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The Impact of Technological Change in Enhancing the Role of Lean Manufacturing as a Strategy to Improve the Productivity of the Organization: A Field Study in Diwaniyah Tires Factory

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***Abstract* :** The current study seeks to demonstrate the impact of technological change in enhancing the role of lean manufacturing and investing it as a strategy to improve productivity as a philosophy based on maximizing the value delivered to the customer, which enables the organization to achieve a competitive position that will bring it success and sustainability. The problem of the study is focused on the impact that technological changes can have in enhancing the role of Lean Manufacturing as a development strategy to improve the productivity of the research sample organization. This study derives its importance from the fact that it deals with a dynamic topic in an attempt to elevate the research sample organization and enhance its position and occupy a distinct market share to reach a leading organization. The study aimed to examine the role of lean manufacturing in order to improve factory productivity. A questionnaire was adopted in order to accomplish the study's goals, and 137 employees from the organization's various departments made up the sample. Two main hypothesis was formulated in line with the study's objectives, and the researchers then used a number of statistical techniques with the help of the statistical programme (Spss vr.24) and (AMOS vr.24) to reach at a number of conclusions, the most important of which are :The mediating variable Technological Change (TE.CH) increased the value of the impact of the Lean Manufacturing (L.M) axis on the axis of productivity improvement (PR.IM) by (0.585). As well as a set of recommendations, the most important of which are: Optimal investment of the technical energies and superior skills in the productive departments and maintaining them in a way that contributes to strengthening the position of those departments in reducing waste and speeding up the completion of tasks.

Keywords: Technological Change, lean Manufacturing, Productivity Improvement

INTRODUCTION: In the midst of the conditions experienced by contemporary organizations and the rapid changes in the business environment characterized by a high degree of complexity and creative chaos, the need has emerged to adopt methods, programs and practices that meet the desired goal in facing these immediate and potential challenges in the future to achieve a competitive advantage and an efficient use of available resources. Lean manufacturing was the most prominent of them, as it is the backbone of the application of lean systems, including the movement of expanding continuous improvement efforts, flexible operations, and good use of personnel and available resources to reduce costs and serve customers beyond the physical limits of the organization. Also, it is one of the modern entrances and a philosophy that includes advanced concepts and methods in managing and performing the operations function on the strategic and operational levels. This requires the commitment and participation of all employees in the organization in managing the transformation process to the use of this approach and its tools instead of continuing with the traditional means and methods, and to devote the idea of adapting to unexpected changes and making effective situational decisions to ensure the success and continuity of the organization by keeping pace with changes in the environment and enhance the ingenuity of technology systems as they constitute a strategic process to increase productivity and push the development process towards achieving the goals. Where (Al-Jawari and Hadi, 2019: 298) indicates that the importance of technological change lies in the fact that it is a tool for rehabilitating the workforce and increasing their capabilities, as technological change eliminates social and economic disparities and reduces inequality between countries to achieve economic development, renewal and vitality, and to show creativity and eliminate routine and the desire to development as well as increasing productivity by reducing the costs of the production process and increasing production efficiency.

METHODOLOGY

A. Study Problem

The study problem stems from the following questions:

- What is the level of lean manufacturing practices in the sampled organization?
- To what extent does technological change affect the enhancement of the role of lean manufacturing in improving the productivity of the sampled organization?
- What is the nature of the relationship between technological change and lean manufacturing and Productivity Improvement in the sampled organization?

Accordingly, the problem of the study is focused on the impact that technological changes can have in enhancing the role of Lean Manufacturing as a development strategy to improve the productivity of the research sample organization.

B. Study Importance

This study derives its importance from the fact that:

- A step to enrich thought in an attempt to identify the reality and level of technological changes and the Lean Manufacturing System as a strategy to improve the performance of the organization research sample.
- An attempt to draw attention to the necessity of adopting technological change as an influential factor in enhancing the role of Lean Manufacturing as an improvement and development strategy.
- The scarcity of relevant research as it is a modern topic in terms of interest.

C. Study Objectives

The objectives of the study can be summarized in the following points:

- Shedding light on the concepts of technological change and lean manufacturing as a strategy to achieve improvement in the nature of the service provided to customers, enabling the organization to succeed and develop.
- Examine the role that Lean Manufacturing plays in achieving improvement and development.
- Seeking to know the level and reality of both technological change and lean manufacturing in the sampled organization.
- Detecting of the level of productivity improvement of the sampled organization.
- Studying and analyzing of the relationship between technological change and lean manufacturing in the organization.

D. Study Hypotheses

In light of the study problem, the following main hypothesis was formulated:

- There is a statistically significant correlation between Lean Manufacturing and Productivity Improvement through Technological Change.
- The Existence of an Impact Relationship for the Axis of Lean Manufacturing in the Axis of Productivity Improvement through Technological Change.

E. Data and Information Collection Methods

- Theoretical aspect: References and relevant literature to determine the scientific background of the study.
- The practical aspect: Survey approach with a questionnaire information.

F. Study Limitations

Spatial limits: The study was limited to Diwaniyah Tires Factory.

Scientific limits: The study is confined to the impact of technological change in enhancing the role of lean manufacturing as a strategy to improve organizational productivity.

Human Limits: the individuals working in the organization at its various levels and divisions.

G. Study Community Society and Sample

Diwaniyah Tire Factory was chosen as an applied field of study for its vital role in providing society with its different products, in the public and private sectors. As for the study sample, it was represented by employees of the organization from all levels and departments. 137 questionnaires were distributed to them, their inquiries were listened to and the aspects related to the study were clarified. 137 forms were received, meaning that the response rate was 100%.

H. Research Gap

This study deals with the concepts of technological change and lean manufacturing and Productivity Improvement which is characterized by modernity in terms of interest in it and it focuses on the level and reality of its application in the Diwaniyah Tires Factory as an important production organization, As well as the lack of twinning between the three variables in previous studies, which was neglected in previous studies.

I. Applied Statistical Methods

The following statistical methods were adopted:

(Confirmatory factor analysis, Regression analysis Cronbach's alpha coefficient, Bootstrapping Style, CFI, IFI, C.R, SE, RMSEA).

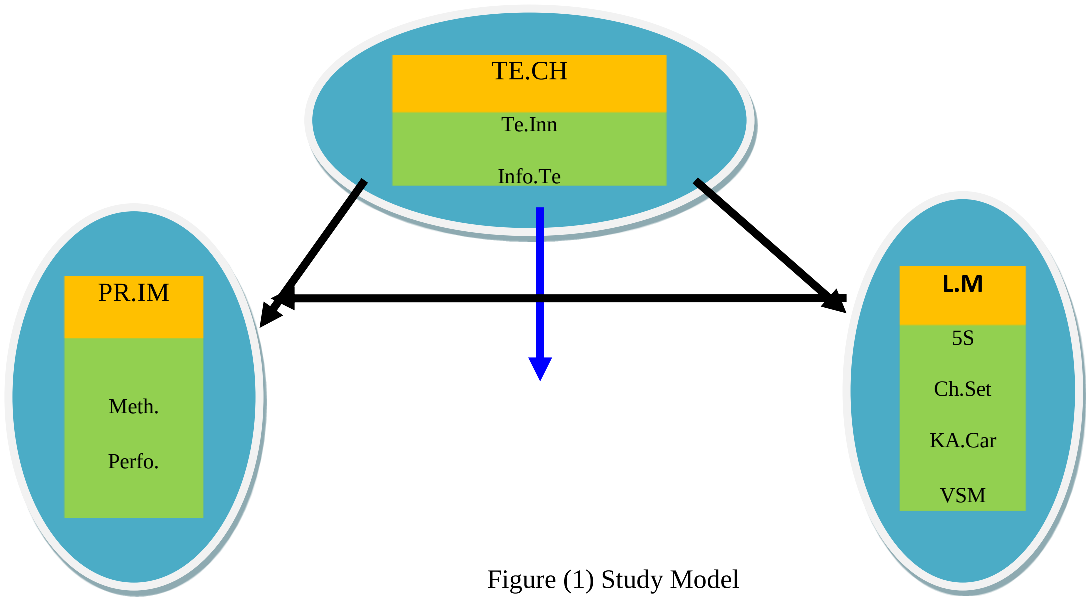

Figure (1) Study Model

LITERATURE REVIEW

1. *Technological Change*

1.1. Technological Changes Conceptualization

Industrial growth has led to change in many aspects of life, with which adaptation to modern technology has become a matter that cannot be overlooked, but rather what is reliable in the future in a world characterized by a high degree of development and scientific and technological excellence. This means that technological change leads to giving organizations new tasks, methods and ways of doing business to meet existing challenges.

There is no doubt that it needs to call for work policies and employees with new and developed skills, and Moore & Smith (2001:2) contend that it influences how we work and think about it in a variety of ways. Al-Qaryuti (2000:260) stated that it entails modifications to the production equipment or methods as well as the connections between various activities and better work flow techniques.

Robbins (2001:544) said that it is changes in technology related to devices, equipment, methods, automation or computer to produce a new good or service. Daft (2001: 356) sees that changes in products and processes that include knowledge and skills capable of achieving a competitive advantage. Mahmoud (2007:13) indicates that there has been progress in the method or technical method used in the production or presentation of products.

Accordingly, Technological change refers to the progress made in techniques, methods, ways of working and the culture of thinking of the organization aimed at adapting to rapid changes to gain a competitive advantage over other similar organizations.

1.2. Reasons for Technological Change

The reasons for technological change can be classified into:

• Increasing capacity and satisfying anticipated demand for the company's goods.
• Cutting production expenses.
• A rise in quality.
• Increasing the ability to deliver goods on time and improving the services offered to customers.
• Differentiating the company's goods from those of rival companies by performing tasks with the necessary degree of flexibility in a way that maximizes customer satisfaction with the variety of goods.
• Deterioration and obsolescence of machinery and procedures. Al-Lami (2007:104)

1.3. Objectives of Technological Changes Organizations seek technological change to achieve a number of goals, including:

- Modifying the physical and chemical properties of the input materials, and introducing new materials in order to compensate for the shortage in the available materials, due to the low quality of materials or machines or their high relative prices, reducing transportation costs, improving the properties of final products, and reducing residual waste.
- Introducing changes in the design and size of equipment, production units and factories in order to improve certain indicators of technical performance (speed, accuracy, durability, safety, yield, repair and maintenance period), in addition to increasing production capacity and achieving a better balance between production stages, preparing and creating facilities for the production of new products or modify existing products.
- Improving automatic control systems, such as computerization of production processes and coordination between production stages, continuous control process design, and feedback systems in factories with the aim of achieving more automated control processes, and ensuring the least possible deviation from the desired operating conditions, or from the characteristics of the desired products In them, and make rapid changes in production levels and product assortment, in response to changes in market requirements.
- Changing the design of existing products or introducing products in order to enter new markets, and maintain market share in existing markets. Qureshi (2014:211)

1.4. Conditions of Successful Technological Change There is a set of conditions that must be met to achieve technological change, including:

- Knowledge of the field: an attempt to know the location of the organization concerned with change from the environment in which it is active, and to eliminate the ambiguity that could cloud this process at any stage of its implementation.
- The ability of those in charge of change to assess: which is represented mainly in their ability to determine the appropriate time for technological change, the time it takes, in addition to predicting the problems that it may face, and the material, financial and human capabilities needed to bring about it, and the threats and risks that impede its progress.
- Access to technological developments: meaning to identify the technological capabilities that exist in the external environment constantly, especially in the technological field used by the industrial organization in its production processes, and to monitor all developments that occur in this field in order to be aware of the technological machines and equipment owned by competitors.
- The ability to assess the available technological capabilities: that is, knowing the extent of the development of the technology used by the organization, and what are the shortcomings in the technical system, and whether this system has the ability to produce in the desired quantity and quality that allows the organization to occupy a prominent position in the market among competitors.
- The ability to possess good knowledge elements: the organization's ability to exploit scientific, theoretical and applied capabilities and various other technological resources to create something new.
- Research and Creativity: The organization should make use of the scientific knowledge it obtains and the experiences of others in analysis, organization and innovation, so that it can also add new things to its production field. Hamdawi (2004: 161-162)

1.5. Technological Change Diminutions Select each of Teixeira (2012:10)، Antonelli & Scellato (2019:62), Ibrahim (2020:51) Technological Change Requirements with the following:

a. Research and development.
b. Technological Innovation.
c. Information Technology.

The researchers adopted both technological innovation and information technology in the current study, as technological innovation is an outcome of research and development.

2. ***Lean Manufacturing***
3. ***2.1. Lean Manufacturing Conceptualization***

The Japanese thought has consistently presented many management systems and philosophies that contributed to raising the level of organizational performance. Lean manufacturing comes to be of interest to many researchers, despite its modernity. Womack et al. (1990:52) define it as a dynamic process of change through a set of principles and tools aimed at continuous improvement. It combines the best features of both extensive and artisanal production. Ross & Associates (2004: 2) indicate that it is a business model that focuses on meeting customer expectations by delivering products with the required quality and the lowest cost at the time of their request.

Bateman & Snell (2007:310) indicate that it is an efficient and effective process that seeks to achieve the highest productivity, comprehensive quality, and cost effectiveness, by eliminating unnecessary steps in the production process and striving for continuous improvement. Chiarini (2012:63) adds that it is a process aimed at eliminating waste to create faster operations, and provide goods or services with high quality and at lower cost.

According to Stevenson (2015:605), it is a versatile system that expends a little amount of resources while yet generating high-quality products or services. According to Heizer et al. (2017:638), this means delivering the consumer with precisely what the customer wants at the exact time the customer wants it while eliminating waste and doing so via continuous improvement.

Panwar et al. (2018: 161) see it as a new approach to thinking about the optimal use of available resources in the organization by eliminating or reducing waste by using a set of appropriate tools, to create an lean organization.

Staedele, et al. (2019: 2) see that it is a production system that focuses on improving operations through the philosophy of continuous improvement, by removing unnecessary activities that do not add value in every part of operations and business. Accordingly, it is a comprehensive and integrated work philosophy and strategy based on the transformation from a traditional organization to an lean organization, which includes dimensions for scaling operations with the aim of reaching the zero defect and striving to activate continuous improvement through the use of a set of tools and methods that eliminate all types of waste and efficient use the available resources of being a social-technical system aiming to create a culture of continuous thinking of quality in all stages of operations to meet or achieve the requirements and expectations of customers or exceed them.

2.2. Lean Manufacturing Principles

In order to determine the principles of Lean Manufacturing, we have conducted a literature survey on this subject and it was found that there are nine principles addressed by a group of researchers. After examination, we found that most of these researchers agreed on five principles: Determining the value, Value flow, production flow, Pull the production, Striving for perfection.

2.3. Lean Manufacturing Goal

There is no doubt that lean manufacturing stems from a management with good specifications seeking to enhance quality in the production process, reduce defects and improve the product, and it can be applied in every organization if the human resource capable of understanding lean manufacturing and its tools is available. Thus, Lean Manufacturing aims, in its final vision, to many goals and benefits, the most important of which are:

Reducing or eliminating waste in operations, Continuous improvement and not to be satisfied with the employees' attitude about what they produce, Productivity improvement, Quality control and defect reduction, High system flexibility in dealing with variables in demand, Reducing costs, Improving customer service to deliver exactly what they want and when they want it, Improving faster response ability and reduce delays, Improving the morale of workers, as they become more involved in the field of work, which greatly improves their motivation, Customer satisfaction is followed by success based on loyalty, Maximizing the existing competitiveness and striving to build new competitive capabilities. Kumar (2014:231-232)

3.4. Lean Manufacturing Techniques

In order to identify the main techniques of Lean Manufacturing, we conducted a literature survey on this topic and it was found that after scrutiny, most of these researchers s agreed on the following tools: 5S work site organization(5S)**,** Quick Changeover /Setup (Ch. Set), Kanban cards (Ka. Car), Value Stream Mapping(VSM).

3. productivity

3.1. productivity Conceptualization

The concept of productivity has attracted the attention of many writers and researchers s in the field of specialization in purposeful attempts to clarify it because it carries multiple meanings, once it refers to the efficiency of the worker and the other to the outputs to be achieved in relation to the inputs, and goes beyond that to reach the state of societal welfare, each according to his philosophy and intellectual background.

Sanjeev (2002:27) sees it as the possibility of producing a quantity of goods and services of equal or better quality with fewer units of production factors during a specified period of time.

Heizer&Render (2004:13) believe that it is the ability to generate results using specific production elements.

According to Chandra (2013:4051), effective use of creativity and resources to raise the value of goods and services is "effective use of creativity and resources." It is the true source of competitive advantage that produces economic viability over the long run and raises everyone's level of life.

According to Yadav and Marwah (2015:192), a ratio is a method to assess the degree to which an organization is able to transform its inputs into outputs (products and services). Saini (2018: 102) see that is the efficiency in production, which is the amount of output obtained through a set of efforts.

The researchers believes that lean productivity that focuses on eliminating waste and continuous improvement and quality is an appropriate concept for our study in the midst of resource scarcity and market need, Rather it is a measure of the good investment of those resources, and based on the foregoing, it is one of the keys to financial success in the organization, allowing it to remain competitive in the market and strengthening the social component in the development of society, It is the ratio between the outputs achieved with quality to the inputs used with quality in the production process.

3.2. Productivity Importance

Productivity is an important indicator by which to infer the degree of development and progress that the national economy enjoys in any country. It achieves an acceptable investment return for it. Hammoud & Fakhoury (2009: 48)

Its importance can be determined from the fact that it is:

- An important element in the success and sustainability of organizations.
- An important element in achieving profits, which represents a source of capital formation and self-investment for organizations.
- An important activity in expanding the scope of the market by providing more goods and services to satisfy the needs of society.
- An important element in the efficient use of productive capacities, and then creating opportunities for employment and employment. Wafaa (2017:56)

3.3. Productivity Dimensions

Sakamoto (2010:67-74) and Almström & Kinnander (2011:760) assert that productivity can be improved by increasing output or decreasing input. To achieve this, it is necessary to focus on improving three basic factors:

- Method (M): The dimension of the method (M) is the most prevalent dimension, and its main purpose is to improve productivity. This dimension can be classified into two types: hardware and software. Devices represent everything related to machines, tools, arrangement, and the like, and devices usually have long-term effects when making a change in the organization. As for software, it includes patterns of movement, organization, training and support, and that change in software can create effects that will last as long as the improvement is maintained.

- Performance (P): The dimension of performance focuses on the motivation of people or the speed of machines, this dimension is often emphasized as a means to increase productivity. Machines can be speeded up by reducing holidays and stops. Performance can be reached by measuring and comparing the standard and actual time.

- **Utilization (U):** The dimension of usage, abbreviated as "U," may relate to either machines or humans, and it reflects the percentage of time that is intended to be spent participating in activities that generate value. Because of the volatility of the technology, it is common for both humans and robots to suffer losses. This might be the consequence of faulty equipment, a narrower breadth of material, or any one of a number of other modifications. The use dimension of productivity includes tasks such as production planning and management, facility maintenance, and quality control. When utilization (U) is increased, inventory, waiting time, and cycle time are all lowered as a direct consequence. Productivity may be increased in several ways, each of which is accounted for here. The method dimension, denoted by M, makes a contribution to the overall effectiveness, whereas the performance dimension, denoted by P, makes a contribution to the overall efficiency. On the other hand, the dimension of use (U) cannot provide unambiguous results if these other two dimensions are not included. As a result, the synergy that exists between the three different aspects of development is ultimately the aim that will provide the best results. Productivity is calculated as the following formula: Method, Performance, and Use. The total increase in productivity may be quantified by multiplying these three variables. Al Rubai (2019:94-95)

THE RESULTS OF THE STATISTICAL ANALYSIS AND DISCUSION

Analytical statistics were used, which includes testing hypotheses related to the direct and indirect effects between the questionnaire's axes. In addition, a set of statistical programs were used to obtain the results, which is the program (SPSS vr. 24), (AMOS vr. 24) and a spreadsheet program (Excel). The confirmatory factor analysis, which falls within the methods of the system of structural equations (SEM), was also used to determine the strength of the paragraphs' participation in the interpretation of its dimensions and axes. To determine the reliability and reliability of the questionnaire, the researchers used Cronbach's alpha coefficient

Confirmatory Factor Analysis: The confirmatory factor analysis depends on two types of variables: latent variables and endogenous variables. The first type here represents the dimensions dependent on the axes, and the second type represents the paragraphs that each dimension contains. A set of criteria is often used to determine the best model from these criteria, the criterion of the ratio of the value of chi-square (χ^2) to the degree of freedom (df) for the model under study, If the p-value is less than (5%), the model is suitable. Judging the ability of items and dimensions in determining the credibility of the questionnaire depends on the weights of the studied model analysis, and these weights are called (factor saturations) for the items on the latent variables.

First Axis: Lean Manufacturing (L.M)

Confirmatory factor analysis is used for the purpose of building a structural modeling scheme for the axis (L.M) for the dimensions and paragraphs of the axis, and then the model under research is accepted or rejected by relying on the aforementioned criteria. Where the researchers used the statistical program (AMOS vr.24)) to achieve this goal.

Axis Dimensions (L.M): The values of the criteria mentioned above were found for the purpose of knowing the suitability of the constructivist model to the confirmatory factor analysis for the L.M axis), and the results are summarized in the following table:

Table (1) criteria for appropriateness of the model

Parameter	X^2(df) Sig.	IFI	CFI	RMSEA
Parameter Value	429.075 (139) 0.000	0.86	0.85	0.00
Decision	Accepted	Accepted	Accepted	Accepted

The results in the table show that the criteria proved the appropriateness of the model proposed by the researchers, which means the possibility of adopting the results of this model in the analysis. The researchers s built a hierarchical diagram of the typical structure of the proposed model related to the paragraphs of the axis (L.M)), and as in the following figure, and we note that the paragraphs have different powers in interpreting the axis belonging to it based on the estimated values of the coefficients or weights above the straight lines directed from the paragraphs to the dimensions:

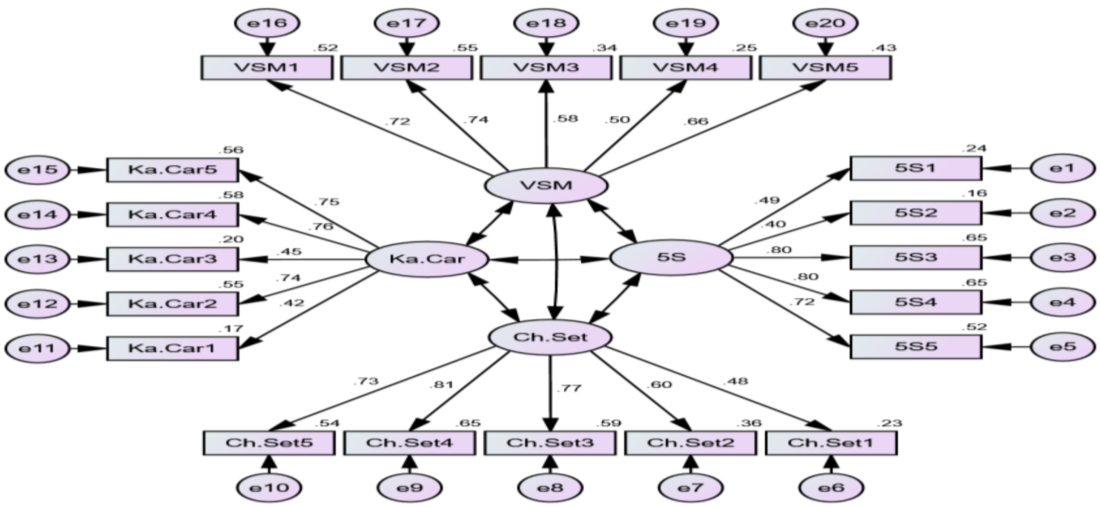

Figure (2) Scheme of the structural model of the axis (L.M)

The preceding diagram demonstrates that the interpretation of the paragraphs for the dimensions can vary to varying degrees. For instance, the paragraph (Ch.Set1) contributed to the interpretation of the dimension (Ch.Set) by a factor of 0.48. This indicates that the value of the paragraph (Ch.Set1) rose by 0.48 standard deviation units when compared to the original value. Standard causes a one-standard-deviation rise in the value of the dimension (Ch.Set) that it affects. The participation of the paragraph (VSM1) in the interpretation of the dimension (VSM) was as follows: (0.72). This indicates that an increase in the value of the dimension (VSM) by one standard deviation is caused by an increase in the value of the paragraph (VSM1) by 0.72 of the standard deviation. The standard regression weights that were calculated by using the Maximum Likelihood Estimates (MLE) approach may be seen in the accompanying table. These weights indicate the amount of interpretation that can be attributed to each of the axis paragraphs.

Table (2) Standard regression weights for each paragraph of the axis (L.M)

	Estimate	Estimate

			Estimate				Estimate
5S1	<---	5S.	.486	Ka.Car1	<---	Ka.Car.	.417
5S2	<---	5S.	.396	Ka.Car2	<---	Ka.Car.	.743
5S3	<---	5S.	.805	Ka.Car3	<---	Ka.Car.	.452
5S4	<---	5S.	.803	Ka.Car4	<---	Ka.Car.	.759
5S5	<---	5S.	.723	Ka.Car5	<---	Ka.Car.	.747
Ch.Set1	<---	Ch.Set.	.477	VSM1	<---	VSM.	.721
Ch.Set2	<---	Ch.Set.	.602	VSM2	<---	VSM.	.742
Ch.Set3	<---	Ch.Set.	.771	VSM3	<---	VSM.	.581
Ch.Set4	<---	Ch.Set.	.808	VSM4	<---	VSM.	.498
Ch.Set5	<---	Ch.Set.	.735	VSM5	<---	VSM.	.658

Second Axis*: *Technological Change (TE.CH)

Confirmatory factor analysis is used for the purpose of building a structural modeling scheme for the axis (TE.CH) for the dimensions and paragraphs of the axis, and then the model under research is accepted or rejected by relying on the aforementioned criteria. Where the researchers s used the statistical program (AMOS vr.24) to achieve this goal. ***Paragraphs of the axis dimensions (TE.CH):*** The values of the criteria mentioned above were found for the purpose of knowing the suitability of the constructivist model for the confirmatory factor analysis of the axis (TE.CH) and an overview of the results may be found in the table that follows:

Table (3) criteria for appropriateness of the model

Parameter	X^2(df) Sig.	IFI	CFI	RMSEA
Parameter Value	827.681 (179) 0.000	0.80	0.80	0.00
Decision	Accepted	Accepted	Accepted	Accepted

The results in the table show that the criteria proved the appropriateness of the model proposed by the researchers, which means the possibility of adopting the results of this model in the analysis. The researchers built a hierarchical diagram of the typical structure of the proposed model related to the axis paragraphs (TE.CH) and as in the following figure, and we note that the paragraphs have different powers in interpreting the axis belonging to it based on the estimated values of the coefficients or weights above the straight lines directed from the paragraphs to the dimensions:

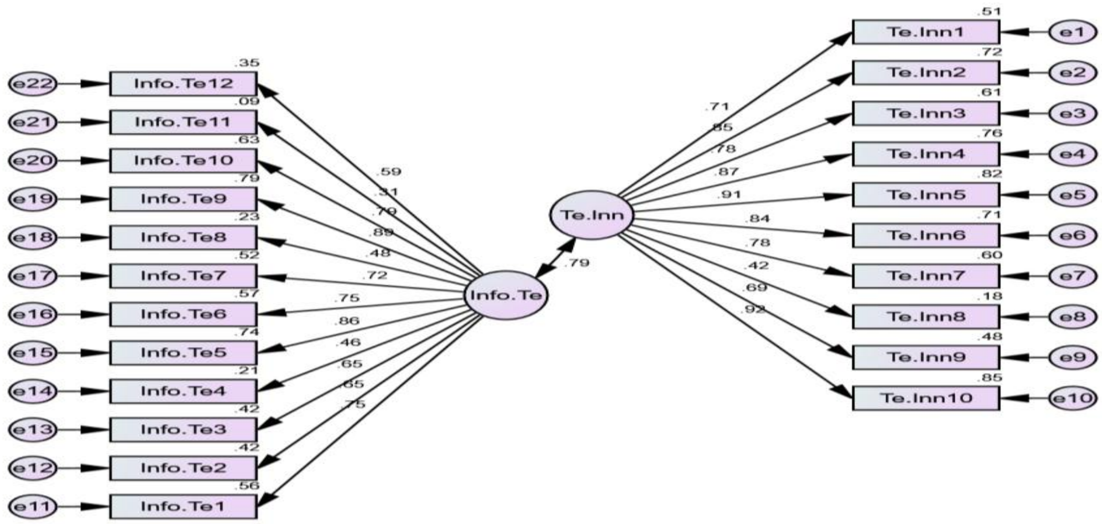

Figure (3) Scheme of the structural model of the axis (TE.CH)

The picture that was shown above demonstrated the existence of various degrees in the interpretation of the paragraphs for the dimensions. For instance, the paragraph (Te.lnn1) contributed in the interpretation of the dimension (Te.Inn) by showing that there are multiple degrees of significance (0.71). This indicates that there was a 0.71 point rise in the value of the paragraph (Te.lnn1) relative to the deviation. Standard causes a one-standard-deviation rise in the value of the dimension (Te.lnn) that it leads to. The contribution that the paragraph (Info.Te1) made to the understanding of the dimension (Info.Te) is as follows: (0.75). This indicates that the rise in the value of the dimension (Info.Te) by one standard deviation is caused by the increase in the value of the paragraph (Info.Te1) by 0.75 from the standard deviation. One The standard regression weights that were calculated by using the Maximum Likelihood Estimates (MLE) approach may be seen in the accompanying table. These weights indicate the amount of interpretation that can be attributed to each of the axis paragraphs.

Table (4) Standard regression weights for each paragraph of the axis (TE.CH)

			Estimate				Estimate
Te.Inn1	<---	Te.lnn.	.711	Info.Te1	<---	Info.Te.	.746
Te.Inn2	<---	Te.lnn.	.848	Info.Te2	<---	Info.Te.	.646
Te.Inn3	<---	Te.lnn.	.783	Info.Te3	<---	Info.Te.	.651
Te.Inn4	<---	Te.lnn.	.870	Info.Te4	<---	Info.Te.	.463
Te.Inn5	<---	Te.lnn.	.908	Info.Te5	<---	Info.Te.	.862
Te.Inn6	<---	Te.lnn.	.844	Info.Te6	<---	Info.Te.	.754
Te.Inn7	<---	Te.lnn.	.776	Info.Te7	<---	Info.Te.	.724
Te.Inn8	<---	Te.lnn.	.419	Info.Te8	<---	Info.Te.	.484
Te.Inn9	<---	Te.lnn.	.690	Info.Te9	<---	Info.Te.	.890
Te.Inn10	<---	Te.lnn.	.923	Info.Te10	<---	Info.Te.	.791

	Estimate				Estimate
		Info.Te11	<---	Info.Te.	.306
		Info.Te12	<---	Info.Te.	.594

Third axis: Productivity Improvement (PR.IM)

Confirmatory factor analysis is used for the purpose of building a structural modeling scheme for the axis (PR.IM) for the dimensions and paragraphs of the axis, and then the model under research is accepted or rejected by relying on the aforementioned criteria. Where the researchers used the statistical program (AMOS vr.24) to achieve this goal. Paragraphs of the dimensions of the axis (PR.IM): The values of the criteria mentioned above were found for the purpose of knowing the suitability of the constructivist model for the confirmatory factor analysis (PR.IM) for the axis (PR.IM), while a summary of the results may be found in the following table:

Table (5) criteria for appropriateness of the model

Parameter	X^2(df) Sig.	IFI	CFI	RMSEA
Parameter Value	532.662 (100) 0.000	0.82	0.82	0.00
Decision	Accepted	Accepted	Accepted	Accepted

The results in the table show that the criteria proved the appropriateness of the model proposed by the researchers, which means the possibility of adopting the results of this model in the analysis. . The researchers built a hierarchical diagram of the typical structure of the proposed model related to the axis paragraphs (PR.IM) and as in the following figure, and we note that the paragraphs have different powers in interpreting the axis belonging to it based on the estimated values of the coefficients or weights above the straight lines directed from the paragraphs to the dimensions:

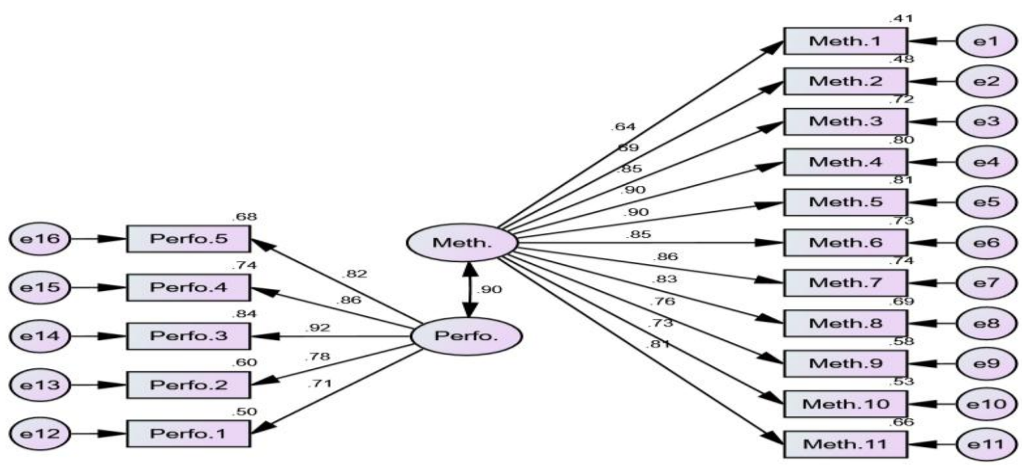

Figure (4) Scheme of the structural model of the axis (PR.IM)

The illustration on the right demonstrates that there are several degrees of interpretation that may be given to the paragraphs about the measurements. For instance, the paragraph referred to as "Meth.1" had a role in the interpretation of the factor referred to as "Meth" (0.64). This indicates that there was a 0.64 percentage point rise in the value of the paragraph (Meth.1) compared to the standard deviation. This results in the value of the dimension (Meth.) increasing by one standard deviation as a direct consequence. The interpretation of the dimension (Perfo.) was helped along by the participation of the paragraph (Perfo.1) (0.71) This indicates that there was a 0.71 percentage point rise in the standard deviation of the value of the paragraph (Perfo.1) This results in the value of the dimension (Perfo.) increasing by one standard deviation as a direct consequence. The standard regression weights that were calculated by using the Maximum Likelihood Estimates technique may be found in the following table. These weights indicate the amount of interpretation that can be attributed to each individual paragraph of the axis.

. Table (6) Standard regression weights for each paragraph of the axis (PR.IM)

			Estimate				Estimate
Meth.1	<---	Meth.	.641	Perfo.1	<---	Perfo.	.710
Meth.2	<---	Meth.	.694	Perfo.2	<---	Perfo.	.776
Meth.3	<---	Meth.	.849	Perfo.3	<---	Perfo.	.916
Meth.4	<---	Meth.	.895	Perfo.4	<---	Perfo.	.860
Meth.5	<---	Meth.	.900	Perfo.5	<---	Perfo.	.823
Meth.6	<---	Meth.	.854				
Meth.7	<---	Meth.	.862				
Meth.8	<---	Meth.	.829				
Meth.9	<---	Meth.	.760				
Meth.10	<---	Meth.	.728				
Meth.11	<---	Meth.	.811				

The stability of the questionnaire: The issue of verifying the reliability of the questionnaire used is one of the important conditions that must be met for the purpose of supporting the results obtained from the studied sample. There are several ways to check the reliability of the questionnaire, the most important and most common of which is the Cronbach alpha coefficient, whose value lies between zero and one. A value close to the correct one indicates a greater credibility of the questionnaire used, and therefore its results can be adopted and vice versa. The following table includes the values of Cronbach's alpha coefficients for each dimension and axis:

Table (7) Cronbach's alpha coefficients

Axis	**Items**	**Cronbach's Alpha**
5S	5	0.81
Ch.Set	5	0.82
Ka.Car	5	0.79
VSM	5	0.75
L.M	20	0.93
Te.Inn	10	0.94
Info.Te	12	0.91
TE.CH	22	0.95
Meth.	11	0.95
Perfo.	5	0.91
PR.IM	16	0.96
Total	58	0.98

The results in the above table show the stability and credibility of the questionnaire used by the researchers.

Main Hypothesis: Direct and Indirect Effects:

Here the researchers studied the direct and indirect effect between the variables based on the presence of the mediating variable (TE.CH), and accordingly, structural models were built and designed using the statistical program (AMOS vr.24) and the effects were tested and their significance by setting the appropriate hypotheses for this purpose.

The main hypothesis: To test the impact of the Lean Manufacturing (L.M) axis on the productivity improvement axis (PR.IM) through the mediating variable Technological change (TE.CH).

The results obtained by the researchers from the statistical analysis related to the criteria for accepting or rejecting the impact model are as in the following table.

Table (8) SEM Structural Modeling Equation Criteria for the Proposed Model

IFI	CFI	RMSEA
0.83	0.83	.00

The results of the criteria in the above table indicate the suitability of the proposed model and therefore it can be adopted in analyzing and drawing conclusions for the indirect effect model among the research variables. The values of the direct effect estimators in the above model in addition to the critical ratios test values and their significance for these estimators are as in the following table:

Table (9) direct effect estimators and critical ratio test values and their significance

			Estimate	S.E.	C.R.	P
TE.CH	<---	L.M	.716	.091	11.948	***
PR.IM	<---	TE.CH	.818	.047	16.566	***

It was discovered through the results of the previous table that there is a direct effect with a significant significance that is lower than the significance level of (5) for the (L.M) axis in the (TE.CH) axis, where the effect value was (0.72) with a critical percentage of (11.948) and this value is a significant value being (p -value) was equal to zero, which is lower than the significance level (5%), and so we can draw the conclusion that there is a direct (0.72). There is a direct effect of significant significance below the significance level of 5% for the axis (TE.CH) in the axis (PR.IM), where the effect value was (0.82) with a critical percentage of (16,566), and this value is a significant value because the p-value for it was less than.05. There is a direct effect of significant significance below the significance level of 5% for the axis (PR.IM), where the effect value was (0.82) with a Since it is equal to zero, which is a value that is less than the significance threshold (5%), we may draw the conclusion that there is a link between the two that is caused by a direct impact. To put it another way, an increment of one unit added to the value of the axis (TE.CH) results in an increment of one unit added to the value of the PR.IM axis (0.82). Regarding the indirect influence, the researchers s used the bootstrapping approach in order to ascertain the values of the organization and evaluate its morale. The values of the indirect influence for the axis (L.M) on the axis (PR.IM) through the median axis (TE.CH) are included in the table that can be found below:

Table (10) values of the indirect effect of the axis (L.M) on the axis (PR.IM) via the median axis (TE.CH)

Path			Estimate	Lower Bounds	Upper Bounds	Sig.
PR.IM	<---	L.M	.585	.521	.669	.009

Through the above table, we find that there is an indirect effect of statistical significance for the axis (L.M) on the axis (PR.IM) through the median axis (TE.CH), where the value of (sig.) is less than the significance level used by the researchers, which is (5%), and therefore the median variable (TE.CH) increased the value of the effect of the axis (L.M) on the axis (PR.IM) by (0.585).

Sub-hypotheses: direct and indirect effects of dimensions

The first sub-hypothesis: Testing the effect of after organizing the work site (5S) on the axis of productivity improvement (PR.IM) through the mediating variable technological change (TE.CH). The results obtained by the researchers from the statistical analysis related to the criteria for accepting or rejecting the impact model are as in the following table:

Table (11) SEM Structural Equation Indicators for Indirect Effect

IFI	CFI	RMSEA
0.92	0.92	.00

The results of the criteria in the above table indicate the suitability of the proposed model and therefore it can be adopted in analyzing and drawing conclusions for the indirect effect model among the research variables. The values of the direct effect estimators in the above model in addition to the critical ratios test values and their significance for these estimators are as in the following table:

Table (12) values of direct impact capabilities

			Estimate	S.E.	C.R.	P
TE.CH	<---	5S	.545	.116	7.578	***

			Estimate	S.E.	C.R.	P
PR.IM	<---	TE.CH	.818	.047	16.566	***

It was discovered through the results of the previous table that there is a direct effect with a significant significance that is lower than the significance level of 5% for the dimension (5S) in the axis (TE.CH), where the effect value was (0.55) with a critical percentage of (7.578), and this value is a significant value being (p -value) was equal to zero, which is lower than the significance level (5%), and as a result, we can draw the conclusion that there is a direct effect (0.55). The values of the indirect influence that the dimension (5S) has on the axis (PR.IM) via the median axis (TE.CH) are included in the table that may be found below:

Table (13) values of the indirect effect of the dimension (5S) on the axis (PR.IM) by the median axis (TE.CH)

Path			Estimate	Lower Bounds	Upper Bounds	Sig.
PR.IM	<---	5S	.446	.372	.520	.018

Through the above table, we find that there is an indirect, statistically significant effect of the dimension (5S) on the axis (PR.IM) through the median axis (TE.CH), where the value of (sig.) is less than the significance level used by the researchers, which is (5%), and therefore the median variable (TE.CH) increased the value of the effect of the dimension (5S) on the (PR.IM) axis) by (0.446).

Second sub-hypothesis: Testing the effect of after setting up and quick configuration on the axis of productivity The results obtained by the researchers from improvement through the mediating variable technological change. the statistical analysis related to the criteria for accepting or rejecting the impact model are as in the following table:

Table (14) SEM Structural Modeling Equation Indicators for the Indirect Effect

IFI	**CFI**	**RMSEA**
0.89	0.89	0.0

The results of the criteria in the above table indicate the suitability of the proposed model and therefore it can be adopted in analyzing and drawing conclusions for the indirect effect model among the research variables. The values of the direct effect estimators in the above model in addition to the critical ratios test values and their significance for these estimators are as in the following table:

Table (15) Direct effect estimators and critical ratio test values and their significance

			Estimate	S.E.	C.R.	P
TE.CH	<---	Ch.Set	.693	.074	11.215	***
PR.IM	<---	TE.CH	.818	.047	16.566	***

It was discovered through the results of the previous table that there is a direct effect with a significant significance that falls below the significance level of 5% for the dimension (Ch.Set) in the axis (TE.CH)), where the effect value was (0.69) with a critical percentage of (11.215), and this value is a significant value that (p-value) was equal to zero, which is lower than the significance level of 5%; as a result, we draw the conclusion that there is a direct effect (0.69). The values of the indirect influence that the dimension (Ch.Set) has on the axis (PR.IM) through the median axis (TE.CH) are included in the table that can be found below:

Table No. (16) values of the indirect effect of the dimension (Ch.Set) on the axis (PR.IM) by means of the median axis (TE.CH)

Path			Estimate	Lower Bounds	Upper Bounds	Sig.
PR.IM	<---	Ch.Set	.567	.495	.654	.009

Through the above table, we find that there is an indirect, statistically significant effect of the dimension (Ch.Set) in the axis (PR.IM) through the median axis (TE.CH), where the value of (sig.) is less than the significance level used before The researchers, which is (5%), and therefore the median variable (TE.CH) raised the value of the effect of the dimension (Ch.Set) on the axis (PR.IM) by (0.567).

The third sub-hypothesis:

Testing the effect of kanban cards on the axis of productivity improvement through the mediating variable technological change.

The results obtained by the researchers from the statistical analysis related to the criteria for accepting or rejecting the impact model are as in the following table:

Table (17) SEM Structural Modeling Equation Indicators for the Indirect Effect

IFI	**CFI**	**RMSEA**
.83	.82	.00

The results of the criteria in the above table indicate the suitability of the proposed model and therefore it can be adopted in analyzing and drawing conclusions for the indirect effect model among the research variables. The values of the direct effect estimators in the above model in addition to the critical ratios test values and their significance for these estimators are as in the following table:

Table (18) of direct effect estimators and critical ratios test values and their significance

			Estimate	S.E.	C.R.	P
TE.CH	<---	Ka.Car	.600	.079	8.743	***
PR.IM	<---	TE.CH	.818	.047	16.566	***

It was discovered through the findings of the table that there is a direct effect of significant significance that is lower than the significance level of (5) for the dimension (Ka.Car) in the axis (TE.CH), where the effect value was (0.60) and with a critical percentage of (7.578), and this value is a significant value that (p-value) was equal to zero and it is lower than the significance level (5%), and as a result, we came to the conclusion that there is a (0.60). The values of the indirect influence that the dimension (Ka.Car) has on the axis (PR.IM) via the median axis (TE.CH) are included in the table that can be found below:

Table (19) values of the indirect effect of the dimension (Ka.Car) on the axis (PR.IM) through the median axis (TE.CH)

Path			Estimate	Lower Bounds	Upper Bounds	Sig.
PR.IM	<---	Ka.Car	.490	.400	.574	.025

Through the above table, we find that there is an indirect, statistically significant effect of the dimension (Ka.Car) on the axis (PR.IM) through the median axis (TE.CH), where the value of (sig.) was less than the significance level used by the researchers, which is (5%), and therefore the median variable (TE.CH) increased the value of the effect of the dimension (Ka.Car) on the axis (PR.IM) by (0.490).

Fourth sub-hypothesis: Testing the effect of dimension (VSM) on the axis (PR.IM) by means of the median variable (TE.CH).

The results obtained by the researchers from the statistical analysis related to the criteria for accepting or rejecting the impact model are as in the following table:

Table (20) SEM Structural Modeling Equation Indicators for the Indirect Effect

IFI	**CFI**	**RMSEA**
0.92	0.92	.00

The results of the criteria in the above table indicate the suitability of the proposed model and therefore it can be adopted in analyzing and drawing conclusions for the indirect effect model among the research variables. The values of the direct effect estimators in the above model in addition to the critical ratios test values and their significance for these estimators are as in the following table:

Table (21) The values of the direct effect estimators and the values of the critical ratios test and their significance

			Estimate	S.E.	C.R.	P
TE.CH	<---	VSM	.610	.091	8.980	***
PR.IM	<---	TE.CH	.818	.047	16.566	***

It was discovered through the results of the table that there is a direct effect with a significant significance below the significance level of (5%) for the dimension (VSM) in the axis (TE.CH), where the effect value was (0.61) and with a critical percentage of (8.980), and this value is a significant value that The p-value was equal to zero, which is less than the significance level (5%), and so we can draw the conclusion that there is a direct effect relationship, in other words (0.61). The values of the dimension's (VSM) indirect influence on the axis (PR.IM) are included in the following table, which is organized around the median axis (TE.CH):

Table (22) values of the indirect effect of the dimension (VSM) on the axis (PR.IM), via the median axis (TE.CH).

Path	Estimate	Lower Bounds	Upper Bounds	Sig.

PR.IM	<---	VSM	.499	.418	.597	.010

Through the above table, we find that there is an indirect, statistically significant effect of the dimension (VSM) on the PR.IM axis through the median axis (TE.CH), where the value of (sig.) is less than the significance level used by the researchers, which is (5%), and therefore the median variable (TE.CH) increased the value of the effect of dimension (VSM) on the axis (PR.IM) by (0.499).

CONCLUSION

The researchers reached a set of conclusions, the most important of which are:

1. The presence of stability and credibility of the questionnaire employed by the researchers based on the values of Alpha Cronbach coefficients for the dimensions and axes of the questionnaire.
2. The validity of the results obtained from the questionnaire.
3. The existence of a direct effect relationship, in other words, the increase in the value of the Lean Manufacturing (L.M) axis by one unit leads to the rise in the Technological Change axis (TE.CH) by (0.72).
4. The existence of a direct effect relationship, in other words, that the increase in the value of the axis of technological change (TE.CH) by one unit leads to a rise in the axis of productivity improvement (PR.IM) by (0.82).
5. The mediating variable Technological Change (TE.CH) increased the value of the impact of the Lean Manufacturing (L.M) axis on the axis of productivity improvement (PR.IM) by (0.585).
6. The existence of a direct effect relationship, in other words, an increase in the value of after the workplace organization (5S) by one unit leads to a rise in the axis of technological change (TE.CH) by (0.55).
7. The mediating variable, Technological Change (TE.CH), increased the impact value after organizing the work site (5S) in the axis of improving productivity (PR.IM)) by (0.446).
8. The existence of a direct effect relationship, in other words, the increase in the value of the quick setup (Ch.Set) by one unit leads to the rise in the axis of technological change (TE.CH) by (0.69).
9. The mediating variable, Technological Change (TE.CH), increased the impact value of (Ch.Set) in the productivity improvement axis (PR.IM) by (0.567).
10. The existence of a direct effect relationship, in other words, the increase in the value of the dimension of the kanban cards (Ka.Car) by one unit leads to the rise of the axis of technological change (TE.CH) by (0.60).
11. The mediating variable Technological Change (TE.CH) increased the impact value of the Kanban cards (Ka.Car) in the axis of productivity improvement (PR.IM) by (0.490).
12. The existence of a direct effect relationship, in other words, that an increase in the value of the value flow map (VSM) by one unit leads to a rise in the axis of technological change (TE.CH) by (0.61).
13. The mediating variable Technological Change (TE.CH) increased the impact value after the Value Flow Map (VSM) in the axis of improving productivity (PR.IM) by 0.499).

According to the study problem and what has been seen in the field, the following should be taken into account:

1. The need to adopt, plant and spread the concepts of lean manufacturing philosophy as a successful business strategy, because of its impact on reducing production costs, waste, and achieving a competitive advantage.
2. The need to provide the financial and moral government support necessary to enable the factory to respond to the requirements of customers, to rehabilitate the infrastructure, modernize technology, and protect its products.
3. Seeking to use the best technologies to search for the best options to improve factory productivity.
4. Encourage working individuals to be creative and innovative, and to adopt the initiative element effectively.
5. Optimal investment of the technical energies and superior skills in the productive departments and maintaining them in a way that contributes to strengthening the position of those departments in reducing waste and speeding up the completion of tasks.
6. The future goal of the factory is to achieve excellence and compete with the imported product in terms of quality and cost.
7. The necessity of activating and continuing to provide future applied studies in the factory to complement the current study, such as: Technological vigilance as an intermediate change in the relationship between lean manufacturing and sustainable competitive advantage.

REFERENCES

- Al Rubaie, Bushra Abdul Hamza, Abbas, (2019), Design of Lean Manufacturing System By Using Value Stream Mapping and Its Impact on Productivity Improvement, PH.D. Degree in Business Adminstration Science.
- Al-Jawari, Munadhel Abbas and Hadi, Kamila Abdel-Wahed, (2019), The Impact of Technological Change in Enhancing Competitiveness, for the Iraqi Economy for the Period 1990-2014, Journal of Administration and Economics, Volume (8), Number (29), College of Administration and Economics, University of Karbala, Iraq.
- Al-Lami, Gh.Q.D., (2007), Technology Management: Concepts and entrances, Techniques and Application. Al-Manahij Press, 1st ed., Amman.

- Almström, Peter & Kinnander, Anders, (2011), The Productivity Potential assessment method, Assessing and benchmarking the improvement potential in manufacturing systems at shop-floor level, International Journal of Productivity and Performance Management, Vol.60, No.7.
- Al-Qarioti, M.Q., (2000), The Theory of Organization and Organizing. Wael Press. Amman.
- Al-Quraishi, M., (2014), Technological Change Impact on Performance of Economic Organizations from Balanced Scorecard Perspective. PhD. Dissertation. Algeria.
- Antonelli C. & Scellato G., (2019), Wage inequality and directed technological change: Implications for income distribution, Technological Forecasting and Social Change, Vol.141.
- Bateman, Thomas S.& Snell, Scott A.,(2007), Management Leading and Collaborating in a Competitive World, 7thEd., McGraw-Hill, Irwin.
- Chandra, P. V., (2013), An Effort To Apply Work and Time Study Techniques in a Manufacturing Unit for Enhancing Productivity. International Journal of Innovative Research in Science, Engineering and Technology, 2(8).
- Chiarini, A., (2012), Lean organization: from the tools of the Toyota Production System to lean office (Vol. 3). Springer Science & Business Media.
- Daft, Richard L. & Noe, Raymond A., (2001), Organizational behavior , New York, Ltra Court. Inc.
- Hamdawi, W., (2004), Human Resource Management. Qalma University. Algeria.
- Hammoud, Khudair Kazem and Fakhoury, Hayel Yaqoub, (2009), Production and Operations Management, Safaa Publishing and Distribution House, Amman, Jordan.
- Heizer, J., Render, B., & Munson, C., (2017), Operations Management: Sustainability and Supply Chain Management (12th Ed). Pearson Education, Inc.
- Heizer, Jay & Render, Barry, (2004), Operations Management, 6th ed, New Jersey, Prentice-Hall Upper Saddle River.
- Ibrahim, Ahmed Abdel Karim, (2020), The Role of Technological Change Requirements in the Dimensions of Green Production, M.Sc. Thesis, In Industrial Management, University of Mosul.
- Kumar, S., (2014), Lean Manufacturing and its Implementation. International Journal of Advanced Mechanical Engineering,Vol. 4, No. 2, 231–238.
- Mahmoud, H.A.M., (2007), Impact of Technological Change on Petroleum Policies in Egypt. PhD. Dissertation in Foreign Trade Economics. College of Trade and Business Management. Hilwan University. Egypt.
- Moore, Lawrence & Smith, David A., (2001), Changing Technology Implies Changing Pedagogy , http://www.Oswego.Edu/NSF- Precalc/ pre, CALC-Technology-Paper.
- Panwar, A., Jain, R., Rathore, A. P. S., Nepal, B., & Lyons, A. C., (2018), The impact of lean practices on operational performance–an empirical investigation of Indian process industries. Production Planning & Control, 29(2).
- Robbins, Stephen, (2001), Organizational Behavior, 9th ed, Prentice- Hall Inc, New Delhi.
- Ross & Associates, (2004), Finding and Recommendations on Lean Production Environmental Management system in the shipbuilding and rapier sector, U.S Environmental innovation, pp: 2-10.
- Saini, D., (2018), Knowledge Performance as an Arbitrator between the Relationship of Organizational Commitment and Productivity. Management and Labour Studies, 43 (1&2) , 100–108.
- Sakamoto, S., (2010), Beyond World-Class Productivity Industrial Engineering Practice and Theory, Springer-Verlag London Limited.
- Sanjeev, Kumar Sharma,(2002), Industrial Engineering and Operations Management, 1st edition.
- Staedele, A. E., Ensslin, S. R., & Forcellini, F. A., (2019), Knowledge building about performance evaluation in lean production: an investigation on international scientific research. Journal of Manufacturing Technology Management.
- Stevenson, W. J., (2015), Operations Management (12thEd). McGraw-Hill Education.
- Teixeira, Aurora, (2012), technological change, in tech chapters published under cc by 30 olicense, eBook (PDF) ISBN: 978-953-51-5624-6,doi:10.5772/2314.
- Wafaa, Boklouf, (2017), The Role of Training in Raising the Institution's Productive Efficiency, Master's Thesis in Human Resources Development and Management, Larbi Ben Mhidi University, Faculty of Social Sciences and Humanities, Algeria.
- Womack, J. P., Jones, D. T., & Roos, D., (1990), The machine that changed the World: The triumph of lean production. New York: Rawson Macmillan.
- Yadav, P., & Marwah, C. S., (2015), The Concept of Productivity. International Journal of Engineering and Technical Research (IJETR), 3(5), 192–196.