A Survey Investigation of Just-in-Time Implementation and its Implications for Management in Four key Industries within Libya

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***Abstract* - This paper investigates the current status of the implementation level of Just-In-Time (JIT) within the Oil & Gas (OGI), Iron & Steel (ISI), Cement (CI) and Construction (C) Industries within Libya and its implication for management within the said industries. A survey methodology has been applied in this investigation using an intensive questionnaire and one-to-one interviews of the correspondent organizations. Based on the analysis of the survey questionnaire and the one-to-one interview responses, the results show that the management body does not have a clear strategy towards most of the areas that are considered as being crucial in any successful implementation of the JIT techniques. The implementation levels of the JIT techniques are found to be in the modest levels even in the organizations that have indicated themselves as JIT implementers. The research has identified management limitations within the investigated areas and has pointed to areas where the management body needs to take immediate actions in order to achieve an effective and successful JIT implementation within their organizations. This is an important finding for the future success of the Libyan industries and the similar ones.**

Keyword- JIT; Industry; Questionnaire; Implementation.

I. INTRODUCTION

Organisations, both manufacturing and services, in recent competitive business environments, are being challenged to improve their performance and effectiveness to ensure their position in the global marketplace. This could be achieved by continuously improving their processes and operations, reducing costs of their services and/or products, and increasing the capacity of their outputs with a satisfactory quality levels, and acceptable prices. These challenges compel the organisations to change beyond the old traditional manufacturing planning and control systems, and implement a new way for operating their businesses towards continuous improvements, with a serious focus on the organizations' internal and external customers [1];[2]. To achieve these aims, manufacturing and quality techniques and philosophies such as JIT (also known as lean/agile) should be used as an effective management system that can help organisations provide a dramatic increase in customer satisfaction [3. Most authors identify the top management as the most important factor in achieving a complete successful and effective implementation of the related manufacturing and quality philosophies and techniques such as JIT. The full acceptance of these philosophies and techniques by the senior and executive managers is crucial to empower the involved teams and individuals to overcome the barriers in the implementation processes throughout the entire organisation [4]; [5].

Libya was relatively poor until the discovery of oil and natural gas in the early 1960's. Since then, the country has turned to industrialisation by engaging in petroleum processing as well as Iron & Steel, Constructions, and Cement. The other manufacturing industries in Libya are small, lightly capitalised, and devoted primarily to the processing of local agricultural products.

Libya is committed to developing its capabilities to produce goods that meet the highest quality requirements for local home and global markets with all the possible products and services, which could be achieved through implementing the latest manufacturing technologies and systems [6].

II. AN OVERVIEW OF JIT

The name JIT refers to resource utilization, that is, units of material, subassemblies, and components arrive in a manufacturing setting "just in time" for their use [7]. This comes in line with reference [8], who stated that a reasonable consensus among researchers JIT is a useful and beneficial approach that can be implemented widely for reducing the manufacturing costs while simultaneously improving the quality of a products and/or services. It was also stated in the same research that one important requirement for JIT full-scale implementation is an increase in the level of technical skills and flexibility of manpower within the organization.

JIT is a production/manufacturing *pull* system used for planning and control operations that are carried out for producing and supplying the requested products and services at the right time they are needed, at the right place, and at the exact desired quantities [9]. The distinctive feature of JIT is to eliminate all kinds of waste, which could be achieved by organising the entire activities throughout the operations' system and hence it is also referred to as a lean or agile methodology [10]; [11]. According to reference [12] a JIT system represents the continuous improvement processes throughout the entire organisation system, which can be applied in both manufacturing and purchasing systems within any organisation [12]. JIT focuses on the complete elimination of waste, which is defined as anything that does not add any value to the services and products [13]. In

addition, the modern manufacturing organisations consider the successful implementation of JIT as a key factor for minimising inventory, minimising lead times and maximising the quality of their products and services [14]; [15]. Reference [6] stated that this could be achieved through setting well-organised networks for manufacturing and transporting the right ordered items exactly at the right time with the right quantities, establishing a long term relationship with suppliers in order to maintain regulated shipments to minimise ordering cost, and to buy enough parts as needed to avoid paying holding costs [16]; [17]; [18]; [6].

For all successful organisations, certainly those that are claiming to be World Class Manufacturers (WCM), the implementation of JIT techniques is essential to their success in the recent global competitive marketplace [19]; [20]; [21]; [22]. This study will investigate the current status of the JIT implementation level within four major industries in Libya, thereby investigating the present status with the aim of improving their path on the road to achieving WCM status.

III. DATA COLLECTION

The data were collected through a survey questionnaire. Prior to the final distribution of the questionnaire, it was pre-tested at two levels. After several intensive reviews of questionnaire with academics and experts conversant with the manufacturing area, it was passed to experts and colleagues for a discussion concerning its contents and the expected level of understanding from the respondents within the targeted organisations considering the Libyan environment. A total of 800 hard copies of the developed survey questionnaires were distributed to the targeted organisations working within the main four sectors. In addition, contact details were provided in a case of any inquiries or clarifications. Out of the 800 JIT questionnaire copies sent to the targeted organisations, a total of 520 copies were returned with the full-completed questionnaires, giving a response rate of 65%.

Complementary to the questionnaire survey, eight interviews were carried out between the researcher and senior managers working within the targeted organisations. During these meetings, information related to each industry was provided to the interviewer, and site visits to the correspondent organisations were additionally carried out in order to collect more knowledge about the manufacturing and management processes and the working environment within these industries.

IV. DATA ANALYSIS AND DISCUSSION

As a first step of analysing the gathered data. A reliability test was conducted for the entire questionnaire. Cronbach's Alpha was used as the Coefficient of Reliability for testing the internal consistency of the constructs of the entire questionnaire. The calculated value of Cronbach's Alpha was found to be 0.96. According to reference [23], an Alpha Coefficient of 0.70 or above is considered adequate for the reliability of the entire questionnaire. Therefore, in this study 0.96 gives strong evidence that the questionnaire responses were reliable.

For the returned questionnaires, 35% were from the OGI, 23% were from ISI, 21% were from CI and 21% were from Construction Industry. All the participating organisations from OGI, ISI and CI were from the governmental sector, as these industries still belong and are completely controlled by the government, whereas, 18% from the surveyed organisations within the Construction industry were from the private sector.

The approximate total number of employees within the surveyed organisations is summarized and illustrated in Table 1.

TABLE I, THE APPROXIMATE NUMBER OF EMPLOYEES WITHIN THE SURVEYED ORGANIZATIONS

Number of employees	Level within industry (%)			
	OGI	ISI	CI	C
Less than 50	5.60	00.0	9.1	00.0
From 50 to 100	00.0	00.0	00.0	18.2
From 101 to 500	00.0	00.0	9.1	45.4
From 501 to 1000	00.0	00.0	54.5	9.10
More than 1000	94.4	100	27.3	27.4

The Table shows that, as expected the OGI and ISI have more than 1000 employees, however, the CI has about 55% of employees are in the range of 500 to 1000. The Construction Industry has a mixture of segments, some small and some very large but majority falling in the 100 to 500 range.

Table 2, illustrates the size of the respondent organisations based on their annual turnover. This table also reflects the findings of Table 1, in that the largest organisations are OGI and ISI.

TABLE II, THE RESPONDENT ORGANISATIONS' SIZE BASED ON THEIR ANNUAL TURNOVER

Approximate annual turnover (Libyan Dinars)	Level within industry (%)			
	OGI	*ISI*	*CI*	*C*
Less than 1,000,000	00	00	00	9.1
From 1 Million to Ten Millions	05	00	27	27
More than Ten Millions	77	91	54	36
Would rather not to say	16	08	18	27

As an important part of the questionnaire survey, it was crucial to ascertain the managerial seniority of the respondents, it can be seen that the majority of respondents for the four surveyed industries are mainly from the middle and lower management. The key financings are summarized in Table 3.

TABLE III, THE MANAGERIAL POSITION LEVELS OF THE RESPONDENTS

Managerial position level	Level within each industry (%)			
	OGI	ISI	CI	C
Top management level	00	00	12	18
Middle management level	23	84	54	45
Lower management level	77	16	34	37

A. *JIT Implementation Levels*

Table 4, shows a summary analysis of the implementation status of JIT practices within the investigated industries.

TABLE IV, IMPLEMENTATION LEVELS OF JIT PRACTICES WITHIN THE SURVEYED ORGANISATIONS

Surveyed industry	JIT implementation Status (%)		
	Yes	No	Do Not Know
OGI	0.0	72.2	27.8
ISI	8.3	75.0	16.7
CI	18.2	63.6	18.2
C	18.2	63.6	18.2

The table shows that the highest implementation status of JIT was in the range of about 18% in the CI and C. Surprisingly, the highest levels of non-implementation of JIT were in the OGI and ISI (over 70%), closely followed by the other two industries. Worryingly, around 20% or over of the respondents did not know the status of JIT implementation status in their respective organisations.

B. *Reasons For Not Implementing JIT Practices*

Developing the findings from Table 4, the questionnaire asked the reasons for non-implementing of JIT practices. To that end, Table 5 presents the findings for these non-implementers of JIT. It seems that the highest reason for non-implementation across all the surveyed organisations with the four industries is unfamiliarity with JIT philosophy (range 43%-99%). An important finding is that the respondents also identified lack of top management support for non-implementation (15%-22%). It is the view of the author of this research that this is the key reason for non-implementation of JIT.

TABLE V, REASONS FOR NOT IMPLEMENTING JIT

Reasons for not implementing JIT practices	Level within each industry (%)				
	OGI	ISI	CI	C	All
Lack of top management support	15	11	22	00	15
Lack of interest within the organisation	07	11	00	00	05
Implementation requires formal approval	21	00	00	00	07
JIT does not fit well with the organisation	14	00	00	00	05
Organisation is unfamiliar with JIT	43	78	66	99	66
JIT is too expensive	00	00	11	01	02
JIT is too complex	00	00	00	00	00

C. *Investigation of The Implementation Status of Some Important JIT Key Element*

The survey tried to investigate the most important key-elements of JIT implementation within each of the surveyed industry. This would provide a much clearer and detailed picture of the existing JIT environment. This reflects the earlier findings of the limited knowledge existing about JIT within these organisations.

Tables 6 & 7 show the sub-elements of JIT key-elements (*Waste Elimination and Continuous Improvement*.) and their implementation levels. A linear scale from 0 (non-implementation) to 6 (full implementation) was used. The extent of each investigated key-element of JIT was broken down into their own sub-elements. As an example the sub-element *continuous improvement* was broken down into 19 sub-elements in order to ascertain the implementation of *continuous improvement* in all the different functions within the surveyed organisations. Thus the value of 2.8 for Continuous Improvement in the OGI is the mean of the 19 sub-elements implementation.

Table 6 shows the 19 sub-elements of *continuous improvement* which have been surveyed for their implementation in the four industries. The results are presented on a linear scale of 0 to 6 as mentioned earlier.

This table shows that the highest values of the overall means across all the industries are in the range of 3.2, which is worryingly low (the range of values is between 1.1 to 4.1) for all the 19 sub-categories of *Continuous Improvement*. There is an implicit input from people involvement for the sub-categories of JIT, the low values indicate to a culture of non-implementation for this very important aspect of JIT (*indicating further to lack of vision, leadership, and knowledge of training*).

The table also illustrated that the highest implementation levels are within implementing preventative maintenance programmes in thee of the surveyed industries, whereas the situation with the Construction Industry is relatively different, and it can be considered as more worrying status than the other three industries.

TABLE VI, THE EXTENT OF THE IMPLEMENTATION STATUS OF THE CONTINUOUS IMPROVEMENT PROGRAMMES WITHIN THE INVESTIGATED INDUSTRIES

Implementation of programmes for Continuous Improvement	Mean			
	OGI	ISI	CI	C
The top management responded to the feedback from the employees on JIT/ Continuous Improvement	1.4	2.4	1.7	1.6
The organisation ensured training programmes for the management body on JIT/ Continuous Improvement	1.9	1.7	1.4	1.1
The organisation ensured training programmes to the administrative staff on JIT/ Continuous Improvement	1.8	2.0	2.9	1.9
The organisation designed the training programmes considering the variety of the employees' learning needs	2.8	3.7	2.8	2.7
The organisation ensured Continuous Improvement training programming to the machine operators	3.7	3.0	2.4	1.9
The organisation carried out research and development to improve the products	2.6	3.6	3.0	1.2
The organisation encouraged a continuous improvement culture within the working environment	2.8	3.8	2.7	1.7
The organisation focused on the requirements of their customers in designing your products and services	3.3	3.5	2.7	1.9
Has the organisation used team-based approaches to problem solving	2.9	3.2	3.1	1.6
The Continuous Improvement I programmes been implemented in the Marketing function	2.3	2.9	2.8	2.4
The Continuous Improvement programmes been implemented in the Design function	2.3	2.2	3.4	2.8
The Continuous Improvement programmes been implemented in the Production function	3.2	4.1	3.4	2.1
The Continuous Improvement programmes been implemented in the Purchasing function	2.9	3.2	3.5	2.5
The Continuous Improvement programmes been implemented in the Finance function	3.0	3.0	3.4	2.9
The Continuous Improvement programmes been implemented in the Production Shop Floor function	2.1	2.6	2.3	2.1
The Continuous Improvement programmes been implemented in the Materials Handling Control function	2.9	3.5	3.9	2.2
The Continuous Improvement programmes been implemented in the QC function	3.4	3.8	4.0	2.2
The Continuous Improvement programmes been implemented in the Preventative Maintenance function	3.8	3.8	3.8	2.3
The Continuous Improvement programmes been implemented in the Shipping function	3.2	3.6	3. 8	2.1
Overall mean	*2.8*	*3.2*	*2.8*	*2.2*

The findings in Table 6 are also reflected in Table 7 for *waste elimination*, although the mean values are slightly higher. The overall mean value is higher at 4.0 for the ISI with average 1.8 to 4.0 (for all industries). This again shows poor extent and quality of implementation of *waste elimination*.

The survey's results implicitly indicate that the four surveyed industries have major wastes (non-value adding activities) in all their manufacturing value chain. Equally importantly, the findings suggest that the employees (all levels) within these industries will be lacking in the cultural aspects of the people/team environment (*continuous improvement, training, team works*) that is a requirement for successful JIT.

TABLE VII, EXTENT OF THE IMPLEMENTATION STATUS OF ELIMINATING THE WASTE WITHIN THE INVESTIGATED INDUSTRIES (SCALE 0 TO 6)

Implemented programmes to eliminate the waste	Mean			
	OGI	ISI	CI	C
Eliminated the waste due to over production	2.6	4.1	3.8	2.0
Eliminated the waste by reducing the queues and the waiting times	3.7	3.5	2.8	1.7
Planned the operations avoiding any extra operations	2.6	4.5	3.0	1.6
Eliminated the waste due to delay of materials before processing	3.4	3.7	3.1	1.8
Eliminated the waste due to unnecessary transportation and conveyance of materials	2.7	3.3	3.3	2.0
Eliminated the waste by reducing the inventory materials	2.7	3.5	3.0	1.8
Eliminated the waste by producing ZERO defects	2.4	4.3	3.0	1.8
Eliminated the waste due to proper utilisation of employees	2.9	4.3	4.0	2.0
Overall mean	*2.9*	*4.0*	*3.3*	*1.8*

V. CONCLUSIONS

This study is the most recent to investigate the implementation status of the JIT philosophy and techniques within the Oil & Gas (OGI), Iron & Steel (ISI), Cement (CI) and Construction (C) Industries in Libya. It makes a contribution by providing an insight into what extent the JIT practices are being implemented within these industries and the implementation for business and human resources development. Some key concluding findings can be summarised as follows:

The actual JIT implementation across most of the surveyed organisations is very low, even within the organisations that consider themselves as JIT implementers. The vision of improving the Libyan manufacturing industries with respect to JIT practices can be fully realised only if all the related institutions such as governmental, academia, business, consultancy and technical training centres, work together to attain this common goal.

Lack of knowledge and unfamiliarity with JIT and its key elements are very obvious across most of the surveyed organisations within all the surveyed industries. Training and ongoing education programmes are essential to achieve an effective and successful JIT implementation, and should be provided to all the related teams and individuals at all levels throughout the entire organisation. Resource commitment is essential to training, education and learning, along with implementing the latest technologies and techniques that are needed to improve the entire manufacturing sector. The training centres should emphasis on lifelong learning and on-going training programmes for the manufacturing sector in order to perform strategic alliance to ensure complete staff skills as part of human resource development.

In addition, the study has identified problems, issues and attitudes that the decision-makers within the industrial environment might face towards implementing JIT techniques and the subsequent planning and implementation of all elements of JIT. Ensuring a high level of understanding of the whole JIT implementation process to all the involved teams certainly will lead to a complete implementation of JIT as a manufacturing and quality control philosophy, thereby moving the Libyan industries towards World Class Manufacturing.

In conclusion, the four surveyed industries are crucial for Libyan economy. However, the survey has identified that they are very distant in terms of JIT implementation and therefore WCM. This implies that these industries are running at well below the global benchmarking of efficiency. The key reasons for this rests with leadership of these industries, and in essence is a human resource issue.

Finally, on a positive note, when asked (during one-to-one interviews) about improving the Libyan manufacturing and services sectors, all the respondents showed enthusiasms and willingness on developing their companies through applying the latest quality techniques in order to achieving a high level of quality improvements. . Furthermore, setting up employers training pilots can be helpful to make it easier for local employers and employees to obtain the needed human resource training for the manufacturing organisation. Skills and innovations are mutually supporting to the manufacturing sector because skills underpin the ability to innovate, which is considered as the driver of the demand for better and higher trained skills needed to achieve WCM.

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REFERENCES

[1] D. Power and S. Sohal, (2000), "Human Resource Management Strategies and Practices in Just-In-Time Environments: Australian Case Study Evidence", Technovation, Vol. 20, pp. 373-387.R. Hokoma, (2016), "A Way Forward For Implementing Just-In-Time Techniques Within Oil & Gas Industries: Domestic Appliances", Journal of Engineering Research, Faculty of Engineering, University of Tripoli, Issue 21, Tripoli, Libya.

[2] Y. Li, and F. Man, (2000), "Genetic Algorithm to Production Planning and Scheduling Problems for Manufacturing Systems", Production Planning and Control, Vol. 11, No. 5, pp. 443-458.

[3] A. Henry, (2004), "Analysis of Parts Requirements Variance for a JIT Supply Chain", International Journal for Production Research, Vol. 42, No. 2, pp. 417-430.

[4] R. Hokoma, M. K. Khan and K. Hussain, (2006a), "The Current Status of MRPII Implementation in Some Key Manufacturing Industries within Libya: A Survey Investigation," in S. Narayanan, K. Gokul Kumar, K. Janardhan Reddy, and P. Kuppan (Ed.), CAD/CAM Robotics and factories of the Future (CARs & FOF- 2006): Proceedings of the 22nd International Conference, Narosa Publishing House, New Delhi.

[5] A. Alghannai and A. Talib B. (2015), "Mediating Role of Organization's Continuous Commitment between Strategy Implementation and Organizational Performance in Libya's Industrial Sector", Australian Journal of Basic and Applied Sciences, Vol. 9, No. 22, pp. 130-135.

[6] A. Azmi and M. Satsh, (2004), "The Perceived Impact of JIT Implementation on Firm's Financial/Growth Performance", Journal of Manufacturing Technology Management, Vol. 5, No. 2, pp. 118-130.

[7] A. Bedia and F. Martinez, (2002), "Modular Simulation Tool for Modelling JIT Manufacturing", International Journal for Production Research, Vol. 40, No.7, pp. 1529-1547.

[8] A. Henry, (2004), "Analysis of Parts Requirements Variance for a JIT Supply Chain", International Journal for Production Research, Vol. 42, No. 2, pp. 417-430.

[9] D. Harrison & D. Petty, (2002), "Systems for Planning and Control in Manufacturing", Butterworth-Heinemann Ltd, UK.

[10] E. Oral and L. Mistikoglu, (2003), "JIT in Developing Countries- a Case Study for the Turkish Prefabrication Sector", Building and Environment, Vol. 38, pp. 853-860.

[11] F. Gupta, (2011), "A Conceptual JIT Model of Service Quality", International Journal of Engineering Science and Technology (IJEST) Vol. 3 No. 3.

[12] H. Chan, (2015), "Implementing Just-In-Time Philosophy To Reverse Logistics Systems: A Review", International Journal of Production Research, Vol. 48, No. 21, pp. 6293-6313.

[13] H. Li-Hsing and K. Wei-Feng (2013), "Applying a Just-In-Time Integrated Supply Chain Model With Inventory and Waste Reduction Considerations", American Journal of Applied Sciences Vol. 10, No. 7, pp. 751-759.

[14] K. Cua and K. McKone, (2001), "Relationships Between Implementation of TQM, JIT and TPM and Manufacturing Performance", Journal of Operations Management Vol. 19, pp. 675-694.

[15] K. Yasutaka , (2013), "A Large-Scale Empirical Study of Just-in-Time Quality Assurance", IEEE Transactions on Software Engineering, Vol. 39, No. 6. Pp. 757-773.

[16] L. Lai, W. Lee, and H. Ip, (2003), " A Study of System Dynamics in Just-in-Time Logistics", Journal of Materials Processing Technology, Vol. 138, No. 1-3, pp. 265-269.

[17] R. Hokoma, M. K. Khan, K. Hussain, and S. Bindra (2006b), "Strategic Impact of JIT Technique For Reducing The Storage & Eliminating The Waste Within Petroleum Industry", Proceeding of the Ninth Mediterranean Petroleum Conference and Exhibition, Tripoli, Libya

[18] R. Hokoma, M. K. Khan and K. Hussain, (2007a), Investigation of the Senior Management Strategy Towards Implementing Manufacturing, Planning and Control Techniques/Philosophies Within the Libya Cement Industry: A Case Study, Proceeding of the 23rd ISPE International Conference on CAD/CAM, Robotics and Factories of the Future, Bogota, Colombia

[19] R. Hokoma, M. K. Khan and K. Hussain, (2008a), "An Investigation of Total Quality Management Implementation Status for the Oil & Gas Industry within Libya ", MEQA, 2nd Annual Congress, Dubai, UAE.
[20] R. Hokoma, M. K. Khan and K. Hussain, (2008b), "Investigation into the Various Implementation Stages of Manufacturing and Quality Techniques/Philosophies Within the Libyan Cement Industry" Journal of Manufacturing Technology Management, Volume 19, No. 7.
[21] R. Hokoma, M. K. Khan, K. Hussain, S. Bindra, and E. Sufia (2006c), "Just In Time (JIT) Technique For Education & Training and Its Possible Application in Libya", Proceeding of the Quality Conference 2006, Tripoli, Libya
[22] R. McMullen, (2001), "An Ant Colony Optimisation Approach to Addressing a JIT Sequencing Problem with Multiple Objectives". Journal of Artificial Intelligence in Engineering, Vol. 15, pp. 309-317.
[23] J. Pallaant, (2005), "SPSS Survival Manual", Second Edition, McGraw-Hill Education, Open University Press, UK.

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