

THE PRESENT IMPLEMENTATION STATUS OF MANUFACTURING AND QUALITY MANAGEMENT TECHNIQUES WITHIN THE LIBYAN IRON and STEEL INDUSTRY

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الملخص

تم في هذه الورقة التركيز على دراسة وتقييم الوضع الحالي لمستويات تطبيق تقنيات الإدارة بالجودة الشاملة (TQM) وتقنيات الإنتاج الآني (JIT) في مجال صناعة الحديد والصلب في ليبيا إضافة إلى دراسة تأثير كل ذلك على المستوى الذي تدار به هذه الصناعة بمختلف مراحل إنتاجها وإدارة عملياتها. حيث اعتمدت هذه الدراسة على طريقة المسح الميداني باستخدام استمارة استبيان مفصلة وشاملة تم تصميمها خصيصاً لهذا الغرض إضافة إلى إجراء بعض المقابلات الشخصية مع عدد من ذوي العلاقة المباشرة بصناعة الحديد والصلب في ليبيا.

المعلومات والبيانات التي تم تجميعها والحصول عليها تم تحليلها علمياً حيث اتضح التواضع من قبل إدارة شركة الحديد والصلب تجاه التطبيق والالتزام بمعظم الاستراتيجيات والتقنيات التي شملتها هذه الدراسة وهي التي اعتبرت ذات أهمية بـمكان في الرقي بمستوى صناعة الحديد والصلب من ناحية الجودة وإدارة المرافق الصناعية بشكل علمي فعال.

الدراسة أشارت إلى وجود بعض القصور في مستوى تطبيق هذه التقنيات وحتى التي وجد أنها مطبقة لم تكن ترقى للمستوى المطلوب. إضافة إلى ذلك تم استخلاص عدة نقاط يمكن عن طريقها أن تقوم الإدارات المعنية بصناعة الحديد والصلب في ليبيا بالاستفادة منها في التطبيق الفعال والنجاح لتقنيات الإدارة بالجودة الشاملة (TQM) وتقنيات الإنتاج الآني (JIT). بهذا نأمل أن تكون هذه الورقة قد ساهمت في توضيح المفاهيم الأساسية لهذه التقنيات لمن لهم العلاقة بهذا الأمر في مجال صناعة الحديد والصلب في ليبيا وإبراز مستويات تطبيقاتها الفعلية في مجال الحديد والصلب إضافة إلى التنبيه إلى أهمية وفوائد تطبيقاتها في المجال الصناعي بشكل عام في ليبيا.

ABSTRACT

This paper investigates the present status of the implementation levels of Total Quality Management (TQM) and Just-In-Time (JIT) within Iron & Steel Industry in Libya and the management implications for this industry. A survey methodology has been applied in this investigation using an extensive questionnaire and one-to-one interviews within the Libyan Iron and Steel Industry. Based on the analysis of the questionnaire survey and the one-to-one interview responses, the results show that the strategies applied by the executive management body towards most of the areas that are considered as being crucial in any successful implementation of the investigated quality and manufacturing management techniques and philosophies are not well-planned.

The actual implementation levels of the TQM and JIT practices found to be in the modest levels within the surveyed industry. The paper has identified limitations

within the Iron and Steel Industry in terms of the investigated quality and manufacturing techniques and philosophies, and has pointed to areas where the senior managers need to take actions in order to achieve an effective and successful implementation of these techniques and philosophies within their business areas. This is an important finding for the future success of the surveyed industry within Libya. It makes a contribution by providing an insight into what extent the TQM and JIT are understood and implemented within the Libyan Iron & Steel Industry.

KEYWORDS: TQM; JIT; Industry; Questionnaire; Implementation; Key-elements

INTRODUCTION

Companies in contemporary business era are being challenged to improve their performance and reputation to ensure their position in this global competitive marketplace. This could be achieved through improving their quality and manufacturing operations, reducing costs of their products, and increasing the capacity of their outputs with a satisfactory quality levels, and reasonable prices. These challenges compel the companies around the globe to change beyond their old traditional quality and manufacturing systems, and implement a new way for operating their businesses towards more effective systems [1]. To achieve these aims, quality and manufacturing systems such as TQM and JIT should be implemented in order to help companies provide a dramatic increase of their profits, reputation, and running their business and manufacturing operations more effective [2]. Most authors have identified the executive management body as the crucial factor in achieving a complete successful implementation of these techniques and philosophies. The full acceptance of these techniques and philosophies by the senior managers is crucial to empower the involved individuals and teams to overcome the barriers in the implementation processes throughout the entire business area [3].

After the release of UN first sanctions on Libya in 2001, Libya has resumed upgrading of its manufacturing industries, aiming to achieve the most possible benefits by implementing the latest quality and manufacturing techniques and philosophies in order to improving the current situation of most industries, including the industry targeted for this study [1, 4-7].

An assessment of Libyan industry recently completed under the guidance of the International Advisory Board [8] shows that there is no overarching strategic manufacturing plan in Libya at the present. It points to the need for developing industrial clusters that contribute to competitiveness and growth in variety of ways in the country. Porter & Yergin, [8] also stated that the infrastructure for storage, handling and transport creates delay and has backlash effect on production quality. The Government's capacity to provide strategic direction and to implement sector wide programmes is limited by the large scale decentralisation of decision making.

AN OVERVIEW OF TQM AND JIT

TQM can be considered as one of the numerous forms of quality management concepts that emerged and took form during the 1970s. Harnesk & Abrahamsson [9] stated that quality management concepts are not only a toolkit for improving companies' efficiency, but can also be seen as symbols giving the company higher credibility. According to Brockman [10]; Oakland [11]; Harrison & Petty [12], TQM can be described as a management philosophy that focuses on the customers'

requirements (and exceeding them) by working towards continuous improvement throughout the entire companies' activities, through the use of continuous statistical monitoring and working towards fulfilling customers' requirements both internal and external to the manufacturing and business environments.

JIT is a manufacturing *pull* system used for planning and controlling operations that can be used for producing, manufacturing and supplying the needed products at the right place, when they are needed, and at the precise ordered quantities. The distinctive philosophy of JIT is to eliminate all kinds of non-value adding activities (waste) by organising the entire system of operations and activities [13]. The JIT system represents the whole continuous improvement processes throughout the entire company system, and it can be applied to all systems within any company [14]; [15]; [16]. This is achieved through setting well-organised networks for producing and transporting precise requirements, through establishing a long-term relationship with suppliers to maintain regulated shipments in order to minimise the total costs [17-19].

Libyan Iron & Steel Company (LISCO) is government owned, is one of the largest companies in Libya, and is situated near a coastal city, about 210 Kilometers East of the capital Tripoli. It operates nine large plants with a capacity to produce about 1,324,000 Tonnes/year [20]. This paper investigates the present implementation status of TQM and JIT as a quality and manufacturing management system within the Libyan Iron & Steel Industry, thereby, suggesting an improved path towards achieving World Class Manufacturing (WCM) status.

METHODOLOGY AND DATA COLLECTION

The data for this study was collected through a questionnaire survey. The questionnaire was pre-tested at two levels: after several intensive reviews with experts conversant with the quality and manufacturing area, the questionnaire was passed to colleague academics for a discussion concerning its contents and the expected understanding levels from the respondents within the targeted industry considering the Libyan environment. Assuming that most of respondents are qualified people, it might be the case that their first language is not English. Hence, the questionnaire contents were translated to Arabic language. This took considerable time as the technical aspects and the language nuances had to be considered when translating the entire questionnaire.

A total of 60 hard copies of the designed questionnaire were distributed to the targeted managers working within the Iron and Steel Industry including most of the related managers within this industry. Each copy of the questionnaire was accompanied with another letter from the researchers providing the reasons for conducting this survey. Out of the 60 questionnaire copies sent to the targeted managers, a total of 32 copies were returned with the full-completed questionnaires, giving a response rate of 53.3%, and thus also representing 100% of the Iron & Steel industry within Libya. Taking in view of the small number of the total population and the returned questionnaires, not too much weight should be placed on the precise *numerical* values obtained.

DATA ANALYSIS AND DISCUSSION

As a first step of analysing the collected 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 0.923. According to Pallant [20], Cronbach's Alpha Coefficient of 0.70 or above is considered adequate for the reliability of the entire questionnaire. Therefore, in the recent research 0.923 gives strong evidence that the questionnaire responses were reliable.

An important part of this survey was to ascertain the managerial seniority of the respondents. The majority of respondents are mainly from the middle management level (78%), whereas 22% are from the lower management level. The directors and the general managers of this surveyed industry did not show any sign of participation for this survey.

TQM and JIT Implementation Status

Table (1) shows a summary analysis of the formal implementation status of the TQM, and JIT practices within the surveyed industry. The Table illustrates a worrying picture as the formal implementation status of JIT is found to be at modest levels and not exceeding 9% of the total respondents. Unlike JIT, the implementation status of TQM is found to be at a relatively higher level (50%), indicating to reasonable implementation status compared with JIT. However, even this implementation level is still low and needs to be considered as a high level of other priority, along with JIT practices in order to improve the Iron & Steel Industry within Libya in terms of quality and manufacturing aspects.

Table 1: Implementation level of TQM and JIT

Investigated Area	Implementation Status (%)		
	Yes	No	Do Not Know
TQM	50.0	33.3	16.7
JIT	08.3	75.0	16.7

Reasons for Non-Implementation of TQM and JIT Practices

Developing the findings from Table (1) the survey investigated the reasons for non-implementation of TQM and JIT practices. Table (2) illustrates the findings for these non-implementers of TQM and JIT. The highest reason for non-implementation across the entire surveyed industry is the unfamiliarity with JIT practices with 77%. Very worryingly, the lack of senior management support was also indicated by all the respondents (100%) as an obstacle for non-implementation of the TQM practices.

Although lack of executive management support was pointed out as an obstacle for non-implementation of JIT by 11% of respondents, it can be considered as the main cause of unfamiliarity with these investigated techniques and philosophies. It was reported by many authors that the full acceptance of these techniques and philosophies by the senior managers is crucial to empower the involved individuals and teams to accept and take part in the implementation processes throughout the entire industry [17-18].

Table 2: Reasons for non-implementation of TQM and JIT

Reasons for non-implementation	Level Within The Industry (%)	
	TQM	JIT
Lack of senior management support	100	11.1
Lack of interest within the company	00.0	11.1
The implementation requires formal approval	00.0	00.0
TQM/JIT does not fit well with the company	00.0	00.0
The company is not familiar with TQM/JIT	00.0	77.8
TQM/JIT is too expensive to implement	00.0	00.0
TQM/JIT is too complex to implement	00.0	00.0
Total	100.0	100.0

The Senior Management's Support Towards Implementing TQM and JIT

The executive management support towards implementing TQM and JIT practices was investigated in more detail and the findings are summarised in Table 3. The TQM findings in this Table do not reflect the previous findings in Table (2), where the respondents pointed to lack of support from the senior managers as the only reason for non-implementation of TQM. Table (3) illustrates a relatively high level of support towards all of the investigated categories (all above 45%). In terms of JIT, the findings in Table 3 reflect Table 2 as both tables illustrate lack of knowledge and unfamiliarity with JIT, and show a high level of support (above 77%) when investigating the "commitment to increasing customer satisfaction". Apart from this, all other investigated categories were found to be practiced at poor levels (not exceeding 19.2%) across the entire strategic level. However, it is difficult to believe that the management is working towards increasing customers' satisfaction without practicing all the related TQM and JIT categories that lead to achieving an effective implementation of these techniques and philosophies. In conclusion, the overall findings from Table (3) indicate towards major improvements to be made for TQM and JIT implementation.

Table 3: The executive management's support towards implementing TQM and JIT

Investigated Category	Level of support (%)					
	TQM			JIT		
	Y	N	D	Y	N	D
Committed to implementing TQM/JIT	54.5	09.1	36.4	08.3	16.7	75.0
Committed to increasing customer satisfaction	90.9	00.0	09.1	83.3	00.0	16.7
Ensured the necessary resources to implement TQM/JIT	72.7	00.0	27.3	16.7	16.5	66.8
Shared the vision of fulfilling TQM/JIT implementation with all the employees	54.5	18.2	27.3	08.3	33.3	58.4
Hold clear visionary goals for TQM/JIT	54.5	00.0	45.5	16.7	08.3	75.0
Developed a detailed implementation plan for TQM/JIT	54.5	36.4	09.1	08.3	41.7	50.0
Identified the necessary Champions for implementing TQM/JIT	45.5	45.5	09.1	08.3	41.7	50.0
Ensured a clear definition of TQM/JIT to all the employees	54.5	36.4	09.1	16.7	41.6	41.7

Key: Y= Yes; N=No; D= Do Not Know

Investigation of the Practicing Levels of TQM and JIT Key-Elements

The survey also investigated the implementation status of TQM and JIT key-elements in order to provide a much detailed picture of the existing TQM and JIT environments. It needs to be pointed out that the respondents for Table (4) may have earlier identified that they are not formally implementing TQM or JIT. However, they may have implemented some key-elements that are related to TQM or JIT, either with or without the knowledge that these key-elements belong to these techniques and philosophies. This reflects the earlier findings of the limited knowledge existing about some of the investigated quality and manufacturing issues within the surveyed area.

Table (4) shows the key-elements of TQM and JIT and their implementation levels. The Table is divided into two main parts, showing the summarised data about TQM and JIT respectively. A Likert Scale from 0 (non-implementation) to 6 (full implementation) was used. The mean value (*m*) on Table (4) is the mean value of the implementation levels of all the sub-elements of each TQM and JIT key-elements. The results of this part of the survey are shown in the adjacent column. The extent of each key-element of TQM and JIT was broken down into their own sub-elements. As an example (see Table 5) the key-element of implementing ISO practices or their equivalent (TQM key-element) was broken down into 6 sub-elements in order to ascertain its implementation level in all the different functions within the surveyed industry. Thus the Likert Scale value of 4.68 (in Table 4) for implementing ISO practices or their equivalent is the mean value of the 6 sub-elements (in Table 5) implementation status within the Libyan Iron and Steel Industry.

Table 4: The extent levels of the implementation status of TQM and JIT Key-Elements

Te/Ph	Key Element	Implementation status (%)			
		Y	<i>m</i>	N	D
TQM	Implemented Total Quality Management programmes	81.8	2.13	18.2	00.0
	Implemented any ISO Practices or their Equivalent (see Table 5)	91.7	4.68	00.0	08.3
	Implemented Quality Function Deployment (QFD)	16.7	1.92	58.3	25.0
	Implemented Failure Modes & Effect Analysis (FMEA)	33.3	1.87	50.0	16.7
	Implemented any Experimental/Taguchui Methods	09.1	1.58	63.6	27.3
	Implemented Statistical Process Control (SPC) practices	63.3	2.96	36.4	00.0
	Implemented any Benchmarking	50.2	2.33	49.2	00.0
	Implemented Cost Analysis Methodology	100	4.21	00.0	00.0
JIT	Implemented internal/external communication networks	83.3	3.47	16.7	00.0
	Implemented any programmes to eliminate the waste (see Table 6)	100	3.93	00.0	00.0
	Implemented any programmes for Continuous Improvement	91.7	3.20	00.0	08.3
	Implemented any programmes to reduce set-up times	45.4	2.56	27.3	27.3
	Implemented any programmes for Group Technology	30.0	1.79	60.0	10.0
	Implemented levelled/mixed scheduling programmes	27.3	1.79	45.5	27.2
	Used Kanban cards/signals as a production control system	10.0	1.54	60.0	30.0
	Implemented a multifunctional skills training programme	81.8	4.37	00.0	18.2
Implemented any Quality Circle (QC) programmes	45.5	2.48	36.4	18.2	
Implemented any preventative maintenance programmes	100	4.76	00.0	00.0	

Key: Y= Yes, *m*=overall mean of all sub-elements, N=No; D= Do Not Know

At a first glance at Table (4), it can be seen that the overall implementation status of TQM is in-line with Table 1. It shows that about 50% of the investigated TQM key-elements are practiced at reasonable levels (above 50%), but with low mean values (mainly lying in the range of 1.58 to 3.50). This implies that even with a high implementation levels of sub-elements (e.g. implementation of TQM programmes at 81.8%), this implementation has been poorly done (as the Likert Scale mean value is only 2.13). The Table also shows that the lowest implementation levels (both positive percent rates and mean values) are within the key-elements of implementing QFD, FMEA and Experimental/Taguchi methods. Although these key-elements are very crucial in implementing a successful TQM system, this research pointed to lack of knowledge about them (along with their benefits), therefore a lot of attention should be applied in order to implement an effective TQM system. Even when the implementation status for the key elements was above $\approx 50\%$, the low Likert Scale mean values (m) of < 2.5 for most of these showed a very poor and ineffective implementation achievement (i.e. the element was implemented but not very effectively).

Unlike TQM, the implementation status of JIT key-elements does not reflect the previous findings in Table (1). Table (1) presented an implementation status of 8.3% of JIT. These findings again indicate to lack of knowledge about JIT techniques and their related issues. The findings for the JIT in Table (4) show a patchy implementation status: 100% for eliminating waste and preventative maintenance programmers, 97% for continuous improvement and 82% for multifunctional training programmers. The implementation levels for the remaining elements of JIT drop below 45% (in the range 10% – 45%). More worryingly (and similar to TQM), the Likert Scale mean values (m) lies in the range 1.54 – 4.76, with an average value for JIT of < 2.5 , representing poor and ineffective implementation execution.

In summarizing Table (4), it can be concluded that the overall implementation status of TQM and JIT across the Libyan Iron & Steel Industry is at poor levels even when it is indicated that these techniques and philosophies are formally implemented. The Table also pointed to lack of knowledge and familiarity of related key-elements along with their benefits across the surveyed industry. Again, a detailed plan towards achieving effective implementation of TQM and JIT should be developed, and ensuring the required resources for the implementation processes certainly will lead to achieving this desired goal.

The following paragraphs cover only two key-elements (for the sake of brevity) in detailed discussion. Table (5) shows the implementation status of ISO practices or their equivalent (TQM key-element) within the surveyed industry. It was found that the category of the top management is committed to implementing ISO standards shows the highest mean value (5.33 from a maximum of 6). This commitment is crucial for achieving a high level of practicing all other sub-elements. The lowest value of 3.42 was of the sub-element of the suppliers implemented ISO standards.

The implementation level of eliminating the waste (JIT key-element) is presented in Table (6). It was found that the category of eliminating the waste by planning and controlling the operations avoiding any extra operations shows the highest mean value (4.50). The overall mean value of eliminating the waste within the Iron & Steel Industry has a value of 3.93, which indicates a modest implementation level, and not reflecting the previous results in Table (4) where all the respondents (100%), indicated that they are fully practicing this key-element. This means a significant concern should be raised

for all these sub-elements (implemented poorly) in order eliminate all types of waste within this industry and thereby increasing their profits and increasing customers' satisfaction.

Table 5: The extent of the implementation status of implementing ISO Practices or their Equivalent (Scale 0 to 6)

Implementing any ISO Practices or their Equivalent	Mean
Management committed to implementing ISO standards	<u>5.33</u>
Implemented ISO documentation system for all business data	5.25
Tested the quality manual for defining ISO instructions	4.75
Ensured the product conforms to customers' requirements	4.75
Been aware of your customers' requirements	4.58
Suppliers implemented ISO standards	3.42
Overall mean	4.68

Table 6: The extent of the implementation status of eliminating the JIT waste (Scale 0 to 6)

	Mean
The company implemented programmes to eliminate the waste	
Eliminated the waste due to over production	4.17
Eliminated the waste by reducing the queues and the waiting times	3.50
Planned and controlled the operations avoiding any extra operations	<u>4.50</u>
Eliminated the waste due to delay of materials before processing	3.75
Eliminated the waste due to unnecessary transportation and conveyance	3.33
Eliminated the waste by reducing the inventory materials	3.50
Eliminated the waste by producing ZERO defects	4.33
Eliminated the waste due to proper utilisation of the employees	4.33
Overall mean	3.93

SUGGESTIONS FOR IMPROVING THE LIBYAN IRON AND STEEL INDUSTRY

From the previous results, it has been shown that TQM and JIT (and their sub-elements) are implemented in various degrees of quality, quantity and effectiveness. Even when a sub-element is deemed to be 100% implemented, but when looked at from the low Likert Scale mean value (*m*), this shows that the 100% implementation has been done very poorly and ineffectively. Hence, there is a need for improvement in all these TQM and JIT philosophies implementations.

Based on the survey findings, a proposed strategy for the Libyan Iron & Steel Industry is developed as guidelines for future improvements. The Libyan Iron & Steel Industry is facing strong challenges, which forces it to take advantages of advances in quality and manufacturing management techniques and philosophies which are related to its managerial and operational processes to opening up to the global market. Figure 1 illustrates the proposed conceptional strategic framework as guidelines to improve the Iron & Steel Industry within Libya.

The World Class Manufacturing (WCM) Company is at the heart of the framework as a desired status to be achieved through applying the proposed strategy. Soft elements such as leadership, teams, communication, culture and commitment are crucial to the successful achievement of WCM, as they are all centred around people development. These successful developments can only be achieved through these soft elements. These elements which are essential in the proposed improvement process towards implementing TQM and JIT philosophies and techniques successfully, along with their sub-elements and related issues which support the implementation process. The framework also proposed that the vision of improving this industry can be fully realised only if all the related professional bodies such as governmental, academia, consultancy and technical training centres, work together to attain this desired goal.

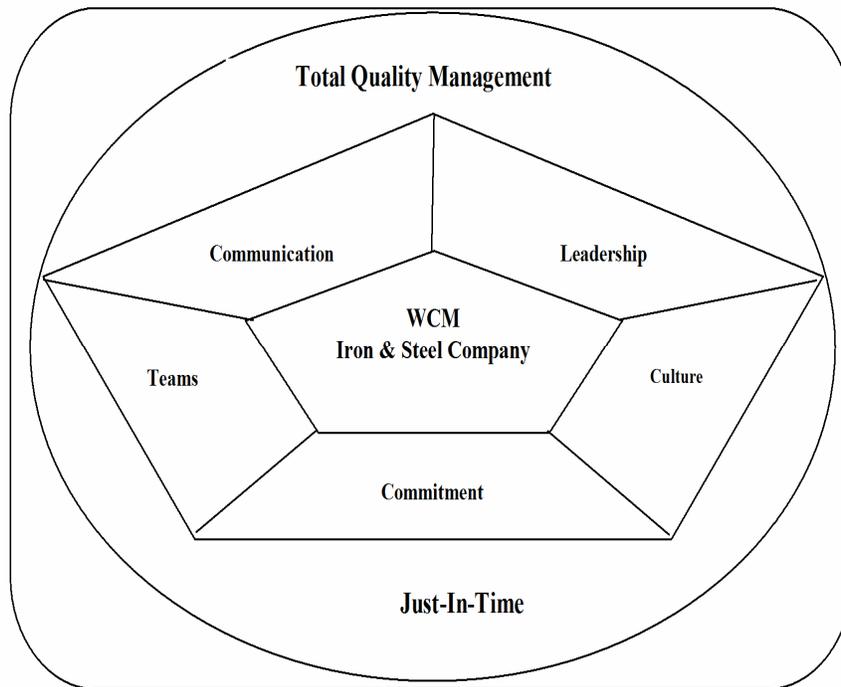


Figure 1: Conceptual Framework for improving the Libyan Iron and Steel industry

CONCLUSIONS

This study is the first to investigate the actual implementation status of the TQM and JIT practices within the Iron and Steel Industry in Libya. It makes a contribution by providing an insight into what extent these techniques are being practiced along with their implication for the quality and manufacturing operations within this industry. Some key findings can be summarized as follows:

- The actual implementation status of TQM and JIT practices across the entire industry is modest. Key reason for this modest implementation is unfamiliarity

with JIT practices and lack of support from the senior managers towards implementing TQM.

- Lack of a detailed plan towards achieving the full implementation of TQM and JIT, including sharing the vision of fulfilling the implementation process with all the related employees and ensuring the required resources for effective implementation of these practices. This means significant amount of resources will need to be allocated for education and training.
- The executive management body within the Libyan Iron and Steel Industry should take serious actions through applying a clear strategy towards most of the areas that are considered as being crucial in any effective implementation of the TQM and JIT practices.
- The vision of improving the Libyan Iron & Steel Industry with respect to TQM and JIT practices can be fully realized only if all the related professional bodies take the full responsibility and work together to attain this goal.

In conclusion, the study has identified difficulties, obstacles and attitudes that the decision-makers within the quality and manufacturing environments in general and in particular within the Iron and Steel Industry in Libya might face towards implementing the TQM, and JIT practices along with the subsequent key-elements. Therefore, ensuring a high level of understanding of the whole quality and manufacturing management systems will lead to an effective implementation.

In addition, the surveyed industry is crucial for Libyan economy. However, this paper has identified that it needs more attention in terms of TQM and JIT implementation to achieve WCM. In essence, the key reasons for this modest status, is unfamiliarity with these techniques and the lack of the senior managers support towards the implementation process.

Finally, on a positive point, when asked (during the one-to-one interviews and meetings) about developing the Libyan industries, all the respondents showed serious willingness and enthusiasm on improving their business area through applying the latest quality and manufacturing management systems and techniques in order to achieving a high level of improvements throughout the entire Libyan manufacturing industries.

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