

The Current Implementation Status of Manufacturing Control Systems for a Key Manufacturing Industry

Rajab Abdullah Hokoma

Abstract—Manufacturing, production and service industries within Libya have struggled with many problems during the past two decades due to many difficulties. These problems have created a negative impact on the productivity and utilization of many industries around the country. This paper studies the implementation levels of the manufacturing control systems known as Manufacturing Resource Planning (MRPII) being adapted within some Libyan industries. A survey methodology has been applied for this research, based on the survey analysis, the results pointed out that the system within these industries has a modest strategy towards most of the areas that are considered as being very crucial in implementing these systems successfully. The findings also show a variation within these implementation levels with a respect to the key-elements that related to MRPII, giving the highest levels in the emphasise on financial data accuracy. The paper has also identified limitations within the investigated manufacturing and managerial areas and has pointed to where senior managers should take immediate actions in order to achieve effective implementation of MRPII within their business area.

Keywords—Control, Industry, Manufacturing, Survey, System

I. INTRODUCTION

ACCORDING to Portland Cement Association [1], the global consumption of Cement is about 1700 million tones/year as cement is the basic component of making concrete with different manufacturing and industrial types and procedures to meet various chemical and physical requirements and interactions. In addition, the cement industry around the globe is considered as one of the most energy intensive manufacturing industries, and it is one of the large energy consumers, consuming about 2% of the global electricity and fuel production [2]. Based on these facts, a clear understanding, and careful planning and control of the manufacturing systems within this industry along with the related managerial operations are required to produce these huge amounts of cement every year more efficiently. Libya was relatively very poor country until the discovery of Oil and Gas. Since then, The country has turned to industrialisation by engaging in petroleum processing as well as cement industries. Libya is committed to develop enhanced abilities for its products to meet the quality standards of local and global consumers. That could be achieved by adapting the highest technologies and most applicable tools and techniques.

Dr. Rajab Abdullah Hokoma is with Mechanical and Industrial Engineering Department, Al-Fateh University, Libya, e-mail: rhokoma@alfateh.edu.ly, Tel:+218(91)4771239

On the other hand, during the last two decades, cement manufacturing industry, which had been expanded during the building boom, was capable of producing about six million tons annually, whereas, according to the Global World Report, 2004, the current status of most industries within Libya is running only with about 50% from its capacity utilisation [3], [4], [5].

Very little research has been carried out over the recent years in the area of manufacturing industry within Libya. However, a little of the published work was in the area of modelling and simulation of the manufacturing operations rather than studying the strategies and implementation status of the manufacturing planning and control systems within this areas. This paper focuses on this area of research to show how this business area is being run with respect to MRPII and to provide insight towards future improvements.

II. MANUFACTURING RESOURCE PLANNING

Manufacturing Resource Planning (MRPII) as a manufacturing planning and control system is a *push* system, established as a second generation of Material Requirement Planning (MRP) during the sixties from the last century. According to Hokoma *et al.*, [6], [7], MRPII was developed to address the MRP limitations. It is based on Bill of Material (BOM), and it includes all the key-elements of MRP, and uses Master Production Scheduling (MPS) as its starting point for creating the initial scheduling. In addition, MRPII is becoming a key information technology system within many manufacturing industries, used to accomplish production scheduling and extracting data from several manufacturing information systems [8].

As an evidence, lack of management support within the MRPII systems could be the main cause of many failures throughout the entire manufacturing and managerial operating and control systems within many organisations. The poor attitude towards the companies' control systems and disability of the executive managers to cope with, and maintain the implementation of MRPII system at the highest level of priority may causes those failures as well. A precondition for effective implementation of MRPII planning and control systems is a high level of file data integrity as the data must be complete, up-to-date and very accurate throughout the entire planning & control system. In line with that, Hokoma *et al.*,

[9], [10] stated that, for achieving fully-implemented MRPII system, data must be collected and filled accurately by understanding the prime objective for this collection and eliminating all possible causes of any type of errors throughout the entire collection system.

Several authors over many years has considered MRPII systems and their implementations problems [Hokoma *et. al.* [9], [10],[11], [12]. The overall results from this published research summarise that the key-elements which considered as crucial for any effective and successful MRPII implementation within the related companies are; management support; data accuracy; education and training; forecasting; RCCP, MPS, CRP, and BOM.

III. QUESTIONNAIRE DESIGN

The gathered data for this research were obtained through a detailed and comprehensive, five pages survey questionnaire. The questionnaire was divided into three main sections, the first section was designed to investigate the profile of the targeted companies and the respondents. The second section, concerning the investigation of the policy applied towards implementing MRPII control system within these companies, whereas, the third part of the questionnaire was designed to ascertain the current implementation levels of each of the investigated MRPII key-elements.

The developed questionnaire was reviewed by several academics and expertise from the area of industry and education for clarity and completeness. The targeted respondents were given a choice to indicate their answers using a multiple choice answer and Likert Scale, each where applicable, to indicate on the most appropriate answers based on their detailed best knowledge.

As a first stage before delivering the survey questionnaire, a letter was mailed to all the targeted companies, providing a general idea about the survey and encouraging the participants to complete the questionnaires seriously. Then, 260 hard copies of the questionnaire were delivered to the targeted companies. Each copy of the questionnaire was accompanied with another letter providing explanations about the target beyond conducting this survey, and providing some contact details in a case of any clarifications. Out of the 260 copies sent, a total of 210 copies were returned fully-completed, giving a response rate of about 81%.

Beside of that, six intensive meetings took place between the author and related companies. During these meetings, information was provided, and site visits to the correspondent companies were additionally carried out in order to gather additional knowledge about the working environment within this business area.

IV. DATA ANALYSIS AND DISCUSSION

As the reliability test is very important in such cases, it was conducted for the entire questionnaire as a first step of analysing the gathered data. 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 0.712. According to Hokoma *et al.*, [13], [14] a Cronbach's Alpha Coefficient of 0.712 or above is considered adequate for the reliability of the entire questionnaire. Therefore, in this survey 0.83 gives strong evidence that the questionnaire responses were reliable.

TABLE I SHOWS THE APPROXIMATE TOTAL NUMBER OF EMPLOYEES

Apr. number of employees	%
Less than 500	30
Between 501 and 1000	49
More than 1000	21

A summary of the analysed data about the approximate total number of employees working within the surveyed companies are provided in Table 1. It shows that majority of the surveyed companies (49%) are with an approximate number of employees in the range between 501 and 1000 and more. The lowest percent rate (21%) of the respondents is from the smaller companies, with only less than 500 employees. That indicates that majority of these companies are large with respect of total number of employees. Figure 1, illustrates the companies' size based on their annual turnover, it can be seen that the majority of these companies are large and with approximate annual turnover of more than 10 Million Pounds. Surprisingly, 50% of the respondents from these companies consider this issue as confidential as they answered with *Would Rather not say*.

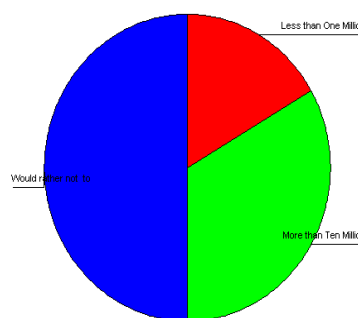
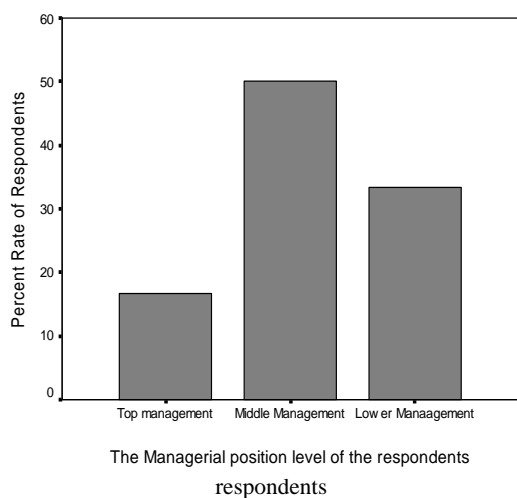


Fig. 1 shows the approximate total annual turnover

Further investigation within this category has been applied and the findings are shown on Figure 2. the majority of the correspondents can be found within middle managerial level, followed by the lower level of management, whereas the top managers' participation can be seen relatively modest. This may reflect forthcoming findings about the actual implementation levels of MRPII and the reasons for the non-implementation as seen by the correspondents themselves.



V. MRPII IMPLEMENTATION LEVELS

Based on the analysed data, the implementation levels of MRPII systems within the surveyed companies is shown on Figure 3. It shows about the half of the surveyed companies did not show any sign of implementing MRPII system. Surprisingly, a range of about 42% from the surveyed companies could not identify whether they had implemented MRPII or not, giving an answer of *Do Not Know*, whereas about 10% had implemented MRPII control systems within their companies.

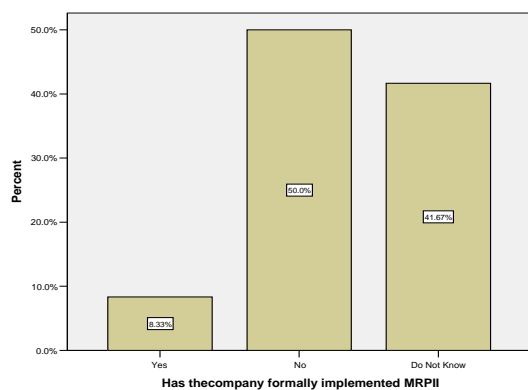


Fig. 3 shows the implementation level of MRPII system

A. Reasons for not implanting MRPII control systems

The respondents who indicated that they did not formally implemented MRPII systems were asked to identify the reasons for that. The reasons with the high rank for not implementing MRPII systems as given by the respondents are shown in Table 2.

TABLE II SHOWS THE GIVEN REASONS FOR NOT IMPLEMENTING MRPII CONTROL SYSTEMS

Given Reason	%
Lack of top management support	28
The company is not familiar with MRPII	64
Implementing MRPII is too expensive	08

It shows that the unfamiliarity of MRPII as a planning and control system can be seen within about 64% of the surveyed companies. This result reflect the lack of knowledge, which have been indicated earlier by many respondents who could not indicate clear answers in many cases, preferring to answer with *Do Not Know*.

B. Top management support towards implementing MRPII

The top management support towards implementing MRPII systems were investigated within all the surveyed companies, whether they have been indicated as implementers of MRPII or not. A summary of the analysed data is illustrated in Table 3, showing very little or no support applied towards the MRPII implementation process throughout the entire strategic level. Only 14% of the respondents for this survey showed some support towards the MRPII implementation. Apart from that, all the positive supports are very modest.

TABLE III SHOWS THE MANAGEMENT SUPPORT TOWARDS MRPII IMPLEMENTATION

Investigated Areas	%
Implementation programmes of MRPII	14
Working towards increasing the customer satisfaction	03
Ensuring necessary resources to implement MRPII	10
Holding clear visionary goals for MRPII implementation	09
Developing a detailed MRPII implementation plan	08
Ensuring a clear definition of MRPII to all the employees	07

C. The Implementation Status of Each MRPII Key-Elements

Further deep investigation was applied to ascertain the implementation levels of MRPII key-elements within the surveyed companies. The findings obtained from the analyzed data are presented in Table 4, which shows that all (100%) of the surveyed companies are focusing on financial data accuracy. The finding also shows that establishing an integrated database for manufacturing and implementing

performance measurement programmes are found to be implemented within about 62% of the investigated companies, whereas the category of implementing inventory status module was found the fourth highest with a percentage rate of about 50% of the investigated companies.

Apart from the category of ensuring training and ongoing education programmes on MRPII control systems within the surveyed companies which found to be at 10%, all other categories were found to be implemented at modest levels.

TABLE IV THE IMPLEMENTATION LEVEL OF THE MRPII KEY-ELEMENTS

Key-elements of MRPII control system	(%)
ensure training and ongoing education on MRPII.	10
emphasis on data accuracy	100
establish an integrated database for manufacturing.	62
use any forecasting module	33
implement Rough Cut Capacity Planning (RCCP).	16
implement Master Production Scheduling (MPS).	16
implement Capacity Requirement Planning (CRP).	16
implement Bill of Materials (BOM).	16
implement the inventory status module.	50
implement Materials Requirement Planning (MRP).	16
implement input/output control within MRPII implementation.	16
implement any performance measurement programmes.	23

D. Correlation Between MRPII Implementation and Level of Top Management Support

The relationship between implementation status of MRPII and the actual levels of practicing the MRPII key-elements was assessed using the Spearman Correlation Test, which measures of the relation between the current MRPII implementation status and the levels of practicing the investigated MRPII key-elements. The direction and the magnitude of the linear correlation can be quantified with the Correlation Coefficient (r), which may range from -1.00 to +1.00. According to Pallant [14], Hokoma *et al.*, [15], the Correlation Coefficient (r) with a negative value represents a negative correlation, indicating that as one variable increases, the other variable decreases, while a positive value represents a positive correlation, indicating that as one variable increases, the other one also increases. The value of 0.00 represents no correlation.

The findings from the correlation test as shown in Table 5, it shows that all the investigated categories are within positive

Correlation Coefficient values, which indicate to a fact that as the practicing of these categories increases, the implementation levels of the MRPII control system within these companies increases too

TABLE V SHOWS THE RELATIONSHIP BETWEEN MRPII IMPLEMENTATION STATUS AND THE MANAGEMENT SUPPORT LEVELS

Category	(r)
Implementation programmes of MRPII	0.79
Working towards increasing the customer satisfaction	0.83
Ensuring necessary resources to implement MRPII	0.43
Holding clear visionary goals for MRPII implementation	0.45
Developing a detailed MRPII implementation plan	0.34
Ensuring a clear definition of MRPII to all the employees and personnel	0.49

The same table also shows that the highest Correlation Coefficient values are with the top management commitment to implement the MRPII control systems and working towards increasing customer satisfaction, whereas, all other investigated categories are falling within modest levels.

VI. CONCLUSIONS

This research discussed the strategy applied towards implementing MRPII systems used for effective managerial and manufacturing operations engineering management within the cement industry as a case study within Libya. The support of the management body along with emphasis levels of the executive managers whose involved within the decision making processes were widely investigated in detail to demonstrate the actual current status levels of the applied strategy towards implementing the MRPII systems within this business area.

Based on the analysis of the gathered data from the related executive managers, the findings demonstrated that the management body does not have a clear detailed strategy towards most of the areas, which are considered as being crucial for achieving effective and successful MRPII implementation. Also, the finding from this research has identified and has pointed to the areas where the management body should take immediate and strategic actions to improve their manufacturing and managerial operations.

The management body within this business area (as a case study and other similar industries) should pay more attention on applying the most reliable training and on-going education programmes to all the involved teams, and providing more

support and flexibility to adapt the most related and up-to-date techniques throughout their business area.

REFERENCES

- [1] World Report International, England, What is the historical background of the Libyan Cement Company, [Online], available from: www.worldreport-ind.com/libya..2004.
- [2] Hokoma Rajab, Mohammed K. Khan & Khalid Hussain (2007), 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, Bogotá, Colombia.
- [3] Hokoma Rajab, Mohammed Khan & Khalid Hussain (2008), "An Investigation of Total Quality Management Implementation Status for the Oil & Gas Industry within Libya ", MEQA, 2nd Annual Congress, Dubai, UAE.
- [4] Hokoma Rajab, Khan K., Hussain K., & Bindra S., (2006), 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.
- [5] Hokoma Rajab, Khan K., Hussain K., (2006), "The Current Status of MRPII Implementation in Some Key Manufacturing Industries Within Libya: A Survey Investigation ", Proceeding of the 22nd International Conference on CAD/CAM, Robotics and Factories of the Future, India.
- [6] Hokoma Rajab, Mohammed Khan & Khalid Hussain (2010), "The present status of quality and manufacturing management techniques and philosophies within the Libyan iron and steel industry" The TQM Journal, Volume 22, No. 2. pp. 209-221.
- [7] Hokoma Rajab, Ibrahim Aburawey & Hala Amaigl, (2010), "Investigating The Implementation Status of Manufacturing Systems for the Libyan Cement Industry: A Case Study.", International Conference on Intelligent Control Systems Engineering, IICSE 2010, Penang, Malaysia.
- [8] Hokoma Rajab, Mohammed Khan & Khalid Hussain (2008), "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. pp. 893-906.
- [9] Abdulssalam Rifai, Rajab Hokoma, Mansor Esbiga, & Hala Omer (2006), The Strategy Applied Towards Implementing JIT and MRPII Planning and Control Techniques within Libyan Construction and Cement Industries, (ICTM), Kuala Lumpur, Malaysia.
- [10] Hokoma Rajab, Mohammed Khan & Khalid Hussain (2008), The Present Implementation Status of Manufacturing Resource Planning (MRPII) System Within The Libyan Textile, Plastic & Wood Industries: A Case Study, Proceeding of the 24th ISPE International Conference on CAD/CAM, Robotics and Factories of the Future, Tokyo, Japan.
- [11] Hokoma Rajab, Tughar M., Rifai A., Edaayf R. & Bindra S., (2007), Strategic Impact of JIT Technique for Construction Industry, Proceeding of the Second International Engineering Conference on Construction and development, Gaza, Palestine.
- [12] Hokoma Rajab, Mohammed K. Khan, & Khalid Hussain (2006), "The Current Status of MRPII Implementation in Some Key Manufacturing Industries within Libya: A Survey Investigation.", Proceedings of the 22nd International Conference, Narosa Publishing House, New Delhi, India.
- [13] Hokoma Rajab, (2010), An Investigation of Total Quality Management Implementation Status For The Libyan Cement Industry: A Case Study, MEQA, 4th Annual Congress, Dubai, UAE.
- [14] Pallaant J., (2005), SPSS Survival Manual, Second Edition, McGraw-Hill Education, Open University Press, UK.
- [15] Hokoma Rajab & El-Buzadi Ali, (2009), An Investigation of TQM implementation status within the Libyan Electronic Industry, Quality Conference-2009, Tripoli, Libya.



Dr. Rajab Abdullah Hokoma began his career in Industrial Engineering in 1990, after his graduation from Industrial Engineering, Garyounis University, Libya, he received his Master's Degree in Enterprise Management at Warsaw University of Technology, Poland.

In 2007 Mr. Hokoma was awarded his PhD in the area of Manufacturing and Quality Planning and Control from The University of Bradford, England (UK).

Presently, his duties and research at The University of Al-Fateh (*main university in Libya*) are in the area of Manufacturing and Quality Planning and Control, JIT, MRPII, TQM, Supply Chain Management, Maintenance Planning, Operations Management, Risk Management and Strategy. His non-lecturing duties include among others, (acting as) the consultant and advisor for manufacturing and quality planning and control and liaison with Industry and Education. Dr. HOKOMA published more than 30 reviewed papers at National & International conferences and Journals within the scope of interested.