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The Effect of Increasing Mechanic Competence via Competence-Based Curriculum on Product Support Performance in Leading Indonesian Heavy Equipment Manufacturers

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ABSTRACT
The amount of product support determines the availability and readiness of heavy equipment. Product support as after-sales service is essential for customers to ensure that the heavy equipment purchased is always ready to use and generates optimal output. Leadtime and mechanic speed in resolving equipment problems and the so-called On Time in Full Solution (OTIF Solution) impact the usability and productivity of the equipment. Product Support Performance is affected by the OTIF Solution, which in turn influences customer satisfaction. The development of mechanic competencies through competency-based training and problems in the field regarding the Special Work Competency Standards is a technique to strengthen mechanics' ability and speed to solve machine problems to achieve good OTIF Solution performance. The purpose of this study is to determine the impact of improving competence. Mechanic via product performance support training with competency-based curriculum Teaching machines carried out this study with poor OTIF Solution performance using the blended learning method and training modules. The findings revealed that once mechanics were trained, the OTIF Solution increased from the previous two years. Specifically, 89 and 88% fell short of the planned range of 90 to 93%.

Keywords: *Product Support, Competency Based Curriculum, Specific Work Competency Standards, Training Need Analysis, Blended Learning.*

1. INTRODUCTION

Heavy equipment is a large size machine and can do serious work such as earthmoving, coal moving. Common types of rich prayers are bulldozers, excavators, wheel loaders, motor graders and heavy dump trucks.

The heavy equipment population is spread across four sectors, namely Forestry, Mining, Construction and Agro. According to data released by one of the Komatsu heavy equipment distributors in Indonesia, Komatsu heavy equipment sales volume from 2014 to 2019 reached 19,411 units of heavy equipment [1].

Competition in heavy equipment sales to dominate the market is very tight. Each distributor will maintain and even increase market share with a pricing strategy and a product support strategy.

Customers as owners of heavy equipment certainly expect their heavy equipment to always be in a good performance and highly efficient so that their heavy equipment can produce optimal production.

Figure 1 Mechanics handling an Excavator that was damaged while operating in the field

For distributors who are leaders in the market, increasing product support is an essential strategy. Leadtime and mechanic speed in solving problems that occur in equipment and the so-called On Time in Full Solution (OTIF solution) affect the equipment's usability and productivity. Performance OTIF solution

affects Product Support Performance, and this affects the level of customer satisfaction. Figure 1 shows several Mechanics handling heavy equipment that was damaged while operating in the field.

The achievement of the OTIF solution is shown in Figure 2, the target so that the customer is not satisfied with the mechanic's ability to identify the problem and service result quality [1].

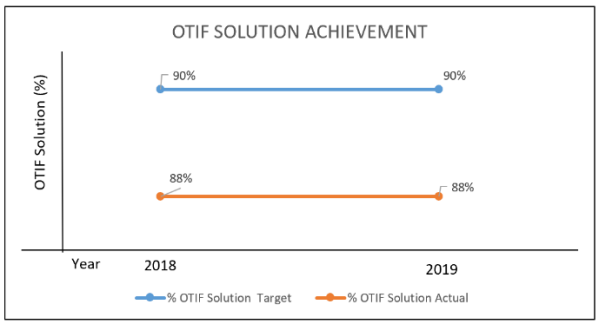

Figure 2 OTIF solution achievement

The readiness of mechanics who have reliable technical skills and knowledge is part of improving product support performance. For this reason, mechanic training is needed following operational needs and training programs that can enhance mechanic competence [2-3].

Training is an essential component in the development of human resources (HR) in an institution to improve the knowledge, skills and positive attitude of human resources to improve the performance of institutions in the face of change and external competition [4].

Training programs can be interpreted as learning experiences that focus on individual efforts to obtain specific skills that can be immediately used.

A training program that is carried out effectively and efficiently will positively contribute to the development and progress of the company. Therefore, the training carried out must be following training need analysis [5-6].

An effective and efficient training program will positively contribute to the development and progress of the company. Therefore, the training must follow the training needs analysis and a competency-based curriculum [7-8].

The first step in creating a competency-based curriculum is to identify these problems in handling machine problems taken from trouble machine data to be analysed so what competencies the mechanic needs to get the job done. The next step is to use the competency requirements to make a training needs analysis and create a competency-based curriculum.

2. METHODOLOGY

2.1. Training Need Analysis and Competency Requirement

Mechanic competency development activities begin with a Training Need Analysis following the operational needs of mechanic abilities. The gap between current mechanic abilities and required mechanic abilities may indicate a problem that can translate into training needs. The condition for mechanic competence is reflected in the achievement of the OTIF solution.

Figure 3 show the machine problem data, and the OTIF solution per machine, both the problem and the OTIF solution for Excavator machines are the biggest problems with 1371 problem. The OTIF solution machine excavator has only been achieved 88% [1].

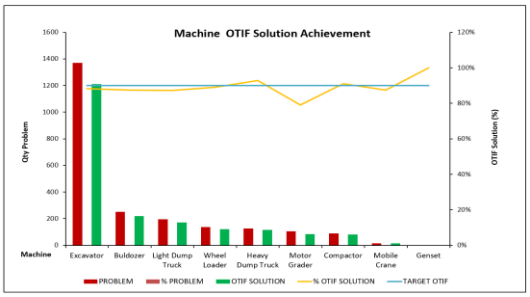

Figure 3 Machine OTIF solution achievement

The machine Problem and OTIF solution data are focused on Machine Excavator for the mechanic's development pilot project. There are nine components and systems used as a reference for measuring the OTIF solution machine in the excavator machine. Each element and method is also measured how much the OTIF solution has achieved. There are three main components and systems for excavators, namely Engine, Hydraulic and Electric is shown in Figure 4 [9-10].

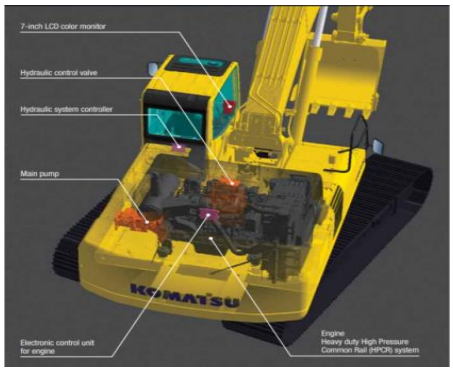

Figure 4 Component and system excavator

From the data on machine system problems and OTIF Solution components on the excavator for OTIF Solution performance in Figure 5, the three parts and systems, namely Engine, Hydraulic and Electrical, are in bad condition. Henceforth, the three competencies will be detailed in specific work competencies. So that

for the development of competency mechanics on machine excavators that will become a pilot project, namely:

1. Troubleshooting engine control system excavator.
2. Troubleshooting hydraulic control system excavator.
3. Troubleshooting electrical control system excavator.

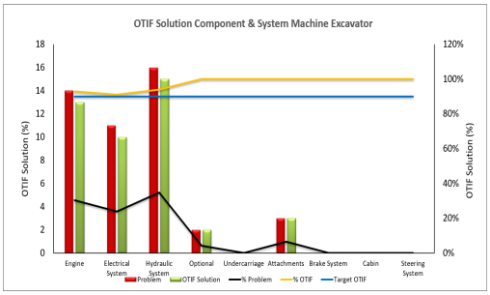

Figure 5 OTIF solution component excavator

2.2. Training Program and Development

2.2.1. Specific Work Competency Standards

Specific work competency standards are competency standards developed and used by organizations to meet their internal organizational goals and meet the needs of other organizations that have a cooperative relationship with the organization concerned. The development of particular work competency standards is based on the need to fulfil the mechanic's competency development activities for the operational needs of the mechanic's abilities as outlined in the training needs analysis. Specific work competency standards may consist of one or several competency units.

Table 1. Matrix of specific work competency standards for trouble shooting engine control system excavator

Competency Unit Title : Implement Trouble Shooting Engine Control System Excavator.
Unit Description : *This unit identifies the competencies required to implement the Trouble Shooting Engine Control System on Excavator heavy equipment.*

No	Competency Element	Performance Criteria	User		
			Mechanic	Instructor	Operator
(1)	(2)	(3)	(4)	(5)	(6)
1	Doing trouble shooting job preparations	1. Damage symptom information has been obtained.	√	√	√
		2. A manual, literature and PM Tune Up form were prepared.	√	√	-
		3. Personal protective equipment and Job Safety Analysis Form prepared.	√	√	-
		4. The machine is parked on a level and safe place.	√	√	√
		5. The machine is ensured to be in a safe condition to do the job.	√	√	-
2	Prepare equipment and tools for trouble shooting work	1. Common tools, measuring tools and diagnostic tools are prepared	√	√	-
		2. Equipment and equipment are certainly suitable for use	√	√	-
3	Doing trouble shooting	1. General Inspection is carried out before the engine is started.	√	√	√
		2. Check the condition of the engine when it starts up	√	√	√
		3. Abnormal machine symptoms are identified.	√	√	-
		4. Check and measure the condition of engine components.	√	√	-
		5. The results of the engine component condition check are stated in the PM Tune Up form.	√	√	-
		6. The results of checking the condition of the engine components are analyzed	√	√	-
		7. Check the components on the engine causing the failure.	√	√	-
		8. The components that cause damage are repaired.	√	√	-
		9. Improvement to prevent the cause of damage done.	√	√	-
4	Create work reports	1. Reports for customers are generated	√	√	-
		2. Technical Service Report created	√	√	-

One example of a specific work competency standard is seen in Table 1, where there are four competency elements, namely making troubleshooting job preparation, prepare equipment and tools for troubleshooting work, making trouble shooting and create work reports. Each competency element in the specific work competency standard will be detailed in performance criteria and user positions that match those competencies [1].

2.2.2. Curriculum and Syllabus

The Curriculum is structured based on competency elements and performance criteria that have been made in specific work competency standards by providing more detailed indicators of the success of each performance criterion and the time needed to study, which in turn can determine the training modules required is shown in Table 2 [8].

Table 2. Training curriculum structure matrix

Training Name : Trouble Shooting Engine Control System Excavator
Total Training Hours : Theory (480 hours), Practice (630 hours)
Training Objectives : Participants are able to perform the Excavator Trouble Shooting Engine Control System according to the Procedure

No	Competency Element	Performance Criteria	Success Indicators	Time Allocation		Training Module
				T	P	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Doing trouble shooting job preparations	1. Damage symptom information has been obtained.	Obtain and obtain information about symptoms of damage	60		Preparation of equipment and trouble shooting work tools
		2. A manual, literature and PM Tune Up form were prepared.	Able to prepare manuals, literature and PM Tune Up forms	30		
		3. Personal protective equipment and Job Safety Analysis Form prepared.	Able to prepare Personal Protective Equipment and Job Safety Analysis forms	30		
		4. The machine is parked on a level and safe place.	Able to do machine parking work in a level and safe place	30		
		5. The machine is ensured to be in a safe condition to do the job.	Able to ensure the machine is in a safe condition to do the job.			
2	Prepare equipment and tools for trouble shooting work	1. Common tools, measuring tools and diagnostic tools are prepared	Able to prepare common tools, measuring tools and diagnostic tools completely.	15		
		2. Equipment and equipment are certainly suitable for use	Able to ensure the appropriateness of the equipment and equipment to be used.	15		

No	Competency Element	Performance Criteria	Success Indicators	Time Allocation		Training Module
				T	P	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
3	Doing trouble shooting	1. General Inspection is carried out before the engine is started.	Able to do a general inspection, namely a walk-around check / visual check before the engine is turned on	15	15	Engine Control System and trouble shooting procedures
		2. Check the condition of the engine when it starts up	Able to carry out checks, namely through the monitor panel and tool work equipment when the engine is turned on	30	60	
		3. Abnormal machine symptoms are identified.	Able to identify symptoms of abnormal symptoms found during machine checking.	30	60	
		4. Check and measure the condition of engine components.	Able to check and measure the performance of engine components.	30	90	
		5. The results of the engine component condition check are stated in the PM Tune Up form.	Able to pour data from performance on engine components in the PM Tune Up form.	15	45	
		6. The results of checking the condition of the engine components are analyzed	Able to perform analysis obtained from inspection of engine components and determine possible causes of damage.	120	300	
		7. Check the components on the engine causing the failure.	Able to check components that are likely to cause damage to the engine.			
		8. The components that cause damage are repaired.	Able to make repairs to components that have been damaged by means of presenting conditions and / or replacing.			
		9. Improvement to prevent the cause of damage done.	Able to make standard standards for the prevention of repeated damage.	30	30	
4	Create work reports	1. Reports for customers are generated	Able to create reports for customers that contain minutes of job completion.	30	30	Technical Report
		2. Technical Service Report created	Able to make a Technical Service Report			

The syllabus is a learning plan for a particular group of training subjects, including competency standards, descriptions of training subjects, essential competencies, performance criteria, performance indicators, training materials, assessments, methods, time allocation and information sources are shown in Table 3.

Table 3. Training syllabus preparation of equipment and troubleshooting work tools

Training Module : Preparation of equipment and trouble shooting work tools
Time Allocation : Theory (180 hours), Practice (0 hours)
Competency standards : Able to prepare the machine and its accessories before doing trouble shooting work according to the procedure.
Training Module Description : This training Module learns about the procedures that must be done to prepare the machines and equipment needed to do trouble shooting work.

No	Competency Element	Performance Criteria	Success Indicators	Training materi	Assessment	Method	Time Allocation T	Time Allocation P	Information Resources
1	Doing trouble shooting job preparations	1. Damage symptom information has been obtained.	Obtain and obtain information about symptoms of damage	8 Step Troubleshooting	Observation & Interview	Lecture	60		Shop Manual
		2. A manual, literature and PM Tune Up form were prepared.	Able to prepare manuals, literature and PM Tune Up forms	Manual Handbook & PM Tune Up Report	Observation & Interview	Lecture	30		Shop Manual
		3. Personal protective equipment and Job Safety Analysis Form prepared.	Able to prepare Personal Protective Equipment and Job Safety Analysis forms	Work safety on the machine	Observation & Interview	Lecture	30		Operation & Maintenance Manual
		4. The machine is parked on a level and safe place.	Able to do machine parking work in a level and safe place	Basic Driving & Operation Procedure	Observation & Interview	Lecture	30		Operation & Maintenance Manual
		5. The machine is ensured to be in a safe condition to do the job.	Able to ensure the machine is in a safe condition to do the job.						
2	Prepare equipment and tools for trouble shooting work	1. Common tools, measuring tools and diagnostic tools are prepared	Able to prepare common tools, measuring tools and diagnostic tools completely.	Methods for selecting and using common tools, measuring tools and diagnostic tools	Observation & Interview	Lecture	15		- Shop Manual - Quality Assurance
		2. Equipment and equipment are certainly suitable for use	Able to ensure the appropriateness of the equipment and equipment to be used.	Calibration methods and standardization of equipment and supplies.	Observation & Interview	Lecture	15		- Shop Manual - Quality Assurance

2.2.3. Blended Learning

For mechanic development programs using Blended Learning, a method is shown in Figure 6. To implement the blended learning program supported by the United Tractors Learning Management System (UT LMS) infrastructure with the name “TOP UP”. United Tractors Learning Management System (UT LMS) is a software application for activities in the network, electronic learning programs (e-learning programs), distributing training materials and enabling collaboration between mechanics and instructors. UT LMS can manage every aspect of the training, from registering participants to storing test results.

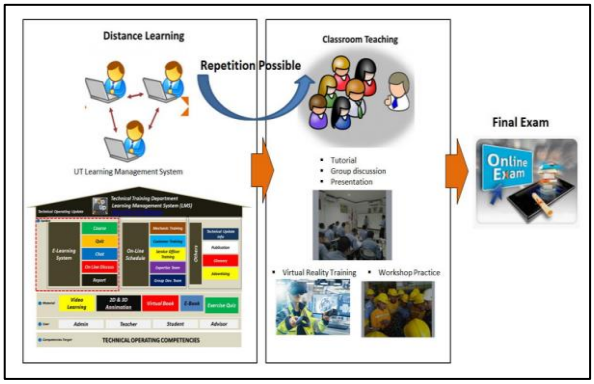

Figure 6 Structure of blended learning

According to the schedule, administrators will register Participants and Course Instructors in the UT Learning Management System called "Top Up" according to the program.

3. RESULTS AND DISCUSSIONS

To determine the mechanics and branches that will be given training, it is determined based on the performance of the OTIF solution where the branch with the Bad category of OTIF solution performance becomes a priority for technical development.

Table 4 shows the 11 (eleven) branches that have OTIF solution performance in the "Bad" category, namely Pakanbaru, Surabaya, Padang, Makassar, Sampit, Tarakan, Pontianak, Manado, Jambi, Bandar Lampung and Palu with a total mechanic of 130 people.

Table 4. OTIF solution machine excavator per branch vs number of mechanic and machine

No	Cab/Site	QtY Mechanic Excavator	QTY Machine Excavator	Problem	OTIF Solution	%	Performance OTIF Solution
1	PAKANBARU	28	429	125	109	87%	Bad
2	SURABAYA	16	254	189	164	87%	Bad
3	PADANG	15	53	33	27	82%	Bad
4	MAKASAR	14	498	59	51	86%	Bad
5	SAMPIT	11	175	69	58	84%	Bad
6	TARAKAN	11	120	80	65	81%	Bad
7	PONTIANAK	10	240	100	83	83%	Bad
8	MANADO	9	174	7	6	86%	Bad
9	JAMBI	8	319	46	40	87%	Bad
10	BANDAR LAMPUNG	5	44	35	25	71%	Bad
11	PALU	3	196	27	23	85%	Bad
12	JAKARTA	13	324	117	106	91%	Good
13	SAMARINDA	33	166	64	58	91%	Good
14	BALIKPAPAN	18	77	141	128	91%	Good
15	SORONG	7	175	23	21	91%	Good
16	PALEMBANG	14	401	14	13	93%	Good
17	JAYAPURA	8	112	117	110	94%	Good
18	MEDAN	11	91	51	50	98%	Good
19	BANJARMASIN	16	213	62	61	98%	Good
20	SEMARANG	7	162	12	12	100%	Good
	Grand Total	257	4223	1371	1210	88%	Bad

The training is carried out using the blended learning method, where the mechanic will train online. Then after the online training, it is continued with tutorials and on-machine practice. Tutorials are conducted online and shown in class with a discussion method facilitated by an instructor [11]. This tutorial event is also a place for sharing mechanics experiences to increase knowledge and skills knowledge among mechanics. After deepening the material through tutorials, with the guidance of an instructor, the training is continued with hands-on practice at the machine excavator to ensure troubleshooting is carried out with the correct procedures, both regarding the procedures for using tools and techniques for solving problems. In this practical training, the mechanic will also try to solve a troubleshooting case study based on the trouble that often occurs in operation and also the trouble simulated by the instructor, which can be detected from the error code on the monitor panel.

3.1. Training Achievement

All mechanics have carried out online training and tutorials in eleven branches for three training modules, namely the engine control system, hydraulic control system and electric control system, to achieve training coverage of 100%.

Table 5 shows the engine control System module all 100% of mechanics passed with the passed training category, the hydraulic control system passed with the given training category of 99.2% or 129 mechanics from

130 mechanics and the electric control system passed with 95.4% passed training categories or 124 mechanics from 130 mechanics.

Table 5. Mechanic training coverage

No	Cab/Site	Participants vs Module						
		Mechanic Plan	Engien Control System		Hydraulic Control System		Electric Control System	
			Actual	%	Actual	%	Actual	%
1	PADANG	15	15	100%	15	100%	15	100%
2	SAMPIT	11	11	100%	11	100%	11	100%
3	PONTIANAK	10	10	100%	10	100%	10	100%
4	BANDAR LAMPUNG	5	5	100%	5	100%	5	100%
5	PAKANBARU	28	28	100%	28	100%	28	100%
6	JAMBI	8	8	100%	8	100%	8	100%
7	MANADO	9	9	100%	9	100%	9	100%
8	TARAKAN	11	11	100%	11	100%	11	100%
9	SURABAYA	16	16	100%	16	100%	16	100%
10	PALU	3	3	100%	3	100%	3	100%
11	MAKASAR	14	14	100%	14	100%	14	100%
	TOTAL	**130**	**130**	**100%**	**130**	**100%**	**130**	**100%**

Figure 7 shows the theory test results provide an overview of all mechanics as training participants who have conducted online theory tests. Mechanics that are declared passed training are mechanics that get a score above 80. In contrast, mechanics who earn a score below 80 are reported not to pass and will be given the opportunity to remedial once with a value above 80, later categorized as passed by corrective.

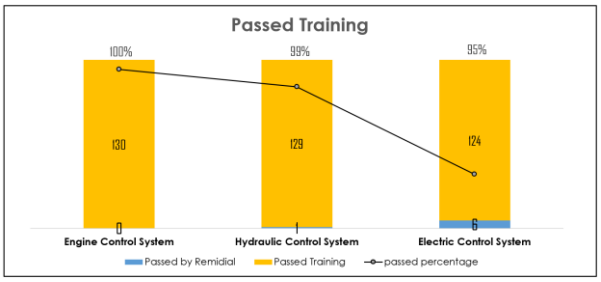

Figure 7 Theory test results

The practical implementation test is carried out directly on the machine excavator and is tested one by one by the trainees by an instructor.

Table 5 shows the practical test results were obtained for three competencies, namely engine control system, hydraulic control system and electrical control system in Good3 position, meaning that proven mechanics can perform troubleshooting well and correctly starting from preparing to solve the problem to the problem is resolved and can be included in technical reports.

Table 6. Trouble shooting assessment skill test result

Competency Elements	Ability Category											
	Engine Control System				Hydraulic Control System				Electric Control System			
	Good1	Good2	Good3	Excelency	Good1	Good2	Good3	Excelency	Good1	Good2	Good3	Excelency
Trouble shooting job preparations	0	0	130	0	0	0	130	0	0	0	130	0
Prepare and using equipment & tools for trouble shooting work	0	3	127	0	0	0	130	0	0	0	130	0
Doing trouble shooting Machine Inspection Program	1	4	125	0	0	0	130	0	0	7	123	0
Doing trouble shooting Machine Trouble Analysis	1	7	122	0	0	6	124	0	0	18	112	0
Create work reports	0	0	126	4	0	6	124	0	0	0	130	0

3.2. Training Program Evaluation

To evaluate whether the program has accommodated the need for increased competency mechanics and the implementation of this program is going well, it is necessary to get input from mechanics as training participants to create a mechanic questionnaire, as shown in Table 7.

Table 7. Mechanic questionnaire result

NO	STATEMENT	CATEGORY				
		Strongly agree	Agree	Disagree less	Disagree	Strongly Disagree
1	The quality of training materials can increase your level of knowledge and skills	343	47	0	0	0
2	The material provided is in accordance with what is needed to support excavator machine troubleshooting	358	32	0	0	0
3	The material provided can be understood and understood well	344	46	0	0	0
4	The material provided can be applied in the workplace and supports excavator troubleshooting work	372	18	0	0	0
5	Online learning time as needed	329	57	4	0	0
6	Tutorial learning time and practice as needed	300	82	8	0	0
7	Practical materials and tools in toubleshooting practice correspond to toubleshooting work	382	8	0	0	0
8	The guidance provided by the instructor in the Tutorial and Practice is easy to understand.	383	7	0	0	0
9	After training are you able to smoothly perform trouble shooting procedures and read trouble shooting charts.	366	24	0	0	0
10	After training are you able to smoothly use the tools to complete touble shooting	379	11	0	0	0

The input of 130 mechanics as responders stated that the program was following the needs of increasing mechanical competence and implementing the program following the mechanic's requirements. As reflected in the majority of respondents said strongly agree and agree. Four responders gave disagree less input at the time allocated for the online learning implementation, and eight respondents gave disagree less information during the tutorial and practical implementation.

To evaluate the program as a whole, starting from the specific work competency standards to whether the curriculum is made, whether it accommodates the need for increasing mechanical competence, and the implementation of this program is running well, it is necessary to get input from the instructor as a teacher in training so that an Instructor Questionnaire is made, as shown in Table 8.

Table 8. Training instructors questionnaire result

NO	STATEMENT	CATEGORY				
		Strongly agree	Agree	Disagree less	Disagree	Strongly Disagree
1	Specific Job Competency Goals and Standards Easy to understand	14	6	0	0	0
2	The learning experiences in the curriculum are appropriate or can support mechanic work	16	4	0	0	0
3	The objectives and competencies are formulated in the curriculum according to the needs of mechanics for operational support	18	2	0	0	0
4	The learning experiences in the curriculum are appropriate or can support mechanic work	17	3	0	0	0
5	Learning experiences are defined in the curriculum according to the amount of time required.	14	3	3	0	0
6	The training programs contained in the curriculum and sylabus can support success in achieving mechanic competencies.	18	2	0	0	0
7	The training programs contained in the curriculum and sylabus can encourage active learning mechanics.	15	5	0	0	0
8	Online training methods, tutorials and practice have been effective	20	0	0	0	0
9	The curriculum and sylabus can be easily understood and understood by the instructor.	17	3	0	0	0
10	The curriculum and sylabus in the training program can be carried out by the instructor	19	1	0	0	0
11	The curriculum and sylabus in the instructor are in accordance with the learning program	20	0	0	0	0
12	The overall implementation of the curriculum and sylabus runs effectively and efficiently	18	2	0	0	0

Of the 20 instructors who taught in this program assessed that the program could be implemented well in increasing mechanic competence according to operational needs. Reflected in the questionnaire results,

most of them stated strongly agree and agree with each statement on the questionnaire.

After the mechanic gets training on the machine excavator, every time there is a problem with the excavator machine, to solve the problem, priority is given to mechanics who have received this training intending to know the increase in mechanical competence have received training in problem-solving and also to improve the performance of the excavator's OTIF solution machine. From the data taken from the HEAT System (Helpdesk Expert Automation Tools) after the mechanic received training on November 9, 2020, to December 10, 2020, 46 problems occurred and were resolved with the appropriate time as many as 43 problems so that the OTIF solution achievement was 93%. Details of the number of the issues and OTIF Solution per component and system can be seen in the OTIF solution achievement Table 9.

Table 9. OTIF solution achievement

No	Component & System	2020 (One Month)				Performance OTIF Solution
		Problem		OTIF Solution		
		Qty	%	Qty	%	
1	Engine	14	30%	13	93%	Good
2	Electrical System	11	24%	10	91%	Good
3	Hydraulic System	16	35%	15	94%	Good
4	Optional	2	4%	2	100%	Good
5	Undercarriage	0	0%	0	0%	
6	Attachments	3	7%	3	100%	Good
7	Brake System	0	0.0%	0	0%	
9	Cabin	0	0.0%	0	0%	
8	Steering System	0	0.0%	0	0%	
	Grand Total	46	100%	43	93%	Good

The results also show that the development of a mechanic competence with a competency-based curriculum impacts improving product support performance, significantly increasing the performance of OTIF solutions. Figure 8 is a reflected that there has been an increase in OTIF solution above the 90% target for components and systems for the engine control system, hydraulic control system and electric control system on machine excavators so that the excavator's OTIF solution machine has increased from 89% in 2018 and 88% in 2019 to 93% in 2020.

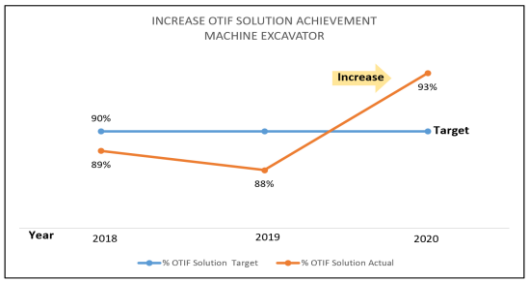

Figure 8 Increase OTIF solution achievement on excavator

4. CONCLUSIONS AND FURTHER IMPROVEMENT

4.1. Conclusions

a. The research results show that the development of mechanic competence through competency-based training and problems in the field can increase the ability and speed of mechanics to solve problems that occur in machines. The knowledge and speed of mechanics to solve machine problems will affect the performance of OTIF solutions. The more issues that are resolved from problems that occur in the machine and the completion time is below the specified time standard, and the OTIF solution performance will be good. Conversely, the more problems are resolved, but the time to solve them is above the specified time standard, the OTIF solution performance will be wrong. A good performance of the OTIF solution reflects good product support performance and vice versa.

b. The research results that have been carried out show that the development of mechanics that refers to the competency standards for particular work and pour in more detail into a competency-based curriculum can align training programs. Competency needs to be required in operations.

c. The research results that have been carried out show that the development of mechanics using the blended learning method, namely mechanic learning independently through online and tutorials containing discussions and direct practice in machines with the guidance of an instructor, is an effective learning method.

4.2. Further Improvement

From the research that has been done, several things need to be further improved and developed to obtain more accurate data and testing of a mechanic competency development program with a competency-based curriculum to increase the performance of the OTIF solution. The following are some recommendations that can be made to optimize this research:

a. To get the accuracy of the relationship between the improvement of mechanic competence and the performance of the OTIF solution, the OTIF solution data is more accurate if taken at least within six months to obtain OTIF solution data from more problem machines.

b. To obtain a more precise training program and following the need for increasing mechanical competence, the preparation of specific work

competency standards, curriculum and syllabus is carried out in collaboration with experts in each machine such as Instructors, Technical Consultants, Quality Assurance and Senior Mechanics.

c. Training with the blended learning method can be carried out in other training modules to accelerate the improvement of mechanic competence across branches by adding time to tutorial and practice sessions.

AUTHORS' CONTRIBUTIONS

Teguh Setiono made contributions as first authors. Data was collected and analysed by Teguh Setiono and Dena Hendriana. All authors (Henry Nasution, Gembong Baskoro, and Edi Sofyan) made contributions to the design of the study and the writing of the manuscript.

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