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Analyzing the Impact of Effective Factors of Implementing TPM System in Manufacturing Organizations (Case Study: Motorsazan Co.)

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Abstract: Nowadays, maintenance is one of the key pillars of the industries and every one has known its importance and role. Wherever we talk about the economic production, the discussion of maintenance is also added. TPM System, as a new strategy for the industries & institutes that devices and equipment play a special role in their service delivery process, has created an extensive evolution. This system is gathering all the effective of factors of service delivery process and ensuring the enhancing of productivity & quality factors by creating proper cultural infrastructure and with the help of OEE (Overall Equipment Efficiency) promotion. The aim of this study is to investigate the impact of effective factors (including structural, systemic, human and systemic) on the implementing TPM system in manufacturing organizations (Motorsazan Co.) This study, according to its purpose, belongs to the applicable category and according to its method of data collection, belongs to the descriptive and is typical of correlation survey. According to the research studies, we have used library and collection of data from field studies (questionnaires). Statistic Sample of this study is of 12 units of Net Department in Motorsazan Co. The results of the analysis of the data indicates that across the 4-factor that mentioned before (including structural, systemic, human and systemic), Human factor has the most impact on implementing TPM system in Mtorsazan Co.

Key words: Organizational Factors, TPM system implementing, Manufacturing Organizations, Motorsazan Co.

The Preface:

In recent decades, competition all over the world has led to tremendous changes in the world-wide industrial activities and the result of that, is today's advanced and up-growing technologies. Big Industry Owners get the competitive advantages in the money and capital markets by utilizing these technologies and combining them with the new management systems and also in this regard, managers always have challenges for conforming their organizations with the required changes in the areas of organizational structure, technology, strategic skills, communications, organizational behavior, Maintenance (P.M.) and others that the area of Maintenance(P.M.) might be one of the most challenges in management. Total Productive Maintenance (T.P.M.) is a modern system that can help to it's advanced systems such as Total Quality Management (T.Q.M.) and Just in Time (J.I.T) by proceeding it's principles and rules. What makes this system so important is that it's implications are beyond the preventive and predictive maintenance in order to increase efficiency and productivity of the machines and also makes it possible to appear creativity and innovation by changing the culture in all over the organization through the activities of related group workings. It persuades all the personnel in the way of thinking of affairs and improving the methods by introducing the "Involvement Management" and removing hierarchies for reformations. The principles of this system is can help non-formal organizations to be organized to achieve the objectives of the Institute and because of being it's procedures in a lower level of the organization, that is up to the operators, if successful, will ensure continuous improvement of the organization.

Implementing TPM causes the involvement of participants in the maintaining of equipment, implementing independent maintenance culture (P.M.), more safety of equipment and worker, clarity of environment, increasing overall productivity of equipment, availability of equipment, increasing product quality and service, increasing the life of equipment, reducing production interruptions and total overhaul and increasing production, profitability, and productivity.

Many foreign and domestic companies, have started implementing TPM, but despite continuous efforts, and more as it should, in this context have not been successful. Researches show that one of the main reasons of the failure of TPM systems in these companies, is not paying enough attention to the accurate feasibility study, not defining and providing the necessary infrastructure and not analyzing the available conditions.

In Iran, manufacturing organizations keep pace with technology development, use complex and update machines and equipment that in order to increase production rate and finally increase productivity and competitiveness in global markets they need to use and implement update systems of maintenance. Since

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manufacturing organizations in the country (e.g.Motorsazan Co.) with a huge amount of investment are growing rapidly, and will have to compete with large companies of the same career in order to get their own proportion in the world market no longer in future, Leaders must prepare their organizations to conform with the new management systems such as maintenance management so that they can get the competitive advantages in the global arena on the basis of the new order existed in management, then go on in the way to achieve the best level of efficiency and reliability. In this context, promotion of maintenance systems in Motorsazan Co. has been defined up to achieve an excellent system in maintenance according to the specified vision is an essential step in order to improve and promote the management of maintenance of the production units that provides route improvement and development route and manufacturing excellence.

By considering that TPM has goals such as maximizing equipment effectiveness, improving efficiency and productivity of maintenance activities, training to boost skill level of personnel involved with TPM activities, etc. Therefore, relevant infrastructures of the above-mentioned goals should be identified in order to improve the implementation of this system. In this paper we have identified all the factors and requirements for TPM implementing in a manufacturing organization (Motorsazan Co.) to achieve the following goals before implementing the system completely:

1. Decreasing the equipment breaks
2. Decreasing quality scraps of productions
3. Adjusting staff requirements and costs
4. Decreasing inventory

Feasibility study is a quite good method to determine the feasibility and benefits of TPM implementing. By this study the priority of requirements that are most in need of improved equipment in performance, has been defined. As this process the start point is determined in the regions that have the greatest chance of success.

Evolutions in the First Period (Hardware Period):

Researches show that the early development of the P.M. has occurred in the years before World War II. At that time the industry wasn't mechanized like now hence, failures and sudden breaks of machines had caused serious problems for those involved in the production. In other words, the concept of preventing of causing defect was not introduced or was not felt as a necessary item by managers and leaders. In addition, most of the machines and production equipment have a relatively simple design and because of this reason, working and repairing the equipment were easy. Therefore there was no need to use systematic maintenance and all of the manufacturing departments control and repair the machines and other equipment whenever they were broken down or stopped. In fact maintenance system (P.M.) was known as "Breakdown Maintenance. Preventive Maintenance is a systematic method for performing maintenance activities with the basis of time (Etti) If P.M. performs in a correct way, it reduces the rate of breaks 10 % or less than 10 % of the failures that have not a preventive program.

The 40^{th} decade or Machines Age was the time that methods of maintenance mentioned above was used more than the others. Believing in machine has made a typical approach that a person was thought as a component of a machine.

Evolution in the Second Period (Age of Software):

During World War II, everything was changed suddenly and rapidly. The stress of war, caused the demands of different types of products to increase in such a situation that, procurement of human resources of industries had been sharply reduced. This caused the mechanization to increase. Nearly in 1950, mechanized machinery design and it's construction was in boom. This period can be known as the beginning of the dependence of industries to the mechanized and automation systems.

With daily increasing of automation, the failure and breaking down of the machineries became more of important. After elapsing a few, increasing trend of failures caused to overshadow the quality and quantity of products and dissatisfaction of industry owners. Continuing this situation caused the directors and officers to consider alternative and appropriate solution for preventing of increasing of defects. In this way, Preventive Maintenance System was proposed in the United States as a remedy or solution and was implemented.

The necessity of producing high quality products with reasonable prices to increase competitiveness in the market, caused to use periodic Preventive Maintenance as the most effective solution.

During the 1950s, Preventive Maintenance graduated gently in order to be responsible to the new industry. In this regard, Productive maintenance system was introduced in 1954 to U.S. industries. In this system therewith the emphasis on the correcting random failures and unexpected breaking down the equipment, techniques and models were developed for different types of devices and equipment by using of Statistics, Operation research, Simulation, Engineering, Economics, Queuing theory and Analytical approaches that related specialists in this field could set all the activities and operations of maintenance in order, predicting failures to plan and schedule their maintenance.

The decades of 1960 could be called the decade of using P.M. in industries. The results of research done in this decade are such as P.M. without repairing (1960), reliability engineering and repairability engineering (1962) that were effective in developing P.M. system. TPM system introduced in 1970 by the Japanese industry can be termed as the latest achievements in the 2nd period of developing maintenance .In fact, it is the same system as the American T.P.M. system that has been improved in order to be adjusted with the Japanese industry system. The key innovation is that the operators themselves pay attention to their affairs of their own machineries by obeying primary principles of T.P.M. T.P.M. is a methodology to increase the availability of equipment, along with lower investment (05 Chana et al., 20)

Makasyulay has described a sample of integrated maintenance strategy (1988) as a methodology of T.P.M. that has the ability to control equipment failures by regarding six major defects. Bagarv (1992) calls P.M. as a cooperative method in maintenance. Nakajima considers T.P.M. as a process that it's working teams has been formed of the engineering skills of P.M. personals (Swanson, 2001). The software age between 1950 to 1990 has a practical approach to the equipment thus, criticizes the machine oriented approach and dose not believe in it's efficiency. But basically, this era focuses on the efficiency of procedures, regulations, executive instructions and in fact, it focuses on the effectiveness of the software and P.M. in the period of software era, most of activities have been accomplished in the context of documenting instructions, statutory and regulations.

Evolution in the Third Period (Age of Brainware):

Increasing the investment in industrial machinery and automation on one hand and increasing its financial and economical value on the other, led the managers and industry owners to think of logical ways to maximize the instrumental life of the equipment and prolonging the economic life cycle. Increasing the effectiveness of the machinery, improving products quality in addition to reducing P.M. costs, preventing damage to the environment, were the cases new developments in the field of maintenance.

P.M. new achievements in this period include:

i. Introducing maintenance system based on the situation of machinery function
ii. Promote the use of CM techniques such as vibration analysis and thermal analysis
iii. introducing and applying various methods of machinery failure analysis
iv. Designing equipment focusing on reliability and repairibility
v. Basic development in organizational thinking toward involvement and working groups
vi. introducing an effective maintenance system
vii. Introducing a P.M approach on the basis of reliability, as a comprehensive method in order to make decision in correct using of different available maintenance systems.

This era believes in this case that the constraints of the resources and available stocks in the world, are increasing so in the nearest future, it causes the most important of these resources to be destroyed at the end. Therefore, Optimal assigning of resources by increasing production capacity and maximizing agriculture in a unit, decreasing consuming of resources and optimizing production methods and techniques continuously can be discussed. The phrase "Maximum Production", refers to product from minimum resources (i.e. maximum saving in resources) that can be realized only by discovering new methods and approaches for example, applying quantitative methods of genetic engineering and biotechnology in changing agricultural products quantities or in an other words, using Brainware. Thus, increasing the Brainware and intellectual development, causes to reduce the vital resources. In recent centuries, after the Industrial Revolution (after the Renaissance) European Industries has grown up tremendously. If we consider a graph for the duration of the evolution of conceptual, It's gradient begins gently and linear at first, then (in recent century) will change to nonlinear. In recent years it had been continued to grow progressively and finally in Brainware, this growing became volcanic because of occurring instantly the conceptual developments. (Davoodpour 1377)

Effective Factors in Implementing TPM:

Regarding to the principles of TPM and focusing of TPM philosophy on human resources, Structural, Technological and Systemic factors are known as the important factors of TPM system implementing. These factors have sub-sectors as followings:

Structural Factors:

The provision definition by the organization, defines the necessity of formal coordination between interactive patterns of organization members. Organizational structure specifies how the functions should assign, who should report and to whom? What are the formal coordinating mechanisms and interactive patterns that should be observed? Three elements that are used in creating of organizational structures, are as following:

Complexity, Being formal and Centralization that in fact the infrastructure of management working in the organizations are T.P.M .structural factors.

Centralization:

Centralization is an index that reflexes the center of decision according to the main and especial policies. (Warriner, 1965) Centralization is an amount of the information the spread all over the organization and also the rate of involving the personnel in long-termed plans. (Yuchtman&Seashor, 1967).

The ability of the managers for paying attention in the field of T.P.M informational data is constraint. Each manager can process the limited amount o the information. If the manger is gotten information more than his capacity, it leads to accumulation of the information. For preventing of this problem, submitting some decision making problems to the others should take so that the centralization of the decision making extends from one point to quite of the organization. This distribution or transformation is discentralized. (Robbins 1943)

Centralization refers to the point that the authority of decision making is centralized there. In some organizations, decision making is centralized. Problems and difficulties shift to the upper part of the organizational hierarchy and Executive managers take the proper action to solve them. The opposite of this kind of decision making is discentralized. In this type the authority of decision making distribute among the lower levels of organization. Considering that with formal and complexity, the organization can take the centralization or discentralized manner to itself, is very important.(Rezayian 1379)

Complexity:

It implies to scale of differentiation in organization. Horizontal differentiation shows the level or extent of horizontal differentiation between departments. Vertical differentiation shows the depth or heights of organizational hierarchy and also implies to number of experts, professional occupations and duration of professional training course for employees.(warriner,1968)

Horizontal Differentiation:

It implies to measure of differentiation between organizational departments based on organization's member, their nature, duties, level of education and training about TPM. When there are several occupations that need to professional knowledge and scientific skill, the organization would be more complex. When organizations establish TPM skilled groups, and develop their departments, they make them different clearly and hence have complicated the interaction between these groups. In fact, by specializing the measure of training and job language will be different for disparate groups and usually each of them used in diverse units of organization .this matter differentiate their position as two persons by different characteristic, further.

Vertical Differentiation:

It implies to depth or height of organization structure. By increasing of organizational hierarchy level, vertical differentiation and organization's complexity increases. Too level between top management and operational management of organization is a potential factor to destroy relations and cause the coordination between personnel units and supervising operational activities by top management to be difficult. Organizations are made of different ancillary systems and these systems needs to relation, coordination and control in order to be effective. A more complex organization needs to relation, effective coordination and control procedures.

Formality:

It is the extent that an organization depends on regulations, rules and approaches in order to direct employee's manner. If a career had have a high formality, it's operator would have low latitude for doing related activities and deciding how and when it would be done. Hence when formality is more there are specified job descriptions, a lot of regulations and rules, clearly work instructions in organization and vice versa.(the same reference) in most industries. Decentralized maintenance department are under control of manufacturing managers, by attention to importance of production realization sensible in manufacturing shop's managers objective, it's necessary to pay more to maintenance department and it's requirements that named "heart of organization" variance examination

Human Factors:

Analyzing and studying in personnel moral requirements is one of the important necessary activities for organizing maintenance, like engaging and employee retention, training the human resources and linkage of salary with performance. For this reason movements in maintenance occur by the people but in manufacturing department people's movements control by machinery movements.

According to the researches, there are different parameters to evaluate the human factors. These parameters are: Making motivation, Opportunity to innovate, Discipline, Coordination of training, Training of new employees, having good approach to work, Generalizing involvement, Doing cultural and art programs. (Momeni et al 1389)

For developing metropolicity , it's necessary to identify and separate successful managers from un successful ones, efficient experts from un efficient ones, competent employees from incompetent ones,

hardworking workers from inactive ones. On the other hand, personnel's approach determines their behavior in the organization, so it plays an important role in increasing or decreasing the productivity of their work. Social factors are known as the following indexes:

Management Methods, Interrelations sense between employee and employers,(Ghaffari 1385) (Momeni et al 1389)

Before making any decision to select a suitable employee and bestow a job for him/her, that especial job should be evaluated and that job's value and the comparison of it's value with another available organization jobs should be determined. On the other hand, along with determining it's value, the job's financial stimulus, salary and wage of it's owner should be determined. The employee who is bestowed the job, should know how much will get in the case of being employed. Therefore the necessity of selecting the workforce scientifically, is determining financial stimulus and evaluation of jobs. Like salary and wage, Appraisal award, overtiming, mission reward, incentive leaving, non- pecuniary award. (Ghafari, 2007) Another important field that should be considered and is widespread is Technical and Industrial Hygiene Protection. In other words, by corresponding job with the employees, securing working environment and preventing accidents and incidents from happening, we can provide proper infrastructure to manage employees' endeavors to enhance organization effectiveness. Such as maintaining physical health, power, working tools and equipment, ventilation, doing the job right at the first time, light, heat and resting time. (Momeni et al 1389) &. (Ghafari, 2007).

Technologic Factors:

Changes in technologic part of the organization impact manufacturing systems. These factors include new approaches beside new equipment and tools. Systemic factors are samples of opportunities and threats that organizations should pay attention to them while documenting strategies. Technologies in organizations are in types of software, hardware and Brainware. (Abbaszadeh 1388). In a manufacturing organization, machine is one of the important components. By utilizing technology, we can strengthen one of the main principles of system and promote the performance of system. The following are the list of systemic factors that play the major role in performance of machines:

Reducing set up time of equipment and machinery
Utilizing of machinery capacity
Correct locating of machinery
reconstructing old machinery
calculating efficiency of machinery and making effort to boost the performance of them
fine tuning machinery
Better maintenance of machinery
Decreasing the number of breakdowns of machinery
taking necessary action to lessen the depreciation factors of machinery and equipment
taking necessary action to lessen the idle time of using machinery and equipment

Factors of Methods and Systems:

It seems that one of the important factors of promoting the productivity in T.P.M. is the way and technique of doing the job. Because by applying different techniques in performing a job, even with trial and error we can find the best and low costing way. The effective factors of the methods are:

Policies:

- Standardizing the methods of performing procedures, documenting and controlling them.
- Finding effective activities in manufacturing products and paying attention to them
- Eliminating muda activities in working instructions
- Continual improvements in work instructions in the workshops
- Acquiring update information and knowledge
- Performing the experimental methods and selecting optimum methods based on feedbacks
- Selecting a method based on it's executing records inside or outside the organization.
- Selecting a method based on personal experiences
- Selecting a method after doing feasibility studies.
- Selecting a method by considering it's role in reducing time or costing

Systems and Methods:

The material used in manufacturing parts and products, has an impact on promoting system performance, that we refer to some of these factors in the following:

A. Paying attention to performance and expected lifetime of the product
B. Improving parts and products transportation systems
C. Supplying materials according to determined specifications

D. Using appropriate containers to prevent damages during transportations
E. Proper storage of materials
F. Eliminating unnecessary movements of parts and products inside the workshops
G. Documenting material standards and keeping them in control
H. Quality control of incoming materials according to company standards
I. Improving quality of the materials
J. Using appropriate and calibrated equipment to control the material specifications.

Mack Kun and his assistants (2001) refer to analyzing the impact of T.P.M. on the production performance of 117 manufacturing companies in America, Italy, German and Japan by using structural equations model and with the questionnaire. They analyzed the effect of two other variables (J.I.T. & T.Q.M.) on the variables (T.P.M. & M.P.) in their model. They analyzed and tested the direct effect of T.P.M. on M.P. and indirect effect of T.P.M. on two variables of J.I.T. and T.Q.M. The results show that T.P.M. has a positive and meaningful impact on reducing cost and increasing quality level and on time delivering performance greatly. These results are gotten in the indirect impacts as the same in direct ones.

Ireland and Dale (2001) began to study TPM implementation in three companies in England. These companies had to implement T.P.M. because of having difficulties of business. Top managers of each company had supported of implementing T.P.M. seriously. The research results show that the main difference in implementing T.P.M. in these 3 companies is related to using of classification of A.B.C. system and the role of facilitators. Etti and his assistants (2004) have referred to the implementing T.P.M. in Nigeria manufacturing industrials. Their research results show that for implementing T.P.M. successfully, strategy and organization culture should be in the same direction with the changes. Also they believe that systemic, systemic and logistics are as the important factors in implementing T.P.M. The research results also show that all the companies regarding the requirements and predecessors of implementing T.P.M. by considering that the companies in Nigeria are in a strong competitive manner, have very good and successful performances and T.P.M. have been worked well and the productivity of the company has been promoted.

Ahmad and his assistants studied in the subject Total Productivity Maintenance (T.P.M.) approach for improving production effectiveness and recover the lack of structure in pharmacy industries of Bangladesh. They identified 6 important factors for implementing T.P.M. in industries that are named senary defects. These 6 defects occur in the influence of machine performance and are classified in 3 main groups:

1. Stagnation (Stopping) Time Defect 2. Speed Defect 3. Quality Defect

O.E.E. (Overall Equipment Effectiveness) is one of the improvement tools in operation fields that it's objective is to improve effectiveness and reducing defects in the framework of T.P.M. T.P.M. is a tool for operators to identify the defects and do the improvements. In fact a key strategy in T.P.M. is identifying and reducing senary (6) defects .Bin Bon and Karim have analyzed the application of T.P.M. in reducing product variations in a Knitting glove factory in Malaysia. The reason of selecting this company is that the most defects and failures occur in Knitted products. They identified 4 factors of causing the failures and defects of products that are as the following: Employee negligence, Low quality of materials, Machines that need to maintain and service and work instructions. These factors are the ones that have the most impact on scrapping the products .They presented the analysis of two data sets in their research. The data collected before implementing T.P.M. and other ones collected after implementing T.P.M. The results show that product variations had been reduced in a large amount and increasing of value added items.

Few studies have done in our country in the field of surveying, documenting and prioritizing of T.P.M. implementation requirements. Some of them are listed as the followings:

Tavakkoli (1380) in his research work entitled "Offering a proposal on the way of implementing T.P.M. in maintenance and technical department of Bandar-e-Imam" points out the existing problems in T.P.M. context and refers to this fact that the image of Third World Countries about maintenance is to fix the problem after failing the machine and when the environment of workshop is polluted and soiled with oil. Therefore, managers should pay too much attention to cleaning, discipline, safety, standards. Tavakoli and Zamanimehr(1386) have referred to the factors of successful implementation of T.P.M. in Saipa in their study. They have mentioned that the most important assets of an economic manufacturing enterprises are human resources and physical assets. Maintenance systems are creating in order to maintain the physical assets and the task of workforce systems is to retain and watch the people in the organizations. Productivity systems are the connective bridge of these two systems and T.P.M. is the most obvious tools of increasing effectiveness of human resources and physical assets. T.P.M. increases overall equipment effectiveness by incorporation of continuous improvement thinking with maintenance thinking. According to their research results, Saipa Company have implemented T.P.M. by performing 12 steps in the length of 3 years.

Nilipour and his assistants (1386) in a study have designed an applicable model of balanced evaluation of maintenance systems' performances. They describe that the necessity of designing and implementing maintenance systems is one of the critical and vital issues of today's industries in our country. Maintaining the nation's capitals on the one hand, and costing high prices for purchasing machinery and equipment on the other

hand, makes to use logically and with planning and also maintaining machines and equipment on time. The Strengths and weaknesses of this sector directly affects on productivity and profitability .So having a comprehensive performance evaluation methodology for this sector along with the strategies of the manufacturing unit is very important.

They point out in their research that the presented applicable model of balanced evaluation, causes the promotion of maintenance system in accordance with meeting system mission based on optimizing machinery capabilities in order to get the maximum rate of production and reducing erosion and damage to achieve maximum efficiency of equipment and maximum benefit with minimum cost. Considering the obtained improvements by applying balanced evaluation of performance methodology, it is predicted that the required capital for designing and implementing this model in the studied plant, will be lower than future benefits and savings so that investment in this field will have an expectable economic justification.

Babayi and assistants (1387) have been studied the analysis of the effective factors in implementing maintenance programs of transport networks' equipment in the field of national and regional dispatching. They have identified these factors and classify them into management, motivation and supporting resources and also analyzed the impact of these 3 factors on implementing maintenance programs. The results of the research they have done, show that each of these factors have a positive influence on implementing maintenance programs. Akhavan Sarraf (1388) have been studied the analysis and calculating the index of O.E.E. for a typical Forging system in their article by the name of "The application of O.E.E. in manufacturing units" . The results imply that increasing one percent in this index, can make large amounts of benefits. But only calculating O.E.E. does not do anything for the organization and only can give the information about general state of the system. The only item that is important in calculating this index, is focusing on it's effective factors. From this point of view, Efforts to improve this index can be considered as a strategic goal that includes all the improvement technical aspects. Then they have studied the effective factors of reducing this index and proposed suggestions to solve the problem and improve it.

Ibrahimi Moghadam (1389) in his article "Maintenance Challenges in the most Iranian Companies" referred to this subject that maintenance process is one of the most vital processes of the organization. Machines failures lead to lose the availability and increase costs. Therefore improving machines' performance and then improving maintenance process, are considered by the experts. The reasons of not succeeding T.P.M. in Iranian companies are not executing required trainings, not having proper tools, not having a plan, not managing, not motivating, the distance between the maintenance personals with the equipment, tiredness of maintenance personals due to heavy maintenance activities.

Din Parast (1389) in his article states that Personnel must be trained and understand that TPM is not a monthly program, but is an organizational standpoint that should be considered permanently.

Momeni et al (1389) in his article titled "Feasibility study of implementing TPM in Khuzestan Petrochemical Company" by using a standard questionnaire of maintenance auditing (ISO 8401) showed that structural and human factors required for TPM deployment in Khuzestan Petrochemical Company does not exist.

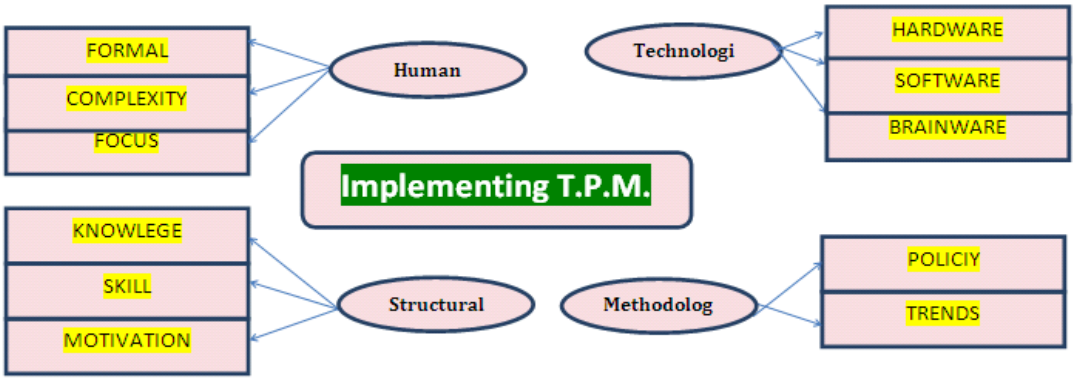
According to review the theoretical and empirical literature, and research purposes, the following research hypotheses are listed.

1 –The structure feasibility of implementing T.P.M. exists in Motorsazan Co.
2 - The systemic feasibility of implementing T.P.M. exists in Motorsazan Co. .
3 - The human resource feasibility of implementing T.P.M. exists in Motorsazan Co.
4-The methodology and system feasibility of implementing T.P.M. exists in Motorsazan Co.

Tools and Methods:

Generally, this article is applicable as the point of purpose, and also, is descriptive and correlation as the point of collecting data. According to research type, data have been collected through the distribution of questionnaire and interviewing with top and middle managers and related experts. The research population is Motorsazan Co. For research sample, 12 units associating with the T.P.M.'s activities among 20 organizational ones have been selected that totally 134 employees are engaged in. To analyze the data collected in this study, inferential statistics such as mean, variance and t test by applying SPSS software is used. The questionnaire used in this study consists of two parts. In designing the questionnaire, the Liker-Scale has been used. The first part is related to demographic characteristic. The second part is related to the questions of four factors of structural, systemic, human and systemic. The validation of questionnaire in this study verified and evaluated by several professors of the Faculty of Management in University of Tabriz, and maintenance experts. Finally, after applying the numerous comments and revisions, validation of questionnaire content was confirmed. Calculated Alpha for the validity of the questionnaire is 0.89, which indicates that, the validity is acceptable.

After studying literature and considering available factors in implementing T.P.M., according to research hypothesis.



RESULTS AND DISCUSSION

Structural Factors and T.P.M.:

As mentioned in the research model, variable of structural factors is made up of three element of: Formal, Complexity and Focus. Table 4-12 shows the relationship between structural factors of the three dimensions.

Results of structural factors in relation to the requirements of TPM				
T.P.M.	Dimension	Structural Factors		
		Formal	Complexity	Focus
	correlation coefficient	0.430	0.540	0.463
	Significant	0.000	0.000	0.000
	Number of observations	121	121	121

According to the above table, the relationship between structural factors of TPM deployment requirements is approved with a confidence level of 95%. According to the table, because significant level is less than 0.05, the zero hypothesis is rejected and significant correlation between these two variables creates.

Human Factors and T.P.M.:

As mentioned in the research model, variable of human factors is made up of three element of: Knowledge, Skill and Motivation. Table 4-13 shows the relationship between human factors of the three dimensions.

Results of human factors in relation to the requirements of TPM				
T.P.M.	Dimension	Human Factors		
		Knowledge	Skill	Motivation
	correlation coefficient	0.656	0.793	0.465
	Significant	0.000	0.000	0.000
	Number of observations	121	121	121

According to the above table, the relationship between human factors of TPM deployment requirements is approved with a confidence level of 95%. According to the table, because significant level is less than 0.05, the zero hypothesis is rejected and significant correlation between these two variables creates.

Systemic Factors and T.P.M.:

As mentioned in the research model, variable of systemic factors is made up of three element of: Software, Hardware and Brainware. Table 4-14 shows the relationship between human factors of the three dimensions.

Results of Systemic factors in relation to the requirements of TPM				
T.P.M.	Dimension	Systemic Factors		
		Software	Hardware	Brainware
	correlation coefficient	0.558	0.373	0.776
	Significant	0.000	0.000	0.000
	Number of observations	121	121	121

According to the above table, the relationship between systemic factors of TPM deployment requirements is approved with a confidence level of 95%. According to the table, because significant level is less than 0.05, the zero hypothesis is rejected and significant correlation between these two variables creates.

Systemic Factors and T.P.M.:

As mentioned in the research model, variable of systemic factors is made up of two element of: Policies and Procedures. Table 4-15 shows the relationship between human factors of the three dimensions.

Results of Systemic factors in relation to the requirements of TPM			
T.P.M.	Dimension	Systemic Factors	
		Policies	Procedures
	correlation coefficient	0.570	0.757
	Significant	0.000	0.000
	Number of observations	121	121

According to the above table, the relationship between systemic factors of TPM deployment requirements is approved with a confidence level of 95%. According to the table, because significant level is less than 0.05, the zero hypothesis is rejected and significant correlation between these two variables creates.

Regression:

Although correlation coefficient shows the intension of relationship between two variables but doesn't shows amount of change in independent variables when several dependant variables effect on it simultaneous .in this instance multiple regression analysis assists researcher to know how much of dependant variable variance is denoted by a set of anticipators. So in this section, route analysis is used for identification the effect of each independent variables on the dependent variables in order to examine total validity of research model. In this stage variables such structural, human, technological and systematically factors are supposed as independent variables and TPM variables as a dependant variable. The results of regression implementation are exploited in below table.

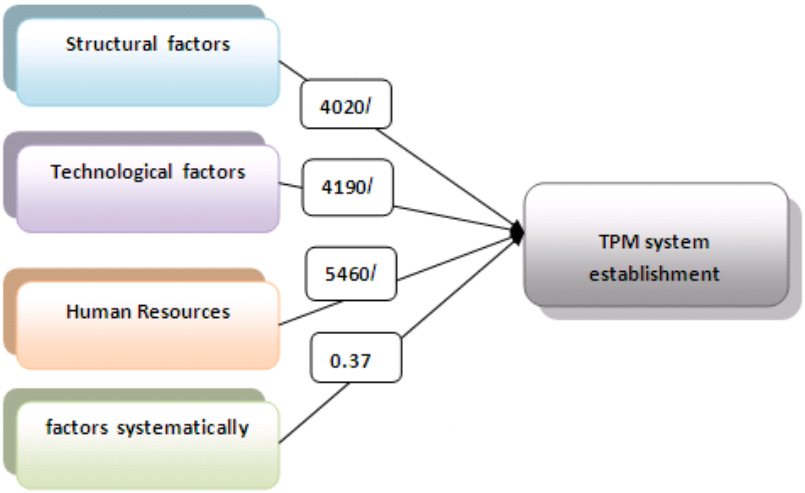
Table 8: Result of regression.

variable	regression coefficients	examination norm error	t- value	significant level	VIF	
structural factors	0.402	0.085	4.668	0.000	1.144	
human factors	0.5460	0.064	6.82	0.000	1.114	
technological factors	0.419	0.064	7.052	0.000	1.179	
systematically factors	0.37	0.025	7.309	0.000	1.181	
adapted determination coefficient						0.92
determination coefficient						0.922
f- value						461.526
standard error estimation						0.31943
significant level						0.00
Watson – Dorbin						1.94
constant value						0.399

checking of this matter that regression can be used or not, is the first stage in regression analysis. For this reason Watson - Doorbin examination is used for checking error's independence. If error's independence theory is declined and errors have correlation with each other, regression can not be used. if this static be in the range of 1.5-2.5, the zero assumption i.e. existance of correlation between errors declined. (coakes & steed, 2003) because of that Watson -dourbin d static (1.94)is in the range of (1.5-2.5),theory of not existence correlation between errors doesn't declined and we can use regression. in following stage and by attention to above table, determination coefficient for first regression stage is 0.92 that shows 92 percentage of changes in TPM are defined by model independent variables. In later stage, model's admissibility is checked from statistical point. According to table no 16-4 and be attention to above table, f statistic meaningful level is lower than 0.05 and this matter validates that change showed by model isn't accidental. As a result this theory that model is linear is validated. In other word f statistic significant level that is lower than 0.05 shows independent variables (structural, human, technological and systematically factors) exposition on dependant variable (TPM) is significant.

The main results of this research provides notable instances to support given relation between research variables in this section the results of data analysis are discussed in the research theory frame.

Hypothesis 1) Implementing T.P.M by considering structural factors in Motorsazan Co . is possible.The overall model is confirmed by a significant factor that can ensure that the structural factors have strong and positive effects on the implementing TPM with 95% of confidence. The results of this study, Mac Kun et al's research (2001), Eti et al's research (2004) and Momeni et al's research (1389) show that structural factors have a direct relationship with the deployment of TPM system.



Hypothesis 2) Implementing T.P.M by considering human resources' factors .in Motorsazan Co is possible. . The test statistical value for this variable in the model is 0.8, which is verifiable in the significant level of 0.05. This effect is strong and positive. Thus, we can state that human factors have a significant effect on the deployment of TPM system with 95% of confidence. The results of this study, Mac-kun et al's research (2001), Eti et al's research (2004), Bin Boone and Karim's research (2011), Tavakoli's research (1380), Babai, et al's research, (1387) Momeni et al's research (1389) and Dinparast's research (1389) are corresponding with each other. This research shows that the human factor has a positive effect on the implementation of TPM system.

Hypothesis 3) Implementing T.P.M by considering technological factors. In Motorsazan Co. is possible.The overall model is confirmed by a significant factor that can ensure that the technological factors have strong and positive effects on the implementing TPM with 95% of confidence. The results of this study, Ahmad et al's research, Bin Boone and Karim's research (2011), Tavakoli's research (1380), Babai, et al's research, (1387) Momeni et al's research (1389) and Dinparast's research (1389) are corresponding with each other

Hypothesis 4) Implementing T.P.M by considering systemic factors .in Motorsazan Co. is possible. The test statistical value for this variable in the model is 0.75, which is verifiable in the significant level of 0.05. Thus, we can state that systemic factors have a significant effect on the deployment of TPM system with 95% of confidence. The results of this study, Mac-kun et al's research (2001), Ireland and Dale's research, Eti et al's esearch (2004), Bin Boone and Karim's research (2011), Tavakoli's research (1380), Nilipour's research, Babai, et al's research (1387) and Momeni et al's research (1389) are corresponding with each other. This research shows that the human factor has a positive effect on the implementation of TPM system.

As mentioned in earlier sections of this paper, the design and deployment of maintenance systems in manufacturing companies, is one of the critical and vital issues in today's industry and requires special factors to be implemented productive and effective. In this study, we have referred to four factors of structural, human, technological and systemic that can help to implement TPM systems. The results of the analysis indicate that human factors are more effective and relative than the others in implementing TPM in manufacturing organizations.In the present, factories are making changes revolution within their activities in order to adapt themselves with the world developments. This is the maintenance discussion that can help the companies to determine the production strategy of the company seriously and effectively. Nowadays, companies involved in issues such as reducing costs, being powerful in competing, continuous improvement, quality and quantity enhancement, lack of natural resources, energy crisis etc. that paying attention to maintenance concept, as a strategy to achieve these objectives, is vital unavoidable. Due to rapid changes of technology, particularly in the areas of computers, automation, information technology and also increasing the value of machine and requiring the skillful workforce, it is necessary for the maintenance of a system, to determine it's strategies with planning and regarding to the future development of specific technologies.

Today, the main challenges that stakeholders of maintenance issues are facing with, are not only learning new techniques and methods, but also deciding and choosing the best and the most effective technique and method for maintenance system is more important. Selecting the correct choice, causes the improvement and quality promotion in machine performance and so reducing maintaining costs. Conversely, if we choose the wrong option, not only we will not solve our problems, but also will make the existing problems harder and then new problems will have to create in the organization.

Hence, the strategic and vital importance of maintenance increases and highlights continuously. Here is that expert workforce face with opportunities and challenges in the areas of maintenance and need for behavior changes and developments.

1. Practical recommendations in the area of human factors:

- Performing required technical trainings in maintenance context for personnel
- Providing appropriate incentive system for innovation, making suggestions and encouraging to accomplish corrective action
- Providing appropriate infrastructure to promote and relocation the personnel of maintenance department in order to realize Meritocracy slogan
- Involving the Maintenance Planning staff in preparing work instructions and procedures
- Involving the Maintenance Planning staff in attending the conferences and seminars related to the P.M.

2. Practical recommendations in the area of structural factors:

- Management approaches of regarding the importance of maintenance in order to maintain production power of the organization and emphasizing personal experiences by the management, as a cultural belief
- Dealing with maintenance issue practically and not theoretically
- Involving the personnel in determining and documenting the maintenance policies
- Considering the documentation of work instructions by the management.

3. Practical suggestions in technological factors.

- Using modern techniques, models and maintenance;
- Study the potential applications of network analysis, feasibility analysis, technical, economic maintenance performed Allocating appropriate time to perform the necessary repairs to equipment, net performance indicators should be measurable and measured.
- Create a centralized information data bank of all equipment within the system;
- Create a comprehensive software capability reporting Top;
- Power management bilateral, regional influences on each other by higher authority;
- Using data from the SCADA system for estimating risk
- Proper planning system implementation and maintenance and repair of equipment for rocessing continuous performance data in order to take advantage of this information to plan repairs.
- Practical suggestions of systemic factors
- mechanized system with the ability to classify various defects and reporting, record keeping and reading instructions, Recorded, and service equipment needs, preparing management reports, reports to be provided at various levels of the organization.
- suitable for creating a database of technical equipment (archive technical documentation) and maintenance records should be kept And consequently a regular and continuous data logging of process and equipment performance is available in this process;
- Appropriate measures were taken to record the integrated

Training workshop for planners to estimate the time required for repairs;

- Proactive planning for system implementation;
- Lack of non-technical issues involved in frequent maintenance planning;

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