known as the Indonesian Qualification Framework (IQF) [2]. This qualification framework organizes qualifications into several levels, and each level has performance indicators

that must be met. Qualifications bridge the equality of worker with experience in industry with graduates of educational institutions. IQF is determined with position and line of business, in each particular position a number of competency units must be mastered at each qualification level. IQF adopted the RMCS (Regional Model Competency Standard) to define competence. RMCS is a competency standard that focuses on the ability of someone to carry out roles and tasks in a particular function [3], the RMCS more focused on technical aspects or hard skills compared to soft skills aspects such as personal motivation, personal characteristics, abilities, and the other.

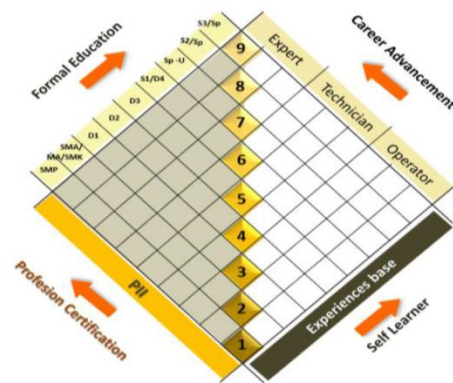


Fig. 3. Improving IQF through various pathway

In service companies it is impossible to develop employee qualifications only on hard skills, because companies must build long-term emotional relationships to ensure customer satisfaction and loyalty. This fact supported by studies that shown the importance of soft skills to improve performance and output quality and customer satisfaction [4]. Regarding customer satisfaction, behavioral competencies have a more significant direct impact than technical competencies, especially for new customers [5]. Behavior competencies with a significant effect on customer satisfaction are emotional competence, empathy, relationship, personal services, compliance with norms, willingness to help, understand the customer needs, the behavior allows customer to trust our services, discipline, responsibility, courtesy and hospitality.

The mechanic qualification standard in the studied company based on the number of competencies mastery that are quantified in the form of points. Point of competence is a method that bridges the number and weight of mastery of mechanical competence, which is determined based on the level of difficulty, work risk and its impact on the company. Mastery of mechanics in a competency is determined by assessment for mechanical mastery in all aspects of competence in the form of skills, knowledge and attitudes. The points will be given three times for each competency based on the level of proficiency as a result of the assessment, namely: competent, proficient and expert. Competency points will be accumulated to determine the grade of mechanics, while the qualifications of mechanics are determined based on the grouping of the grades (Fig. 4.).

QUALIFICATIONS ON GENERALIST POSITION		MECHANIC		
		GRADE	POINT	QUALIFICATIONS
Senior Expert	Senior Manager	G11 B	1991 - up	Senior Chief Mechanic
		G11 A	1900 - 1990	
Expert	Junior Manager	G10 B	1809 - 1899	Chief Mechanic
		G10 A	1718 - 1808	
Specialist	Branch Dept. head	G9 B	1628 - 1717	Senior Mechanic
		G9 A	1538 - 1627	
	Supervisor	G8 B	1453 - 1537	
		G8 A	1368 - 1452	
	Officer	G7 B	1283 - 1367	
		G7 A	1198 - 1282	
Officer		G6 B	1114 - 1197	Mechanic
		G6 A	1029 - 1113	
		G5 B	899 - 1028	
		G5 A	768 - 898	
		G4 B	658 - 767	
		G4 A	547 - 657	
		G3 B	452 - 547	
		G3 A	355 - 451	
		G2 B	260 - 354	
		G2 A	165 - 259	
Officer		G1 B	83 - 164	Junior Mechanic
		G1 A	0 - 82	

Fig. 4. Mechanic qualification based on grade and point groupings, and the equivalence with other positions [6]

Competency in company consists of three types of competencies : TOC, BMC and BC, but for determining the grade of mechanics only based on TOC. BMC and BC are only applied as a check on changes in the qualification of mechanic at the senior mechanic level up to the senior chief mechanic known as hard screen, therefore mechanical qualifications are determined by mastery of mechanics in the TOC. The TOC definition is carried out in accordance with Model Occupational Skill Standard (MOSS), which is determined based on a mechanic's job list in product support services. This job list is divided into 4 groups, namely preventive maintenance, component replacement, troubleshooting and component overhaul. In addition, the list of competency is divided by application based on the type and size of heavy equipment, so if a job is implemented on a different type or size of heavy equipment, the job will also become a separate competency (Table I)

TABLE I  
TECHNICAL OPERATING COMPETENCIES OF MECHANIC [6]

SPECIALISM	GROUP	COMPETENT	POINT		
			C	P	E
Off highway Dumptruck	Preventive Maintenance	Periodic Inspection_Off highway Dumptruck	6	7	8
Off highway Dumptruck	Preventive Maintenance	Periodic Service_Off highway Dumptruck	14	18	20
Off highway Dumptruck	Preventive Maintenance	etc			
Off highway Dumptruck	Component Replacement	Engine Assy Replacement_Off highway Dumptruck	18	23	25
Off highway Dumptruck	Component Replacement	Engine Turbocharger Replacement_Off highway Dumptruck	6	7	8
Off highway Dumptruck	Component Replacement	etc			
Off highway Dumptruck	Component Overhaul	Resealing Wheel Brake _Off highway Dumptruck	14	18	20
Off highway Dumptruck	Component Overhaul	Engine Cylinder Head_Off highway Dumptruck	30	39	42
Off highway Dumptruck	Component Overhaul	etc			
Off highway Dumptruck	Troubleshooting	Troubleshooting Engine System_Off highway Dumptruck	26	34	36
Off highway Dumptruck	Troubleshooting	TroubleshootingPower Train System_Off highway Dumptruck	20	26	28
Off highway Dumptruck	Troubleshooting	etc			

The arrangement of the competencies that is based on a job list causes the mastery of a mechanic's competency really depends on his work experience. Each sector and work location has very different job characteristic for product support services, due to different models and types of heavy equipment, besides that the application is also different. Different models and types and their applications will cause different patterns of problem, so that

maintenance patterns, damaged components and handling work will also be different. Differences patterns in each sector and location of heavy equipment support, will also generate the different pattern of the mechanic competency mastery. Both scenarios allow mechanic to get the same points and same grade or qualification but have different proficiency. This condition is not in line with the IQF, the IQF level is determined based on the proficiency level in a sector of work which in the industrial sector.

### B. Quality Function Deployment (QFD) Method

The Quality Function Deployment (QFD) is a Japanese management approach that was introduced starting in 1972. The purpose of QFD was to enable all workers to contribute to the design of new products in line with Company Wide Quality Control (CWQC) in the Japanese management approach. In principle, this method is a Matrix Diagram (MD) method that uses 4 matrices consisting of: customer requirements, assessment requirements, product design and performance assessment. QFD Method is very effective for making product design that meet customer requirements. The purpose of QFD is to "deploy" the customer's voice to all design lines and cross-functional teams create a House of Quality (HoQ) matrix for ensure all product features match customer requirements.

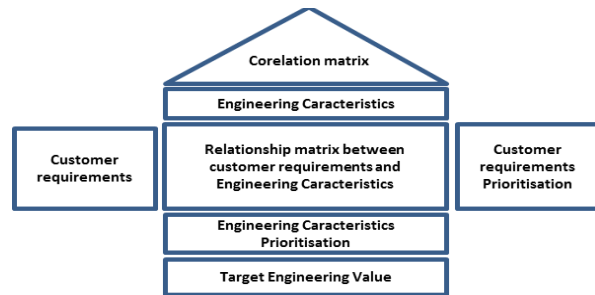


Fig. 5. The House of quality (HoQ) [7]

The main objective of HoQ is to convert customer requirements into engineering characteristics and establish target values for the product. HoQ is a matrix for describing the conceptual map in the product design process. HoQ is a construction to collect and understand customer requirement and find the prioritize of the product features characteristics needed to fulfill it. QFD method is a flexible method applied in many fields, such as creating training and curriculum design [8].

### C. Customer Satisfaction

Customer satisfaction is the compatibility between the customer and what the customer receives, not limited to the services or products provided but how the service or product is delivered. The Research found that customer satisfaction is influenced by satisfaction with employees, product usability, and the ability to build emotional relationships with customers. The measurement of customer satisfaction using a questionnaire and using interviews [9] [10].

### D. Correlation Test

Correlation test is a process to test the impact of a variable on other variables in the form of a single variable

or multivariate. Many methods are used by researchers to conduct correlation test, the most important is how to choose the right method in accordance with the research objectives and character of the data. Many examples of methods used by researchers in testing an existing variable on customer satisfaction, among which are used are: Structural Equation Modeling (SEM) with AMOS software or Partial Least Squares (PLS), Statistical Package for the Social Sciences (SPSS) [9][11][12].

### E. Research Methods

The process flow and research steps are as shown in Fig.6.

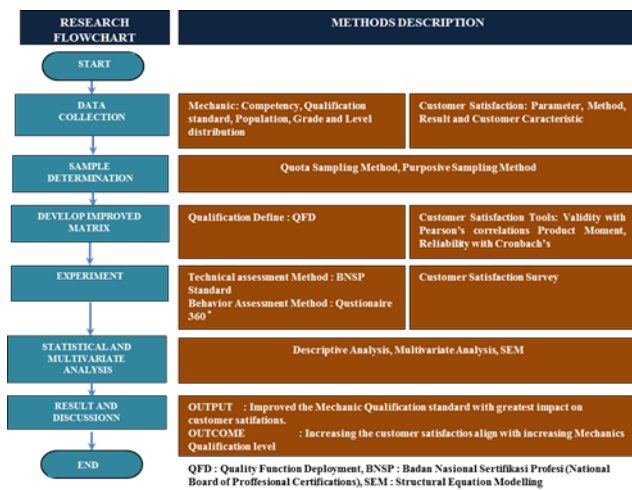


Fig. 6. Research flowchart and methods

## III. RESULTS AND DISCUSSIONS

### A. Improvement of Mechanic Qualification Standard

Voice of customer are obtained based on the results of a questionnaire survey broadcast to selected customers based on the intensity and quantity of transactions with the service division, the survey received responses from 34 respondents. The results of the validity test using Pearson's Correlation Product Moment show that all questionnaire items are valid ( $r > r_{table}$ ) [13], and the reliability test using the Cronbach's alpha test method, the resulting alpha 0.942 which is greater than 0.7 [14] so it is reliable. The result of survey shows that there is a gap between the importance of something to the customer and the company's competitiveness, indicated by the distribution of the score item requirements that are below the ideal area (Fig. 7.).

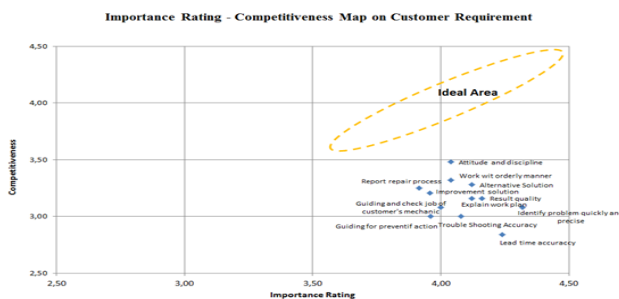


Fig. 7. Importance rating – competitiveness map for customer requirement analysis [9]

Determination of competency requirements in improving qualifications is carried out by convert the importance rating and competitiveness from customer requirements into the importance rating and competitiveness of mechanic competency with the bridging relationship score that has been determined in QFD, the results of this process can be seen in Fig.8.

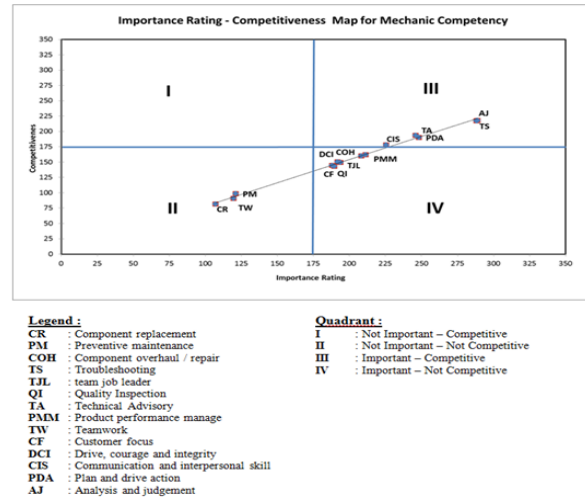


Fig. 8. Importance rating – competitiveness map for mechanic competency [9]

Based on the map of importance rating and competitiveness for mechanic competency, the development of mechanic competency in the right direction. It is indicated by a linear pattern between importance rating and competitiveness, which indicates the competencies with high important rating to customer has high competitiveness. But based on the level of competitiveness, the competency of mechanic is still lacking, because it is still below the diagonal line and there are also many competencies in quadrant IV.

The competency of mechanic consists of 3 groups, namely TOC, BMC, and BC. Each of these competency group has fundamental differences in both the rating scale, assessment method and the characteristic of its competency. TOC of mechanic is a main competency of mechanic to perform heavy equipment maintenance. TOC which has a proficiency aspect, which is determined by the level of mastery of the type of competence in maintenance work and the versality of the aspects that are determined by the mastery of various types of heavy equipment. Proficiency in practice has more effect on the performance of mechanics, therefore in TOC the proficiency ratio is higher than versality with a ratio of 7:3.

BMC of mechanic is a competency related to business or administrative processes to support the maintenance of heavy equipment. BMC for mechanic is quite simple, does not have many variants and proficiency level. BC of mechanic is a competency related to the soft skill of mechanic in its function to serve customer in heavy equipment maintenance. BC is the same for each qualification level of mechanic, but have different requirement in proficiency level. The proficiency level is determined based on the fulfillment numbers of the key performance in each competency, with results in the form

of a score on 1-5 scale. In proposed mechanic qualifications standard, the weight of each competency in the competency scoring is determined based on the percentage of importance rating in QFD. The TOC competency score will be added up with the BMC and BC competency scores, and to simplify process, the score scale will be equalized into a scale of 1 to 100. Therefore, TOC and BMC score must be multiply 100 for the scale equalization and BC score must be multiply 20.

TABLE II  
PROPOSED MECHANIC QUALIFICATION STANDARD

QIF of Mechanic	Technical Operating Competency								Business Management Competency				Behavior Competency					Total STD Score					
	PM		CM		TS		COB		STD Score	L/L	QI	PPM	TA	STD Score	TW	DCI	CF		CIS	PDA	AJ	STD Score	
	Prof	Ver	Prof	Ver	Prof	Ver	Prof	Ver															
Junior Mechanic	100%	100%	100%	100%	50%	30%	25%	30%	15					0	3	3	3	3	3	3	3	26	42
Mechanic	100%	100%	100%	100%	100%	60%	60%	60%	22	1	1			14	3	3	3	3.5	3.5	4	4	29	65
Senior Mechanic	100%	100%	100%	100%	100%	100%	100%	60%	25	1	1	1		21	3	3	3	4	4	4	4	32	78
Chief Mechanic	100%	100%	100%	100%	100%	100%	100%	100%	26	1	1	1	1	30	3	4	4	4	4	4	4	34	90
Chief Senior Mechanic	100%	100%	100%	100%	100%	100%	100%	100%	26	1	1	1	1	30	3	4	4	4.5	4.5	5	5	37	93

### B. Implementation the Proposed Qualification of Mechanic

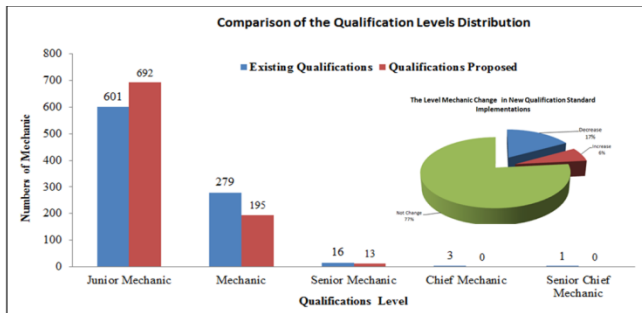


Fig.9. Comparison the distribution of mechanic qualification level based on existing qualification with proposed qualification

The implementation results show an increase in the number of mechanic at the junior mechanic level and a decrease at all levels above (Fig. 9). This condition indicates that several mechanics have met TOC standards but have not met the standard requirements of BMC and BC in the new qualification standards, especially at the senior level of mechanics and above. Although some mechanics with a good mastery of BMC and BC have an increase in qualification at the new qualification standard. This condition shows that the new qualification standard is more comprehensive and fair to occupy the mechanic level, because based on evaluate the mechanic with increase qualification are mechanic with high performance in mechanic competition events and innovation events.

### C. Result of Customer Satisfaction Survey

The customer satisfaction survey was conducted on selected customers in each branch or support location with priority based on transaction frequency, and obtained feedback from 43 customers.. The composition of respondents in the customer satisfaction survey is in accordance with the mechanical composition as well as the profile and business composition of the company under study. The results of the validity test using Pearson's Correlation Product Moment show that all questionnaire items are valid ( $r$  value  $>$   $r$  table) [13], and the reliability

test results using the Cronbach's alpha, showing the alpha value in this questionnaire is 0.917. The results of this reliability test show that the questionnaire is reliable because the alpha value is greater than 0.7 [14].

TABLE III  
SUMMARY RESULT OF CUSTOMER SATISFACTION SURVEY

Customer Satisfaction Items	Satisfaction Result		Validity* (Pearson's Correlation Product Moment)				Reliability* ( $\alpha$ )
	Mean	Median	r-xy	r-value	r-table	Interpretation	
The attitude, behavior and discipline	3,40	3	0,916	14,62	1,683	Valid	0,917
Service and communication of mechanic	3,26	3	0,914	14,42			
Quality of maintenance and repair result	3,14	3	0,883	12,02			
Trouble shooting ability and recommendation	2,95	3	0,880	11,88			

### D. Correlation Analysis of The Mechanic Qualification Standard with Customer Satisfaction

The customer satisfaction survey is an assessment of customer related with the competency and services of mechanic. The result of this survey represents the customer satisfaction level with competency and services of mechanic in branch or site support generally. Customer satisfaction will measure the correlation to the qualifications of the mechanic. The qualification data of the mechanics are individual data, therefore for data equivalence it is necessary to determine the qualification trend at the branch or support site. In data with an asymmetrical distribution and not a bimodal distribution, the measurement of the tendency uses the mode [15]. Feedback from 43 customers resulted in customer satisfaction scores for 6 branches and 22 support sites, then the qualification mode of the 28 supporting points was analyzed for correlation with the level of customer satisfaction using SEM on the Qnyq software.

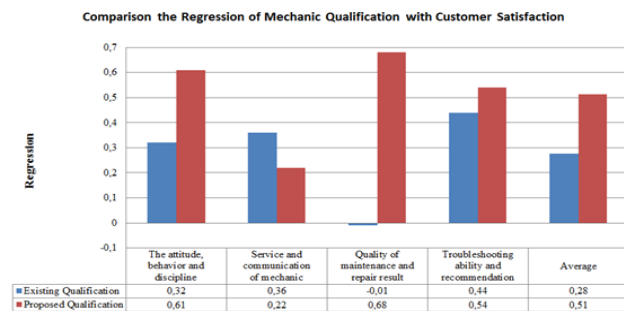


Fig. 10. Comparison the correlation of mechanic qualification standard with customer satisfaction from SEM result

SEM analysis results show the correlation between mechanical qualification standards with customer satisfaction on the proposed qualification standards compared to the existing qualification standards better in 3 aspects (behavior, attitude and discipline, quality of repair and maintenance as well as problem solving and recommendations), and decreasing in service and communication aspects (Fig. 10). The average impact of the proposed mechanical qualification standards is 185% (0.51 and 0.28) higher than the existing mechanical qualification standards. Analysis of significance, the existing mechanic qualification standard have insignificant impact at repair and maintenance quality aspect, and had a

moderate impact at other aspects. The proposed mechanic qualification standard have moderate impact at service and communication, troubleshooting and recommendation, and high impact at behavior, attitude and discipline, and repair and maintenance quality [16]. The results of significance analysis indicate that the proposed mechanic qualification standard has more significant and consistent impact on all measured customer satisfaction items compared to the existing mechanic qualification standard.

The conclusion is the mechanical qualification standard with comprehensive requirements of TOC, BMC, and BC on the proposed mechanical qualification standard has a higher and consistent impact on customer satisfaction with an increase of 185%, therefore the hypothesis in this study is proven to be correct.

#### IV. CONCLUSIONS AND RECCOMENDATIONS

##### A. Conclusions

- Improving the mechanic qualification standard using QFD is proven to align the qualification standard with customer requirement.
- The proposed mechanical qualification standard with comprehensive requirements on TOC, BMC, and BC has a higher and consistent impact on customer satisfaction with an increase of 185% over existing mechanic qualification standards.

##### B. Recommendations

To minimize resistance from mechanics to the implementation of the proposed mechanical qualification standards, by preparing a development program for mechanics who do not meet the requirements at the qualification level at the new qualification standard.

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