extent of implementation of lean manufacturing in industrial organizations
A case study of the cement and derivatives corporation in chlef

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Abstract:
This study aims to find out the extent of the application of lean manufacturing pillars in the cement enterprise in Chlef. To achieve this goal, the study adopted the descriptive and analytical analytical method, and the questionnaire was used as the main tool for data collection, where it was distributed to a sample of 58 individuals and 50 of them were returned. After analyzing the data using the statistical package SPSS 26 and testing the hypothesis, the study found that there is an impact of applying the pillars of lean manufacturing in the sample institution, especially the organization of the work site, which received the highest percentage of agreement among the members of the study sample with 86%, and the overall productive maintenance with 80%. The study recommended the need to educate workers to cooperate and participate in maintenance activities, as well as the need to accept the creative ideas presented by workers to improve production methods, in addition in addition to working on introducing more flexible equipment at the level of production.
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1. INTRODUCTION:

Various local or global industrial organizations are facing major challenges, the most important of which is the renewed and accelerated technological development aimed at improving production systems and providing an industrial environment that facilitates the activities of these organizations, in order to keep pace with global changes in light of economic challenges, and this is through gaining the advantage and competitiveness that allows to conquer the local and global market continuously; accordingly, we focus in this study on the lean manufacturing system which is considered one of the most important new strategic management systems for highly efficient manufacturing processes in light of the optimal use of the organization's resources that constitute the outputs at the end of each exploitation cycle, as lean manufacturing ensures the reduction of the size of the inventory. To determine the importance of applying Lean Manufacturing, we have chosen the Cement and Derivatives Corporation as an industrial organization that manufactures one of the basic building materials and is the sample chosen to analyze and study the subject of our research; accordingly, we raise the following issue:

To what extent is lean manufacturing applied in the cement and derivatives organization in chlef?

In order to answer this question, it is necessary to analyze and study all the elements associated with lean manufacturing and its processes. These elements are summarized in the following sub-questions:

What is meant by lean manufacturing?

What are the key elements (pillars) to activate lean manufacturing?

What are the objectives of lean manufacturing and its field applications in an industrial organization?

Study hypothesis:

To facilitate the study and analysis, we adopted the following hypothesis:

The cement and derivatives organization in Chlef adopts the lean manufacturing system in all work practices.

Objectives of the Study:

This study aims to identify the nature of the lean manufacturing system and the basic requirements that must be met for the successful implementation of this system; in addition, the following objectives have been identified:

1- Identifying the main pillars of the lean manufacturing system that will reduce all forms of waste and achieve customer satisfaction.

2- Measuring the extent of the application of lean manufacturing in the Algerian industrial organization.

The Significance of the Present Study:

The significance of this study lies in the importance of the lean manufacturing system as a strategic system for the optimal exploitation of resources and the minimization of defective production, thereby generating numerous economic benefits for industrial organizations. These benefits include reduced product costs, enhanced product quality, and the provision of products to customers in accordance with their expectations, as well as competitive pricing. This contributes to the recovery of the national economy and the promotion of sustainable development. Furthermore, this system assists industrial organizations in achieving sustainability in their environmental performance, thereby contributing to environmental preservation, a matter of paramount importance in the contemporary era.

Methodological Tools for the Study:

We relied in our research studies on the descriptive and analytical method to list the various literature and concepts related to the topic, and on the statistical method to collect and analyze various statistics and data to study the case of the Cement and Derivatives Corporation in Chlef. This approach entailed the conduction of recurrent field interviews with members of the management staff at various levels and with workers on the production lines for the purpose of clarifying the questionnaire paragraphs. In addition to the aforementioned methods, we employed the SPSS26 software to analyze and test the study hypothesis.

2.The Theoretical Framework of the Study

In this section, we will address the theoretical framework of this study by presenting the concepts of the lean manufacturing system and its main pillars, in addition to presenting its main objectives.

2.1 Theoretical Concepts about Lean Manufacturing

2.1.1 WOMac's Concept of Lean Manufacturing

In his book published in 1990, WOMAK presented a comprehensive concept of lean manufacturing, through which he identified the efficient and effective attributes to achieve the greatest manufacturing performance, as he considered manufacturing lean because it uses less of all resources compared to mass manufacturing (traditional manufacturing), as it depends on the exploitation of half of the production elements represented in labor, space (land), investment in tools and engineering hours to develop a new product, and requires keeping less than half of the required inventory on site, which leads to fewer defects, this definition addresses system efficiency by integrating the relationship between inputs and outputs, while system effectiveness by integrating the relationship between outputs and organizational goals. (Wickramasinghe & Wickramasinghe, 2017, p. 535)

2.1.2 TAIICHI OHONO Concept

TAIICHI OHONO is considered the first innovator of the manufacturing system, as he defined it as “reducing the time line from the moment the customer orders the product to the moment he receives the money from him by eliminating all kinds of waste that does not add value to the product.” (Al-Rai. M, 2021, p. 53)

2.1.3 DAVIS Concept

Davis defined lean manufacturing as these activities are characterized by their integration and design to achieve the manufacture of products in large quantities, with the lowest possible inventory levels of raw materials, semi-finished materials and finished products. The objective is to ensure that components reach the workstation when required, where they are processed and rapidly transferred to the subsequent stage of the process. The fundamental principle underpinning lean manufacturing is that "production does not occur unless there is a requirement for it". (Al-Dabbagh & Safwan, 2010, p. 102)

2.2 The Pillars of Lean Manufacturing

There are numerous pillars upon which the lean manufacturing system is based, yet this study will address the five pillars that are considered most significant by the majority of writers and researchers in this field.

2.2.1 5S Workplace Organization

The 5S methodology is the primary implement within the framework of lean manufacturing systems, aimed at minimizing waste within the workplace and enhancing productivity through the implementation of five distinct practices: stands for sort, set in order, shine, standardize, and sustain (Al-Beheiry, 2020, p. 120) The attainment of the desired outcomes of lean manufacturing systems is contingent upon the maintenance of a tidy, organized and uncluttered workplace. Repetitive, haphazard, and uncoordinated practices inevitably yield outcomes that contradict the principles of lean manufacturing, consequently leading to a multitude of errors. This, in turn, necessitates the incessant cessation of machinery for maintenance due to recurrent unintentional incidents, resulting in delays in production and significant wastage (Dandis, 2018, p. 28) .

2.2.2 Total Productive Maintenance (TPM)

Comprehensive productive maintenance is a novel systemic approach to maintenance that works to meet new maintenance needs, through which equipment is managed, maintained and preserved. Comprehensive productive maintenance constitutes a relational relationship between all organizational functions (mainly production and maintenance) aimed at achieving product quality, improving operational performance, continuously improving the effectiveness of equipment, and ensuring safety and security. (Abdel, 2020, p. 37).

The emergence of the concept of comprehensive productive maintenance was synchronized with the emergence of manufacturing systems that depend on automation, such as the lean manufacturing system, and this helped to develop and spread this concept widely (Abboud & Khazal , 2014, p. 20).The comprehensive productive maintenance adopts the principle of everyone's participation in maintenance work, as it aims to maximize the effectiveness of the machine, reduce the rate of breakdowns and accidents, reduce machine downtime, and improve the effectiveness of equipment to the maximum extent possible. (Azzizia, 2020, p. 591)

2.2.3 KAIZEN Continuous Improvement

The concept of continuous improvement is derived from the Japanese word KAIZEN, which is a compound of two words, KAI meaning change, ZEN meaning for the better, i.e. change for the better, which can be fully translated into CONTINUAL IMPROVEMENT meaning continuous improvement, and this management philosophy was invented by Taichi Ohno to lead organizations, (Abdelkhalek, 2016, p. 242).

The concept of continuous improvement is defined by the Japanese as follows:

A study of daily operations must be conducted with a view to simplification and continuous improvement. Each work process must be continuously improved in order to achieve higher levels of performance. The way of working must be changed for the better slowly, gradually and continuously. Each current process must result in some form of material, moral or intellectual waste, and this waste must be eliminated in a continuous manner in order to achieve added value to the process and product and thus to the customer. The core idea of Kaizen is to eliminate all forms of waste. As asserted by (Ben Khaznaji & Garziz, 2021, p. 1595).

2.2.4 Just-in-time Production (JIT)

The JIT system is a manufacturing philosophy of Japanese origin, it is a set of operational procedures that are based on producing the required products, in the required quantity and quality, at the prevailing prices in the period in which the customer places the order, this system (jit) is based on the fundamental rule that there should be no production running at the end of the cycle so that the raw material needs are purchased periodically in order to produce the necessary materials according to the current cycle time needs only, and there is no stock of finished products in warehouses by delivering finished products to customers at the end of the cycle. In short, the materials received must enter the production process immediately and the semi-finished parts are assembled on time into products that are finished on time and shipped to customers (Ben Amer & Berhouma, 2018, p. 97).

The JIT system is a manufacturing philosophy whose main principle is the elimination of inventory at all stages, and it focuses on performing what is required on time, and it works continuously to find solutions to issues and eliminate activities that do not add value in order to produce high-quality products and reduce excess energy in order to reduce waste of materials and time. (Ben Bayra, 2021, p. 129).

2.2.5 Cellular Manufacturing

The process of arranging and organizing equipment and people within factories that adopt traditional manufacturing systems is based on what is required by the operation or processing process, where a group of parts moves from one processing center to another.

An operation or processing process in which a group of parts moves from one processing center to another, and during this transition process, which takes a certain amount of time, other parts and units within the system wait their turn to move to the next center for processing, and so on, resulting in increased material and time waste in addition to a high percentage of inventory (Al-Kiki, 2012, p. 125). As for the cellular manufacturing method, which is considered an essential element of the lean manufacturing system, in an essential element of the lean manufacturing system, is based on a completely different principle. In order to reduce the waste of time and materials, decrease the inventory ratio, and utilize the labor and space allocated to the manufacturing process in a more efficient manner, Ohno reorganization of the factory was implemented, resulting in the division of the factory into manufacturing cells that use the advantages of flexibility and efficiency in performance. This method is referred to as cluster technology (cellular manufacturing).

This method (cellular manufacturing) is based on the fact that products that are similar in terms of shape and manufacturing requirements should be manufactured in one cell dedicated to them, where this cell is planned and arranged and then assembled a number of machines dedicated to that production process, and these groups are called families, and This is with the aim of reducing the time and movements of transporting materials and moving workers between production departments, as for the cell, it is a group of individuals, equipment and workstations, organized according to the order of the process flow for the purpose of manufacturing each production unit or part of it, so it is called a cell or flow line (Wilson, 2010, p. 214).

3. Field Study

The Cement and Derivatives Corporation in Chlef was selected to conduct the field study due to its distinguished reputation in the domain of manufacturing. Furthermore, the corporation's workforce, comprising both senior management and regular employees, possesses a substantial experiential background in manufacturing, a prerequisite that aligns with the study's objectives. The study encompassed a diverse range of participants, including managers, department heads, production line officials, and workers.

3.1 Description of the Study Sample

The population of this study consists of employees and workers in the organization under investigation. The sample of respondents included managers, department heads, departments, officials, and production line workers, for a total of 58 individuals. This sample was selected based on their knowledge of the study's variables, the nature of their work, their experience in the field of manufacturing, and their commitment to providing the best for the organization.

3.2 The Study Tool

The researchers employed direct interviews with members of the study sample to introduce them to the tenets of lean manufacturing, thereby facilitating their comprehension of the inquiries posed by the primary study instrument, a questionnaire meticulously designed to collect and analyze information, and thereby achieve the study's objectives and address the hypotheses. The questionnaire consisted of 5 axes, each axis consists of 8 paragraphs, and in order to measure the response of the sample members to the questions of the questionnaire, the five-point Likert scale was adopted, which consists of five options (agree, strongly agree, neutral, disagree, strongly disagree). This questionnaire was distributed to 58 individuals, of which 50 questionnaires were retrieved, of which 50 were suitable for analysis, where their data were analyzed using the statistical package program SPSS26.

3.3 Stability of the Study Instrument

In order to determine the stability of the data collection tool and the reliability of the sample's answers to the questionnaire statements, Cronbach's alpha coefficient was used to confirm the stability of the tool.

Table 1. Cronbach's alpha test results for the dimensions of the study instrument

Questionnaire Dimensions	Number of Phrases	Cronbach's alpha coefficient
Organization of work	08	**0.891**
Comprehensive productive maintenance	08	**0.887**
Continuous improvement	08	**0.862**
Just-in-time production	08	**0.867**
Cellular manufacturing	08	**0.877**

Source: Prepared by the researchers relying on the spss26 program

Based on the results of Table No. (01), which represents the Cronbach's alpha test for the dimensions of the study tool, we note that the value of the Cronbach's alpha coefficient for the five dimensions ranged between (0.862 and 0.891) and all values are close to one, which means that the degree of credibility of the answers is very high.

3.4 Results and Testing the Hypotheses of the Study

3.4.1 Workplace Organization

Table 2. Percentages of response scores to the dimension of workplace organization among workers of the Cement and Derivatives Corporation in Chlef

Degree of Response	Percentages
Strongly Disagree	%0.25
Disagree	%4
Neutral	%9.75
Agree	%61.5
Strongly agree	%24.5

Source: Prepared by the researchers relying on the SPSS26 program

It is clear from Table No. (02), which shows the percentages of the response scores for the dimension of work organization among the workers of the Cement and Derivatives Corporation in Chlef, that 86% of the study sample members agree that the Cement and Derivatives Corporation in Chlef applies the organization of the workplace within the organization.

✔The validity of the hypothesis will be tested through the statements and the total score of the workplace organization dimension through the “T” test calculated for one sample, and the degree of neutrality 3 has been adopted as a criterion for comparison with the arithmetic mean of the statements.

Table 3. Arithmetic mean and probability value (sig) for each of the paragraphs of the work organization dimension among the workers of the Cement and Derivatives Corporation in Chlef

M	Paraghraphs	Arithmetic mean	Standard deviation	Relative arithmetic mean	Calculated “t” value	Probability value “sig”"	Ranking
1	The factory works to make the workplace clean by production and unnecessary materials, which facilitates the transportation of materials and the movement of workers	4.22	0.81	84.4	10.58	0.000	2
2	In the factory, workplaces are divided according to specialization, where the workplace is chosen to suit the work	4.00	0.78	80	9.03	0.000	6
3	Tools, materials and equipment are labeled using the labeling method	4.06	0.65	81.2	11.49	0.000	5
4	Factory management educates workers on the importance of tidying up the workplace and urges them to return equipment and tools to their designated places so that they are easily accessible	4.32	0.62	86.4	15.03	0.000	1
5	Workers are keen to clean the machines and the workplace after work to provide a safe and healthy work environment	4.12	0.65	82.4	12.01	0.000	3
6	The factory uses standardized rules for	3.82	0.74	76.4	7.75	0.000	8

	work and activities in order to clarify for each worker the work assigned to him						
7	By arranging and organizing the productive elements in the workplace, the factory seeks to reduce time wastage	4.08	0.60	81.6	12.71	0.000	4
8	The factory separates necessary production materials from unnecessary wastes to ensure smooth workflow	3.86	0.78	77.2	7.76	0.000	7
	Overall score for the work organization dimension	4.06	0.47	81.2	15.68	0.000	/

Source: Prepared by the researchers relying on the SPSS26 program

Through the results of the above table, we notice that the arithmetic mean of the study sample members about **the work organization dimension** for all its statements was generally high (4.06) with a standard deviation (0.47), meaning that the study sample members believe that **the workplace organization dimension** is applied within their work organization, in addition to the value of the arithmetic means ranged between 3.82 and 4.32 for the answers of the study sample members to the paragraphs of this dimension with a high degree, and the order of the paragraphs of this dimension came as follows: In the first place is the phrase “The factory management educates workers about the importance of organizing the workplace and urges them to return equipment and tools to their designated places so that they are easily accessible” with an arithmetic mean of 4.32 and a standard deviation of 0.62 with a high degree. The second place was given to the statement “The factory works to make the workplace clean by producing and removing unnecessary materials, which facilitates the transportation of materials and the movement of workers” with a mean of 4.22 and a standard deviation of 0.81 with a high score. The third place was given to the statement “Workers are keen to clean the machines and the workplace after completion, providing a safe and healthy work environment” with a mean of 4.12 and a standard deviation of 0.65 and a high degree of agreement. While the fourth place was given to the statement “The factory seeks through the arrangement and organization of productive elements in the workplace to reduce time wastage” with an arithmetic mean of 4.08 and a standard deviation of 0.60 with a high degree of agreement, while the fifth place was given to the statement “Tools, materials and equipment are named using the labeling method” with an arithmetic mean of 4.06 and a standard deviation of 0.65 with a high degree of agreement. In sixth place by the statement “In the factory, workplaces are divided according to specialization, where the workplace is chosen to suit the work” with an arithmetic mean of 4.00 and a standard deviation of 0.78 with a high score. While the statement “The factory separates necessary production materials from unnecessary waste to ensure work flow” ranked seventh with an arithmetic mean of 3.86 and a standard deviation of 0.78 with a high score, while the statement “The factory uses standardized rules for work and activities in order to clarify the work assigned to each worker” with a mean of 3.82 and a standard deviation of 0.74 with a high score.

When comparing the probability values “sig” we find that they are less than the significance level of 0.05 and therefore there is statistical significance for all statements and the total score of the dimension, in addition to that the arithmetic mean of this dimension was generally high (4.06) and standard deviation (0.47), which indicates the high approval of the sample members on the paragraphs of this dimension. Therefore, the researchers believe that there is a statistically significant effect of the application of this dimension, and this appears in the great interest of the organization's management in educating workers to organize and clean the workplace by removing unnecessary waste to ensure the smooth flow of work and create a safe and healthy environment, as well as The workers are keen to clean the machines after completion and return them to their designated places, as the factory relies on standard rules (dividing workplaces into cells, the method of labeled cards) and thus it can be said that the workers of the Cement and Derivatives Corporation in Chlef see that their work organization is applied after the organization of the work site, and this confirms the validity of the hypothesis.

3.4.2 Productive Maintenance

Table 4. Percentages of response scores to the dimension of overall productive maintenance among the workers of the Cement and Derivatives Corporation in Chlef

Degree of response	Percentage
Strongly Disagree	%0.75
Disagree	%6.50
Neutral	%12.75
Agree	%52.50
Strongly Agree	%27.50

Source: Prepared by the researchers relying on the SPSS26 program

It is clear from Table No. (04), which shows the percentages of the response scores for the dimension of comprehensive productive maintenance among the workers of the Cement and Derivatives Corporation in Chlef, that (80%) of the study sample members agree that the Cement and Derivatives Corporation in Chlef applies comprehensive productive maintenance within the organization.

✔The validity of the hypothesis will be tested through the statements and the total score of the comprehensive productive maintenance dimension through the “T” test calculated for one sample, and the degree of neutrality 3 has been adopted as a criterion for comparison with the arithmetic mean of the statements.

Table 5. Arithmetic mean and probability value (sig) for each of the paragraphs of the comprehensive productive maintenance dimension among the workers of the Cement and Derivatives Corporation in Chlef

M	Paragraphs	Arithmetic mean	Standard deviation	Relative arithmetic mean	Calculated “t” value	Probability value “sig”	Ranking
1	Factory management trains workers in basic maintenance skills	4.02	0.91	80.4	7.88	0.000	6
2	Each worker performs routine maintenance on the machines they work on, such as cleaning, lubrication and inspection.	4.20	0.72	84	11.64	0.000	1
3	The factory follows a system of preventive and predictive maintenance on an ongoing basis	4.18	0.77	83.6	10.77	0.000	2

4	Engineers and technicians in charge of maintenance develop a set of operations to repair the machines within specific time plans "planned maintenance"	4.12	0.84	82.4	9.33	0.000	3
5	The factory provides the necessary tools, equipment and facilities for the maintenance process	4.12	0.82	82.4	9.61	0.000	4
6	The factory works to detect and eliminate the sources of defective production caused by frequent machine downtime	4.08	0.69	81.6	10.98	0.000	5
7	All workers in the factory, from the highest level of management to production line workers, cooperate and participate in maintenance activities	3.48	0.99	69.6	3.41	0.001	8
8	The factory management is interested in the opinions and suggestions for maintenance provided by all employees in order to achieve productive efficiency	3.76	0.82	75.2	6.56	0.000	7
	Overall Degree Productive Maintenance Dimension	3.99	0.61	79.8	5.73	0.000	/

Source: Prepared by the researchers relying on the SPSS26 program

Through the results of the above table, we note that the arithmetic mean of the study sample members about the dimension of comprehensive productive maintenance for all its statements was generally high (3.99) with a standard deviation (0.61), meaning that the study sample members believe that the dimension of comprehensive productive maintenance is applied within their work organization, in addition to the value of the arithmetic means ranged between 3.48 and 4.20 for the answers of the study sample members to the paragraphs of this dimension with a high degree, and the order of the paragraphs of this dimension came as follows: "Each worker performs routine maintenance of the machines on which he works, such as cleaning, lubrication and inspection" with an arithmetic mean of 4.20 and a standard deviation of 0.72 with a high degree, while the second place went to the phrase 'The factory follows the preventive and predictive maintenance system on an ongoing basis' with an arithmetic mean of 4. 18 and a standard deviation of 0.77 with a high score, followed by the third place, which was returned to the phrase "The engineers and technicians in charge of maintenance develop a set of operations to repair machines within specific time plans 'planned maintenance' with an arithmetic mean of 4.12 and a standard deviation of 0.84 with a high degree of agreement. "The factory provides the necessary tools, equipment and facilities for the maintenance process," with a mean of 4.12 and a standard deviation of 0.82, with a high degree of agreement. "The factory works to detect and eliminate sources of defective production caused by frequent machine downtime" was ranked fifth with a mean of 4.08 and standard deviation of 0.69, followed by 'Factory management trains workers on basic maintenance skills' with a mean of 4.02 and standard deviation of 0.91, with a high degree of agreement. The phrase "Factory management is interested in the opinions and suggestions for maintenance provided by all workers in order to achieve productive efficiency" ranked seventh with an arithmetic mean of 3.76 and a standard deviation of 0.82 and a high degree, while the phrase "All workers in the factory from the highest level of management to production line workers cooperate and participate in maintenance activities" ranked eighth and last with an arithmetic mean of 3.48 and a standard deviation of 0.99 and a high degree.

When comparing the "sig" probability values, they are less than the 0.05 significance level and therefore there is statistical significance for all statements as well as the total score of the dimension, in addition to that the arithmetic mean was generally high (3.99) with a standard deviation (0.61), which indicates the high approval by the sample members for the paragraphs of this dimension, so the researchers believe that there is a statistically significant effect for the application of comprehensive productive maintenance in the research sample organization, and the evidence of this is that the factory adopts the method of preventive and predictive maintenance to avoid breakdowns in the future to avoid waste caused by frequent stops, and the planned maintenance method to maintain machines within specific time plans, and the factory management works to raise the basic maintenance skills of workers through training programs, who in turn, they are keen to carry out routine maintenance of machines and rely on the principle of the participation of everyone from different positions in maintenance activities, so it can be said that the workers of the Cement and its derivatives in Chlef see their organization as implementing the dimension of productive maintenance comprehensive. This confirms the validity of the hypothesis.

3.4.3 Continuous Improvement

Table 6. The percentages of the response scores to the continuous improvement dimension among the workers of the Cement and Derivatives Corporation in Chlef

Degree of response	Percentage
Strongly Disagree	%0.75
Disagree	%10.25
Neutral	%21.75
Agree	%51.25
Strongly Agree	%16

Source: Prepared by the researchers relying on the SPSS26 program

It is clear from Table No. (06), which shows the percentages of the response scores for the dimension of continuous improvement among the workers of the Cement and Derivatives Corporation in Chlef, that (67.25%) of the study sample agree that the Cement and Derivatives Corporation in Chlef applies continuous improvement within the organization

The validity of the hypothesis will be tested through the statements and the total score of the dimension through the "T" test calculated for one sample, and the degree of neutrality 3 has been adopted as a criterion for comparison with the arithmetic mean of the statements.

Table 07. The arithmetic mean and the probability value (sig) for each of the paragraphs of the dimension of continuous improvement among workers Cement and Derivatives Corporation in Chlef

M	Paragraphs	Arithmetic mean	Standard deviation	Relative arithmetic mean	Calculated "t" value	Probability value "sig"	Ranking
1	Factory officials and workers have the conviction and commitment to continuous change for the better	3.78	0.84	75.6	6.55	0.000	4
2	Factory management forms working teams to follow up on continuous improvements	3.70	0.86	74	5.73	0.000	5
3	Factory management motivates employees to come up with new ideas, innovate, and continuously look for ways to improve processes	3.40	0.98	68	2.85	0.006	8
4	Factory management believes that continuous improvement programs help maintain and control the quality of products	3.88	0.87	77.6	7.13	0.000	1
5	Factory management conducts training courses to develop the continuous improvement skills of employees.	3.78	0.93	75.6	5.91	0.000	3
6	Factory officials and employees realize that the absence of errors does not mean that there is no need for a continuous improvement process	3.70	0.70	74	7.00	0.000	6
7	Factory management instills a culture of eliminating waste (activities that do not add value)	3.62	0.90	72.4	4.86	0.000	7
8	The process of improving and developing products is based on customer needs	3.86	0.88	77.2	6.90	0.000	2
	Overall degree for the continuous improvement dimension	3.71	0.63	74.2	7.95	0.000	/

Source: Prepared by the researchers relying on the SPSS26 program

From the results of the table above, we notice that the arithmetic mean of the study sample members about the continuous improvement dimension for all its statements was generally high (3.71) with a standard deviation (0.63), meaning that the study sample members believe that the continuous improvement dimension is applied within their work organization, in addition to the value of the arithmetic means ranged between 3.40 and 3.88 for the answers of the study sample members to the paragraphs of this dimension with a high degree, and the order of the paragraphs of this dimension came as follows: "The factory management believes that continuous improvement programs help maintain and control the quality of the products: In the first place is the phrase "The factory management believes that continuous improvement programs help in maintaining and controlling the quality of products” with an arithmetic mean of 3.88 and a standard deviation of 0.87 with a high degree, while the second place was returned to the phrase “The process of improving and developing products is based on the wishes of customers” with an arithmetic mean of 3.86 and a standard deviation of 0.88 with a high degree, followed by the third place which returned to the phrase “The factory management conducts training courses in line with developments to develop continuous improvement skills among employees” with an arithmetic mean of 3.78 and a standard deviation of 0.93 with a high degree of agreement. The fourth place was given to the statement “Factory officials and workers have the conviction and commitment to continuous change for the better” with an arithmetic mean of 3.78 and a standard deviation of 0.84 with a high degree of agreement, while the fifth place was given to the statement “Factory management forms work teams that follow up on continuous improvements” with an arithmetic mean of 3.70 and a standard deviation of 0.70 and a standard deviation of 0.86 with a high degree of agreement, followed in sixth place by the statement “Factory officials and workers realize that the absence of errors does not mean that there is no need for continuous improvement” with a mean of 3.70 and a standard deviation of 0.70 with a high degree of agreement. While the statement “Factory management works to instill a culture of eliminating waste (activities that do not add value)” was ranked seventh with an arithmetic mean of 3.62 and a standard deviation of 0.90. The seventh rank with a mean of 3.62 and a standard deviation of 0.90 with a high score, while the statement “Factory management motivates workers to put forward their new ideas, innovation, and continuous research on ways to improve operations” ranked eighth and last with a mean of 3.40 and a standard deviation of 0.98 with a moderate score.

When comparing the probability values “sig”, we find that they are less than the significance level of 0.05, and therefore there is statistical significance for all statements and the total score of the dimension, except for the third statement, whose probability value was greater than the significance level of 0.05. In addition, the high level of the arithmetic mean gives an indication of the high degree of approval of the paragraphs of the continuous improvement dimension by the sample members, so the researchers believe that there is a statistically significant effect of applying this dimension in the organization, and this is evidenced by the conviction of the organization's management and workers that continuous improvement programs help To this end, the organization organizes training courses to develop the skills of continuous improvement among workers, and also motivates them to present their creative ideas, and thus it can be said that the workers of the Cement and Derivatives Corporation in Chlef believe that their organization applies the dimension of continuous improvement. This confirms the validity of the hypothesis.

3.4.4 Just- in –time Production

Table 08. Percentages of response scores to just in-time production dimension among workers at the Cement and Derivatives Corporation in Chlef

Degree of response	Percentage
Strongly Disagree	%2
Disagree	%10.25
Neutral	%19.50
Agree	%53.50
Strongly Agree	%14.75

Source: Prepared by the researchers relying on the SPSS26 program

It is clear from Table No. (08), which shows the percentages of the response scores to the dimension of on-time production among the workers of the Cement and Derivatives Corporation in Chlef, that (68.25%) of the study sample agree that the Cement and Derivatives Corporation in Chlef applies on-time production within the organization.

The validity of the hypothesis will be tested through the statements and the total score of the dimension through the "T" test calculated for one sample, and the degree of neutrality 3 was adopted as a criterion for comparison with the arithmetic mean of the statements.

Table 09. The arithmetic mean and the probability value (sig) for each of the paragraphs of on-time production among the workers of the Cement and Derivatives Corporation in Chlef

M	Paragraphs	Arithmetic mean	Standard deviation	Relative arithmetic mean	Calculated "t" value	Probability value "sig"	Ranking
1	The factory's production system works to minimize all forms of waste and reduce defective production	3.82	0.98	76.4	5.89	0.000	2
2	The factory works to minimize all types of inventory	3.62	0.80	72.4	5.44	0.000	5
3	The factory management works to determine the needs and requirements of customers through sufficient studies and customer surveys	3.50	0.93	70	3.79	0.000	7
4	Production is only carried out based on receiving orders from customers	3.20	1.16	64	1.21	0.229	8
5	The factory operates a system of scheduling production operations in accordance with demand	3.60	0.90	72	4.69	0.000	6
6	The factory works through a set of procedures to deliver products on time	4.16	0.58	83.2	14.04	0.000	1

7	Factory employees participate in various training courses to improve their on-time delivery system	3.76	0.82	75.2	6.53	0.000	4
8	Factory management is keen to continuously monitor the performance of workers in order to minimize errors to ensure on-time delivery	3.84	0.76	76.8	7.75	0.000	3
	Overall Degree Production Dimension Score On time	3.68	0.49	73.6	9.88	0.000	/

Source: Prepared by the researchers relying on the SPSS26 program

From the results of the table above, we notice that the arithmetic mean of the study sample members about the continuous improvement dimension for all its statements was generally high (3.71) with a standard deviation (0.63), meaning that the study sample members believe that the continuous improvement dimension is applied within their work organization, in addition to the value of the arithmetic means ranged between 3.40 and 3.88 for the answers of the study sample members to the paragraphs of this dimension with a high degree, and the order of the paragraphs of this dimension came as follows: “The factory management believes that continuous improvement programs help maintain and control the quality of the products: In the first place is the phrase “Factory management believes that continuous improvement programs help in maintaining and controlling the quality of products” with an arithmetic mean of 3.88 and a standard deviation of 0.87 with a high degree, while the second place belongs to the phrase “The process of improving and developing products is based on the wishes of customers” with an arithmetic mean of 3.86 and a standard deviation of 0.88. The third place was given to the statement “Factory management conducts training courses in line with developments in order to develop continuous improvement skills among employees” with an arithmetic mean of 3.78 and a standard deviation of 0.93 with a high degree of agreement, while the fourth place was given to the statement “Factory officials and employees have the conviction and commitment to continuous change for the better” with an arithmetic mean of 3.78 and a standard deviation of 0.84 with a high degree of agreement, while the fourth place was given to the statement “Factory officials and employees have the conviction and commitment to continuous change for the better” with an arithmetic mean of 3.78 and a standard deviation of 0.84 with a high degree of agreement. While the fifth place was occupied by the phrase “Factory management forms working teams to follow up on continuous improvements” with an arithmetic mean of 3.70 and a standard deviation of 0.86 and a high degree, followed by the phrase “Factory officials and workers realize that the absence of errors does not mean that the continuous improvement process is not needed” with an arithmetic mean of 3.70 and a standard deviation of 0.70 and a high degree, while the phrase “Factory management works to instill a culture of eliminating waste (activities that do not add value)” occupied the seventh place. “Factory management motivates workers to put forward new ideas, innovate, and continuously look for ways to improve operations” ranked seventh with a mean of 3.62 and a standard deviation of 0.90 with a high score, while ‘Factory management motivates workers to put forward their new ideas, innovate, and continuously look for ways to improve operations' ranked eighth and last with a mean of 3.40 and a standard deviation of 0.98 with a moderate score.

When comparing the probability values "sig", we find that they are less than the significance level of 0.05, and therefore there is statistical significance for all statements and the total score of the dimension, except for the third statement, whose probability value was greater than the significance level of 0.05. In addition, the high level of the arithmetic mean gives an indication of the high degree of approval of the paragraphs of the continuous improvement dimension by the sample members, so the researchers believe that there is a statistically significant effect of applying this dimension in the organization, and this is evidenced by the conviction of the organization's management and workers that continuous improvement programs help To this end, the organization organizes training courses to develop the skills of continuous improvement among workers, and motivates them to present their creative ideas, and thus it can be said that the workers of the Cement and Derivatives Corporation in Chlef believe that their organization applies the dimension of continuous improvement. This confirms the validity of the hypothesis.

3.4.5 Cellular Manufacturing

Table 10. Percentages of response scores to the cellular industrialization dimension among workers of the Cement and Derivatives Corporation in Chlef

Degree of response	Percentage
Strongly Disagree	%1.25
Disagree	%8
Neutral	%22.5
Agree	%52
Strongly agree	%16.25

Source: Prepared by the researchers relying on the spss26 program

It is clear from Table No. (10), which shows the percentages of the response scores for the cellular manufacturing dimension among the workers of the Cement and Derivatives Corporation in Chlef, that (68.25%) of the study sample agree that the Cement and Derivatives Corporation in Chlef applies cellular manufacturing within the organization.

The validity of the hypothesis will be tested through the statements and the total score of the cellular manufacturing dimension through the "T" test calculated for one sample, and the degree of neutrality 3 was adopted as a criterion for comparison with the arithmetic mean of the statements.

Table 11. Arithmetic mean and probability value (sig) for each of the cellular post-manufacturing paragraphs use among workers at the Cement and Derivatives Corporation in Chlef

M	Paraghraphs	Arithmetic mean	Standard deviation	Relative arithmetic mean	Calculated "t" value	Probability value "sig"	Ranking
1	The factory utilizes the internal arrangement of machines and machinery to allow materials to	3.78	0.73	75.6	7.48	0.000	4

	flow easily without waiting time						
2	The factory divides workplaces into manufacturing cells so that the product is produced in them instead of moving from one place to another.	3.54	0.95	70.8	4.01	0.000	7
3	Products of similar shape and manufacturing requirements are produced in one dedicated cell	3.70	0.86	74	5.73	0.000	5
4	The production department uses small and flexible manufacturing equipment	3.22	0.99	64.4	1.56	0.125	8
5	Factory management seeks to minimize waiting times and eliminate delivery delays	4.02	0.62	80.4	11.58	0.000	2
6	The cell manufacturing process helps reduce the inventory of manufactured and semi-finished items	3.56	0.64	71.2	6.14	0.000	6
7	Factory management organizes training sessions to create efficient work cells	3.84	0.97	76.8	6.08	0.000	3
8	The factory has multi-skilled workers who are able to perform various operations within the production line	4.26	0.69	85.5	12.83	0.000	1
	Overall score for the cellular manufacturing dimension	3.74	0.48	74.8	10.80	0.000	/

Source: Prepared by the researchers relying on the spss26 program

Through the results of the above table, we notice that the arithmetic mean of the study sample members about the cellular manufacturing dimension for all its statements was generally high (3.74) with a standard deviation (0.48), meaning that the study sample members believe that the cellular manufacturing dimension is applied within their work organization, in addition to the value of the arithmetic means ranged between 3.22 and 4.26 for the answers of the study sample members to the paragraphs of this dimension with a high degree, and the order of the paragraphs of this dimension came as follows: “The factory has workers with multiple skills that enable them to perform various processes within the production line” with a mean of 4.26 and a standard deviation of 0.69: “The factory has workers with multiple skills that enable them to carry out various operations within the production line” with an arithmetic mean of 4.26 and a standard deviation of 0.69 with a high degree, while the second place went to the phrase ‘the factory management seeks to reduce waiting times and eliminate delays in delivery’ with an arithmetic mean of 4.02 and a standard deviation of 0.62 with a high degree of agreement, followed by the third place, which was returned to the statement “The factory management organizes training courses to form effective work cells” with a mean of 3.84 and a standard deviation of 0.97 with a high degree of agreement. The fourth place was given to the statement “The factory uses the internal arrangement of machines and machinery to allow materials to flow easily without waiting time” with a mean of 3.78 and a standard deviation of 0.73 with a high degree of agreement, while the fifth place was given to the statement “Products of similar shape and manufacturing requirements are produced in one cell dedicated to them” with a mean of 3.70 and a standard deviation of 0.86 with a high degree of agreement, followed by the sixth place for the statement “The cell manufacturing process helps reduce the inventory of manufactured and semi-finished materials” with a mean of 3.56 and a standard deviation of 0.64 with a high degree of agreement, followed by the statement “The cell manufacturing process helps reduce the inventory of manufactured and semi-finished materials” with a mean of 3.56 and a standard deviation of 0.64 with a high degree of agreement. “The factory divides workplaces into manufacturing cells so that the product is produced there instead of moving from one place to another” ranked seventh with a mean of 3.54 and a standard deviation of 0.95 with a high score, while ‘The production department uses small and flexible manufacturing equipment’ ranked eighth and last with a mean of 3.22 and a standard deviation of 0.99 with a moderate score.

When comparing the probability values “sig”, we find that they are less than the significance level of 0.05 and therefore there is statistical significance for all statements and the total score of the dimension, except for the fourth statement, which had a probability value greater than the significance level of 0.05, so the researchers believe that there is a statistically significant effect of applying cellular manufacturing in the organization. Therefore, the researchers believe that there is a statistically significant effect of the application of cellular manufacturing in the organization, and this appears in the flow of raw materials easily in the supply chain without waiting time due to the use of the method of internal arrangement of machines, and the factory divides the workplaces into manufacturing cells where similar products are produced in one cell dedicated to them in order to avoid moving the product from one place to another, and thus it can be said that the workers of the Cement and Derivatives Corporation in Chlef see that their organization applies the dimension of cellular manufacturing.

4. Findings and Recommendations :

Based on the theoretical treatment of the study variables, data analysis, and hypothesis testing, it is possible to draw a set of conclusions and propose a set of recommendations.

4.1 Results of the Study :

- The study concluded that there is a statistically significant effect of applying of lean manufacturing in the cement and derivatives organization in Chlef.
- The study showed that the degree of application of lean manufacturing pillars in the Cement and Derivatives Organization in Chlef was 73.95% agreement among the study sample members.
- Through the results of the statistical analysis of the study, it is clear that the dimension of Workplace organization topped the ranking list, as it received the highest percentage of agreement (86%) by the members of the study community, while after Comprehensive productive maintenance came in second place with an agreement rate of 80%, while both

the dimensions of on-time production and cellular manufacturing ranked third with an agreement rate of 68.25%, while continuous improvement came at the end of the ranking with an agreement rate of 67.25%.

- The results of the statistical analysis show that the sample organization is interested in the dimension of work site organization, comprehensive production maintenance and production on time by a large percentage, and this is shown in educating workers and urging them to organize and clean their workplaces and carry out preventive and predictive maintenance work continuously, and work according to a set of procedures in order to deliver products on time.
- The sample organization pays attention to the dimension of continuous improvement and cellular manufacturing, but to a lesser extent, and this appears in the involvement of workers in training courses to develop continuous improvement skills and to form effective work cells.
- The study showed that the use of flexible and small manufacturing equipment at the level of the production department is relatively low.

4-2 Recommendations :

- This study recommends that managers and officials adopt a lean manufacturing system and seek the assistance of specialists and experts in modern manufacturing systems.
- Seeking to schedule training courses for administrative staff and production line managers on the lean manufacturing system.
- Motivating and sensitizing employees of different ranks and departments to cooperate and participate in maintenance activities.
- Work on adopting creative ideas submitted by employees and increasing their level of motivation for the purpose of continuous improvement.
- Introduce smaller and more flexible manufacturing equipment at the level of production departments to ensure work flow.
- Conduct adequate studies by surveying customers to determine their needs and demands.

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