



Application of JIT on Materials and Labor Management of Construction Site

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ARTICLE INFO

Published on 27th of May 2024
Doi: 10.54878/6q4v5p60

KEYWORDS

Just in time for construction, planning, and improving performance.

HOW TO CITE

Application of JIT on Materials and Labor Management of Construction Site. (2024). *Emirati Journal of Civil Engineering and Applications*, 2(1), 50-57.
<https://doi.org/10.54878/6q4v5p60>

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ABSTRACT

In the Just in Time (JIT) management process, planning should be carried out in a way that provides an optimum fit between the tools, the workers and technical laborers, and the management. Planning should enable all the parties involved to coordinate themselves with the design and production system, based on the understanding that the service and production systems require knowledge to facilitate the implementation of the Just In Time production system. Just In Time production systems are implemented for the purpose of optimizing the production process and creating efficiencies through waste reduction both in terms of materials and processes. In short, the JIT production system is a process that optimizes both products and services in terms of quantity, timing, and materials. Based on the above, the aim of this project is to understand the effectiveness of implementing the JIT production system in the construction sector. The survey method has been implemented to find the site base result. The main hypothesis of this project is, there is a positive relation between JIT and improved construction project efficiency. Research, surveys, and questionnaires were used to assess the independent and dependent variables. Sample of 100 managers, engineers, laborers, and planners in the field was randomly reached and researched. Samples and questionnaires were answered and prepared. The effects of the Just In Time production system in construction were tested using statistical tests including the chi-square test for the presence or absence of a positive relationship. The results of the studies show that there is a significant relation between skills and proficiency and the overall JIT concept for reaching the goal of a more efficient construction site and pattern.

1. Introduction & Background

The Just In Time (JIT) system is one of the most advanced planning, scheduling, and production control systems that has been placed at the top of the pyramid of new systems.

In terms of economic constraints and the complexity of developing markets, optimal use of available resources and knowledge and timely response to customer demands in different market segments has become inevitable. Organizations have to remove structures and traditional practices to maintain their market share.

The Just In Time production system was pioneered by Toyota. The effectiveness of the system quickly attracted the attention of other Japanese companies, who altered the JIT system to meet the specific requirements of their respective industries. However, over the last three decades, despite the introduction of this system by the Japanese, most efforts to implement the principles of this system have been conducted by non-Japanese companies. In the Middle East, the concept and definition of distributed system principles and theories have been misunderstood, thus the system was not properly used to develop and promote growth. Instead, most people consider it to simply be a program for inventory control, while the removal of excess inventory in warehouses is only one aspect of the system [1].

Other benefits of this system are the significant reduction of the work load during construction, timely product delivery according to customer space requirements, reductions in scrap, waste, and rework tails, increases in productivity, and improved relationships by offering users a better and more successful, motivated, and happy work force [1].

It can be stated that the JIT system emphasizes timely delivery of much-needed materials required in the process of production and consumption of goods. Such a system is very accurate, thus requiring careful planning, effective coordination, sincere cooperation between employees and managers, and implementation of desired organizational culture and work ethics. Implementing the above results in voluntary discipline and self-control throughout the group.

2. Literature Review

2.1. Organization and Its Concepts

According to Scott's theories, "organizations are collectivities oriented to the pursuit of relatively specific goals" [2], a system of common meanings which is accepted by a determined group at a time, in an obvious and collective manner. Based on this definition, we can define the culture in wider dimensions to reach to a common term. According to this system, the meaning, action, and behavior of the group shall be specified [3]. Organization may also be defined as some people who reach an agreement to pursue a common objective [4]. Culture is a common characteristic of all organizations. In other words, organizations have different cultures that enable them to reach a common objective. Upon this, organizational culture may be a common word among different companies which are emphasized by traditions, stories, myths, products, and organizational symbols. The manager is considered to be the symbol of the organization [4].

In organizations, possessing common characteristics results in the appearance of a phenomenon called "organizational culture," which may form the ethical characteristics of the organization's personnel. Some organizations, like the personality of the personnel, may be isolated, conservative, creative, timid, etc [5].

Culture is a common characteristic in micro- and macro- dimensions. For association, organizations need individual morale, motivation, creativity, and free spirit to reach the intended organizational culture. According to this, to reach an association or collective identity among personnel, some commitments are made for individuals that are beyond their resources.

The culture affects the process of decision-making and problem solving, motivation, individual's consent and spirit, and the degree of creativity and innovation; in a word, we may not find something independent and free from the role of culture in management.

Organizational culture grants a feeling of identity to personnel of the organization. Culture causes individuals to commit beyond their personal interests and benefits [8].

Managers of organizations may control the professional and social actions and behaviours of the personnel through organizational culture (strong), unwritten rules, and group norms and cares [6].

Findings of experts confirm that the success of organizations, besides hardware-like structure, strategy, and systems, also requires software such as employees, skills, styles, and employee values (organizational culture). Also, successful implementation of the strategy in organizations shall be required to provide necessary cultural arrangements, and changes in the organization may not be made without the agreement and accompaniment of organization's culture. It should be known that the basis for judgment on the culture of organizations is the amount of their coordination and harmony with the organization's missions [4].

In case the common values of the members of the organization are contrary to those which increase the effectiveness of the organization, the culture shall be considered as an impediment. Possibly, this condition appears when the organization is located in an active environment [6].

2.2. Strategic management

Strategic management is a vital tool that enables the organization to remove weaknesses and resist circumferential threats, relying on its strengths and existing opportunities, and as a result to have a competitive advantage for the organization. This type of management is accompanied with a new concept and causes a change in management theories. Organizational schools (classic, neo-classic, modern, and necessity) emphasized some aspects of the organization and its performance that were controlled by the management (organization's combination, the role of individuals in organization's behavior, human relationships, and work environment) [7]. Therefore, before the early 1970s, managers believed that good days were ahead and the future program was merely an expansion of a previous program of the organization because the environment was relatively stable and this need was not felt [7]. By continuous economic growth, the reliable circumferential conditions were removed and some expeditious changes and events occurred in the world. Therefore, society's fast and complicated changes and their effect on the growth and development of companies caused the managers to focus on the environment of the organization. Some concepts such as system, economy, long-term programming, strategy, and strategic management processes have been taken into consideration by experts on management. Strategic management" means managing strategically. "Strategic" means to act to reach the goal. "Strategy"

means reaching general objectives [8]. According to this definition, "strategy" means the coordinated attempt of the elements of an organization to reach objectives. This causes the formulation of an organization's method and establishment of a coordinated and adaptive method for accomplishing goals. In the science of management, the objectives of the company are determined in the long-term. Strategic management deals with long-term goals and furthers the objectives of the organization in the same direction as the mission by adjusting the effect of the organization's external circumference [9].

Strategic management is the art and science of compilation, implementation, and assessment of multilateral decisions that enables the organization to reach its long-term objectives. In fact, strategic management is a multi-dimensional structure of the processes and results that facilitate a company's strategies. In all steps of compilation, the three following issues must be considered in the implementation and assessment of strategic management [10]:

1. Global events have real effects on strategic decisions. The foundations of strategic management are based on the level of managers' knowledge of competitor companies, markets, prices, governments, suppliers of raw materials, shareholders, distributors, and customers all over the world. Therefore, the price and quality of the company's products and services must be competitive on a global level.
2. Information technology is a vital instrument for strategic management. The advantage of the worldwide web is that these companies have been able to obtain the latest information and to act upon this information. Collectively, electronic commerce results in a decrease in costs, problems, and distances, and companies may, through their efficiency, increase the quality of their products and obtain more income.
3. Preserving the environment is a very important issue in strategic management. Mark Starick says that: "the main strategic issue is that we prevent the destruction and annihilation of the environment across the world". Strategic management has two principal steps of assessment and control [11]. Assessment includes designing and determining the framework, scheming and digitizing the framework, and revising, as well as redesigning the strategic project.

2.3. Just-in-Time (JIT) Production

JIT is a Japanese production management method which was expanded in 1970 and accepted in Toyota production factories for the first time by Mr. Taichi Ohno. The main subject in this method was satisfying the requests of customers. Because of the success of JIT management, Taichi Ohno is called the father of JIT.

After the primary introduction of JIT by Toyota, from the middle of the year 1970, many companies followed this method. This theory gained more protection and was used in many companies extensively.

One of the reasons behind the expansion of JIT and other primer production methods after World War II was that the Japanese people were very motivated to develop better construction methods and assist in the reconstruction of their economical structure. They also had a collection of specifications that worked; for example, they preferred to focus on work than idleness and laziness; they followed continuous development and improvement; they considered work to be an obligation of life; they prioritized group working, not individualism; they put more emphasis on reaching a common target. These motivations and specifications guided the Japanese economy to success [12].

The Japanese manufacturers tried to find a way to attain maximum efficiency with limited resources, because of natural and economic pressure after World War II. For this reason, they focused their activities on “optimizing the relationship between cost and quality”.

At that time (before the introduction of JIT), there were some production defects in the existing systems. According to Hirano’s opinion, these defects included stock problems, production defects, excessive costs, production in large groups, and time of delivery. Stock problems consisted of unused accumulated stocks that not only were not optimized, but their warehousing and management required much effort. Other mentioned problems included warehousing components, breakages in parts and equipments, and unbalanced production levels. Considering these production defects, the manufacturers found that a simple defect in the product could destroy the credit of the manufacturer. Manufacturers found that they had to establish a defect-free process, instead of producing

large amounts or a specific kind of product, to be able to produce some products with more verity. Also, there were some problems in excessive costs, where the existing system could not decrease the costs or manage the intended fast dispatch of product [12].

2.4. Just In Time Production in Japanese Management

Just In Time management is a new system that has considerable effects on lowering costs, improving quality, and accelerating time of delivery of products to the market. In fact, using Just In Time systems has been a main reason behind the Japanese people’s success in different markets. The example of Toyota’s success, one of the first users of JIT in the automobile market, is a very good example. In today’s competitive environment, the continuity of survival of a variety-based production system without JIT is hardly possible.

The philosophy of Just In Time production was developed by the Japanese Toyota Motors Company. JIT refers to a production system in which the operations are performed only when necessary or when there is a demand. The basic principle of JIT theory is the belief that the existence of stock is the reflection of excessive residues, and eliminating residues and waste results in a lowering of stocks and increase in efficiency [13, 14].

3. Research Methodology

3.1. Research Design

Considering the nature of present research and the statistical universe, citation and survey methods were used. The methods used for data collection in this research are slip-taking, questionnaires, and interviews.

Also, this research is descriptive and is conducted through cross-sectional methods. Descriptive research is a non-experimental research method in which the independent variable is not applied by the researcher and is out of his control. In this research, events are objectively described. These events examine the effective variables in Just In Time production in the construction industry.

The researcher has no role in these events and merely examines, collects, and analyzes them. In addition, it is also survey research. In this method, the

possible relationship between two or more variables is studied and its data are collected through polls and examinations of different viewpoints in the statistical universe. In this kind of research, in order to collect more information, we questionnaires are used. The present research has no cause-and-effect aspect; it is not intended to prove that Just in Time production is a factor of product quality. Rather, it measures the effect of variables, and expresses its results, and finally finds:

Does a meaningful relationship exist among structural factors, Just In Time production, and increases in building construction quality? What are the effects of structural factors and Just In Time production on the level of quality?

Based on these facts, researcher questionnaires are used to examine the level of service and quality in the industry of production and its effect on the amount of production and increase in quality.

3.2. Questionnaire

Firstly, in order to examine the questions of research in the first section, Just In Time production is expressed based on its content as the questions of research. Some of the questions are general and some of them are specialized for the subject of research.

So, the following questionnaire was compiled:

In compiling the questionnaire, we attempted to obtain the research targets through answering questions. Some of its questions were prepared according to the Scale Likert method. The target of this scale is to measure an attitude toward a subject on the basis of the values of society. It is applied to examine political, social, and economic issues which are examined on a systematic level. In the Likert Scale, the buoys are usually 15 to 30 or more buoys. When compiling the buoys, indifferent, unrelated, and ambiguous buoys should be prevented. The number of buoys which have oppositional and/or consentient tendencies must be almost same and the scale of responses usually consists of 5 parts (absolutely agree, agree, almost, disagree, absolutely disagree). We can change the words of buoys based on the target and method of research. The buoys are directly distributed after preliminary research. Also, after the compilation of the pre-test questionnaire, 30 samples must be taken to eliminate ambiguous buoys after quantitative (validity) and qualitative (credit) examinations.

3.3. Data Analysis Approach

- Graphics techniques:

Techniques are being used in order to clarify the issues raised and the variation of project style. Therefore, data tables can be found on the charts, views, histograms, diagrams, and specific types of each place. At this stage of the research, applied research and innovation is more congenial. But knowing the experience and innovation of others, commonly accepted techniques are necessary for everyone. Use of the following techniques is due to these reasons:

Graphic techniques provide clear grounds and make the understanding process too easy, resulting in cause crystallization. Thus, when population growth and its impacts (including cumulative increase in population over the next few years) are shown with the use of these techniques, they are better and bolder [15].

The reason behind using graphic colours and lines is to show the results more clearly. The most noted and favourable result is faster and better recall of the data, because of the association. It also makes the reminding skills faster and reduces mental absence. Seeing the related subject and data of the research in a certain color will bring up the vision.

The visualization results provide grounds for prudent decisions. For example, you might set the scene for a simulation of the possible implications of a military action; it shall invite politicians to greater prudence [15].

Reducing the official and dry shape of research monotony gives a new dimension to the study. The present results are evident in realizing own tastes, there is an opportunity to update the data obtained and the expression better blends science with art. Graphic design allows the researchers to be creative and use liberal thought to show their results, expanding the amount and type of users in terms of quantity and variety of causes. In mathematical or theoretical research, the expert researcher takes a few calls while subtle graphics techniques increase attraction. These reach more people over time to produce a more comprehensive study, people with different education, due to its expertise and diversity. By this means many graphic techniques are useful in achieving deep community insertion of the research.

- Diagrams used in research:

The most common pie chart diagrams that are used in social studies and a lot of information about the proportions of ingredients give the viewer a quantity for the preparation of this chart. The quantity of components is usually a "convert to percentage". Based on that circle into 100 parts, given that the circle has 360 degrees, each section is equal to $6/3^\circ$. Thus, by multiplying the quantity of which we have, in $6/3$ quantity of the surface is occupied. If that is the sheer amount of data, the proportion of each quantity was calculated.

- Inferential statistics:

It is important to note that the ability to generalize inferential statistics does not exist in descriptive statistics. The descriptive statistics of our data cannot be generalized to the entire population to work in inferential statistics.

Based on the theoretical framework for answering the research questions and hypotheses that we consider; a generalization of the test is done in inferential statistics.

- Nominal and Chi Square test:

Chi-square test of the hypothesis that $2 * 2$ degrees of freedom is that one does not have the best of Phi and Cramer, v is used. The chi-square test only shows whether there is a relationship but does not reveal the severity of the test. If we have to get the chi-square test, we use the Nominal. The significance level for the chi-square test is not high; we then also have to take other tests such as the Nominal as not significant.

4. Presentation of the results

Value (Chi-square value)	DF (Degrees of freedom)	SIG (Significance level)	
38.2	8	.000	Pearson Chi-Square

Table 1: Hypothesis 1

Value (Chi-square value)	DF (Degrees of freedom)	SIG (Significance level)	
86.72	7	.000	Pearson Chi-Square

Table 2: Hypothesis 2

Value (Chi-square value)	DF (Degrees of freedom)	SIG (Significance level)	
38.2	8	.000	Pearson Chi-Square

Table 3: Hypothesis 2

5. Discussion and Conclusion

5.1. Discussion of results

Plenty of research has been conducted on Just In Time production both in the Middle East and abroad, but not much research has been conducted for determining the factors affecting Just In Time Production. Organizational factors and factors effecting construction in a given country are among the areas less studied. Of course, this does not mean that no research has been conducted in this field, but it was somewhat difficult to access these resources because of the problems and limited facilities available to the researcher.

The present research is compiled in five chapters and every chapter is allocated to some factors. The first chapter includes research generalities that examine the design of the problem, the subject's importance, and the general structure of the research, which includes designing questions, hypotheses and objectives of the research.

The second chapter emphasizes the examination of the research's theoretical foundations. The dependent and independent variables of the research are examined separately and their descriptive relationships are described.

The third chapter includes the research methodology, the nature of related methods, the process of questionnaire structures, the amount of convergence questionnaire's questions, question reliability and validity, examination of effective indices, and effectiveness of questions.

In the fourth chapter, questions are described by offering charts, tables, and content interpretations. Thus, the hypotheses are rejected or confirmed through the Chi test in order to examine the relationship between two variables. The main objective of this test is to examine the relationship between variables and quantify the content of questions as examined by SPSS 16 Software.

The fifth chapter examines the results of research generalities, theoretical foundations, and descriptive and inferential statistics tests. Also, the limitations, difficulties, and some suggestions on the subject of the research are contemplated and some suggestions are offered for future research.

Hypothesis 1: It seems that there is a meaningful relationship between a project's technical infrastructures and obtaining JIT

According to results obtained from Table 1 and the results obtained from the Chi Square Test, the amount of Chi is "38.2", the freedom degree is 8, reliability distance is 95% and meaningfulness level is equal to, etc. In other words, the available information of H0 and H1 are rejected and confirmed, respectively. That is, there is a meaningful relationship between a project's technical infrastructure including management commitment, JIT Production Strategy, and purchase strategy with access to JIT.

Hypothesis 2: It seems that there is a meaningful relationship between the level of worker's skills and decisions with obtaining JIT

Also, according to results obtained from hypothesis No.2 (Table 2) and the results obtained from the Chi Square Test, the amount of Chi is "86.7", the freedom degree is 7, reliability distance is 95% and meaningfulness level is equal to, etc. In other words, the available information of H0 and H1 are rejected

and confirmed, respectively. That is, there is a meaningful relationship between decisions made by workers and the achievement of JIT.

Hypothesis 3: It seems that there is a meaningful relationship between utilizing JIT and improving project efficiency

There is a meaningful relationship between utilizing JIT and reaching quality improvement. According to available data related to the amount of Chi 2 obtained from hypothesis 3 (Table 3), the amount of Chi is "38.2", the freedom degree is 8, reliability distance is 95%, and meaningfulness level is equal to, etc. In other words, the available information of H0 and H1 are rejected and confirmed, respectively. That is, there is a meaningful relationship between utilizing JIT and its achievement.

Also, considering the available data, all three hypotheses of the research have been confirmed, which represents the increase of quality and organizational programming for reaching Just In Time Production, and this requires accurate attention from the specialists in this area.

5.2. Conclusion and Recommendation

As is shown in the above paragraphs, all three hypotheses are confirmed. It is noteworthy that when the relationships between dependent and independent variables were examined separately (according to Chi 2 Test), the relationships of variables were confirmed on a binary basis. However, the necessity of examining all aspects of the subject of research is very important. Reaching the quality of products in the best manner requires the coordination between all aspects including work force, technical sector, facilities, etc.

A lack of sufficient facilities for obtaining information sources related to the subject of the research, along with a lack of organizational data on the effects of Just in Time production in the building construction organizations, has affected the comprehensiveness of this paper. Construction companies lack sufficient familiarity with the JIT method and academic resources on the topic are scarce. Certain companies such as Baran Building and Construction failed to provide full and timely cooperation on the research, particularly in completing the questionnaires and verbal interviews related to the project. The above mentioned, along with a lack of samples, has provided certain limitations towards conducting this research.

Several factors have been known as effective factors in the area of Just In Time Production, especially in the field of building construction. Examining all hidden and apparent variables is not possible; therefore the necessity of research and examination on cause and effect relationships between variables requires the effort of researchers and effective forces in this field.

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