Executive Manager's Opinion about Just-In-Time Implementation Status in the Middle East Industry

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Abstract

The purpose of this study is to identify and evaluate the scale of implementation of Just-In-Time (JIT) in the different industrial sectors in the Middle East. This study analyzes the empirical data collected by a questionnaire survey distributed to companies in five main industrial sectors in the Middle East, which are: food, construction, chemicals, fabrics and engineering. The following two main hypotheses are formulated and tested: 1- The requirements of JIT application differ according to the type of industrial sector. 2- The elements of JIT application differ according to the type of industrial sector. Descriptive statistics and ANOVA test were used to examine the two hypotheses. This study indicates a reasonable evidence for accepting these main hypotheses. It reveals that there is no standard way to adopt JIT as a production system, where each industrial sector should concentrate in the investment on critical requirements and elements that differ according to the nature and strategy of production followed in that sector.

Index terms— Just-In-Time, questionnaire, types of industrial sectors.

1 INTRODUCTION

IT is a very important and relevant topic to all operations managers today. It aims to meet demand instantaneously, with perfect quality and no waste (Slack et. al, 2004). It has become a major factor of competitiveness in the global environment (Aghazadeh, 2003). JIT systems, which are designed to produce or deliver goods or services as needed and minimize inventories, require major changes in traditional operating practices (Krajewski and Ritzman, 2010). JIT originated in the 1950s at Toyota Motor Company in Japan, through continuous effort to solve manufacturing problems. JIT is often referred as the Toyota production system. Many definitions have been put forward for JIT. **??**ouad and AlBayati (2002) defined JIT as organizational philosophy that utilizes important procedures to maximize profit through minimizing inventory. Vollmann et al (1997) defined JIT as an approach to minimize the waste. Whereas, Wantuch (1989) defined JIT as a production strategy with a new set of values to continuously improve quality and productivity.

JIT is characterized by reduced inventory, improved quality (Gomes and Mentzer, 1991), reduced lead times, enhanced flexibility, worker empowerment, improved morale, minimum waste (Boyer, 1991) and timely response to customer needs. JIT is based on two principles: elimination of waste; and respect and full utilization of human resources and capabilities. Potential waste is apparent at every stage of the production process (Herod, 2000). The most important kind of waste to eliminate with JIT is the imbalance between customer demand and production. Inventory is generated by overproduction which leads to a waste of money. Operating with internal customers, this imbalance may exist at each stage in production, including the relation between supplier and producer. Waste may also arise during production for a number of other reasons, i.e. waiting, transporting, processing and producing defective goods. He and Hayya (2002) mentioned that after analyzing thirty eight articles published between 1982 and 1990, it is found that, in a total of 44 industrial companies, inventory was reduced by 68%, defect rates reduced from 6% to 0.5%, quality increased by 50%, and space reduced by 46%.

Questionnaires have been used and are still being used by many researchers to assess the JIT implementation benefits. Most of research has examined the effect of JIT philosophy in developed countries. He and Hayya (2002) used statistical analysis methods to examine the empirical data from a questionnaire survey to test the hypothesis that JIT has a positive impact on the quality of food. They used four quality measures. Of these measures used, product quality, following USDA standards, and customer satisfaction score extremely high, with product safety scoring slightly lower. They concluded that most of the responding food companies considered themselves to be among the best quality-food producers. Kristensen et. al. (1999), in their study, used a questionnaire survey run in manufacturing companies in the Nordic companies and East Asian companies, to evaluate to what degree the effects of TQM and JIT are to be expected. They found that JIT companies are very professional and facts-driven. They base their success on high quality of relationships with suppliers, employees and customers. Fouad, (1991) identified and J companies. He concluded that the British owned manufacturing companies are showing a high degree of interest in training programs, but they ; and the American owned companies; are still using the formal paper work for selecting their suppliers.

Not much attention has been paid to the study of the implementation of JIT in less developed countries. Amoako-Gyampah and Gargeya (2001) examined the implementation of JIT production systems in Ghana. After He analyzed a survey questionnaire, he found that the Ghanaian manufacturing firms which implemented JIT invested in JIT production in terms of their efforts in employees training, setup time reduction, cellular manufacturing, continuous quality improvement, and supplier partnership.

The Middle East countries are recognized to be from the less developed countries. There is a crucial need to adopt the new technologies in the production management. The industrial sector in the Middle East suffers from many problems that can be cured by intelligent implementation of JIT system. The main four problems are: high inventory levels, high percentages of scrap and rework, high setup and lead times, and a huge shortage in the communication systems with the suppliers.

In this study, a questionnaire survey will be analyzed to evaluate the scale of implementation of JIT in the different types of industry in Middle East from the executive managers point view. It will bring out the critical JIT requirements and JIT elements essential to the successful incubation of JIT according to the type of industry.

2 II.

3 RESEARCH METHODOLOGIES

a) The JIT hypothesis Many researchers wrote about the main components of JIT. Davisom et al. (2000) mentioned that JIT depends on the use of superior technology and electronic data interchange, which facilitates the development of technology skills and technologically advanced manufacturing equipment and facilities.

Landry et al. (1998) used words like "mutual trust" and "partnership" to describe the buyer-supplier relationship in a JIT environment. Pheng and Chuan (2001) and Yui (1997) argued that JIT is an efficient management system to cope with schedule fluctuations. Krieg and Kuhn (2002) considered kanban production control system as one of JIT major operational elements.

After a deep study of the previous researches, the main JIT requirements and JIT elements are summarized in Table 1, and a comprehensive questionnaire is designed to contain them all. The questionnaire will assess the executive manager's opinions about the critical JIT requirements and the critical JIT elements, and how these two JIT components differ according to the type of industrial sector. In this study the following two main JIT hypotheses will be tested:

Hypothesis 1: The requirements of JIT differ according to the type of industrial sector.

Hypothesis 2 : The elements of JIT differ according to the type of industrial sector b) The survey questionnaire Through field interviews and pilot pretests, we modified the JIT requirements and elements in order to accommodate the quality characteristics in the industrial companies included in the study. We targeted the main five types of industrial sectors in the Middle East, which are: the construction, food, chemical, fabric and engineering.

A pretest questionnaire, based on the JIT requirements and JIT elements listed in Table 1 , was then sent to the selected companies. The pretest results indicated that although some large plants were willing to share information with us, small companies were defensive about their proprietary quality and safety data. The numbers of companies in all five industry types that felt comfortable with the points presented in the questionnaire are described in Figure 1. The survey questionnaire was designed to reflect the pilot pretest, and the JIT requirements and JIT elements were thus fine-tuned. According to He and Hayya (2002), minimizing cost, establishing trust and providing reward are the three key considerations for a usable questionnaire. To minimize cost associated with manager's time, only the questions essential to the study was asked, which led to a two-page questionnaire. To establish trust a covering letter explaining the purpose of the study and assuring confidentiality is included with the questionnaire. Finally the reward was an offer to present academic service and a promise to share the survey results.

4 STATISTICAL ANALYSES

The survey questionnaire consists of 34 various questions, 9 of these questions cover JIT requirements and the rest questions cover JIT elements. A five-point Likert scale is used as follows: number 5 = strongly agree, 4 =

agree, 3 = neutral, 2 = disagree, 1 = strongly disagree. The analysis, using SPSS, utilizes descriptive statistics and ANOVA test.

Table 2 shows the statistical data of the survey results for the five types of industrial sectors. The mean and standard deviation were calculated for each JIT requirement and the variability in mean response to the different JIT requirements according to the type of industrial sector is tested using ANOVA test, where Ftest values for the different JIT requirements are listed. 2 shows that the mean value of JIT requirements (Q3, Q4, Q5 and Q7) which are: Top management plays a pivotal role in spreading JIT understanding for the different levels of management (Q3), The relations between management and workforce are mutual and both parties accepts criticism (Q4), Management encourages continuous training programs for all employees (Q5), and Companies objectives towards improving production lines and continuous improvements (Q7), exceed the central value of 2.5, indicating that all the executive managers irrespective of the type of industrial sector felt positive towards these requirements. Whereas, they all felt negative towards three of JIT requirements (Q2, Q8 and Q9) which are: Top management plays a pivotal role in spreading JIT understanding for the different levels of management (Q2)„ The company is moving towards implementing JIT through a strategic planning process (Q8)„ The company realizes that implementing JIT will not bring a return on investment in a short period of time (Q9)„ which have mean scores around the central value of 2.5. As noted from the F-test values, there is no significant difference in the opinions of the executive managers concerning the preceding JIT requirements.

Figure 2 shows the mean response for the other requirements (Q1 and Q6) which are:

Company strives for reducing inventory levels to the minimum (Q1)„ The communications tools between company and suppliers are excellent (Q6), which shows significant differences (see the F-values) in the opinions of the executive managers concerning these two elements revealing that the implementation of JIT depends on the type of industrial sector.

5 (G)

Figure 2 : Mean values for the executive managers' responses to Q1 and Q6 For Q1, the food and construction sectors emphasized on the fact that inventory level minimization have to be of the most critical items in the requirements of JIT, therefore the critical actions towards JIT in these two sectors is to get zero inventory level since the raw materials and the finished products have special physical properties that they are susceptible to fast damage. Whereas, the other three sectors: chemicals, fabrications and engineering, may invest first in other JIT requirements since their raw materials and finished products can sustain storage in the inventory without damage. Also, the low inventory level needs frequent set up times which is reasonable at industrial sectors which have normally low setup times as the food and construction sectors.

On the other hand, the food, chemicals and fabrication sectors emphasize the fact that high investment should be put in achieving high technological communication tools (Q6) with the suppliers; this is may due to the awareness of the managers about the importance of the communication tools with the suppliers in reducing the costs associated with high lead times and deteriorated quality.

Previous results demonstrate that, JIT requirements differ according to the type of industrial sector, which verifies hypothesis 1. Thereby, the application of JIT production is not standard for all industrial sectors. Table 3 shows the statistical data of the survey results for the five types of industrial sectors. The mean and standard deviation were calculated for each JIT element and the variability in mean response to the different JIT elements according to the type of industrial sector is tested using ANOVA test, where F-test values for the different JIT elements are listed. The executive managers responses towards the different elements of JIT are described in Table 3, is described in the following paragraphs. The supplier evaluation (Q10-Q15): all the respondents considered price (Q10), quality (Q11), technical design capabilities (Q14) and mutual relation with supplier (Q15) as main criteria for assessment of the suppliers. They believe that it is essential to have a "partnership" relation with the supplier and to be sure that the supplier can deliver the right quality at the right time. The respondents disagreed on two criteria for evaluating the supplier: small lot sized (Q12) and Geographical location (Q13). The F-value listed in Table 3 indicates that there is a significant difference in the mean response to these two JIT elements. As Figure 3 shows, while the food and construction sectors require that delivery should be in small lot sizes and the geographical location is important, the other three sectors: chemicals, fabrication and engineering, do not. This is due to the fact that geographic location is one of the most important factors of suppliers evaluation in the food and construction sectors, as local suppliers reduce waste associated with the delivery time, and decrease risk and uncertainty associated with long lead times, thereby making the system more flexible. The lot size for the two sectors should be small because the raw materials used in the food sector cannot be stored for long time because they spoil easily, and the raw materials used in the construction sector cannot be stored because of its large volume. As said in section 3.1, these two sectors have low levels of inventory, so their stock shipments must be frequent, with small lot sizes and short lead times. Since a contract might require a supplier to deliver goods as often as several times per day, the geographical location of the supplier is essential to cut transportation cost and to facilitate the communication tools. This is not the case in the chemicals, construction and engineering sectors. Since getting zero inventory level is not a critical requirement for JIT application, they may have larger lot sizes and they may have suppliers who are not near the door.

6 (G)

7 Q13

The supplier relationship (Q16-Q24): all the respondents considered Healthy profits to suppliers (Q18), Quick payment of invoices (Q19), Precise product specifications (Q20), Designs that matches the suppliers technologies (Q21), Precise forecasting (Q22), Reasonable changes in lot sizes (Q23) and Enough time for planning when lot size changes (Q24) as important elements in the relation with the suppliers. On the other hand, they considered single sourcing of fabricated parts, components and materials (Q16) and Long term employment and contracts (Q17), as less important. When asked about the reason that prevent them from considering single sourcing and then long term contracts, they easily replied with the fact that "in the middle east, one cannot rely on one supplier, because 90% of these suppliers do not give the right quality in the right time". They argued that a long term cultural change is needed to adopt this JIT element.

Quality control (Q25-Q29): the respondents agreed on all the elements of quality control, except: Authorizing operators to stop production line when a quality problem arises (Q27). This means that in all types of industrial sectors, JIT system must seek to eliminate scrap and rework in order to achieve a uniform flow of materials. Effective JIT system requires conformance to product specifications and implementation of statistical methods in quality control. The respondents agreed that quality must be controlled at the source, with workers acting as their own quality inspectors and machine condition monitors. At the same time all respondents said that Authorizing operators to stop production line when a quality problem arises (Q27) cannot be applied in their own companies, where decisions on whether a process should stop and whether the product conforms to specifications are often deployed to managers not to the operators. In the Middle East countries managers need to revise their philosophies and then invest in the employees in order to ensure that their skills correspond to the amount of quality authority that is given to them. They must have no resistance to change and they should develop new culture in their companies.

Preventive maintenance (Q30): all the respondents considered preventive maintenance programs as a critical element in JIT application since JIT emphasis finely tuned material flows and little buffer inventory between workstations. The preventive maintenance can reduce the frequency and duration of machine downtime. Time utilization (Q31-Q33): all the respondents agreed to consider all these elements (Q31-Q33) as critical in applying JIT system. They said, achieving low setup times and production lead times often requires close cooperation among engineering, management and labor, through investment in automated material handling vehicles (management role), simplifying designs, eliminating unneeded process (engineering role) and preparing for changeovers while the current job is being processed (operators role).

Multifunctional workforce (Q34): all the respondents agreed on the fact that when the skill level required performing most tasks are low, a high degree of flexibility in the workforce can be achieved with little training; an aspect important to the uniform flow of the production system. As effective production system demands a group of employees with broad qualifications who can be rotated and hence able to have many different tasks. As a conclusion, hypothesis2: The elements of JIT differ according to the type of industrial sector in the Middle East, is verified through the JIT elements concerning the evaluation of suppliers; lot size (Q12) and geographical location (13). The managers in the food and construction industry (G) considered these two JIT elements to be critical in the application of JIT, while the other three sectors: chemicals, construction and engineering said that the investment in these two JIT elements can be postponed to a later time.

IV.

8 CONCLUSIONS

The theme of this study was to identify and evaluate the scale of implementation of JIT in the five different types of industrial sectors in the Middle East. A comprehensive questionnaire was designed to assess the executive manager's opinions about the critical JIT requirements and the critical JIT elements, and how these two JIT components differ according to the type of industrial sector. There were significant differences between the food and construction sectors, and the other sectors in the survey: chemicals, fabrications and engineering. The differences rise from the fact that not all sectors can adopt JIT on the same scale. The different sectors differ in the production nature and strategy. In our study, the respondents in the food and construction sectors emphasized on the need for low inventory levels, small lot sizes and near the door suppliers.

Firms that have highly repetitive manufacturing processes and well defined material flow use low inventory levels which requires frequent stock shipments and frequent setup times, this is applicable in the food and construction sectors which cannot store the raw materials nor the finished products for a long period of time.

Therefore, the food and construction sectors, but not the chemicals, fabrics and engineering sectors should consider the application of the pull system of JIT as a first step towards full implementation of JIT.

The following are main aspects of JIT systems which are not applicable by managers in the Middle East, and which obstructs the development of the modern production systems in their countries:

? Playing a pivotal role in spreading JIT understanding for the different levels of management. They must realize that implementing JIT will not bring a return on investment in a short period of time. ? Thinking of strategic planning processes to adopt JIT system step by step and then gain its benefits. ? Giving the operator the authority to stop the production line when the quality problems arise without waiting for the top management

orders. This can be achieved by making continuous training courses for these operators. ? Looking for ways to improve efficiency, delivery times and quality, and reduce inventories through supplier chain. The companies have to establish close ties with their suppliers by creating an atmosphere of mutual trust, extensive interaction between parties, sharing plans for the future, and a full disclosure and discussion of problems to reach mutually agreeable solutions. This relation should result in a "win-win" relationship, where both parties have an interest in maintaining a long-term, profitable relationship. [1] [2]

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Figure 1: Figure 1 :

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Figure 2: Table 1 :

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Symbol	Construction		Food		Chemicals		Fabrication		Engineering		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F-test
Q1	3.4	0.84	4.2	0.44	3.1	0.83	2.6	0.51	3.0	1.03	*3.37
Q2	2.0	0.47	2.4	0.54	2.6	0.61	2.2	0.63	2.2	0.86	1.78
Q3	4.2	0.63	3.8	0.44	3.9	0.79	3.3	1.05	3.6	0.81	1.76
Q4	4.1	0.73	4.4	0.54	4.2	0.67	3.6	0.84	4.1	0.74	1.44
Q5	3.1	0.73	4.2	1.09	3.4	0.74	3.6	0.84	3.7	1.16	1.39
Q6	2.3	0.94	3.8	0.44	3.4	0.63	3.2	0.63	2.8	0.41	**7.39
Q7	3.9	0.73	4.2	0.83	4.2	0.77	3.9	0.73	3.7	0.79	0.83
Q8	1.8	0.63	2.2	0.83	2.2	0.86	2.0	0.47	2.0	0.79	0.49
Q9	1.6	0.51	1.8								

Figure 3: Table 2 :

[Note: a) Hypothesis 1: The requirements of JIT differ according to the type of industrial sector Table]

Figure 4: 0.83 1.8 0.94 1.5 0.52 1.4 0.50 0.79

3

Symbol	Construction	Mean	SD	Food	Mean	SD	Mean	SD	Mean	SD	Mean	Chemicals	Fabrication	Engineeri
Q10	4.2	0.63		4.0	0.70		3.8	0.77	3.9	0.73	3.8	0.77		
Q11	3.5	0.70		4.2	0.44		4.2	0.94	3.6	0.84	4.1	0.91		
Q12	3.4	0.56		3.8	0.83		3.2	0.56	2.4	0.69	2.7	1.22	*2.99	
Q13	3.9	0.73		4.6	0.54		3.3	0.81	2.2	0.63	3.2	0.94	**9.67	
Q14	4.0	0.81		4.2	0.44		4.2	0.79	4.0	0.81	4.2	0.79		
Q15	4.0	0.81		4.2	0.44		3.6	0.72	3.8	0.42	4.2	0.77		
Q16	1.9	0.73		2.0	1.00		2.8	1.08	2.7	0.67	2.8	0.94		
Q17	1.9	0.56		1.8	0.44		2.4	1.06	2.6	0.96	2.4	0.91		
Q18	3.7	0.67		3.8	0.44		3.6	0.81	3.6	0.69	3.4	0.82		
Q19	4.0	0.52		4.2	0.54		3.8	0.94	4.0	0.82	4.0	0.74		
Q20	3.5	0.52		4.2	0.44		4.1	0.99	3.8	0.78	4.3	0.61		
Q21	3.8	1.03		3.8	0.44		3.9	0.88	4.0	0.66	4.1	0.83		
Q22	3.6	0.84		4.0	0.00		3.7	0.79	3.3	0.82	4.0	0.88		
Q23	3.3	0.48		3.8	0.44		3.8	0.67	3.4	0.51	3.7	0.79		
Q24	3.8	1.03		3.6	0.54		3.8	0.74	3.8	0.42	3.7	0.88		
Q25	3.8	1.25		3.6	0.54		3.4	0.73	2.8	0.63	3.3	0.97		
Q26	3.5	0.84		3.6	0.54		3.5	0.63	3.0	0.66	3.0	0.96		
Q27	2.4	0.84		3.0	0.70		2.2	0.67	2.4	0.51	2.6	0.91		
Q28	4.0	0.47		4.0	0.70		4.0	0.65	4.2	0.91	3.8	0.67		
Q29	2.9	0.56		3.4	0.54		3.0	0.37	3.2	0.78	3.4	0.83		
Q30	3.6	0.96		4.2	0.44		3.7	0.88	3.5	0.84	3.4	0.98		
Q31	3.4	0.51		4.0	0.00		3.5	0.83	3.3	0.67	3.3	0.81		
Q32	4.0	0.94		4.2	0.44		4.1	0.63	3.7	0.67	3.6	0.81		
Q33	3.1	0.56		4.0	0.00		3.4	0.91	3.4	0.51	3.4	0.73		
Q34	3.9	0.87		4.4	0.54		4.2	0.77	3.9	0.56	4.2	0.70		

Figure 5: Table 3 :

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