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Possibility of Applying JIT Production System And its Impact on Reducing Production Costs An Applied Study on Iraqi Productive Organizations

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Abstract

The current study aimed to recognize the effect of a just-in-time production system (JIT) on reducing production costs, especially in terms of serious competition, rapid technological development, and continuous changes in the business environment, which leads to an increase in paying attention to applying JIT on productive organizations. The most important findings of the study are that applying the JIT production system leads to reducing all types of inventory, which leads to improving the organization's performance. Also, its application leads to the removal or reduction of activities that do not add value to the product, which is reflected in the reduction of direct costs in the organization. The study recommended the necessity of applying the JIT system by the productive organizations and becoming acquainted with the successful experiences of international organizations that adopt this system, with the need to alert production officials in organizations to organize the productive operations sites in a way that reduces production time, in addition to providing sufficient flexibility to reduce the time required for the production process and reduce production cycle.

Keywords: JIT Production System, Production Costs.

Introduction

Today, the world is witnessing many rapid developments in various fields, which has resulted in the emergence of major challenges before all production and service sectors about choosing a production system that works to determine and reduce the cost of the product, which is considered one of the important strategic decisions before management because of its impact on the organization continuity. In this context, one of the most important goals of any organization: industrial, productive, or service, is to achieve a competitive position compared to similar organizations working in the same field, and at the same time make optimal use of its human and financial resources, reduce production time, and produce the product with high quality, which leads to customer satisfaction. In light of global

developments and the use of information technology means and tools in all aspects of life, organizations need to search for new methods of production management that enable them to fulfill their obligations to customers and allow them to grow and expand. In this context, the JIT production system is considered a new philosophy that involves new concepts and methods in the organization's management and performance to achieve a competitive advantage, efficiency in the use of resources, and respond quickly and effectively to changes in demand and customer needs. It is also considered one of the most important approaches, or relatively modern systems that can be used to reduce production costs in many of the organization's main functions, such as purchasing, storage, and production. In continuation of the above, after the emergence of this system, it has become the traditional production system, which depends on collecting large quantities of materials and parts from suppliers, converting them into a finished product, and paying them. To market without knowing customer needs is an inappropriate system. It was necessary to switch to a new system that begins with identifying customer needs, then contracting with suppliers, and then planning production, which resulted in serious efforts by the management of organizations, especially productivity, towards applying this system and this is what is known as the JIT system. Therefore, there was an urgent need for the study and analysis of the determinants and dimensions of that system and its various effects on reducing product cost.

Study Methodology

The Study Problem

As a result of the intensity of competition, many organizations sought to reduce inventory to the minimum possible extent, and circumstances did not allow it to be reduced to the required extent, but as a result of technological progress and tremendous developments in the present era, it has become possible to reduce it. In this context, (JIT) production costing system represents a revolution in commodity inventory control systems, but productive organizations still need a long time to adopt such a system, as this includes purchasing control technology and production time control technology, where controlling time means: adhering to the specified time exactly, in other words, reducing time continuously, or limiting the period separating the date of issuing purchase orders and the date of receipt of materials from suppliers(pre-production) and the date of completion of production and the date of delivery of finished products to customers, that is, reducing or eliminating waiting periods as possible, which leads to achieve significant effects in reducing production costs as a result of reducing supply periods. It is worth noting that damaged or defective units produced cause many problems in the work environment, which contradicts the philosophy of the JIT system. Therefore, this system seeks to reduce the damaged or defective units to the lowest possible percentage, or it is almost unacceptable in that system, as one of the damaged units or a defective product may affect the time of delivery of the order or may not deliver it on time, which conflicts with the objectives

The Study Objectives

The general objective of this study is to determine the return as a result of using the production system on time, and several objectives branch out from the main objective as follows

1- Presenting the concept, objectives, elements, and requirements of (JIT) production system.
2-Analyzing and explaining the effect relationship between using JIT and reducing total production costs in productive organizations.

3-Preparing and applying a field study to identify the most important determinants of JIT that have an impact on reducing production costs in general and the cost of production, lost, and spoilage in particular.

Study Approach

In light of the nature and problem of the research, its importance, and objectives, the research methodology is represented by: The integrated scientific method, both inductive and deductive, as follows

1-**The inductive approach**: through studying and reviewing the pioneering and previous writings that dealt with the JIT production system and its impact on reducing production costs, reducing waste, and reducing production time.

2- **Deductive approach**: Through this approach, the research seeks to determine the impact of applying JIT production system and its impact on reducing costs in production organizations. This is done by conducting a field study on a group of operating productive organizations.

A Panorama of (JIT) Production System

The tremendous development in modern manufacturing systems has led to the necessity of finding new philosophies for work within organizations. Among these philosophies that organizations have recently turned to is the philosophy of just-in-time production, which began to be applied in Japan, where this philosophy contributed to reducing production costs, speeding up performance, and zeroing inventory. This topic addresses the following points:

The Concept And Philosophy of (JIT) Production System

The production philosophy appeared in the eighties of the twentieth century due to the tremendous technical development witnessed by the industry. It was used for the first time by the Japanese company Toyota, which had previously adopted a strategy of understanding, communicating, and approaching its consumers and suppliers. It was able to do this through developing a set of requirements that formed the framework for what we call now (Just-In-time system). These developments of the Japanese company Toyota and other industrial organizations have received encouragement and support, especially since the philosophy of this system emerges essentially from the reality of Japan's environment, which is characterized by scarcity of space, limited land available for use, and scarcity of natural resources (Al-Mitoti, 2003).

Garrison (2002) explained that the just-in-time production system is a system based on three main pillars that represent the focus of this system, which are

1- Commitment to cancel all activities that do not add value.
2- Commitment to achieving and maintaining a high level of quality.
3- Commitment to a continuous improvement program.

As for Anderson (2005:118), he considered it an expression used to describe the system of producing the parts necessary for the production process until they arrive and are received at the site of the production process. While Schonberger (1992, 98) described it as the production of final goods and their delivery on time for sale by assembling parts at the specified time to form the final goods, and purchasing raw materials at the specified time to manufacture the parts. Al-Matarneh (2007: 30) believes that the just-in-time production system is a method that relies on technology to reduce waste at the time of purchase and

production, and dispense with all types of inventory in a way that leads to reducing costs for the production process, increasing production, and meeting customer needs promptly and in specified quantities. Some have described it as an approach to operations that attempts to meet immediate demand with the required quality and without wastage or loss. The essence of JIT thought is to eliminate waste as a result of waiting, and waste as a result of defective or re-operated materials, surplus inventory, and unnecessary spaces. Without a doubt, this achieves a reduction in costs and an improvement in revenues with a reduction in the required investment. Based on the previous definitions, we can define the just-in-time (JIT) production system as a production system that aims to achieve a distinctive competitive position by improving productivity, eliminating waste, and dispensing with all types of inventory.

Objectives of (JIT) Production System

1- **Considering suppliers as partners**: Assuming suppliers as partners and relying on a specific number of them enables the just-in-time purchasing (J.I.T.P) system to be followed (Fakher, 2005, p. 420). This concept is characterized by the following facts

-Reducing the number of suppliers (minimal suppliers)
-Long-term contracts
-Small lot size
-Collecting payments at specific times, rather than after each transaction

2- **Improving the plant layout**: In a just-in-time production system, all the necessary machines are placed in one place to produce a specific product together, and the result is the presence of several production flow lines in which all production requirements are fulfilled. This approach to factory arrangement aims to find a small factory, for each product, which is often referred to as a factory within a factory. This leads to savings in material handling costs, and no need for warehouses for incomplete production (Garrison, 2002:219).

3- **Multi-skilled workers**: Due to the new arrangement of the factory according to the requirements of the just-in-time production system, the workers must possess comprehensive experience, because the production cell or line includes heterogeneous machines that perform different operations and functions. The worker in traditional production systems is specialized in working on one machine, but in the JIT system, he must be familiar with working on all the machines of a single manufacturing cell and carrying out repair and maintenance operations, and other necessary inspection and examination work.

4- **Simplifying production activities**: The just-in-time production system is supposed to simplify production activities and eliminate unnecessary activities that do not add value to the product so that manufacturing time is exactly equal to operating time only. This is difficult to achieve, but it can be viewed as a target time, so Japanese organizations have rewritten the previous equation to be

Manufacturing time = time that adds value + time that does not add value
The time that adds value is only operating time, while inspection, handling, and waiting times are considered times that do not add value (203 - Hussein, 2000: 202)

5- **Automation of production lines (manufacturing cells)**: Automation of equipment enables the preparation time to be significantly reduced because the preparation process will be limited to just changing the computer program, and this is done in a few minutes, and thus

it is possible to move from producing one product to another quickly and avoid the need to produce large batches which enables greater manufacturing efficiency when linking manufacturing cells with the material handling system and with each other via a central computer. These arrangements are called a flexible manufacturing system, and they allow the production of different products, but similar in size and type of raw materials needed, reduce preparation time and costs, and move very quickly to produce a new product, and thus respond quickly to customer needs (Fakher, 2005: 420)

6- **Comprehensive Quality Control**: to have a production system operate on time successfully, a comprehensive quality control system must be established, starting from the process of receiving raw materials and ending with the final delivery of the product to the customer, and this control must be continuous.

7- **Small-sized Batch**: The just-in-time production system is based on producing small batches that achieve the following:
-Quick detection of damage or defect, as small batches achieve immediate feedback on damaged units.
-Small-sized batches help reduce storage costs, in addition to transportation and handling costs (Hilton, 1999: 208)
In addition to the above, applying the JIT system requires other requirements such as an activity-based costing system, an activity-based management system, supply chains, and value chains, a re-engineering system, a quality control system, skilled workers, and suppliers with a high degree of commitment.

8-**Kanban System** is a pull system, as the production process in its normal course depends on transferring the product under manufacturing from the completed stage of production to the next stage. However, in the pull system, the subsequent stage imposes the transfer of the product under manufacturing from the previous stage only when needed. That is, the work is drawn upon request and according to need or requirement. (Robert, 2001:351) The requirements for applying the just-in-time production system are extremely strict and stringent. However, this system has met with great success in practical life as a result of the enormous benefits that have been obtained as a result of its application. The benefits of the system have been embodied in a way that is clear from the results of studies conducted on the Japanese manufacturing environment, as it is noted that the Japanese organization that created the idea of this system has achieved many benefits from their application of this system, as inventory was reduced to 90%, which is close to the ideal state of the system, and the preparation time was reduced to 85% as well. Defects and damage were reduced to 95%, which is very close to zero defects. Finally, handling time was reduced to 75%, which in turn reduced production costs to a large extent in the production process. (Smith 1999: 334-335).

3-An analysis of previous relevant studies and derivation of hypotheses

3-1 A Study for Qi et al (2009) entitled: "'Supply chain strategy, product characteristics, and performance impact: evidence from Chinese manufacturers."
This study aimed to identify the impact of supply chain strategy and product characteristics on the financial performance of a sample of 604 Chinese operational organizations. The study found a positive impact of strategies or dimensions of the just-in-time production system, which include limited-waste manufacturing, responsive manufacturing, or their integration

on the financial performance of Chinese organizations. The study also found that there is a positive effect of product characteristics or attributes on the financial performance of Chinese organizations.

3-2- A Study for Aksoy & Ozturk (2011) entitled: Supplier selection and performance evaluation in just-in-time production environments"

The success of the Just-in-time system on the ground has led the Turkish industrial organization to expand its application, especially to achieve a competitive advantage in today's global markets. This study aimed to help Turkish industrial organization by applying the JIT system in

- Choose the most suitable suppliers.
- Evaluating their performance.

The process of obtaining materials is a very important issue in the effective and successful implementation of the JIT system. Therefore, the evaluation of the supplier's performance and selection plays a major role in the success of this system. This study presented proposed interconnected network systems that help production organizations choose suppliers and evaluate their performance, through data taken from the factory showing that these proposed systems can be used effectively.

3-3 A Study for (Khalil, 2015) entitled: "Influences of the success of applying the just-in-time (JIT) production system in Jordanian industrial organizations"

The study dealt with the concept of just-in-time production (JIT) and studied some of its objectives, advantages, and the extent of its impact on stock levels of raw materials in organizations in an attempt to reach zero levels, as well as the emergence of this system and its beginnings in Japan and attempts to apply it in America. The study also found that the just-in-time (JIT) production system leads to reducing costs on the product, as well as improving the quality of the product and reducing spoilage and manufacturing defects, due to the rapid detection of these defects or damages, due to the speed of selling inventory and not being waiting for in warehouses for long periods, and this, therefore, leads to quickly provide feedback from customers and thus solve problems, correct errors and defects, and make the product competitive in the local and international markets. The study dealt with the concept of just-in-time production (JIT) and studied some of its objectives, advantages, and the extent of its impact on stock levels of raw materials in organizations in an attempt to reach zero levels, as well as the emergence of this system and its beginnings in Japan and attempts to apply it in America. The study also found that the just-in-time (JIT) production system leads to reducing costs on the product, as well as improving the quality of the product and reducing spoilage and manufacturing defects, due to the rapid detection of these defects or damages, due to the speed of selling inventory and not being waiting for in warehouses for long periods, and this, therefore, leads to quickly provide feedback from customers and thus solve problems, correct errors and defects, and make the product competitive in the local and international markets.

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This study demonstrated the ability of the operational organizations under study to respond to production requirements on time (JIT) to reach the goal. It also concluded that production requirements can be established on time in the samples under study, and this system provides quality and saves waiting time for the product, Preparation time, increasing worker skill, as well as minimum inventory.

By analyzing the previous Arab and foreign studies, the researcher concludes the following observations

- Most studies praised the results that organizations obtain by applying the JIT production concept.

-The concept of JIT production reduces production costs in many of the functions carried out by the organization.

-The concept of JIT production has gained confidence in many foreign countries in America, Japan, and Turkey.

- Our country, Iraq, did not expand in applying the concept of JIT production.

Most of the applied studies were based on opinion poll models only, and this concept, when applied essentially, requires a lot of research and experiments to ascertain the extent of its validity in organizations.

Study Hypotheses

From the mentioned previously, the following study hypotheses can be derived:

- The first null hypothesis: There is no statistically significant relationship between applying the just-in-time production system and reducing costs.
- The first alternative hypothesis: There is a statistically significant relationship between applying the just-in-time production system and reducing costs.
- The second null hypothesis: There is no statistically significant relationship between applying the just-in-time production system and reducing production time.
- The second alternative hypothesis: There is a statistically significant relationship between applying the just-in-time production system and reducing production time.
- The third null hypothesis: There is no statistically significant relationship between applying the production system on time and reducing waste.
- The third alternative hypothesis: There is a statistically significant relationship between applying the just-in-time production system and reducing waste.

An Analyzing and explaining the impact relationship between using JIT and reducing total production costs in the productive organizations

In the modern era, interest in cost systems has increased, making organizations compete to provide the required goods, quality, and appropriate cost. Organizations can now control the cost side and not the price side, which has resulted in the need for these organizations to develop new cost systems that provide managers with information that can be relied upon to accurately determine the cost and try to achieve this without affecting quality.

It is worth noting that many studies (Al-Halafi, 2000; Al-Bakri, 2001; Al-Hadithi, 2002; Al-Mutarna, 2007, Kerschberg, Larry & Hanjo, Jeong, 2005 Eker, Melek & Fikri Pala, 2008; LeBlanc, et al., 2008 Adeyemi, S. L., 2010.

There has been consensus that there is a correlation between the JIT production system and the cost items and elements in organizations, as the JIT system achieves a set of cost reduction channels, perhaps the most important of which are: Reducing holding costs: JIT system seeks to reduce inventory of all types, which leads to reducing inventory holding costs.

2 - Reducing the cost of supply: JIT system always seeks to reduce the number of suppliers, which results in reducing the cost of supply.

3 - Reducing transportation and handling costs: One of the tools for the success of JIT is arranging the factory machines in the form of cells, which saves the cost of transportation and handling.

4 - Reducing obsolescence costs: Under the specified production system, inventory is not maintained, which leads to reducing the obsolescence of the organization’s raw materials and products.

5 - Lack of need for inspection: JIT production system trains workers to increase their ability to use machines and carry out machine maintenance work as required.

6 - Increasing the efficiency of using the used space in the factory: This is through using the space allocated for inventory in expansions of production lines.

7 - Reducing the number of workers: JIT production system is limited to highly experienced and competent workers, and workers who do not have the above requirements are eliminated.

Fields of applying JIT production system

The application of the JIT production system achieves many advantages that make it a powerful competitive weapon after it has demonstrated a superior and integrated ability to influence the dimensions of the production system, starting with suppliers, transformational processes, inventory, and workers, all the way to the final products, distributors, and customers. Therefore, the application of the JIT production system leads to a reduction in cost and an improvement in revenues (Najim, 82, 2004) However, there are many advantages achieved by following the JIT system in the production process, which can be explained in the following points

1- Production with better quality.
2- Production quality becomes the responsibility of every worker and not just the responsibility of quality inspectors.
3- Reducing the product cycle in production processes by eliminating unnecessary activities that hinder the production process.
4- Flow and smooth production process.
5- Reaching zero inventories.
6- Reducing costs related to transportation, handling, storage, office work, etc., and thus increasing profitability.
7- Increase productivity and improve operational performance by increasing the rate of return on investment, increasing the profit margin, and increasing the inventory turnover rate.
8- Increasing workers' participation and productivity by working as a team, and sense of responsibility.
9- Meeting customers' requests and desires with high capacity.

Field Study

The field study aims to analyze and evaluate (JIT) production system and its impact
To reduce costs in some organizations subject to the study, through a sample of financial officials, cost management, a group of production engineers in addition to research management officials and development in the organizations under study. Accordingly, the field study will be divided into:

Discussing the methodology and procedures for the field study: Which includes a detailed description of the methodology and procedures that were followed in applying the field research. It also addresses an explanation of the study methodology, a description of the study population and sample, the preparation of the main tool for the study (the questionnaire), an examination of its validity and reliability, and the procedures that benefit the study tools and their application as follows:

Field study methodology: - To achieve the research objectives and test its hypotheses, we relied on:

A - Inductive approach

Based on this, the most important studies and research were analyzed and extrapolated by reviewing books, Arab and foreign research and articles, and abstracts of relevant seminars and conferences.

B. Implementing an exploratory study on the research topic:

First, carry out a set of meetings with a small random sample of some financial and cost management officials and production engineers, in addition to research and development management officials in the organizations under study, to identify the extent of their awareness of the effectiveness of using (JIT) production system and its impact on reducing costs, where the content of the study and the method of applying the survey study were presented. After that, a survey questionnaire consisting of scheduled questions was distributed using a three-graded Likert scale, so that the weights of the answers varied from agree (3) to somewhat agree (2) to disagree (1), then the percentages of the exploratory questionnaire statements were estimated. The results of the exploratory study showed the importance of the following points:

1- Productive organizations still need time to adopt such a system, as this includes the technology of controlling purchasing and the technology controlling production time.

2- Production organizations are still searching for methods to reduce production costs, which may prompt them to use modern production methods without affecting customer satisfaction, the most important of which is the JIT production system.

3- It is important to demonstrate the suitability of the JIT production system to the requirements of the Iraqi environment.

Based on the above, there is a strong justification for conducting this field study to try to find a proposed framework for the impact relationship of using (JIT) production system on reducing costs.

The Deductive Approach

Based on this a proposed vision was developed for how to link logically the variables of both (the JIT) production system and the cost-reduction variables. This will be done by directing a survey list to the sample groups, as well as personal interviews, to test the validity or invalidity of the hypotheses on which the research is based.

Describing the Field Study Tool

The data collection tool that was relied upon was to obtain the primary data necessary for the current study in a survey list, which was prepared and its phrases developed based on the standards developed by previous researchers in the field of research, in addition to the results of the exploratory study through the opinions of the sample. Distribute the questionnaires to the sample members, respond to their inquiries, collect them, and then perform the data transcribing operations. It is worth noting that the basic survey list was designed according to a five-point graded Likert scale to determine the answers of the sample members so that the weights of the answers range from Completely Agree (5) to Agree (4) to Neutral (3) to Disagree (2) to disagree (1), according to the nature of each field of the questionnaire, which enables obtaining continuous data and ensuring a normal distribution of data, until accepting the application of statistical methods to it. In addition, to avoid what is called common methodological variance in the research tool, it was intended to collect data related to the independent and dependent variables of the current study over separate periods to reduce the tendency of the sample members to seek to achieve uniformity in the answers and maintain their consistency. The list of questions included the following parts

The first part: includes a set of demographic questions that determine some important characteristics of the sample to ascertain the extent of their interest in the research topic.

The second part: is divided into three axes as follows:
1- The first axis: The impact relationship between applying the JIT system and reducing costs: It included 8 statements from (1 – 8).
2- The second axis: The impact relationship between applying the JIT system and reducing production time: It included 8 statements from (9-16).
3 The third axis: The impact relationship between applying the JIT system and reducing spoilage rates: It included 7 statements from (17 – 23).

Field Study Community and Sample

1- **Study population**: To achieve the objectives of the study, the study population consists of working productive organizations. The sample categories for the study population were selected from the following categories:

A- Financial and cost management officials
B- Production engineers in organizations
C- Research and development department officials

Study Sample

Due to the impossibility of using the comprehensive inventory method in collecting data for the current study due to several considerations, including time, effort, and cost, a simple random sample was chosen from the study population, amounting to (145) items, which represent 10% of the members of the original study community, where the allocation method was used to distribute the study sample among the previous categories, and the questionnaires were distributed manually, at a rate of 50 items for the first category, financial and cost management officials, 45 items for the second category, production engineers, and 50 items for the third category, research and development management officials.

Distribution of the Study Sample

Three productive organizations were selected as follows
1 – Al-Kufa ancient Cement Plant
2-Men Ready Garments Plant in Al-Najaf
3- Al-Najaf Tire Plant
(132) questionnaires were collected, representing 91.03% of distributed questionnaires. After conducting statistical analyses of missing values and irregular values, (5) questionnaires were deleted due to their invalidity, so the number of final questionnaires that were subjected to statistical analysis became (127) forms, representing 87.58% of the total distributed forms. Table (1) shows the demographic characteristics of the study sample members according to academic qualifications and years of experience, in addition to the sample's job level.

Table 1
Dividing the study sample according to demographic characteristics

Property	Category	Number	Ratio
Certificate	Bachelor	88	69,29
	Master	27	21,26
	Doctorate	12	9,45
Experience Year	Less than 5 years	38	29,92
	5-10	46	36,22
	More than 10	43	33,85
Occupation	Financial and cost management officials	45	35,40
	Production engineers	39	30,80
	Research and development department officials	43	33,80
Total		127	100

From the previous table, it is clear that the proportion of the research sample is large and specialized in the field of study, and the results obtained from it can be relied on.

1- **Validity and reliability using Cronbach's Alpha method**

Validity and reliability were estimated through Cronbach's Alpha scale. If this scale exceeds 60.0, it is possible to rely on the results of the study and circulate them to society. The reliability coefficient is calculated by the percentage of the square root of the validity coefficient, the alpha value. Table No. (2) shows that the value Both the validity and reliability coefficients for the various questionnaire axes reached (80.0%, and 89.94%) at the level of the total questionnaire, respectively, which is a high percentage, which confirms the possibility of relying on the results of statistical analysis and the possibility of applying them to the study population.

Table 2
Validity and reliability measures for the various axes of the questionnaire according to the Cronbach's alpha test

Questionnaire Axis	Statement Number	Validity Alpha Value	Reliability
Effect Relation between Applying JIT and Reducing Costs	1-8	0,762	0,8730
Effect Relation between Applying JIT and Reducing Production Time	9-16	0,699	0,836
Effect Relation between Applying JIT and Reducing Damaged Ratio	17-23	0,701	0,8370
Total%	1-23	0,800	0,894

Testing the Normal Distribution of Questionnaire Data

Smirnov Z Kolmogorov test was used to test the normal distribution of the questionnaire data to determine whether the survey data follows a normal distribution or not. It is an important test for analyzing the data before testing the hypotheses to ensure the validity of the results of the statistical tests used. The results of the normal distribution test were

according to Table No. (3), the content of the questionnaire axes follows a normal distribution, where the significance level of the (Z) values for the study variables was non-significant, which confirms the validity of the sections of the questionnaire for the statistical analysis.

Table 3
Results of the Smirnov Z Kolmogorov test for the normal distribution of data the various questionnaire axes

Questionnaire Axis	Z value	Significant
Effect Relation between Applying JIT and Reducing Costs	1,570	0,168
Effect Relation between Applying JIT and Reducing Production Time	1,090	0,168
Effect Relation between Applying JIT and Reducing Damaged Ratio	1,090	0,168

Thus, the validity and reliability of the study tool have been confirmed, in addition to the validity of the normal distribution of the questionnaire data, which indicates the validity of the questionnaire and its suitability for analyzing the results, answering the study's questions, and testing its hypotheses.

Study Variables

This research contains two types of variables
1- The independent variable: represented by (JIT) production system
2- Dependent variables: They are expressed in variables related to reducing costs, reducing production time, and reducing the damage ratio.

The Statistical Methods Used

Appropriate statistical methods were used to analyze the results of the questionnaire forms according to what was stated by (Snedecor, & Cochran, 2016) which are:
1- Correlation analysis and estimation of the relative contribution R^2 of the questionnaire items to its various sections to determine the strength of the association between the variables of the study to prove or deny the hypotheses, with note that correlation analysis and relative contribution estimation exclude the effect of personal bias in sample answers, so we can rely on the results of estimating the correlation and relative contribution coefficients with a high degree of confidence.
2- Regression analysis to arrive at a model of the relationship between the variables of the study and find a proposed framework for the impact relationship between (JIT) production system and both reducing costs and reducing production time in addition to reducing spoilage rates.

Field Study Hypotheses

- The first null hypothesis: There is no statistically significant relationship between applying the JIT production system and reducing costs.
- The first alternative hypothesis: There is a statistically significant relationship between applying the JIT production system and reducing costs.
- The second null hypothesis: There is no statistically significant relationship between applying the JIT production system and reducing production time.

- The second alternative hypothesis: There is a statistically significant relationship between applying the JIT production system and reducing production time.
- The third null hypothesis: There is no statistically significant relationship between applying the JIT production system and reducing waste.
- The third alternative hypothesis: There is a statistically significant relationship between applying the JIT production system and reducing waste.

Analyzing the results and discussing the hypotheses

One of the most important results of the statistical tests conducted on the questionnaire items is through analyzing and discussing them completely and in detail and determining the extent of the statistical significance of each of them in identifying the analysis and evaluation of the just-in-time (JIT) production system and its impact on reducing costs in some production organizations, in addition to testing special hypotheses by studying. Below are the most important results of the field study conducted on the data obtained from the questionnaire results:-

Testing the Validity of the First Theoretical Hypothesis

1- Results of the correlation analysis Table (4) shows the correlation between the cost reduction variables as dependent variables and applying the JIT production system as an independent variable

2-

Table 4

Correlation between cost reduction variables and the application of the JIT production system in productive organizations

Reducing Cost Variables	**Correlation coefficient R**	**Relative Contribution % R^2**	**Significance**
1-The ability to detect and correct errors at the lowest possible costs	0,239	5,71	0,004
2-Effectively reduce production costs	0,392	15,37	0,000
3- Reducing indirect costs and unnecessary expenses	0,585	34,22	0,000
4- Creating a great diversification in production without the need for additional costs	0,274	6.10	0,003
5- Taking preventive measures to produce at a low cost	0,632	39,94	0,000
6- Reducing the cost of holding inventory to its lowest levels	0,353	12,46	0,000
7- Reducing waiting costs across production lines	0,145	2,10	0,081
8- Activating the efficiency of production stages, which leads to reducing production cost	0,595	35,40	0,000

From the previous table, it became clear that there is a strong direct relationship between reducing production costs effectively, reducing indirect costs and unnecessary

expenses, taking preventive measures to produce at a low cost, and reducing the cost of maintaining inventory to its minimum levels, in addition to activating the efficiency of production stages, which leads to reducing Production costs and the application of JIT production system in productive organizations, where the values of their correlation coefficients reached. 3920, 5850, 6320, 3530, and 5950, and its relative contribution is 15.37%, 34.22%, 39.94%, 12.46%, and 35.40%, respectively, with statistical significance at a significance level of 0.01. This means that the more interest there is in applying the JIT production system in productive organizations, the more this will lead to improving the cost reduction variables with the same values of their relative contributions. The results also showed that there is a direct and significant relationship at the 1% level with values lower than the previous variables, between the possibility of detecting errors and correcting them at the lowest possible costs and creating a great diversification in production without the need for additional costs, and between applying the production system on time in Production organizations, where the relative contribution value of these variables reached 5.71% and 6.10%, respectively. The results also confirmed the non-significant effect of applying the JIT production system in productive organizations on reducing waiting costs across production lines.

Regression Analysis and Testing the Statistical Hypothesis

Variables expressing cost reduction with high relative weights and significant significance at the 1% level (Table 4) were used to estimate the dependent variable and to arrive at a predictive model for the impact relationship between applying the on-time production system as an independent variable and cost reduction as a dependent variable, where it is estimated the value of the regression coefficient, correlation coefficient, and partial standard regression coefficient, in addition to the linear pairwise test between variables to ensure the model accuracy of.

Table (5) shows the results of the regression analysis to determine a predictive model for the influence relationship between applying the just-in-time production system and reducing costs. By examining the results of the table, it is noted that there is a direct and highly significant relationship, as the value of the regression coefficient between the model variables reached (1.365). It was also noted that the value of the partial standard regression coefficient increased, reaching (9340), thereby confirming the existence of an influential relationship between applying the production system on time reducing costs and ensuring the independence of the model variables with the absence of autocorrelation in the error term between the independent variables (Collinearity Statistics) by estimating the variance inflation factor (VIF). The results of Table (5) confirm that there is no multi-collinearity between the variables of the model, as the VIF values fell to less than “5”; which is the limit of significance, which confirms the validity of the relationship and the validity of the regression model and that the effect of applying JIT production system on reducing costs is certain, rather than a coincident.

The results also showed that the correlation coefficient between applying the on-time production system and reducing costs reached R (0.934) and the coefficient of determination (R Square) was 87.2%, meaning that applying the on-time production system leads to reducing costs by the amount of the coefficient of determination and at a significant level of (0.000), which confirms the significance of the regression relationship

Table 5

Results of regression analysis to determine a predictive model for the effect relationship between applying JIT production system and cost reduction

Independent Variable	**Reducing Costs**				
	regression coefficient	**Regular Error**	**Partial Regular Regression coefficient**	**T Value**	**VIF Significance**
Equation constant	-1,246	0,146		-8,532	--
Applying JIT production system	1,365	0,044	0,934	31,280	1,00
Correlation R			0,934		
R Square			%87,2		
Significance Level			**		

Based on the previous results, the second null hypothesis can be rejected: "There is no statistically significant impact relationship between applying the JIT production system and reducing production time." The alternative hypothesis is accepted

A-Testing the validity of the second theoretical hypothesis:

Table (6) shows the correlation between the variables of reducing damaged ratio as dependent variables and applying the JIT production system as an independent variable

Table 6

The correlation between the variables of reducing production time and applying JIT production system in productive organizations

Reducing production time Variables	**Correlation coefficient R**	**Relative Contribution % R^2**	**Significance**
9- Continuous Production without stopping	0.539	29,05	0.000
10- Contributing to making the production lines close to each other, which helps provide the appropriate time for handling raw materials and complementary parts of the production process.	0,153	2,34	0,066
11- Increasing the efficiency of the operating stages according to the time specified for each stage	0.353	12,46	0.000
12- Prepare production tools on time	0.320	10.24	0.000
13- Completion of production activities on time	0.674	45.43	0.000
14- Organizing production operations sites in a way that reduces production time	0.626	39.19	0.000

15- Providing the necessary flexibility to reduce the time required for the production process and reduce the production cycle	0.329	10,82	0.000
16- Placing production machines in one place to save transportation and handling time	0.265	7,02	0.001

From the previous table, it became clear that there is a strong direct relationship between continuing production without interruption and increasing the efficiency of the operating stages according to the time specified for each, preparing production tools on time, completing production activities on time, and organizing productive operations sites in a way that reduces productivity time, in addition to providing the necessary flexibility to reduce the time required for the production process, reduce the production cycle, and implement the JIT production system in productive organizations. The values of their correlation coefficients were: 5390, 3530, 3200, 6740, 6260, and 3290, and their relative contributions were 29.05% and 12.46%, 10.24%, 45.43%, 39.19%, and 10.82%, respectively, with statistical significance at a significance level of 0.01. This means that the more interest there is in implementing the JIT production system, the more this will lead to a reduction in production time through these variables with the same values of their relative contributions.

While the results also showed that there is a direct and significant relationship at the 1% level, with a value lower than the previous variables, between implementing JIT production system and placing production machines in one place to save transportation and handling time, where the value of the relative contribution of this variable was 7,02%. The results also confirmed the non-significant effect of applying the JIT production system on productivity by contributing to making production lines close to each other, which helps provide the appropriate time for handling raw materials and complementary parts of the productive process.

B- Regression Analysis and testing the Statistical Hypothesis

The variables expressing reducing spoilage rates with high relative weights and significant significance at the 1% level (Table 6) were used to estimate the dependent variable and to arrive at a predictive model for the influence relationship between applying the JIT production system as an independent variable and reducing spoilage rates as a dependent variable, where the value of the regression coefficient, correlation coefficient, and partial standard regression coefficient are estimated, in addition to the linear pairwise test among the variables to ensure the accuracy of the model. (Table 7) shows the results of the regression analysis to determine a predictive model for the influence relationship between implementing the JIT production system and reducing production time. From the results of the table, it is noted that there is a direct and highly significant relationship, as the value of the regression coefficient between the model variables reached (1.193). We also notice an increase in the value of the partial standard regression coefficient, reaching (0.937), which means that there is an impact relationship between implementing JIT production system and reducing production time.

To ensure the independence of the model variables with no autocorrelation in the error term between the variables (Collinearity Statistics), we estimated the variance inflation factor (VIF). The results of Table (7) confirm that there is no multicollinearity between the variables of the model, as the VIF values fell to less than “5”, which is the limit of significance, which confirms the validity of the relationship and the validity of the regression model and

that the effect of applying the just-in-time production system on reducing production time. Production is certain and is not due to chance. The results also showed that the correlation coefficient was (R 0.937) and the coefficient of determination was (R Square) 87.8%, meaning that implementing the JIT production system leads to reducing production time by the coefficient of determination with a significance level of (0.000), confirming the regression relationship significance.

Table 7

Results of regression analysis to define a predictive model for the impact relationship between applying JIT production system and reducing Production Time

Independent Variable	**Reducing Production Time**				
	regression coefficient	**Regular Error**	**Partial Regular Regression coefficient**	**T Value**	**VIF Significance**
Equation constant	-0,556	0,126	--	-4,421	--
Applying JIT production system	1,193	0,037	0,937	32,013	1,00
Correlation R			0,937		
R Square			%87,8		
Significance Level			**		

Based on the previous results, the second null hypothesis can be rejected: “There is no statistically significant impact relationship between applying the JIT production system and reducing production time.” The alternative hypothesis is accepted.

A-Testing the validity of the third theoretical hypothesis

Table (8) shows the correlation between the variables of reducing damaged rates as dependent variables and the implementation of the JIT production system as an independent variable

Table 8

The correlation between the variables of reducing spoilage ratio and the implementation of JIT production system in the productive organizations.

Variables of Reducing Damaged ratio	**Correlation coefficient R**	**Relative Contribution % R^2**	**Significance**
17- Reducing excess inventory, which leads to reducing the rates of loss and damage	0.387	14.98	0.000
18- Reducing machinery breakdowns, resulted in lower rates of damaged	0.214	4.58	0.010
19- Low rates of defected materials and parts.	0.610	37.21	0.000
20- Reducing product accumulation rates, thus reducing damaged rates	0.680	46.24	0.000
21- Eliminate extravagance by eliminating unnecessary activities	0.340	11, 56	0.000
22- Attracting high talents, resulting in the quality of products and thus reducing damage rates	0.643	41,34	0.000
23- Re-operating defective units making them high-quality units	0.310	9,61	0.000

It became clear, by the previous table, that there is a strong direct relationship between reducing redundant inventory, which leads to reducing the rates of loss and spoilage, lowering the rates of defective materials and parts, and lowering the rates of product overstock, and thus reducing the rates of spoiled items and eliminating waste by eliminating Unnecessary activities in addition to attracting highly qualified people, which is reflected in the quality of products and thus reducing spoilage rates and implementing the production system on time in production organizations. Its correlation coefficient values reached .3870 6100, 6800, 3400, and 6430) and their relative contribution (14.98% and 37.21%, 46.24%, 11.56%, and 41.34%,) respectively, with statistical significance at 0.01 significant level, which means that the more attention there is to implementing JIT production system, the more this leads to a decrease in the value of the damaged percentages at the same values as their relative contributions, while the results also showed that there is a direct and significant relationship at the 1% level and with values lower than the previous variables, between reducing machinery breakdowns, which is reflected in lowering damaged rates, restarting defective units and making them high-quality units, and implementing JIT production system on time. The relative contribution value of these variables was 4.58% and 9.61%, respectively

Regression Analysis and testing the statistical hypothesis

The variables expressing reducing damaged ratio with high relative weights and significant significance at the 1% level (Table 8) were used to estimate the dependent variable and to arrive at a predictive model for the influence relationship between applying the on-time production system as an independent variable and reducing spoilage rates as a dependent variable, where the value of the regression coefficient, correlation coefficient, and partial

standard regression coefficient are estimated, in addition to the linear pairwise test between the variables to ensure the accuracy of the model.

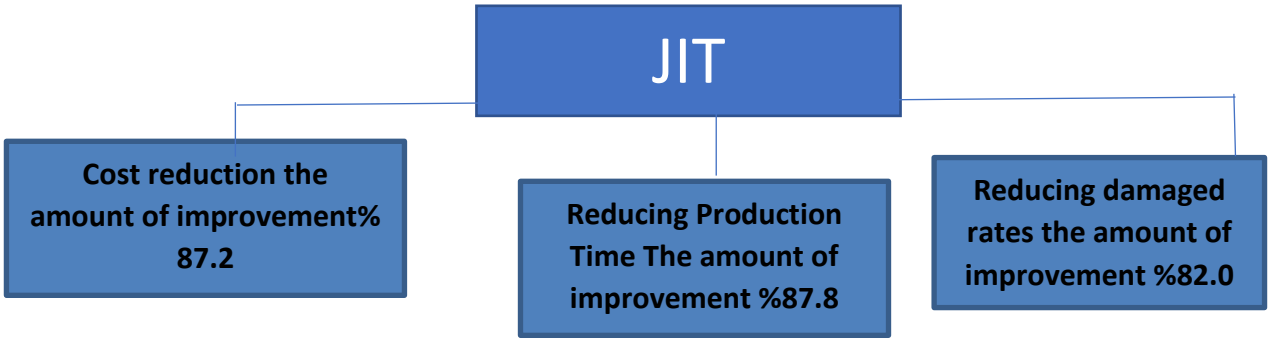
Table (9) shows the results of the regression analysis to determine a predictive model for the influence relationship between applying the JIT production system and reducing damage rates. By examining the results of the table, it is noted that there is a direct and highly significant relationship, as the value of the regression coefficient for the model variables reached (1.140). It was also noted that the value of the partial standard regression coefficient increased, reaching (0.905), confirming that there is an impact relationship between applying JIT production system and reducing spoilage rates. To ensure the independence of the model variables with no autocorrelation in the error term between the model variables (Collinearity Statistics), the variance inflation factor (VIF) was estimated. The results of Table (9) confirm that there is no multicollinearity between the variables of the model, as the VIF values fell to less than "5", which is the limit of significance, which confirms the validity of the relationship and the validity of the regression model and that the effect of applying just-in-time production system on reducing the percentage of damaged is correct and is not due to chance. The results also showed that the correlation coefficient reached (R) 0.905 and the coefficient of determination (R Square) 82.0%, meaning that applying the JIT production system leads to reducing damage rates by the amount of the coefficient of determination and with a significance level of (0.000), which confirms the significance of the regression relationship.

Table 9
Results of regression analysis to define a predictive model for the impact relationship between applying the JIT production system and reducing damaged rates

Independent Variable	**reducing damaged rates**				
	Regression coefficient	**Regular Error**	**Partial Regular Regression coefficient**	**T Value**	**VIF Significance**
Equation constant	-0,349	0,144		-2,423	--
Applying JIT production system	1,140	0,045	0,905	25,500	1,00
Correlation R			0,905		
R Square			82,0%		
Significance Level			**		

Based on the previous results, the third null hypothesis can be rejected: "There is no statistically significant impact relationship between applying JIT production system and reducing damaged rates." The alternative hypothesis is accepted. Accordingly and in light of the results of statistical analysis, the following framework can be derived to indicate the influence relationship between the (JIT) production system and cost reduction in production organizations. The following figure (1) illustrates this

The impact relationship between just-in-time (JIT) production system and cost reduction in organizations



Source: Prepared by the researcher

Conclusions

One of the most important findings of the study is that the just-in-time production system is one of the modern systems used by Iraqi organizations, and it is necessary for these organizations to adopt this system and organize the sites of production operations. If the researched organizations fully implement this system, it will save a lot of unnecessary additional costs. Applying the JIT production system leads to reducing all types of inventory, which leads to shifting investment to areas that lead to improving the organization's cost performance. Likewise, applying it leads to eliminating or reducing activities that do not add value to the product, which is reflected in reducing direct costs in the organization. Applying the JIT production system leads to cost reduction, in addition to reducing lost, damaged, and defective items. There is a strong direct relationship between effectively reducing production costs, reducing indirect costs and unnecessary expenses, taking preventive measures to produce at a low cost, and reducing the cost of keeping inventory to its minimum levels, in addition to activating the efficiency of production stages, which leads to reducing production costs between the application of JIT production system in productive organizations. The values of their correlation coefficients reached 3920, 5850, 6320, 3530, and 5950, and their relative contributions are 15.37%, 34.22%, 39.94%, and 12.46%, 35.40%, respectively, with statistical significance at 0.01. This means that the more interest there is in applying the JIT production system in production organizations, the more this will lead to improving the variables of cost reduction with the same values of their relative contributions.

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