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### Total productive maintenance and its effective impact on the flow of the production process

#### Field and statistical study on the woolen industries complex of Bani Waleed

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**Abstract:** This paper dealt with a study on total production maintenance (TMP) and its effective impact on improving and continuing the flow of production, as it is one of the basic pillars of industrial companies, due to the necessity of maintaining material and human resources on an ongoing basis. The study aimed to reveal and verify the impact of applying the maintenance system on the woolen Industries complex of Bani Waleed to reduce breakdowns and increase performance in the factory. To achieve the objectives of the study, an inspection form based on the principles of (TMP) was used as a data collection tool to evaluate the maintenance program within the factory. The results were adopted according to a Likert three-point scale. The results concluded that the total productive maintenance rate in general reached a value of (1.62), which indicates There is a decline in the factory's performance level, which affects its ability to control the workflow during breakdowns. The study also concluded that the inspection model applied to evaluate total productive maintenance can be used generally on various industrial companies and recommended the necessity of applying the total productive maintenance system in industrial operations to reduce malfunctions and increase efficiency and production capacity, and to develop implementation programs for the maintenance system represented by continuous training and development.

**Keywords:** Total productive maintenance, pillars of (TMP), training and continuous development, efficiency and level of performance, the woolen industries complex of Bani Waleed.

#### Introduction

In light of the scientific developments that the world is witnessing in various industrial processes and the changes occurring in the work environment, it has become necessary for industrial institutions to carry out various modernizations in order to continue and improve their industrial performance, which guarantees them the ability to compete as required, represented by "total productive maintenance," which has a major role. In the production process, which works to extend the operational life of machines and equipment, raise their performance, increase the level of quality, and reduce breakdowns and production costs to the lowest possible level[1].

Total Productive Maintenance (TMP) is one of the main concepts in the field of maintenance and production management, as it aims to achieve safety and efficiency in production processes. It is a basic, comprehensive approach to ensure the continuity of production operations without unplanned interruptions and reduces costs associated with maintenance. Its success depends on developing a clear strategy by management and allocating the necessary resources to implement it with the required effectiveness [3].

Comprehensive productive maintenance is also one of the pillars that industrial organizations rely on for continuous improvement and

development. Recently, interest in it has increased rapidly among specialists in this field due to the intense competition to provide the best. This interest calls us to preserve the assets, whether they are equipment, machines, or equipment, to continue their operation with the required effectiveness by developing integrated programs for their maintenance so that they do not stop working partially or completely [2].

Maintenance management has a major role in the life of industrial institutions that consider it a field for investment. It is considered important in the organizational structure that depends on quality in the sequence of tasks through planning, scheduling, and control using modern administrative methods. Effective management is able to keep pace with future changes and the required updates to systems and procedures, which makes them successful and able to avoid malfunctions before they occur [4].

The primary objective of this paper is to evaluate the current situation of the woolen industries complex of Bani Waleed and to know all the methods and measures taken by the complex with regard to maintenance during the occurrence of malfunctions and how to deal with them. Are modern methods of maintenance applied in a way that is compatible with the nature of the complex's or factory's work? Is there an organizational administrative hierarchy? For work orders related to maintenance methods during downtime or holidays.

### **The concept of total productivity maintenance (TPM)**

Total productive maintenance (TPM) is a comprehensive approach to dealing with assets with the aim of achieving the highest levels of efficiency in production and maintenance, and it has been developed and understood in different ways by many experts in this field [3].

From the perspective of Seiichi Nakajima, considered one of the early pioneers of total productive maintenance, (TPM) is a comprehensive system that aims to eliminate equipment-related losses by involving all employees in the organization, from shop floor workers to senior management. Nakajima believes that (TPM) is not just a maintenance

tool, but rather a management strategy aimed at improving equipment performance and increasing productivity through interaction and cooperation between all levels of the organization[3][4].

As for Kilpatrick, (TPM) is a method directed at improving equipment efficiency by applying preventive and predictive maintenance, with a focus on reducing breakdowns and increasing equipment life. Kilpatrick believes that the active participation of all team members is the basis for the success of this method, as employees are trained in basic maintenance skills and are motivated to take responsibility for the equipment they work on [5].

Venkatesh points out that (TPM) is a way to achieve operational excellence by improving equipment efficiency and reducing breakdowns and downtime. He stresses that applying (TPM) requires a consistent methodology, including all individuals from direct workers to senior management, to achieve sustainable improvements [8].

Mishra considers (TPM) to be part of a continuous improvement philosophy, as it focuses on integrating maintenance with the daily operations of manufacturing. Mishra believes that the true effectiveness of (TPM) comes from collective commitment and an organizational culture that fosters collaboration and shared responsibility [6].

Katkamwar et al, also point out that (TPM) contributes to improving production quality and reducing costs by reducing downtime and increasing equipment efficiency. They emphasize the importance of analyzing data and using modern technology to achieve sustainable improvements that will enhance team spirit and increase employee participation in improvement processes. They believe that continuous training and effective communication between all organizational levels are the key to successful implementation of (TPM) [7][9].

In summary, and from our point of view, we can define total productive maintenance as a comprehensive management system that aims to improve the overall performance of equipment through cooperation and effective participation by all members of the

organization, with a focus on prevention and prediction of problems before they occur.

**Table 2:** shows the results of the inspection models related to (TMP).

**foundations of Total Productive Maintenance**

(TPM) is based on several basic principles that contribute to achieving the desired goals of this system[3], as shown in Figure 1.

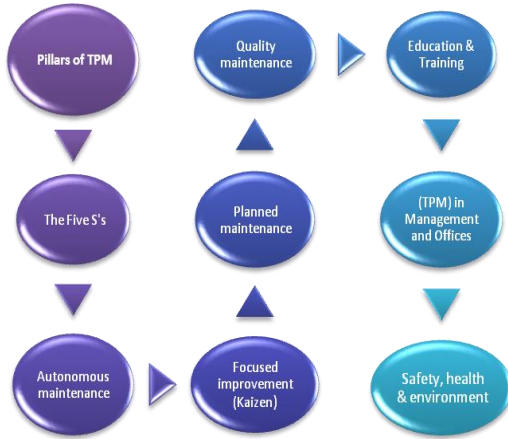


Figure 1: shows the foundations of (TMP).

**Results**

The Likert three-point scale was used to analyze the data obtained from the inspection models as indicated in Table 1.

**Table 1:** illustrates the data analysis for the Likert 3-point scale.

Level	Scale	Lower Limit	Upper Limit	Interval
Disagree	1	1	1.66	1 : 1.66
Neither agree	2	1.67	2.33	1.67 : 2.33
Agree	3	2.34	3.0	2.34 : 3.0

Through the results obtained from the inspection models for comprehensive productive maintenance, as shown in Table 2.

P.N	The pillars of (TPM)	Average	Level	General Average
1	The Five S's	2	Neither agree	1.62
2	Autonomous maintenance	1.73	Neither agree	
3	Focused improvement (Kaizen)	1.57	Disagree	
4	Planned maintenance	1.55	Disagree	
5	Quality maintenance	1.64	Disagree	
6	Education & Training	1.2	Disagree	
7	(TPM) in Management and Offices(	1.52	Disagree	
8	Safety, health & environment	1.76	Neither agree	

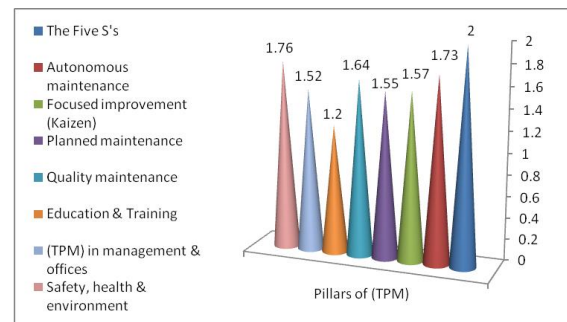


Figure 2: shows the results of the Pillars of (TMP).

It was found that the inspection model related to the five S's may obtain a rate of (2) within a partially achieved standard, where important things are used at work and placed in their appropriate place, unimportant things are disposed of, attention is paid to the ideal storage method for the items used to facilitate

access to them when needed, and attention is paid to cleanliness. Continuous inspection to ensure that the work is performed correctly.

The inspection model related to autonomous maintenance may obtain a rating of (1.73) within a partially achieved criterion, meaning that workers are familiarized with the features and benefits of self-maintenance, a special schedule is drawn up for methods of general inspection, cleaning, lubrication, lubrication, and electrical inspection, and operators are familiarized with using inspection manuals in the correct manner, in cooperation with supervisors. Specialists, it has been observed that these contents are used incompletely.

The inspection model related to focused improvement (kaizen) may obtain a rate of (1.57) within the unachieved standard, which includes developing plans to make and implement continuous improvements to technical and administrative functions to increase the effectiveness of work-related machines and equipment, and identify the causes of problems and errors that occur during work and address and correct them, Using appropriate tools and applications for the principle of continuous improvement, and developing plans to eliminate all types of losses during work, as these contents are used incorrectly.

The inspection form related to planned maintenance may obtain a rate of (1.55) within the unachieved standard, which in turn includes documentation of the processes of evaluating the condition of machines and equipment within a maintenance information system, which is based on analyzing, storing and retrieving that information and required data when needed at different times, as well as developing Implementing plans related to preventive maintenance to discover faults before they occur, and to address weaknesses and deficiencies occurring in machines and equipment with the aim of returning them to their normal condition. We note that this content is not followed properly.

The inspection model related to quality maintenance may obtain a rate of (1.64) within an unachieved standard, which includes paying attention to machines and equipment, by ensuring the support of quality assurance methods for activities related to maintenance

management, identifying parts that affect the quality of products, and using materials that conform to specifications in the process. Manufacturing, so that it does not negatively affect the machines and equipment used in production, as well as identifying the operational working conditions that lead to defects in the quality of products, and knowing their sources so that they are easy to get rid of. From the above, it is clear that these contents are not being taken into account as required.

The inspection form related to education and training may obtain a rate of (1.2) within an unachieved standard, which includes developing and implementing training plans for comprehensive productive maintenance, by preparing schedules and training programs that contribute to increasing skills related to operation and maintenance, and providing all the supplies required for training, so that training is done. Managers, engineers and operators in accordance with their responsibilities, and conduct evaluations of training programs related to comprehensive productive maintenance. We note that these contents are not taken into account appropriately, resulting in a decline in the level of education & training.

The model for total productive maintenance in the management and offices may obtain a rate of (1.52) within an unachieved standard, which includes the effective participation of all employees in everything related to the administration and offices related to (TPM), to raise the efficiency of work performance in all departments, and reduce maintenance-related costs. As well as the time required to retrieve data and information related to maintenance, provide a clean and tidy work environment within maintenance workshops, and reduce the level of inventory to the lowest possible, so that it facilitates the appropriate exploitation of the workplace. We note that these contents are not taken into account in a way that is compatible with the nature of the work.

The model for safety, health and environment may obtain (1.76) within a partially achieved criterion, which includes providing all requirements for safety, health and environment for all workers and operators, developing awareness plans and programs related to the field of work, in addition to arranging places in a way that is compatible

with the nature of the work and providing modern learning methods. So that it reduces disasters and injuries that occur during work

As well as providing all medical services to workers and operators, giving educational lectures related to the work environment, and placing advertisements and posters indicating this. From the above, we notice that these contents are being taken into account in an incomplete manner.

### Conclusions

Through the results of the evaluation on the extent of commitment to applying the concepts of comprehensive productive maintenance on the Woolen Industries Complex of Bani Waleed, it was found that:

1. The general rate of total productive maintenance reached (1.62) within an unachieved standard.
2. The inspection form for the five years obtained a rate of (2) within a partially achieved standard.
3. The inspection form for the autonomous maintenance received a rate of (1.73) within a partially achieved standard.
4. The special inspection model for focused improvement (Kaizen) obtained an average of (1.57) within an unachieved standard.
5. The special inspection model for planned maintenance receives a rate of (1.55) within an unachieved standard.
6. The special inspection model for quality maintenance obtained a rate of (1.64) within an unachieved standard.
7. The inspection form for education and Training received a rate of (1.2) within an unmet standard.
8. The special inspection model for total productive maintenance obtained a rate of (1.52) within an unachieved standard.
9. The special inspection model for safety, health and environment

obtained a rate of (1.78) within a partially achieved standard.

10. The inspection form is a general form that can be used by all factories and various production companies.
11. Total productive maintenance concepts can be applied in full cooperation between all sections and departments within the factory.

### Arabic section:

الصيانة الانتاجية الشاملة وأثرها الفعال في سير العملية الانتاجية

دراسة ميدانية حول مجمع الصناعات الصوفية بني وليد

### الملخص

تناولت هذه الورقة دراسة حول الصيانة الانتاجية الشاملة وأثرها الفعال في تحسين واستمرارية تدفق الانتاج، لكونها ركيزة من الركائز الاساسية لدى الشركات الصناعية، لضرورة المحافظة على الموارد المادية والبشرية بصورة مستمرة. فقد هدفت الدراسة الى الكشف والتحقق من اثر تطبيق نظام الصيانة على مجمع الصناعات الصوفية بني وليد لتقليل الاعطال ورفع الاداء في المصنع. ولتحقيق اهداف الدراسة تم استخدام نموذج فحص مبني على مرتكزات الصيانة الانتاجية الشاملة كأداة جمع البيانات لتقييم برنامج الصيانة داخل المصنع وقد تم اعتماد النتائج وفقا لمقياس ليكرت الثلاثي، وخلصت النتائج الى ان معدل الصيانة الانتاجية الشاملة بشكل عام بلغ ما قيمته (1.62)، الذي يدل على وجود تدني في مستوى الاداء الخاص بالمصنع، مما يؤثر على قدرته في التحكم بسير العمل اثناء حدوث الاعطال. وكذلك توصلت الدراسة الى ان نموذج الفحص المطبق لتقييم الصيانة الانتاجية الشاملة يمكن استخدامه بشكل عام على مختلف الشركات الصناعية و اوصت بضرورة تطبيق نظام الصيانة الانتاجية الشاملة في العمليات الصناعية لتقليل الاعطال وزيادة الكفاءة والقدرة الانتاجية، ووضع برامج تنفيذية لنظام الصيانة متمثلة في التدريب والتطوير المستمر.

**الكلمات المفتاحية:** الصيانة الانتاجية الشاملة، مرتكزات الصيانة الانتاجية الشاملة، الكفاءة ومستوى الأداء، التدريب والتطوير المستمر، مجمع الصناعات الصوفية بني وليد.

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