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ANALYSIS OF THE PILAR TPM EFFECT ON PRODUCTIVITY TO IMPROVING THE COMPETITIVENESS OF TEXTILE INDUSTRIES IN INDONESIA

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Abstract

The growth of the textile industry is growing rapidly in Indonesia, both on a large scale (macro) and small scale (micro). Based on data from Ministry Industrial in 2016, the textile and textile products industry (TPT) is currently ranked third in national exports and The Indonesian government is targeting exports of the textile and textile products (TPT) of 2019 to reach USD 15 billion and USD 30 billion in 2025. This is a big challenge for all companies to increase the amount of their exports so that all targets are expected. Productivity is one challenges faced so that needed various systems one of which is TPM. TPM is a method used to increase machine productivity through maintenance of equipment. Aim from research this is for knowing how much influence TPM pillars are measured formatively through Autonomous Maintenance, Planned Maintenance Against an Administrative Office Productivity. Data collected and then processed using the SmartPLS 3.0 application. Evaluation is carried out for the outer model (measurement model) and then the Inner model (structural model). Research this find results that of the 3 selected TPM pillars Autonomus Maintenance has a significant effect to productivity while Planed Maintenance has influence was and who occupies position last one is a maintenance office administration small. Paper this recommend that top management commitment infor improve skills and knowledge employee especially operators so that the TPM pillar runs with well and so that productivity of the textile industry more and more high will chaotic to value export so that have power competitiveness industry high Indonesian textiles to other countries.

Keywords: *Pillars of TPM, Industry Textiles, Factors Significant, Impact, SEM-PLS.*

1. Introduction

In the current era of globalization, business competition is very sharp, both in the domestic (national) market and in the global (international) market. The growth of the textile industry is growing rapidly in Indonesia, both on a large scale (macro) and small scale (micro). The development of the textile industry resulted in increased competition among companies struggling in the textile industry and increasing economic growth. Based on data from the Ministry of Industry in 2016, the textile and textile industry (TPT) currently ranks third in national exports and absorbs employment of up to 2.79 million people with production that is able to meet 70 percent of national clothing needs.

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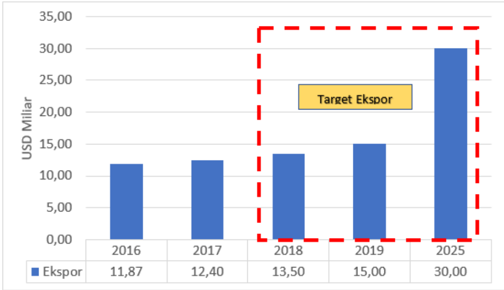

Figure 1.1 Target Ekspor Indonesia

In 2016, exports of textiles and textile products reached USD 11.87 billion, while in 2017 exports of textiles reached USD 12.4 billion, and the Indonesian government is targeting exports of textiles and to USD 15 billion USD30 billion in 2025. This is a big challenge for the entire company to increase the number of exports so that all targets are expected to be achieved. But there is still something to be done that exists in the textile industry. There are a number of challenges besides import duty, domestic challenges that affect the low number of Indonesian exports. According to General Chair of the Indonesian Textile Association (API), Ade Sudrajat stated that high electricity tariffs hampered textile production and made it difficult for Indonesia to compete with Vietnam and Bangladesh. This is because electricity tariffs in both countries are cheaper than Indonesia. There are also inadequate infrastructure factors and result in slow delivery and high logistics costs. And productivity that is considered still not optimal. Stating that the productivity of the textile industry production machinery in Indonesia is still not optimal and suggestions from the study suggest using the TPM method to increase productivity. TPM is a method used to increase machine productivity through maintenance / maintenance of equipment. To implement the TPM (Total Productive Maintenance) concept in a manufacturing company, strong foundations and sturdy pillars are needed. The foundation of TPM is 5S, while the main pillar of TPM consists of 8 pillars or usually referred to as 8 Pillars of TPM (Eight Pillar of Total Productive Maintenance). According to Maier et al.(1998) in the literature review of Ahuja, IPS, &Khamba, JS (2008) explaining that maintenance and office administration is a factor that reflects the implementation of TPM. This prompted researchers to examine how the influence of Autonomus Maintenance and Plan Maintenance on productivity to improve the competitiveness of the textile industry.

II. LITERATURE REVIEW

1. Understanding TPM

Total productive maintenance (TPM): TPM is a unique Japanese philosophy, which has been developed based on the Productive Maintenance concepts and methodologies. This concept was first introduced by M/s Nippon Denso Co. Ltd. of Japan, a supplier of M/s Toyota Motor Company, Japan in the year 1971. Total Productive Maintenance is an innovative approach to maintenance that optimizes equipment effectiveness, eliminates breakdowns and promotes autonomous maintenance by operators through day-to-day activities involving total workforce (Bhadury, 2000).

TPM has been widely recognized as a strategic weapon for improving manufacturing performance by enhancing the effectiveness of production facilities (Dwyer, 1999; Dossenbach, 2006). TPM has been accepted as the most promising strategy for improving maintenance performance in order to succeed in a highly demanding market arena

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(Nakajima, 1988). TPM is a highly influential technique that is in the core of "operations management" and deserves immediate attention by organizations across the globe (Voss, 1995, 2005).

"TPM aims at:

1. Establishing a corporate culture that will maximize production system effectiveness.

2. Organizing a practical shop-floor system to prevent losses before they occur throughout the entire production system life cycle, with a view to achieving zero accidents, zero defects and zero breakdowns.

3. Involving all the functions of an organization including production, development, sales and management.

4. Achieving zero losses through the activities of 'overlapping small groups'." Japan_Institute_of_Plant_Maintenance (1996)

2. Benefits of TPM Implementation

The literature documents dramatic tangible operational improvements resulting from successful TPM implementation. "Companies practicing TPM invariably achieve startling results, particularly in reducing equipment breakdowns, minimizing idling and minor stops (indispensable in unmanned plants), lessening quality defects and claims, boosting productivity, trimming labor and costs, shrinking inventory, cutting accidents, and promoting employee involvement (as shown by submission of improvement suggestions)." (Suzuki 1994 p. 3) He cites, for example, PQCDSM (Productivity, Quality, Cost, Delivery, Safety, Morale) improvements for early TPM implementers in Japan.

1. P – Productivity.

Net productivity up by 1.5 to 2.0 times. Number of equipment breakdowns reduced by 1/10 to 1/250 of baseline. Overall plant effectiveness 1.5 to 2.0 times greater.

2. Q – Quality.

Process defect rate reduced by 90%. Customer returns/claims reduced by 75%.

3. C – Cost: Production costs reduced by 30%.

4. D – Delivery: Finished goods and Work in Progress (WIP) reduced by half.

5. S – Safety.

Elimination of shutdown accidents. Elimination of pollution incidents.

6. M – Morale: Employee improvement suggestions up by 5 to 10 times.

3. Pillar TPM

The basic practices of TPM are often called the pillars or elements of TPM. The entire edifice of TPM is built and stands, on eight pillars (Sangameshwran and Jagannathan, 2002). TPM paves way for excellent planning, organizing, monitoring and controlling practices through its unique eight-pillar methodology. TPM initiatives, as suggested and promoted by Japan Institute of Plant Maintenance (JIPM), involve an eight pillar implementation plan that results in substantial increase in labor productivity through controlled maintenance, reduction in maintenance costs, and reduced production stoppages and downtimes.

There are a variety of tools that are traditionally used for quality improvement. It provides an easy way of deploying activities through its TPM promotion organization

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involving 100% of employees on a continuous basis. TPM uses the following tools to analyze and solve the equipment and process related problems: Pareto Analysis, Statistical Process Control (SPC – Control Charts, etc.) Problem Solving Techniques (Brainstorming, Cause-Effect Diagrams and 5-M Approach) Team Based Problem Solving, Poka-Yoke Systems, Autonomous Maintenance, Continuous Improvement, 5S, Setup Time Reduction, Waste Minimization, Bottleneck Analysis, Recognition and Reward Program and Simulation (Jostes and Helms, 1994). Figure 3 shows the framework for TPM implementation and depicts the tools used in the TPM implementation program with potential benefits accrued and targets sought, while Table III depicts the key activities to be holistically deployed for effective 5S implementation at the workplace.

TPM provides a comprehensive, life cycle approach, to equipment management that minimizes equipment failures, production defects, and accidents. These objectives require strong management support as well as continuous use of work teams and small group activities to achieve incremental improvements.

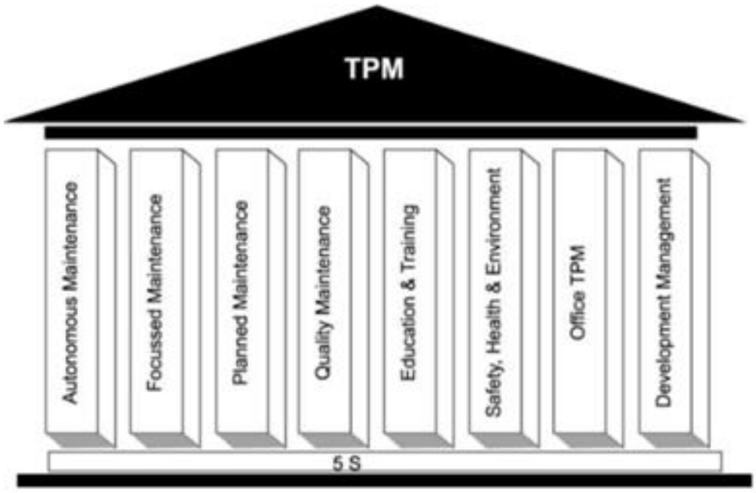

Figure 2.1 TPM Pillar

4. PLS SEM

Partial Least Square / (PLS) is a family-based regression method introduced by Herman OA Wold for the creation and development of models and methods for the social sciences with a predictive-oriented approach. PLS is an alternative method of (SEM) which can be used to overcome the problem of the relationship between complex variables but the size of the data sample is small (30 to 100), since SEM has a minimum sample size of 100 (Hair /et.al./, 2010) . PLS is used to determine the complexity of the relationship between a construct and other constructs, as well as the relationship between a construct and its indicators. PLS is defined by two equations, namely inner model and outer model. Inner model determines the specification of the relationship between the extract and its indicators (Yamin and Kurniawan, 2009)

III. RESEARCH METHODOLOGY

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The research methodology is used as a reference in conducting research so that the research process carried out can run systematically. In the presence of this methodology, then the problem solving cycle can be carried out in a structured manner. Troubleshooting steps can be seen from the following picture.

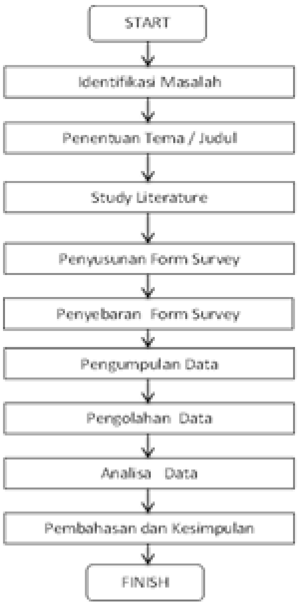

Figure 3.1 Flow chart of research methods

IV. RESULT AND DISCUSSIONS

In this study, hypothesis testing uses Partial Least Square (PLS) analysis techniques with smartPLS 3 programs. The following is the model framework tested:

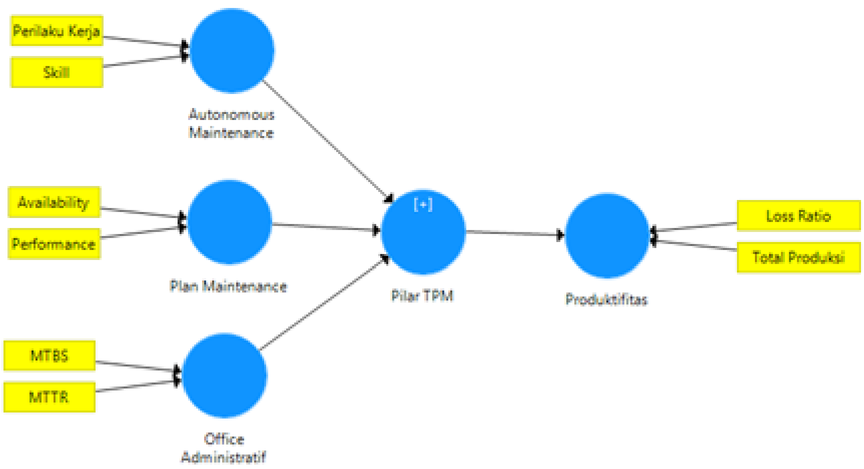

Figure 4.1 . Structural Model Framework

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Based on Figure 1, the research hypothesis that will be proven in this study is the presence or absence of a significant effect of the TPM Pillar which is measured formatively through autonomous maintenance, maintenance plan and office administration on productivity.

4.2 Flow Chart of Analysis

In this study, in the outer model section, all variables are formed formatively. Meanwhile, the Pillar TPM variable is measured by the secondary order so that there is a second order stage and the 1st order. The flow chart of the analysis carried out can be seen in Figure 2.

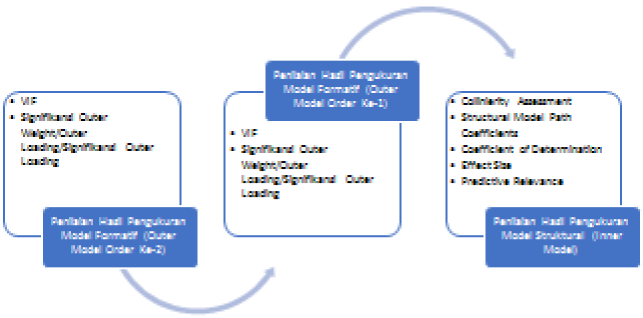

Figure 4. 2 Flow Chart Analysis

4.3 Evaluation of Formative Model Measurement Results (2nd Order Outer Model)

The results of the second order formative model of this study can be seen in general Table 1 and Figure 1.

Table1.Results of Formative Model Measurement (2nd Outer Model Order) Stage 1

Indicator	VIF	Outer Weight	Significance of Outer Weight	Outer Loading	Significance of Outer Loading
Availability	6,506	0.859	0.211	0.998	0,000
IMCI	1,002	0.968	0.179	0.955	0.185
MTTR	1,002	0.296	0.662	0.254	0.711
Performance	6,506	0.151	0.829	0.942	0,000

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Work Behavior	1,195	0.007	0.895	0.409	0.002
Skill	1,195	0.997	0,000	1,000	0,000

Red = Fulfill

Yellow = Not Fulfilling

Based on Table 1, the autonomous maintenance measurements can be seen that there is no multicollinearity in work behavior and skill (seen from the VIF value <5). On examining significance of the outer weight it can be seen that the skill is significant (significance of outer weight <0.05) while performance behavior is not significant (significance of outer weight> 0.05), so skill is used while work behavior needs examination of outer loading. On checking outer loading, the value of outer loading work behavior is <0.5, so it needs to be continued on checking the significance of the outer loading. On checking the significance of outer loading, the significance value of work behavior has been <0.05 so that work behavior can be used.

Table 2.Results of Formative Model Measurement (2nd Outer Model Order) Stage 2

Indicator	VIF	Outer Weight	Significance of Outer Weight	Outer Loading	Significance of Outer Loading
Availability	1,000	1,000		1,000	
MTBS	1,000	1,000		1,000	
Work Behavior	1,195	0.010	0.830	0.412	0.002
Skill	1,195	0.996	0,000	1,000	0,000

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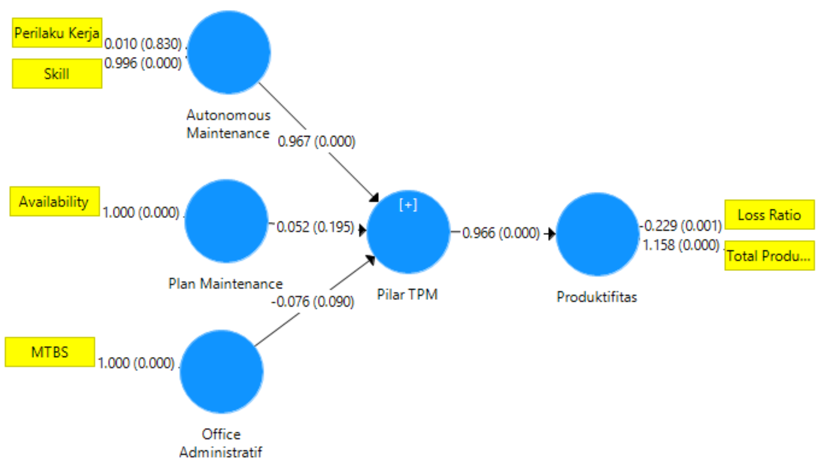

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Based on Table 2, on autonomous maintenance measurements it can be seen that there is no multicollinearity in work behavior and skill (seen from the VIF value <5). On examining significance of the outer weight it can be seen that the skill is significant (significance of outer weight <0.05) while performance behavior is not significant (significance of outer weight> 0.05), so skill is used while work behavior needs examination of outer loading. On checking outer loading, the value of outer loading work behavior is <0.5, so it needs to be continued on checking the significance of the outer loading. On checking the significance of outer loading, the significance value of work behavior has been <0.05 so that work behavior can be used.

4.4 Assessment of Formative Model Measurement Results (1st Order Outer Model)

The measurement results of the 2nd order formative model this research in general can be seen in Table 3 and Figure 5.

Table 3. Results of Measurement of the 1st Order Formative Model Stage 3

Indicator	VIF	Outer Weight	Significance of Outer Weight	Outer Loading	Significance of Outer Loading
Autonomous Maintenance	1,295	0.967	0,000	0.995	0,000
Loss Ratio	2,233	-0.231	0.001	0.628	0,000
Office Administrative	1108	-0,076	0.118	-0.155	0.343
Plan Maintenance	1,353	0.052	0.193	0.454	0,000
Total Production	2,233	1,160	0,000	0.987	0,000

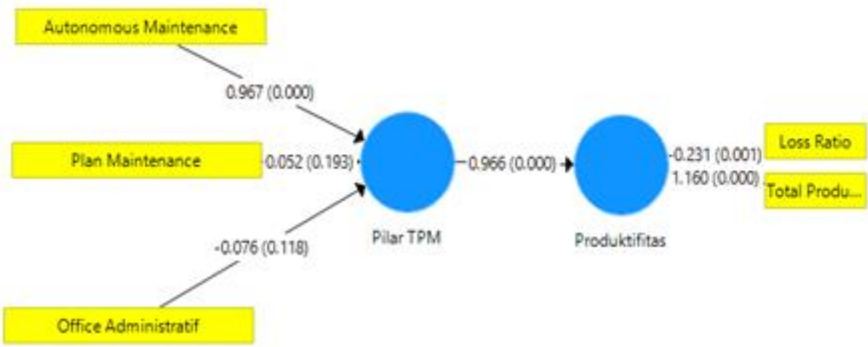

Figure 2. Result Phase 3

Based on Table 3, in the measurement of productivity it can be seen that there is no multicollinearity in the loss ratio and total production (seen from the VIF value <5), so

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that it can be continued on examining the significance of the outer weight. On examining significance of the outer weight it can be seen that both are significant (significance of outer weight <0.05) so that both are used.

Table 4. Results of Measurement of the 1st Order Formative Model Stage 4

Indicator	VI F	Out er Weight	Significa nce of Outer Weight	Oute r Loading	Significa nce of Outer Loading
Autonom ous Maintenance	1, 232	0.98 7	0,000	1,00 0	0,000
Loss Ratio	2, 233	- 0.249	0,000	0.62 1	0,000
Plan Maintenance	1, 232	0.03 0	0.501	0.45 8	0,000
Total Production	2, 233	1,17 1	0,000	0.98 6	0,000

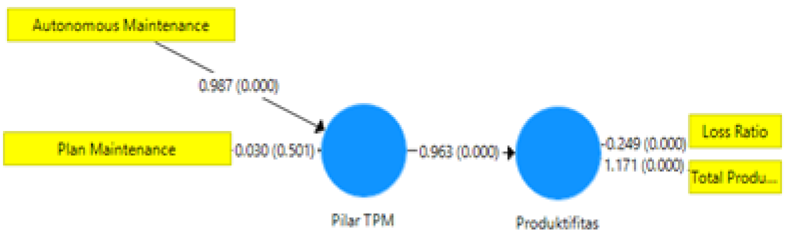

Figure 3. Result Stage 4

4.5 Evaluation of Structural Model Measurement Results (Inner Model)

4.5.1 Collinierity Assessment

Table 5.Inner Model VIF

Variable	Pillar of TPM	Productivity
Pillar of TPM		1
Productivity		

4.5.2 Structural Model Path Coefficients

Coefficient analysis of structural models is used to determine which relationships have a significant effect. The results of the coefficient analysis of structural models can be seen in Figure 7 and Table 6. If p-value <α (0.05) then the relationship is significant, whereas if p-value is ≥ α (0.05) then the relationship is not significant.

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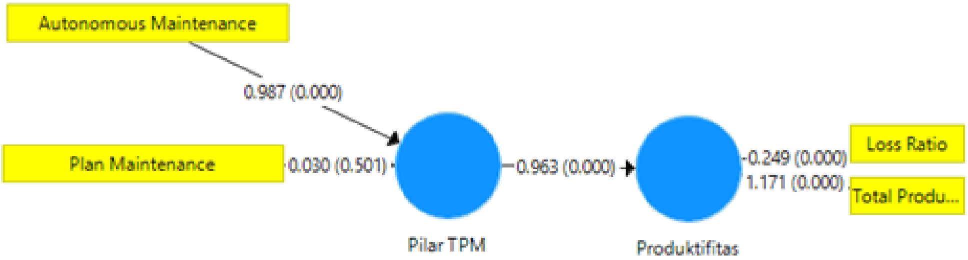

Figure 4. Results of SEM-PLS analysis

Table 6. Coefficient and Testing of the Effect of Structural Models

Influence	Coefficient	T Statistics	P Values
Pillar TPM -> Productivity	0.963	140,482	0,000

Based on the results of Table 6, it can be seen that the Pillar of TPM has a significant effect on productivity because the p-value <0.05. The coefficient of influence of TPM pillars on productivity is positive, which means that the increasing pillars of TPM will cause productivity to increase as well. In Figure 7 it can be seen that the largest TPM pillar is formed by Autonomous Maintenance, only after that Plan Maintenance (this can be seen from the largest outer weight value). While the greatest productivity is formed by total production, only after that loss ratio.

4.5.3 Coefficient of Determination

The coefficient of determination is used to measure the accuracy of estimation. The results can be seen in Table 7. In general the R 2 value of 0.75 is considered to have a large estimation accuracy, R 2value of 0.50 is considered to have a moderate estimation accuracy, and an R 2 value of 0.25 is considered to have a weak estimation accuracy.

Table 7. Coefficient of Determination

Latent variable	R 2
Productivity	0.928

Based on the results of Table 7, it can be seen that the accuracy of productivity estimates is in a large category because it has a value of more than 0.75. This means the accuracy of the estimation is quite good.

4.5.4 Effect Size

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In addition to evaluating the value of R 2 of all endogenous variables we can use f 2 . The difference f 2 with R 2 is f 2 more specific to each exogenous variable. The results of testing f 2 can be seen in Table 8. In general the value of 0.02 is considered to have a small effect size, 0.15 has a medium effect size and 0.35 has a large effect size.

Table 8. Effect Size

Variable	Pillar of TPM	Productivity
Pillar of TPM		12,89909
Productivity		

Based on the value of f 2 in Table 8 it can be seen that the Pillar of TPM has a large effect size on organization performance.

4.5.5 Predictive Relevance

In addition to evaluating the value of R 2 as a criterion of prediction accuracy, researchers can use the value of Stone-Geissers Q 2. The value of Q 2 is obtained using the blindfolding procedure. As a relative measurement of predictive relevance, a value of 0.02 is considered to have small predictive relevance, 0.15 has moderate predictive relevance and 0.35 has a large predictive relevance. The results of predictive relevance (Q 2) can be seen in Table 8.

Table 9. Preductive Relevance

Latent variable	Q^2
Productivity	0.595

Based on the results in Table 8, it can be seen that predictive relevance for impact to customer and organization performance is large .

V. CONCLUSIONS

It was concluded that the TPM Pillars analyzed, namely Autonomus Maintenance, Planed Maintenance and Office Administration had a significant influence on productivity. The order of the influence of the TPM pillar variable on productivity is Autonomus Maintenance, Planed Maintenance and Office Administration. Autonomous Maintenance has the greatest influence. Whereas Planed Maintenance is under moderate influence and the Administrative Office is in the fall analysis so that it can be concluded at the last position.

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Maintenance Autonomus is the biggest of productivity. This makes the management of the company must have a great commitment in improving skills and sufficient knowledge so that the TPM pillar can run well so that engine reliability increases and productivity increases.

The survey results are for the textile industry. According to the type of industry the ratings can vary and new hierarchies can be obtained easily. For the chemical industry, the main priority might be in the SHE pillar, while the service industry might be an OTPM.

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