

COMPETENCY ENHANCEMENT AND EMPLOYEE EMPOWERMENT IN A TPM ORGANIZATION - AN EMPIRICAL STUDY

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ABSTRACT

Total Productive Maintenance (TPM) has been widely renowned as a strategic weapon for improving manufacturing performance to world class level. This has been successfully implemented in many organizations across worldwide. TPM establishes a system of productive maintenance, covering the entire life cycle of equipment, all departments, involves participation of all employees from top to bottom. This paper deals the TPM implementation; how it has been improving the competency level of employees at the Leading belt manufacturing company located in Madurai, Tamilnadu, India and also compares the employees' competency in non TPM line of the same company. A literature survey was undertaken, the elements into tangible and intangible benefits of TPM implementation. From the competency assessment survey information, the role competency gap of each employee has been calculated by using Analytic Hierarchy Process (AHP) and Role Competency Matrix (RCM). This study integrates TPM implementation with employee training, empowerment, teamwork, compensation and management leadership in a theoretical model for studying employee competency within the framework of Management system. The results of this study shows the significant employees competency enhancement during the TPM implementation.

KEYWORDS—Analytic hierarchy process, TPM implementation, intangible benefits, role competency matrix, Total Productive Maintenance.

I. INTRODUCTION

TPM is a manufacturing program designed primarily to maximize equipment effectiveness throughout its entire life through the participation and motivation of the entire work force. In response to the maintenance and support problems encountered in manufacturing environments, Nakajima (1988) developed and introduced the concept of total productive maintenance (TPM). TPM is a maintenance system that addresses equipment maintenance through a comprehensive productive-maintenance delivery system covering the entire life of the equipment in every division including planning, manufacturing, and maintenance and involving all employees from production and maintenance personnel to top management (McKone, Schroeder, & Cua, 1999; Chan, Lau, & Ip, 2005). Nakajima (1988) in the 1980s provided quantitative metric called Overall Equipment Effectiveness (OEE) for measuring productivity of individual equipment in a factory. This supports the improvement of equipment effectiveness and thereby its productivity.

This work aims to show the TPM implementation having major impact on increasing the competency level of the employees and their empowerment.

For that employee competencies are assessed in both lines (TPM implemented line – case group and non TPM line – control group) of the manufacturing plant personnel and analyzed. Competency based mapping process helpful to assess and upskill the workforce, which would be prepared to perform effectively in their job. This workforce harmonization will eventually lead to higher business performance and improved productivity.

II. LITERATURE REVIEW

A. Total Productive Maintenance

TPM is defined by Nakajima (1988) as the combination between the involvement of total employee and Japanese thought of managing total quality and “American preventive maintenance”. This shows the importance and the role of employees in TPM implementation and its success.

TPM is a maintenance program which involves a newly defined concept for maintaining plants and

equipment. The goal of the TPM program is to markedly increase production while, at the same time, increasing employee morale and job satisfaction. The TPM Program closely resembles the popular Total Quality Management (TQM) Program. Many of the same tools such as employee empowerment, bench marking, documentation etc. are used to implement and optimize TPM (J. Venkatesh, 2007).

Many literatures have highlighted that TPM has stood out as a vehicle, which has been very conducive to the realisation of improvements at shop floor level (from elementary counter measures to technologically complex projects), involving technical staff, foremen and workers.

It should be acknowledged that a TPM implementation is not a short-term program, it is a continuous journey. The employees have to give their excellent support and the TPM committee to put their maximum efforts throughout the implementation. Apparently, successful TPM implementation achieved better and lasting results and changed people (knowledge, skill, and behavior) during the progress.

B. Competency

United Engineers, Malaysia (2007) defined individual ability based on several important criteria crucial in planning and organizing, communication, analysis and solving problems, customer orientation focus, staff development, leadership, achievement orientation, decision making and working as a team to achieve an organization's goals. Le Deist and Winterton (2005) explain that ability is competence that is an unclear concept that touches on knowledge and skills and various elements that are important. The competency is an underlying characteristic of an individual that is causally related to criterion-referenced effective and/or superior performance in a job or a situation.

The important lesson to be learned from the Gap Analysis Competency Assessment is that simply having all the jobs filled isn't enough. All the jobs have to be filled by employees who exhibit the necessary competencies. And in many cases, current employees do not fully meet all the competency

requirements. This is critically important information to have in designing the Gap-Closing Strategies.

C. Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is a multi-criteria decision-making approach and was introduced by Saaty (1997). The AHP has attracted the interest of many researchers mainly due to the fine mathematical properties of the method and the fact that the required input data are rather easy to obtain. The AHP is a decision support tool which can be used to solve complex decision problems. It uses a multi-level hierarchical structure of objectives, criteria, sub criteria, and alternatives. The relevant data are derived by using a set of pair wise comparisons. These comparisons are used to obtain the weights of importance of the decision criteria, and the relative performance measures of the alternatives in terms of each individual decision criterion. If the comparisons are not perfectly consistent, then it provides a mechanism for improving consistency (Saaty, 1977).

D. Role Competency Matrix

Gargi Keeni (2006) states that role competency matrix is a tool used to document and compare the required competencies for a position with the current skill level of the employees performing the roles. It is used in a gap analysis for determining the critical training needs also as a tool for managing people development. It can also be used in succession planning as a means of identifying employees who have critical skills needed.

III.METHODOLOGY

A. Purpose of research

The purpose of this research is to explore the effects of TPM implementation on employee’s competence development. This research was performed for production and maintenance employees in the manufacturing lines of the leading belt manufacturing company located in Madurai, Tamil Nadu, India. Competency gap study was conducted on the production line that implemented TPM successfully, a case group; also with a control group of the same company, the line that did not undertake TPM events during that time period. This is indeed to find the difference between competency gaps of both the production line employees.

B. Research hypothesis and questionnaire survey

Hypothesis were defined at the beginning of the study to confine the statistical analysis to the specific research questions.

Hypothesis – Case vs. Control group

* Null Hypothesis, Ho: There is no significant difference in the employees’ competency gap between the case and the control group.

* Alternate Hypothesis, Ha: There is some significant difference in employees’ competency gap between the case and the control group.

The study comprises of literature study and survey methodology. From The literature study 24 intangible benefits of TPM implementation for employee’s competency enhancement are formulated as questionnaires.

The survey based on questionnaire is done for five levels of people at Leading belt manufacturing company located in Tamil nadu, South India and data was collected from 10 production operators, 15 production executives, 10 maintenance Foremen, 10 maintenance engineers and 5 managers of each line. Following that the collected data were used to calculate the competency level of each employee and role competency matrix.

In role competency matrix, the weightage for each competency has been calculated by using AHP. Each employee’s competency level was rated in the scale of 0 to 4 based on their level. In the first step, the required competency level for different role was fixed in the scale of 0 to 4. The actual competency level of each employee has been attained from the survey questionnaire, after that the role competency gaps for the 100 employees were calculated and the results were analyzed.

The following are the steps followed in role competency gap and matrix formation (Gargi Keeni, 2006):

- Step 1: Identify skills and knowledge areas.
- Step 2: Identify roles in the organization.
- Step 3: Mapping of competencies to roles.
- Step 4: Provide weightage for competencies using AHP
- Step 5: Gather competency level of employees.
- Step 6: Compute competency gap of employees.
- Step 7: Review of the competency gap.

C. Skills and knowledge areas and their ratings

Based on the guide lines of Job descriptions, roles and the list of general Competencies/Skills (Cite HR), there are fifteen Competencies selected for the competency assessment. They are Job knowledge, Planning Skills, Ability to work under stress/pressure, Computer literacy, Willingness to shoulder additional responsibility, Time Management, Integrity, Communication skills, Decision making skills, Leadership qualities/motivational skills, Team building skills, Reliability/Dependability, Result orientation, Innovativeness/Creativity and Adaptability. Skills and knowledge levels finalized and peer reviewed by the plant HR team along with research team.

These skills are rated during the assessment by the immediate superior (N+1) of the employee (N) and approved by the next higher level to the assessor (N+2). The employee competency are rated as poor, average, good, very good and excellent and they are rated Likert scale as 0, 1, 2, 3 and 4 respectively (JIPM).

TABLE 1: COMPETENCY RATINGS AND ITS DENOTATION

Competency Level (Ratings)	Denotation
Level 0	Absence of knowledge
Level 1	Has an exposure to the knowledge area but not practiced it
Level 2	Has an exposure to the knowledge area and practiced it
Level 3	Has an exposure to the knowledge area, practiced over a period of time, and is a perfectionist.
Level 4	Excellence – Is a researcher and master in the particular knowledge area

D. Roles in the organization

Totally there are 5 levels of employees are involved in this assessment, they are selected by Simple

Random Sample (SRS) of a given size 50 among the 500 employees in that plant from each line, i.e., TPM implemented line and non TPM line. There are 5

Managers, 15 production executives, 10 Production Operators, 10 Maintenance Engineers and 10 Foremen were selected from each line for the survey, as for the comparison purpose numbers and levels are maintained as same.

E. Competency Mapping

The required level of each competency for the role is finalized and set by the top management along with the research team. The 15 competencies are remaining same, only the required level varies with the job role and their proficiency level for both lines. Based on the role, required level is set for each competency for the assessment. This competency mapping is important to identify level of competencies for individuals. This will help in focusing on training needs required to achieve the goals of the position and company and help the employees develop toward the ultimate success of the organization.

F. Weightage for competencies

Assigning the weights on employee competencies is one of the most effective ways to communicate the

relative importance of competencies and goals to employees. Knowing the relative weights helps employees to prioritize their work and efforts on a day-to-day basis, as well as make decisions when faced with competing demands. When assigning weights to competencies and goals on competency assessment, it is ensuring that these truly reflect the organizational values and priorities. Getting agreement on weighting can sometimes be a challenge, but the resulting discussion is always valuable.

Since pair wise comparisons are the keystone of these decision-making processes, correctly quantifying them is the most crucial step in multi-criteria decision-making methods. The values of the pair wise comparisons in the Analytic Hierarchy Process (AHP) are determined according to the scale introduced by Saaty (1977). According to this scale, the available values for the pair wise comparisons are members of the set: {9, 8, 7, 6, 5, 4, 3, 2, 1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9}. From AHP Weightage for the 15 competencies are derived, shown in Figure 1.

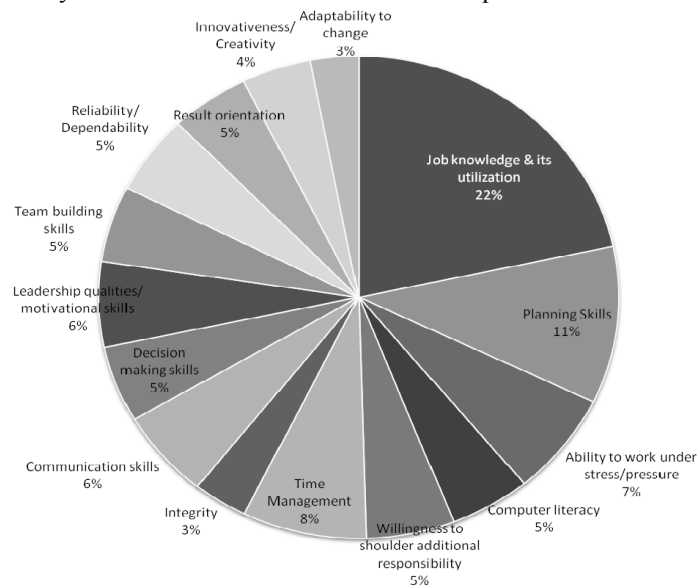


Figure 1. Weightage for 15 Competency

G. Competency level of employees

The assessment process provides an opportunity for the supervisor and employee to assess what has been accomplished against agreed upon individual objectives and job requires. From the survey, the competency levels of employee (N) are assessed by their immediate superior (N+1) and survey results for 50 employees in the organisation were collected and used for data analysis.

H. Competency Gap Calculation

Measuring competency gaps within your organization and addressing them proactively allows to focus on the areas you need most to impact your business performance.

Competency gap for a role,

$$\delta CI_R = \sum_{i=1}^p [(\delta CI_C)_i * (C_W)_i] \tag{1}$$

$$\delta CI_C = (C_{EL} - C_{RL})/n \tag{2}$$

Where

δCI_R is competency gap for a role

δCI_C is competency gap for a specific competency

C_{EL} is competency level of an employee, which is rated on a scale of 0-4.

C_{RL} is required competency level for a role, which is rated on a scale of 0-4.

C_W is the competency weightage, which is computed using AHP.

p is the number of competencies.

n is the level of ratings.

I. Model Calculation

Case Analysis – Role competency gap for the production operator 1, based on his 15 competency level.

$$\delta CI_R = \sum_{i=1}^p \left[\left(\frac{C_{EL} - C_{RL}}{4} \right)_i * (C_W)_i \right] \tag{3}$$

Case study for operator 1:

Employee level of competency, required competency level and weightage for the all the competencies are listed in Table 2 Role competency gap for Operator 1 (Based on 15 Competencies) is

$$\delta CI_R = 0.35325$$

Likewise competency gap found out for all the other operators, Managers, Production Executives, Maintenance Engineers and Foremen. The results are compiled and given in Role Competency Matrix. If competency results show negative then the employee’s competency is lower than required, positive means higher than needed. In the case of zero, the employee competencies exactly match with the required.

TABLE 2: COMPETENCY RATINGS OF OPERATOR 1 AND REQUIRED LEVEL FOR OPERATORS.

Competency	Employee Level [C _{EL}]	Required Level [C _{RL}]	Weightage [C _w]
1. Job knowledge & its utilization	4	3	0.21639
2. Planning Skills	4	1	0.10483
3. Ability to work under stress/pressure	1	2	0.06907
4. Computer literacy	4	1	0.05011
5. Willingness to shoulder additional responsibility	3	2	0.05504
6. Time Management	4	2	0.07711
7. Integrity	2	2	0.03399
8. Communication skills	4	1	0.05934
9. Decision making skills	3	1	0.05144
10. Leadership qualities/motivational skills	3	1	0.05699
11. Team building skills	3	2	0.05136
12. Reliability/Dependability	2	2	0.05252
13. Result orientation	3	3	0.04913
14. Innovativeness/Creativity	3	1	0.04299
15. Adaptability to change	4	2	0.02969

IV. ANALYSIS AND DISCUSSION

From that role competency assessment, the 49 employees have the higher competency level than required competency level that means the 98% employees have the higher competency level because of working under the TPM implemented company. Thus from this study we can evident that the TPM will improve the competency level of each employee. When desired competencies are clearly articulated, employees can be expected to bear more responsibility. For developing those competencies, TPM can help the organization's core competency improvement and sustain their position and reputation among the industries.

The required competency level, actual competency and the role competency gap for the 10 production operators are shown in Fig.2, One of the operator has the minus value in role competency gap that denotes that operator has the lower competency level than the required level and that operator need to improve his competency, remaining 9 operators having positive value for the competency gap, i.e., they have higher competency level.

Fig.3, summaries the competency gap analysis results for the TPM line. The required competency level and the actual competency level have significant positive gap for the 5 managers, which is illustrated in that. It shows that all the 5 managers adequately competent for the post and having higher competency level than the required level. Also the 15 production executives have the higher competency level than the required competency level. Their average competency gap is 0.225. This shows they are very much proficient and highly competent for their job and they are ready for the next leap in their carrier.

All the 10 maintenance engineers have the higher competency level than the required level, the role competency gap for the 10 maintenance engineers are shown in that Fig.3. The required competency level has been set high for maintenance engineers as they are key people in plant to go for new challenges. The role competency gaps for the 10 maintenance foremen are higher than the required competency level. As like maintenance engineers, they are also

expected with higher competency for the new initiatives of the plant.

The extraction of the competency gap results analysis for the Non TPM line is shown in Fig. 4. In non TPM line, other than the production executives some people in all level have deficiency in competency, 18 among the 50 people have negative value and that employees' have the lower competency level than the required and their competency level need to be improved by training or suitable competency improvement program. Other 38 employee's competency gaps are above zero, which means that these employees have the higher competency level than required competency. Even though some of them have positive competency gap, their average competency gap are found to be much lower than the TPM line results.

A. Testing of hypothesis

An independent 2-sample Z test was performed to determine if the case and control groups, as the sample sizes are 50, this survey comes under the category of large sample. Competency gap results of 5 managers, 15 production executives, 10 production operators, 10 maintenance engineers and 10 Foremen were used for this analysis, Z values are tabulated $|Z| > 2.58$ (Z value at 1% level of significance) is the condition for rejecting the null hypothesis. In the above table Z values for all roles and overall are above the 2.58. This shows that, there is a significant difference in employees competency gap between the case and the control group. i.e., The Z test results rejecting the null hypothesis and predominantly accepting the alternate hypothesis for 99% two-sided confidence interval.

Competency gap results between TPM and Non TPM line is recorded in Fig.5. It's obvious that the TPM implemented line employees are having more competency than the non TPM line. Only the production executives are having minimum difference. These results obviously accepting that the TPM implementation made momentous enhancement in employees' competency.

The assessment gives the employee information of what is necessary to perform at a higher level, and specifically what skills and competencies are necessary to develop for success. The organization, in turn, gains a sense of the employees fit and potential within the company as well as a clearer understanding of which competencies result in higher performance.

This study helped to manage the competency by assessing their human capital, which led to an increase in process maturity and productivity improvements. In addition, it gives a clear identification of trends and gaps in competency development areas and standardizes the job descriptions. Competency gap measurement evaluate each employees methods of achieving results, 'his/her fit with the company' and 'potential' to be promoted to demanding assignments. Enhanced business performance realized over a period of time through a streamlined talent management process. It also leads to effective succession planning, formal performance evaluation and investment in the right learning and development programs.

The prominent role of competency development in enhancing the success of employees and organizations has drawn the attention of practitioners leading them to introduce competency development as a central part of their human resource practices. For organizations, focusing on the continuous development of their employees' competencies is also necessary, since it gives them the opportunity to stand out to their competitors.

From the study, it is found that organizations develop the competencies of their employees through a combination of training, on-the-job learning and career management. As such, in reality, the process of competency development is one integrated whole, making it difficult to separate the different practices from each other. The competency development is making its entry into a lot of organizations nowadays and is becoming a crucial strategic management tool in today's work environment.

V.CONCLUSION

Successful implementation of TPM for the organization has enhanced the competencies of their employees at their level. That crafts the employees to bear more responsibility and improve the organization's core competency and maintain the reputation among the industries. Competency Measurement provides the competency gap that may exist between case and control group. Competency assessment provides critical information for management to generate the necessary training and development programs to cultivate sustainable talent pools for the future. During the process of TPM implementation the major number of employee's competency has been improved, also provides the organization for positive challenge of upgrading and retaining their valuable workforce, and employees recognize that development programs enhance their job security and prospects for career growth. Also motivate the companies to adopt for the new improvement projects. From the study it's clear that the TPM implementations improve the plant performance and productivity to world class level

and also make the employee's fit and potentially competent for their work and future challenges.

VI.FUTURE WORK

The competency gap analysis can be done periodically to assess the competency enhancement to the employees. It can also be incorporated with Training Need Analysis (TNA) and Training Plan (TP) for the employees. Competency gap analysis and each competency / skill factors correlation can be identified. The performance of complex competencies that cannot be broken down into simple parts, there is a need to make a shift from individual methods to an integral program, intertwined with the education program.

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