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THE FACTORS AFFECTING ON THE SUCCESS OF IMPLEMENTING TOTAL PRODUCTIVE MAINTENANCE IN THE MANUFACTURING COMPANY (NS BLUESCOPE VIETNAM)

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Abstract

The competition in business environment becomes more strictly, manufacturers must introduce lots of new products on the high quality level with suitable price. Thus, new technologies have been applied, manufacturing systems become more complex. Therefore, a new strategy for maintenance such as Total productive maintenance (TPM) becomes really necessary. Many organizations have implemented TPM to increase the effectiveness of manufacturing system. However, implementation of TPM still meets a lot of drawbacks. This paper, will focuses on the factors can help implementing the TPM successfully in manufacturing organizations. This study is an attempt to look at the successful factors of TPM implementation at NS BlueScope Vietnam, a steel manufacturer

Introduction

The more continuously development of technology improves, the more complexity of manufacturing systems increase in order to satisfy rising demand of customer about implementation and effectiveness. Lots of systems are operating at below level of maximum capacity which can make productivity at low level if compared with the operating cost. More automatic equipment, robotics, and high technology controlled by computer are used in the factory in order to improve productivity. Thus, maintenance works become harder, the cost increases significantly.

The cost for operation, maintenance and support are intangible cost. However, they affect much on product cost, as a reason makes production cost higher initial estimation.

The higher competitiveness influences on the profit and position of a company in the market. So, the maintenance activities are no longer considered as support function, non-added value to business. Various companies have proved that effective maintenance strategy can bring a lot of benefits throughout Total Productive Maintenance (TPM) program.

An approach, improvement of maintenance activities for manufacturing factory is to implement and develop Total Productive Maintenance (TPM) program effectively. However, there are a lot of organizations fail to develop this system. This is hard program to implement, with heavy effect of culture, finance, differences of each department, and barriers about characteristics of work.

Total Productive Maintenance (TPM) system has been applied at NS BlueScope Vietnam for a year. It has showed that some initial success, however there are still a lot of obstacles which require management team must overcome.

This paper will show a general picture about implementation of TPM program, realization of the difficulties, obstacles and determine primary factors can affect on the success of this process which helps the management team have appropriate strategy for next steps.

Moreover, other organizations which have the similar situation can consider this as a reference so that they can apply this for factories.

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Research Methodology

Significance of research in theory Side
With the reference of previous papers, scientific researches and interview with specialists at the company combined with the use of questionnaire for survey is an effective way to realize factors affecting the implementation of TPM.

Significance of research in practice
Realization, analysis, classification of factors on success of implementation TPM at the factory can help to predict future risks and propose solution for preventing, and minimizing the negative impacts.

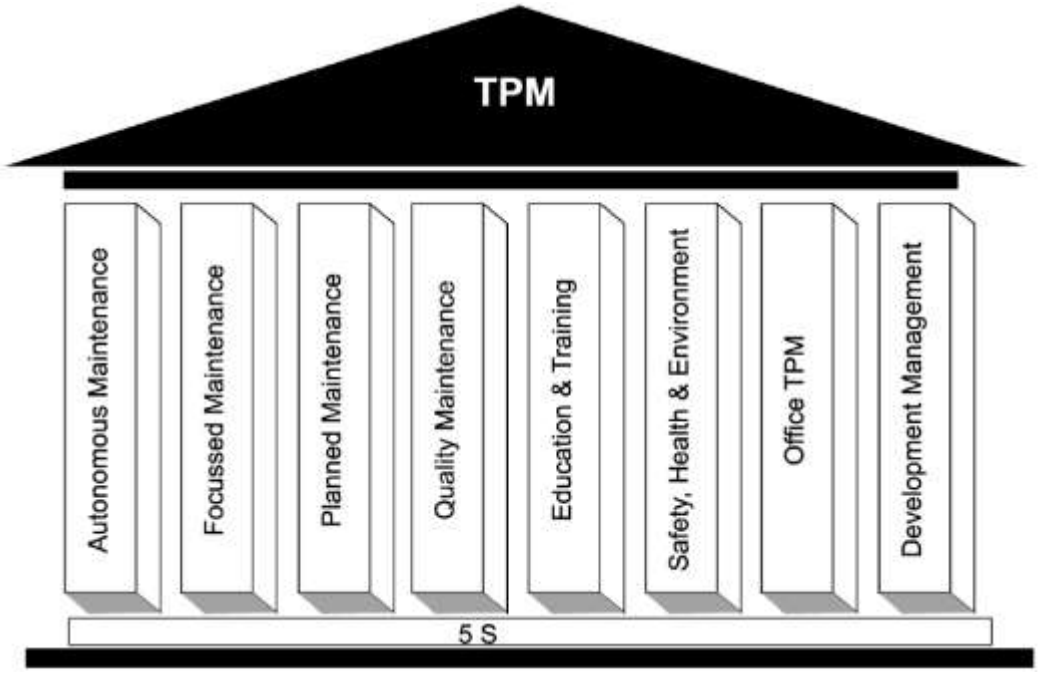
To help the managers can implement management more effective, suitable to characteristics of each work and culture at organization.

Provide more solution, reference, for outside BlueScope managers can apply for their companies.

Literature Review

Defining TPM
TPM has different definitions by researchers all over the world. One of researchers is Nakajima S, he has basic definitions, the importance, objective, benefit and drawbacks of TPM, he stated that: "manufacturing program designed primarily to maximize the effectiveness of equipment throughout its entire life by the participation and motivation of the entire workforce".

As mentioned above, TPM plays a very important role in manufacturing. As the research of Chan et al (2003), from 15% to 40% with an average of 28% of total production cost can be attributed to maintenance activities. If implementing TPM well, it can save a lot of cost for maintenance, for reducing for break down cost, etc. So, implementation of TPM to factory is really necessary.



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In the discussion of I.P.S.Ahuja and J.S.Khamba, TPM includes eight factors as following:

1. Autonomous Maintenance: Operators implement some basic maintenance works. So, maintenance technicians and engineers can spend more time on implementing more complicated activities which can help to avoid waste of human resource.
2. Focused Maintenance: priority to focus on improving important problem. Besides, innovative ideas form individuals or departments are still encouraged.
3. Planned Maintenance: Implement preventive maintenance in order to avoid unscheduled delays, repeated errors, increase machine life time, reduce cost for maintenance
4. Quality Maintenance: build an effective quality management system, analyse production procedure, control the quality of maintenance activities.
5. Education & Training: establish training system for employees about TPM and maintenance not only participating training courses but also understanding deeply what are taught.
6. Safety, Health and Environment: establish a safe environment without accident, pollution, occupational diseases.
7. Office TPM: collect, analysis data, supply information and satisfy requirement of production.
8. Development Management: consider, analyze all steps of production lines, and improve process.

- These pillars create the TPM house. If a company wants to apply TPM, they must implement all above elements and maintain them. These pillars will give operators greater "ownership" about the equipment, reduce significantly instances of unplanned stop time, quality maintenance will help reduce number of defects, or other pillars will support production through improving administrative operation, etc.

The JPIM'S 12 steps to implement TPM

Stage 1: Preparatory stage of importing TPM
Step 1. Determination manifesto of importing TPM among operation stratum
Step 2. Education and advocating of importing TPM
Step 3. TPM promoting organization and establish career structure demonstration
Step 4. Basic Policy and Target Setting of TPM
Step 5. Design the main plan of carrying out TPM

Stage 2: Commencement of importing TPM
Step 6. The implementation of TPM (the Kick-Off Meeting)

Stage 3: Implementation stage of importing TPM
Step 7. Establish efficiency system for production department
Step 8. Establish initial management system for new products and new equipment
Step 9. Establish quality maintenance system
Step 10. Establish efficiency system for management and indirect departments
Step 11. Establish management system of safety, health and environment

Stage 4: Realization stage
Step 12. Full implementation and level upgrading of TPM

Data Collection Method
To achieve the objectives, secondary, primary research and survey will be used. With secondary research, data will be selected to realize common factors and special factors happening in implementing process.

Secondary and survey will be combined with theoretical about quantitative and qualitative research, using idea collection, document analysis, and participant observation.

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The author collected about 60 factors from the previous researches, journals, papers of the scientists all over the world. After using group discussion with management team at NS BlueScope for filtering these factors, the author will implement questionnaire survey and data analysis for 25 remaining factors which divided into 5 main groups' factors.

Variable	Factors
Training and Skill development (TSD)	1. Technical trainings to the operators 2. Carry out high-quality, high-effective educational trainings 3. Make all employees understand the meanings of TPM promptly 4. Draw up educational training plans carefully 5. Guidance from professionals
Management commitment (MC)	1. Long-term commitment to TPM by senior managers 2. Continuous and obvious concentration and support to TPM by senior managers 3. High value on long-term benefits by senior manage 4. Support and participation of all directors
Plan and Strategy (PS)	1. Carry out effective feasibility studies 2. Develop effective lead-in plan 3. Clear management plans and implementation of factory management 4. Develop a strategy which is suitable for company's environment, equipment and products
Willingness of Employee (WE)	1. Acquire the support from employees within the company 2. Full empowerment to the employees 3. Overall employee involvements 4. High involvement willingness of the operators to the maintenance works 5. Acquire the consensus of all employees within the company 6. Cognition and support to TPM activities by maintainers
Measurement of performance and Recognition (MR)	1. Measurable policies, targets and effectiveness 2. Establish specific department to carry out TPM activities 3. The operating department must take out more inspections to related industries, and attend workshops 4. Make the best of equipment maintenance records, and seize the opportunities of improvement 5. Good maintenance data record or maintenance status

GENERAL INFORMATION ABOUT THE COMPANY

NS BlueScope Vietnam LTD. Co

"A subsidiary of 50:50 joint venture enterprise between BlueScope and Nippon Steel & Sumitomo Metal Corporation of Japan. NS BlueScope Coated Products serves the building construction, manufacturing and home appliance industries with innovative, high quality coated & painted steel products across ASEAN and North America region. Our metal coating, painting and roll-forming businesses employs over 3,000 people across 29 plants in Indonesia, Thailand, Malaysia, Vietnam, Singapore, Brunei and the US, and over 300 employees in Vietnam. For more than two decades, NS BlueScope Vietnam has carefully nurtured and continue to build on our reputation for unsurpassed quality in premium steel products and pre-engineered solution for Projects, Retail, Manufacturing and Home Appliances segment.

Today, NS BlueScope is a name synonymous with high quality, innovation and solution design. The customer will find our steel products at homes, shopping malls, offices, factories and practically all iconic buildings from Kuala Lumpur's Twin Towers to Suwarnnabhumi Airport in Bangkok to St Theresa's Church in Singapore to possibly your next dream house."

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(Source: http://www.bluescope.com.vn/?about=overview-en)

In order to secure a lot of strict requirement in current situation such as maintaining product at high quality, reducing cost, increasing productivity, BlueScope Vietnam has been investing lots of money on technology and human. One of the strategies is apply total productive maintenance (TPM) system for manufacturing.

DATA ANALYSIS

After collecting the potential factors and build the framework for analysis, questionnaire survey will be used to get all the necessary information for research analysis. Ideas, questions are taken from the specialists, employees at NS BlueScope Vietnam and papers of researchers.

Application of the mathematic statistical analysis is necessary to find out the main factors and discuss these results.

1. Analysis of business situation and performance of the company based on the steps as below:
2. Implement Descriptive statistic of samples
3. Respondent profile
4. Assessing the Reliability of Scales: Cronbach's alpha
5. Exploratory Factor Analysis (EFA)
6. Cronbach's Alpha analysis after Exploratory Factor Analysis
7. New model based on Exploratory Factor Analysis
8. Model testing via regression analysis
9. Pearson coefficient of correlation formula
10. Correlation analysis between independent variable and dependent variables
11. Evaluation and testing the appropriation of model
12. Multivariate regression formula and meaning of regression coefficients
13. Retesting of model

From 5 main groups with 25 factors, after implementing analysis, it is re-arranged

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
TSD2	.795				
TSD1	.744				
TSD3	.702				
TSD4	.684				
TSD5	.610				
MC4					
WE5		.834			
WE6		.731			
WE3		.704			
WE4		.662			
MC3			.702		
WE2			.645		
WE1			.632		
MC2			.599		
MC1					
PS2				.786	
PS3				.725	
PS1				.650	
PS4					

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MR5					.684
MR4					.680
MR6					.650
MR3					.641
MR1					.591
MR2					

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 11 iterations.

Group	Variable	Description
Training and Skill Development (TSD)	**TSD2**	Carry out high-quality, high-effective educational trainings
	TSD1	Technical trainings to the operators
	TSD3	Make all employees understand the meanings of TPM promptly
	TSD4	Draw up educational training plans carefully
	TSD5	Guidance from professionals
Involvement of Full Workforce (IW)	**WE5**	Acquire the consensus of all employees within the company
	WE6	Support to TPM activities by maintainers
	WE3	Overall employee involvements
	WE4	High involvement willingness of the operators to the maintenance works
Top-down Teamwork spirit (TS)	**MC3**	Support and participation of all directors
	WE2	Full empowerment to the employees
	WE1	Acquire the support from employees within the company
	MC2	Continuous and obvious concentration and support to TPM by senior managers
Plan and Strategy (PS)	**PS2**	Develop effective lead-in plan
	PS3	Clear management plans and implementation of factory management
	PS1	Carry out effective feasibility studies
Control and Recognition (CR)	**MR5**	Make the best of equipment maintenance records, and seize the opportunities of improvement
	MR4	Establish overall and long-term targets
	MR6	Good maintenance data record or maintenance status
	MR3	Recognition and award for employees
	MR1	Measurable policies, targets and effectiveness

Output will be the final model for the research including 3 main group factors: Training and Skill Development, Top-down teamwork spirit, Involvement of full workforce with 13 observed factors.

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Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t
		B	Std. Error	Beta	
1	(Constant)	.841	.250		3.369
	X1	.347	.059	.421	5.855
	X2	.221	.057	.262	3.861
	X3	.206	.061	.266	3.364

a. Dependent Variable: Success

Standardized regression formula:

Y = 0.421X1 + 0.262X2 + 0.266X3

Or Y = 0.421(TE) + 0.262(IW) +0.266(TS)

After converting to standardized regression formula, factor "***Training and skill development***" affects most on the success of TPM implementation, beta = 0.421. The second is "***Top-down Teamwork spirit",*** beta = 0.266. The last is "***Involvement of Full Workforce"***, beta = 0.262.

RECOMMENDATIONS AND CONCLUSION

Assessment of research objectives

The research provides the important information regarding the TPM implementation process. It shows the most affecting factors can contribute to the success of this process, can help implement effectively. A model is created, which includes the main factors affecting the successful implementation of A TPM program.

Recommendation

Training and skill development

Yamashina (2000) has state that training and education strategic plan is essential to the long-term success of TPM. Before implementing TPM, the employees have to be made aware of about the TPM and its advantages. It is necessary that employees including managers should participate several courses regarding TPM concepts, the new role of maintenance and production department. These courses should also give examples about success of other companies applying TPM to motivate the participants and show benefits which TPM can help.

When every employee awares about TPM, training should be provided to all employees in the manufacturing department before TPM is applied to the real production. Operators have to be trained by the company and maintenance employees about maintenance daily tasks. Besides, maintenance technicians should improve their skills about the management to consult production operator when necessary. Similarly, Chan et al (2003) assert that a well-deployed maintenance training system is a key success factor to provide production with necessary

skills. Some essential topics for development programs involve the development of employees' technical, problem-solving to fully achieve maintenance by operators. In general, TPM implementation can be implemented via awareness, training and practice. TPM should be the important thing for training new production employees. The continuous training will help to overcome resistance to TPM.

In Bluescope, should supply the technical training courses such as: automation system, electricity distribution system, maintenance planning, etc. Besides, training courses about soft-skill: communication skill, planning skill, etc are necessary as well. Management team should have suitable training courses to each employee in short-term and long-term which can help to support the implementation of TPM at the company.

Top-down Teamwork spirit

Tsang and Chan (2000) who investigated the implementation of TPM in various companies, management commitment is crucial to put across that TPM is an integral part of the company's maintenance strategy. Managers should show the behaviour and must make employees understand about openness, trust, teamwork, continuous improvement and learning are the core values of the company. With the author's opinion, total commitment from management team is necessary to success of such an implementation of change like TPM it is. Managers must always support employees about the difficulties they have to face. Management team must show that, they are members in implementation of TPM team. Accordingly, from previous research demonstrate that management commitment comes in the form of operators' time and investment of money. Moreover, a huge of TPM researchers, such as Hansson and Backlund (2003), Ghobadian and Gallear (2001) and Lycke (2003) argue that the implementation of TPM requires major resources such as human resources and funds to enable the necessary input of competence, expertise and participation for the accomplishment of all TPM objectives. So, many departments will involve to this process, they have to be willing to cooperate with each other under the support of Management team. Managers need to allow sufficient time for the implementation process otherwise failure is expected. TPM must be seen as a long-term commitment to strive for zero losses and not a way of obtaining short-term fixes, (Bamber et al, 1999). People have to accept that TPM will take a long time along with the development of the company. It is necessary to change the existing maintenance culture and employees' attitudes and values.

Furthermore, top management involves in the process will enhance the morale of production operators as well as maintenance personnel which can help to overcome reluctance of those. It is important that the management makes it clear to everybody that the support of each other from manager to worker is really necessary.

Involvement of Full Workforce

Operator resistance

The previous research showed that existed general resistance to change by operators and maintenance personnel due to new tasks assigned to them and the redefined roles of both departments. In a recent study Cooke (2000) discovered that for some operators taking responsibilities in basic maintenance tasks represents a practice of teamwork and cooperation. Production people considered it as unfair and one-sided that they had to share maintenance work but maintenance never share the operators' job. In NS BlueScope it could be noticed that people did not accept the TPM concept as they thought that TPM would try to increase number of tasks of production operators with the objective to reduce maintenance people. These problems can cause a lack of TPM know how and not understanding the principles of TPM. In research of Cicmil (1999) there are some reasons for resistance to change which include: too much effort to implement, loss of status, more work in the future and loss of personal control. For most production employees TPM means doing more work but without any more money. Through action research, Lycke (2003) observed that it was hard for production operators to stop producing and go to a meeting instead of this to discuss problems and to develop solutions for improvement and that above all it wasn't easy to get them to talk. Similarly, in NS BlueScope the author became aware of this and noticed that operators were not used to work in teams and they did little to express their concerns and daily troubles. They want to stand out of the process of Implementing TPM. It is the operators' culture and work values that explain this behavior because in most companies shop floor workers are much focused on the operation of their machines and they comply to the hidden rule "Do what you are told to do". This is where TPM collides with the traditional working patterns of operators and the considerable degree of change inherent in TPM becomes obvious.

Maintenance resistance

Taking into account the maintenance department the majority of technicians were reluctant to transfer technical skills and responsibilities to the production. Maintenance people did not consider operator training and the establishment of autonomous maintenance as their task and target. Once maintenance transferred an activity they did not provide additional training and support to optimize the shifted skill. The reason behind this involves the notion that maintenance technicians are uncertain about their job security, (Patterson, 1995). "Sometimes maintenance people do not want to help or teach operators because they are considered as a threat", (CME Group speakers).

Moreover, maintenance personnel were skeptical about the operators' ability to practice preventive maintenance what led to the situation that technicians did not want production people to get their hands on the equipment and they preferred them not to touch anything. An instrumentation technician of CME reported that mechanical wise operators can help you to make out the problem and they usually get it right but electrical wise they don't have any idea and the only thing they produce is confusion. This somehow reflects the skill gap, which has to be filled if the operators are to be more involved in the maintenance function. The majority of the behavioral barriers mentioned above can be attributed to a form of organized resistance that appears by either not knowing 'what' (tangible, measurable objectives) or not understanding of 'how' (implementation methodology, concepts). The results are low morale, disinterest and a lack of enthusiasm.

Besides the direct workforces are operators and maintenance employees, the involvement of other department such as quality management, human resources, commercial, etc. are also really necessary. They are indirect workforce to implementation of TPM, but contribute to the success of it. Thus, the involvement of all work-force plays a very important role to the implementation of TPM.

The limitation of research and recommendation for further study

Principally, the results from research come from one single organization operating in its own specific manufacturing environment, it is NS BlueScope; hence one must be aware that this limits the findings in terms of variety and that indubitable there exist other barriers, obstacles and factors affecting the successful implementation of TPM.

Moreover, the information from the focus group discussion, participant observation and document analysis may constitute a basis for conducting further primary research in the form of in-depth interviews to examine in detail the nature of e.g. barriers to the implementation of TPM. The outcomes of this research do not cover aspects of the TPM concept nor do they provide information about how to overcome the classified barriers and obstacles plus the enormous process of change what indicates the need for further research in means of collecting specific implementation tools and techniques.

Conclusion

Based on 25 observed factors can affect to success of implementation of TPM at NS BlueScope Vietnam. From the analysis of data the research has showed that there are 3 main group factors: Training and skill development, Top-down Teamwork spirit, Involvement of Full Workforce, with 13 observed factors in these 3 groups can contribute most to the success of TPM implementation. These factors can explain 62.3% the success of implementation TPM in NS Bluescope Vietnam. The management team can look at this research and have the suitable plan for next steps in the future.

Besides, the other companies which want to apply TPM to their factories will have a reference. However, they should consider and analyses all of aspect: the similarities and differences between NS BlueScope and their companies before application

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