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An Investigation into Material Handling Impact Factors on Performance Levels Within Libyan Service Organisations- A Case Study

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ABSTRACT

This paper focuses on investigating the impacts of material handling (MH) on the performance factors within Libyan service organisations. The main objective of this paper is to ascertain the impacts of MH within Al-Khoms seaport for achieving better performance and generating invaluable efficiency and cost reduction. An analytical descriptive approach is used, and findings illustrate that the role of MH management for minimising the whole expenses within the targeted seaport is the key performance among all the investigated factors. Also, a positive correlation between MH and the organisation performance factors was clearly seen since MH reduces handling costs, organisation hazards and idle time for labors. Based on the findings, further research will be proposed for improving the processes of MH and effective decisions within organisations using simulation models.

التحقق من تأثيرعوامل مناولة المواد على مستويات الأداء في المؤسسات الخدمية الليبية- دراسة حالة

فرج فرحات الضبيع

قسم الهندسة الميكانيكية والصناعية، كلية الهندسة، جامعة المرقب، الخمس، ليبيا

الكلمات المفتاحية:
العوامل المؤثرة
المنظمات الخدمية
مستويات الأداء
مناولة المواد
ميناء الخمس البحري

الملخص

تُركز هذه الورقة على التحقق من تأثير مناولة المواد على عوامل الأداء في المؤسسات الخدمية الليبية. الهدف الرئيسي من هذه الورقة هو التأكد من تأثيرات مناولة المواد داخل ميناء الخمس البحري من أجل تحقيق أداء أفضل وكفاءة عالية، وخفضاً للتكاليف. سيتم في هذه الورقة استخدام المنهج الوصفي التحليلي، حيث توضح النتائج المتحصل عليها بأن عامل دور إدارة مناولة المواد في تقليل كافة المصاريف داخل الميناء المستهدف يعتبر العامل الأكثر أهمية من بين كافة العوامل التي تمت دراستها. كذلك يوجد ارتباط موجب قوي بين مناولة المواد وعوامل أداء المؤسسة، باعتبار أن مناولة المواد تُقلل من تكاليف المناولة ومن المخاطر ، وكذلك من الزمن الغير مُستَغَل للعمالة. بناءً على هذه النتائج، يتم اقتراح أعمال بحثية مستقبلية لتحسين عمليات مناولة المواد وكذلك القرارات الفعالة داخل المنظمة باستخدام نماذج المحاكاة.

Introduction

Handling of materials effectively could be considered as a key-factor for maximising efficiency and effectiveness within almost all service and production organisations. That refers to the movement, controlling, protection, and utilising storage spaces of materials [1]. According to [2], material handling (MH) is required for less congestion, appropriate delivery and reducing idle time of machines as a result of non-availability or accumulation of materials at workplaces.

To ensure smooth MH, effective material handlers are required during the new management approach in order to perform their tasks. This can maintain the safety of employees, operators, and resources [3]. Materials management is a tool that can be used effectively in promoting profit maximisation as well as minimising risks arising from the use of MH [4, 5]. It comprises all the activities associated with the acquisition, handling, controlling, and movement of materials, aiming to maximise the use of the organisations' resources by preserving suitable flow of materials for production processes as well as minimising the holding cost of excessive inventories [6, 7, 8].

Al-Khoms Seaport is one of the main seaports in Libya, established in 1991. with a total area of 60.7521 Hectares. In 2010, it has awarded the international quality certificate in the field of Occupational Health and Safety Assessment Series (OHSAS 18001, 2007). Al-Khoms Seaport was also selected as the first port in Libya to implement the electronic management project, and the unified window, as the first port in Libya to be linked with Libya's international trade network.

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Moreover, the port is characterised by the presence of a railway line to be connected in future with the other Libyan cities [9, 10].

The main goal of this paper is to investigate the MH impacts on the performance levels within Al-Khoms Seaport. The expected contribution is to highlight the importance of increasing material flow efficiency, and to reducing the total costs throughout the working area.

An Overview and background of MH

Basically, MH is related to production and manufacturing flow. It can be used to utilise the available time and allocate proper utilities during the handling, storage, and controlling of material [11]. MH is an essential element in most production and distribution systems and has adverse effects on the performance of organisations [12]. In a typical manufacturing system, MH accounts about 25% of all workforces, 55% of all company space, 87% of the production time, and 15-75% of the total cost of the product [13].

Recently, many research have been carried out to solve the problem of selecting MH equipments and their roles for improving the performance measures within organisations. For instance, Analytic Hierarchy Process (AHP) was successfully adopted for selecting the optimal MH equipment out of three alternatives, which are forklift, conveyor belt, and automated guided vehicles (AGV's). The selection was based on four criteria with each having three sub-criteria and a total of 12 criteria for all alternatives. The obtained findings show that the efficacy of AGV's have a very high positive impact, which found to be at 40% associated with all criteria and sub-criteria as compared to the other two alternatives, which are forklift and conveyor belt [14].

In another study, the effect of MH on supply chain efficiency was determined within large flour processing firms in Eldoret Kenya. The study adopted a descriptive survey design. The results illustrate a positive impact of MH practices on supply chain efficiency, and recommended that mechanical devices and machines are required for many MH operations to minimise lifting and bending requirements [15]. Also, the impacts of MH on performance of cement manufacturing firms in Machakos County, Kenya was addressed. The main purpose of that study was to achieve better performance and generating a high level of efficiency and cost reduction. A descriptive correlational research design was adopted, concluding that there was a significant impact of automating MH on the performance of cement manufacturing firms in Machakos [16]. According to [17], the influence of MH practices on performance of manufacturing organisations in Nairobi, Kenya was additionally studied. The study adopted a descriptive survey design with a population size of 355 large-scale manufacturing firms in Nairobi. The findings demonstrate that the efficacy of material logistics planning such as preparation of logistics plans, smart materials logistics goals and usage of logistics plans enhances the capability of the organisation for keeping optimum stocks.

Methodology and Data Collection

A comprehensive questionnaire was developed using 5-Point Likert scale for obtaining the required data from Al-Khoms Seaport to investigating the actual MH practice. Factor analysis and structural equations modeling were used to analyse the collected data. The questionnaire was pre-tested by colleagues through an intensive discussion concerning its contents and the expected understanding levels from the targeted respondents.

The questionnaire was designed to cover two sections, the first is related to qualifications, career position, work experience, and specialisation, whereas the second is designed to evaluate the extent of performance measures, comprising the main seven factors being related to mangening and improving the material handling systems within the selected service area. These factors mainly focus on the role of top management for developing material handling, followed by the role of material handling management for minimising the whole expenses, then the role of security and safety management, whereas, the fourth factor deals with the role of human resource management. The role of platform management is consired to be the fifth factor. The last two factoes being investigated, which are the role of vehicles management and the role of materials department.

In order to come up with accurate scientific results, weights being given from (1-5) using the Likert 5-Point Scale to answer the expressions as shown on Table 1, using the range of each point to be at 0.8. Also, the overall Alpha Cronbach Coefficient was calculated and it is found to be in range of 0.94, which is considered to be reasonable.

Table 1: The used Likert 5 – Point Scale illustration

Category	Strongly Disagree	Disagree	Do not know	Agree	Strongly Agree
Numerical value	1	2	3	4	5
Score	1 – 1.80	1.81 – 2.60	2.61 – 3.40	3.41 – 4.20	4.21 – 5.00

Before piloting the questionnaire, it was sent to three colleagues for evaluation, providing some recommendations for improvement to ensure relevance, objectivity and effectiveness. The results of the pilot study were analysed and the necessary changes achieved. Then, a total of 20 hard copies were distributed to the targeted participants. Each copy of the questionnaire was accompanied with another letter providing the reasons for conducting this survey. The response rate was 100 % of the sample size.

Discussion and Result Analysis

The objective of this section is to present and analyse the data obtained from the survey, illustrated as follows:

1. Demographic Information:

As mentioned before, various demographic details concerning the respondents were obtained, so the main resultss are clearly shown in Table 2.

Table 2. The characteristics of the respondents

Variable Factors		Frequency	(%)
Qualifications	High school or equivalent	5	25
	Higher diploma	4	20
	Bachelor degree	9	45
	MSc/ PhD	2	10
Career position	General manager	1	5
	Head of department	3	15
	Head of unit	7	35
	Employee	7	35
	Other	2	10
Work experience	Less than 5 years	0	0
	From 5 years to 10 years	6	30
	From 11 years to 15 years	8	40
	From 16 years to 20 years	4	20
	More than 20 years	2	10
Specialisation	Engineering	7	35
	Accounting	0	0
	Adminstration	5	25
	Economy	3	15
	Other	5	25

Table 2 demonstrates that most of the participants are well educated, standing at the level of 55%, indicating that the surveyed sea-port is managed with well-educated and qualified people. With regard to the distribution of respondents by hierarchical level, the table shows that the majority (about 55%) of the respondents are related to the management body of the surveyed place, giving a very good indicator that they are serious towards developing and improving their business area. The table also reveals that the respondents are with a good experience within their work place as about 70% of them having an experience of more than 10 years at their recent position.

2. Data related to the Performance Measurements:

This section investigated the impact of MH on the performance factors being early mentioned, these factors were statistically analysed to define their impact on the organisational performance. The findings are illustrated in Table 3.

Table 3. The impact of MH on the performance factors

Factor Symbol	Performance Factor	Mean value 1-5 Scale	Rank
F_1	Role of top management for developing MH.	3.60	2
F_2	Role of MH management for minimising expenses.	3.76	1
F_3	Role of security and safety management.	3.47	3
F_4	Role of human resource management.	3.43	4
F_5	Role of platform management.	3.15	6
F_6	Role of vehicles management.	3.03	7
F_7	Role of materials department.	3.37	5

As it is clear in Table 3, the calculated mean scores are ranges from 3.03 to 3.76. The role of MH management for minimising the whole expenses within the targeted seaport can be seen as key performance for the issue; whereas, the role of top management for developing MH within the seaport stands at the second level of importance within the issue. The remaining factors are found to be fluctuating within similar mean values, indicating that this may suggest that it is crucial to implement the modern techniques of MH effectively within this seaport.

3. Correlation between Variable Elements:

Theoretically, correlation is a measure of the relation between two variables or more. Correlation can be ranged from –1.00 to +1.00. The value of –1.00 represents a perfect negative correlation, while a value of +1.00 represents a perfect positive correlation. A positive correlation between two variables means that if one of them increases, the other will increase. On the other hand, a negative correlation between two variables means that if one of them decreases, the other will decrease as well. In addition, a value of 0.00 represents a lack of correlation.

To be more effective and achieving the main objective of this study, correlation between the different factors being investigated and the findings are illustrated in Table 4.

From the table, it is clear that all factors had a positive correlation, showing that the highest correlation of 0.779 was for the correlation between the role of human resource management (F_4) and the role of vehicles management (F_6), while the lowest correlation was for the correlation between the role of security and safety management (F_3) and the role of platform management (F_5). Pearson's correlation matrix shows that there is a very high positive correlation between the role of top management for developing MH (F_1) with the role of MH management for minimising expenses (F_2), F_4, and F_6. Also, there is a very high positive correlation between the factor F_2 with F_4 and F_6. In addition, there is a very high positive correlation between the factor F_5 and F_6. Furthermore, there is a very high positive correlation between the factor F_6 and the role of materials department (F_7).

Table 4. Correlation between Variable Factors.

		F_1	F_2	F_3	F_4	F_5	F_6	F_7
F_1	Pearson Correlation	1	.670**	.316	.767**	.476*	.669**	.467*
F_2	Pearson Correlation	.670**	1	.390	.696**	.531*	.650**	.433
F_3	Pearson Correlation	.316	.390	1	.540*	.276	.453*	.571**
F_4	Pearson Correlation	.767**	.696**	.540*	1	.538*	.779**	.557*
F_5	Pearson Correlation	.476*	.531*	.276	.538*	1	.597**	.511*
F_6	Pearson Correlation	.669**	.650**	.453*	.779**	.597**	1	.622**
F_7	Pearson Correlation	.467*	.433	.571**	.557*	.511*	.622**	1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is very significant at the 0.01 level (2-tailed).

On the other side, the matrix illustrates that there is a high positive correlation between the factor F_1 with F_5 and F_7. There is also a high positive correlation between the factor F_2 and F_7. Additionally, there is a high positive correlation between the factor F_3 with F_4 and F_6. Furthermore, there is a high positive correlation between the factor F_4 with F_5 and F_7. Moreover, there is a very high positive correlation between the factor F_5 and F_7. However, Pearson's correlation matrix also shows that there is a low positive correlation between the factor F_1 and F_3. Also, there is a low positive correlation between the factor F_2 with F_3 and F_7. In addition, there is a low positive correlation between the factor F_3 and F_5. From the obtained positive correlation, it is clear that the selected case study has being managed by well-educated and qualified people, having good experience within their work place.

Conclusions

This study presented the impact of MH on the performance measurements within a service organisation known as Al-Khoms Seaport, adapting the descriptive survey as a type of the quantitaive research. The findings demonstrated that the role of MH management for minimising the whole expenses within the targeted seaport factor was the key performance. In addition, a positive correlation between MH and the organisation performance factors, which would lead to minimise the holding cost therby, minimising the whole cost of service as well as the risk arising from MH. Moreover, it is clear that paying attentions on improving and enhancing any of the related factors will indeed result a positive improvement for all the other related factors, in different words, improvements are beneficial and sure will be having a value added to all the factors within the surveyed seaport.

Further Research

The author recommends that simulation models can be used to continuously improve the performance measures for the purpose of increasing the overall effectiveness of MH processes.

References

[1]- Vieira, G. B. B., Pasa, G. S., Borsa, M. B. N. O., Milan, G. S. and Pandolfo, A., (2011), Materials Handling Management: A Case Study, Journal of Operations and Supply Chain Management, **4**, **2**, 19-30.

[2]- Chopra, S., & Meindl, P., Supply Chain Management: Strategy, Planning, and Operation, Pearson Education, 6th ed., 2016.

[3]- Lyson, K. and Farrington, B., Purchasing and Supply Chain Management, Pearson Education, London, 2006.

[4]- Eldabee, F., A Robust Optimisation Framework for the Simultaneous Cost-risk Reduction in Just-in-time Systems, PhD Thesis, University of South Australia, Australia, 2015.

[5]- El Dabee, F., Marian, R. & Amer, Y., (2015), A Robust Optimisation Approach of a Simultaneous Cost-Risk Reduction under a Just-in-Time Environment using a Genetic Algorithm, Applied Mechanics and Materials, **743**, 307-316.

[6]- Brutus, I. A. and Chiyem, O., (2015), Assessment of Materials Management and Profitability of an Organisation, Journal of Policy and Development, **9**, **3**, 153-165.

[7]- Hokoma R., El-Dubei F., Minimizing Inventory Costs throughout the Supply Chain within a Cement Factory: A Case Study, MEQA, 4th Annual Congress, Dubai, UAE, 2010.

[8]- Hokoma R., Khan M., & Khalid H., (2008), Investigation into the Various Implementation Stages of Manufacturing and Quality Techniques/Philosophies Within the Libyan Cement Industry, Journal of Manufacturing Technology Management, **19**, **7**. 893-906.

[9]- Libyan Seaports Company, Al-Khoms Seaport Report, 2014.

[10]- Hokoma R. and Bindra S., Libyan Railway: A Gateway to Europe, Libyan Railways Exhibition & Conference, LIREX-2010, Tripoli, Libya, 2010.

[11]- Kilic, H., Durmusoglu, M. and Baskak, M., (2012), Classification and modeling for in-plant milk-run distribution systems, International Journal of Advanced Manufacturing Technology **62**, **9–12**, 1135–1146. DOI:10.1007/s00170-011-3875-4.

[12]- Kathurima, R., Ombul, K. and Iravo, M., (2016), Effects of Materials Handling Systems on Performance of Cement Manufacturing Firms in Machakos County, International Academic Journal of Procurement and Supply Chain Management, **2**, **1**, 21-36.

[13]- Jacobs, R.F., Chase, R.B. and Aquilano, N.J., Operations and Supply Management, McGraw Hill Boston, 2009.

[14]- Zubair, M., Maqsood, S., Omair, M. and Noor, I., (2019), Optimization of Material Handling System through Material Handling Equipment Selection, International Journal of Progressive Sciences and Technologies (IJPSAT), **15**, **2**, 235-243.

[15]- Rono, N., (2020), Effect of Material Handling Practices on Supply Chain Efficiency of Flour Processing Firms in Eldoret, Journal of Procurement & Supply Chain, **4**, **1**, 69-80.

[16]- Kathurima, R. I., Ombul, K. and Iravo, M. A., (2016), Effects of Materials Handling Systems on Performance of Cement Manufacturing Firms in Machakos County, International Academic Journal of Procurement and Supply Chain Management, **2**, **1**, 21-36.

[17]- Kisioya, D. K. and Moronge, M., (2019), Influence of material handling practices on performance of large-scale manufacturing firms in Nairobi County, Kenya. The Strategic Journal of Business & Change Management, **6**, **4**, 745-760.