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Improving Construction Forecasting Logistics Using Material Requirement Planning (MRP) Technology in Nigeria

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The technological aspect of construction logistics, most especially the forecasting is over looked, and little is understood in the Nigerian construction industry. This research investigates how MRP technology could be utilised from the manufacturing and retailing industries background to improve the forecasting processes of construction logistics. The qualitative method was adopted in this study. Lagos State and the F.C.T. Abuja, Nigeria were the selected geographical scope of this study, from which 5 manufacturing companies, 5 retailing companies and 5 construction projects were purposively selected. The research instruments were observation guide and semi-structured interviews. The result revealed that 80% and 40% of the observed manufacturing and retailing industries respectively, adopted the MRP technology for forecasting purposes in the following areas: material forecast, demand forecast, product forecast and production forecast. However, only 20% of the observed construction projects adopted the MRP technology for forecasting purposes in the following areas: 5% for demand forecast (demand control), 6.7% for material forecast (Stock control), and 20% for product forecast (product output). It was also revealed that utilization of the MRP technology could lead to the achievement of the following benefits: proper resource planning, reduced inventory level, improved production scheduling, lessening costs of production, reduction in inventory level, effective treatment of scheduling problems, and efficiency of supply chain system. The research concludes that effective utilization of MRP technology in the logistic system of the construction industry could lead to realization of full efficiency gains in the forecasting aspect (demand control, stock control, production output control, and procurement process) of the construction industry. It is recommended that the Nigerian construction industry should leverage on this in order to create the best ways of handling the MRP technology to improve the forecasting logistics systems of the construction process.

Keywords: Construction, MRP, Forecasting, Logistics, Technology

Introduction

The construction industry is recognised internationally as one of the information-intensive industry which is often criticized for delivering projects late and over budget (Sardroud & Limbachiya, 2010). Therefore, logistics activities can assist in creating time, place and form utility, thereby enhancing product value (Bienstock *et al.*, 2008). Türkeli *et al.* (2010) asserted that logistics is a business planning framework for the management of material, service, information and capital flow required in today's business environment.

Construction logistics is an area that has a significant effect on project and industry performance and yet has remained largely unchanged over many years (Sullivan *et al.*, 2010). Logistics of construction projects is a multidisciplinary process, including all materials, commodity concretes, equipment, purchases, transportation, warehouses, transporting, packing, allocating and information processing (Duiyong *et al.*, 2014). Bienstock *et al.* (2008) stated that the introduction of technology can have significant effects on

logistics operations, facilitating collaboration among construction industry partners. Therefore, choosing the right technology activities or subprocesses is very crucial to any construction to gain competitive advantage in today's competitive market. Bhandari, 2014 and Irizarry *et al.* 2013 emphasised that the benefits of construction logistics technology majorly, is to improve the performance of construction in term of time, control, effectiveness, efficiency and reduce large waste caused by inefficient materials management.

Basu (2011) and Dim *et al.* (2015) noted that most clients, design teams, contractors and the suppliers in construction industry have little knowledge of new-logistics technologies for forecasting purposes. Langeley *et al.* (2009) opined that logistics is misunderstood and often over looked with the excitement surrounding logistics management and all the related technologies that have been developed to support the construction management.

Research evidence has shown that previous studies on construction logistics from different parts of Nigeria have focused on transportation, effectiveness or efficiency in logistics, supply chain and so forth, however, very little is focused on logistics technology, especially the use of MRP technology for forecasting to improve construction logistics processes. Therefore a wide gap has been identified in the Nigeria construction logistics processes (Ahuja *et al.*, 2009; Equere & Tang, 2010). However, the technological aspect of construction logistics, most especially the forecasting is over looked, and little is understood in the Nigerian construction industry. Thus, in view of this problem, the research assesses the level of MRP technology utilisation from the manufacturing and retailing industries background to improve the forecasting processes of the Nigerian construction logistics.

To achieve this aim, the following research questions were asked: what are the forecasting related tasks in the manufacturing, retailing and construction industries? What is the percentage level of usage of MRP technologies in execution of these tasks in the industries? And what are the accruable benefits to construction from the utilization of the MRP technology.

Literature Review

Construction Logistics

Construction logistics planning entails the coordination of supply and site activities by integrating their decisions and recognising existing inter dependencies to minimise the total material management cost (Braun *et al.* 2015; Gadde & Dubois, 2010). Logistics can represent an important option, not only because it increases operational efficiency, but because it can positively affect customer's behavioural intentions (Giovanis *et al.*, 2013). Also, Efendigil *et al.* (2008) emphasise that increasing efficiency in logistics operations, such as the recovery of the returned products is one way in which businesses attempted to maintain and increase competitiveness in the global economy. Therefore improvement in the utilization of logistics management activities in construction can assist the managers in making better decisions for the construction industry (Hälinen, 2015). According to Voigtmann and Bargstädt (2010), good logistics on construction sites will save time and reduce construction costs. Zellner (2008) recommended an intensive cooperation between the construction industry and their customer, which bring about logistics. One of the main aspirations of this reorientation was to introduce processes that successfully had been implemented in other industries, most of which relate to the logistics side of companies (Gadde & Dubois, 2010).

Construction Logistics Technology

Owing to the need for new technologies for logistics management systems that are capable of integrating construction supply chain, the utilization of technology in construction logistics emerged in the 1990s (Bruckmann *et al.*, 2016). According to Bruckmann *et al.* (2016), one of the most attractive aspects of technology in logistics is the opportunity to reduce personnel costs,

while at the same time achieving a constantly high production quality. Sardroud and Limbachiya (2010) believed that logistics technologies are important in successfully controlling and managing construction projects which will meet the scope, quality, safety, cost and time.

The use of technology in managing the logistics process has drawn increasing attention in the corporate world (Wu *et al.* 2006; Liu, 2013) . For instance, the United States industries are increasingly dependent on the benefits brought about by technology to improve supply logistics management agility, reduce cycle time, achieve higher efficiency, and deliver products to customers in a timely manner (Wu *et al.*, 2006).

MRP Technology as a Forecasting Logistics Tool in the Construction Industry

The MRP is a production planning and control systems used to forecast and coordinate order fulfilment by synchronizing material and resources availability to customer demand (Bayraktar *et al.*, 2009). The functions of MRP technology according to Imetieg and Lutovac (2015) include production planning, scheduling, and inventory control systems used to manage manufacturing processes. The accuracy of demand forecasts will significantly improve the production scheduling, capacity planning, material requirement planning and inventory management (Kandananond, 2012**;** Imetieg & Lutovac, 2015).

The MRP technology provides good forecasting information necessary for effective decision making (Madapusi & Souza, 2012).The key elements of the MRP technology according to Samuel and Ondiek (2014) are: Master Production Schedules (MPS), Bill of Materials (BoM), and the inventory file.

Research Methodology

The qualitative approach that is rooted in the phenomenological research paradigm was adopted in this study. This is because an in-depth investigations (observation) of the MRP related technology from the manufacturing, retailing and construction industries were made. The qualitative method allows in-depth understanding, discovery, clarification of situation and provides a researcher with a unique avenue to probe into responses or observations (Guest *et al.*, 2013).

An observation guide and semi-structured interviews were the instruments through which the primary data for this research was collected. Only the MRP technology utilisation in these companies/projects was observed. This included four (4) MRP technology from manufacturing companies, two (2) from retailing companies and one (1) from construction project, making a total of seven (7). The observation was carried out with the aid of the workers of the industries (manufacturing and retailing) and construction projects who are stationed to work on the MRP technology. The results of the observation of the MRP technology for the companies and the construction projects is stated in Table 1.

The respondents of the interview were one (1) worker each from the different company/projects visited who are stationed to work on the MRP technology. This included 4 respondents from manufacturing companies, 2 respondents from retailing companies and one (1) respondent from a construction project, making a total of seven (7) respondents from the companies. The only questions asked for the interviews was on the accruable benefits of the MRP technology to the construction industry and the summary of the responses are presented on the last column of Table 1.

The geographical study areas for this study was manufacturing and retailing industries, and construction projects within Lagos state and Abuja, the Federal Capital Territory (FCT) of Nigeria.

This included: 2 and 3 manufacturing, 4 and 1 retailing and 3 and 2 construction projects from Abuja and Lagos State, respectively. These two geographical study areas were

selected, because they both have lots of manufacturing and retailing companies and many construction projects. Moreover, these two cities are among the metropolitan cities in Nigeria with highest population of professionals within the built environment with many ongoing construction projects.

Moreover, purposive sampling technique was employed, which according to Leedy and Ormrod (2014), a qualitative researcher often employs the purposive sampling through which the selection of individuals or organisation is done, based on their experiences, to yield adequate information about the topic under investigation. A typical research sample size for a phenomenological study under qualitative research according to Leedy and Ormrod (2014) ranges between 5 and 25 participants. For the purpose of this research, a sample of 15 companies/projects was selected which included 5-manufacturing companies, 5-retailing companies and 5- construction projects. These numbers were the industries that meet the requirement of the sampling (purposive sampling 2.8 billion Naira and above, as at 28th August 2017). However, companies/projects to the capital base/value of 2.8 billion Naira and above are matured enough and presumed to have advanced technologies such as the MRP (Soliman & Karia, 2015).

The collected data for this research were analysed by using descriptive analytical tools which included frequencies and percentiles. The results were presented in a Table and a Figure using descriptive analyses. The tabulated results from the instruments were divided into two parts. The first part consisted of the related tasks in manufacturing and retailing industries, while the second part consisted of tasks and sub-tasks in the construction industry. In the first part, the technologies were identified in five (5) manufacturing and five (5) retailing companies; this making a total of 10 companies. The identification in each of these companies represent 20% of the 100% for the five manufacturing and five retailing companies respectively. Also, the tasks in the five (5) manufacturing companies, and retailing companies were identified, with each occupying 20% of the 100%. For example, demand forecast in Table 1 was used by 4 manufacturing companies out the five (5) manufacturing companies, each company occupying 20%. This means 20% multiply by 4 industry, equals to 80% of the 100% of the five manufacturing companies. The same process applies to the five (5) retailing companies. Moreover, for identification of the technologies in the 5-construction projects, each occupied 20% of 100%. The tasks that correspond to the manufacturing and retailing companies were also identified, each occupying 20% of 100% for the five (5) projects in the construction industry.

The tasks under the construction project were sub-divided into sub-tasks, for which 20% occupied by each project was further sub-divided into the sub-tasks under the projects in the construction projects. This means demand control only occupied 20% which will be divided among the number of sub-tasks that appear under demand control. For example, the corresponding task to demand forecast in construction is demand control in Table 1. Therefore, demand control as a main task, each occupying 20% to make 100%, the 20% under "demand control" was further divided into 4 different sub-tasks in demand control (material demand on side, labour demand on side, equipment demand on site and plant demand on site) that is, 20% divided by 4 equals to 5% for each sub-task. Furthermore, the total of this percentages from the manufacturing, retailing and construction industries were utilised to produce the percentage level of usage of the task and sub-task in the three industries. This was done by dividing each percentage unit of the task by the overall percentage total of the industries (manufacturing + retailing + construction) and multiply by 100%.

For example, using this formula: L= U/T x 100%. Where, U= Unit percentage of one task of the three industries; T= Total percentage of manufacturing, retailing and construction industries; and L= Percentage

level of usage of each unit percentage task, Moreover, the total percentage and percentage proportion of tasks in the three (3) industries were used to develop the Figure 1. Also, the workers/operators shared their experiences in form of a brief interview on the relevant benefits of the technology that could accrue to the tasks and sub-tasks in the construction logistics processes in Nigeria.

Results and Discussion

The MRP technology and level of usage across the industries

The Table 1 shows that 80% and 40% of the manufacturing and retailing industries respectively, adopted the MRP technology for forecasting when compared to the construction industry that used only 20% of the technology for forecasting. These results confirm the finding of Samuel and Ondiek (2014) who opined that MRP technology is mostly used in the manufacturing industry.

80% of the companies in the manufacturing industry used the MRP technology for materials forecast and demand forecast. Also, 40% of the companies in the retailing industry used the MRP technology for materials forecast and demand forecast, with the material forecast and demand forecast occupying percentage proportions of 8.9% each. However, only 20% of the projects in the construction industry used the MRP technology for demand forecast in the area of demand control, with 5% for materials demand on site occupying a percentage proportion of 1.1%. These results support the findings of Samaranayake (2012), Kandananond (2012) and Sarkar *et al. (*2014) on the correctness of demand forecasts to expand the production scheduling.

Additionally, 40% of the companies in both manufacturing and retailing industries used the MRP technology for product forecast, occupying percentage proportions of 8.9% each, in relation to other MRP technology related tasks. Equally, 20% of the projects in the construction industry used the MRP for production forecast (production output), occupying a proportion of 4.4% for programme of work among others. The results are also in line with the findings of Imetieg and Lutovac (2015) on effective forecast to reduce cost of product.

On sales and production forecast, the companies in the manufacturing industry used 40% and 60% for the sales and production forecast respectively, occupying percentage proportions of 8.9% and 13.3% respectively. Conversely, the sales forecast was not used in the projects in the construction industry for forecasting purposes.

It was therefore revealed by the respondents in the construction projects studied that though, the MRP technology was not fully utilized by them, but could be utilised to improve the following areas of the construction logistics tasks:

i. Demand control: material, labour and equipment and plant demand on site.
ii. Stock control: Material on site, order management, and material to be used.
iii. Production output control: labour output and plant output
iv. Procurement (Bidding process)
v. Procurement process: invitation to tender, submission of tender, tender evaluation and report.

Accruable benefits of MRP technology to the construction industry

It is also clear from Table 1 that the interviewed respondents deemed that the following benefit could be accrued to the construction industry if the MRP technology is utilised in the forecasting processes of logistic management, these include: provision of better resource planning and reduced inventory level on construction site; provision of accuracy of demand forecasts on construction site; improve the production scheduling, improved capacity planning, material requirement planning and inventory management; efficiency of supply chain system on site; provision of relatively quick, real and effective treatment of scheduling

problems; lessening cost of production orders in construction works; and provision of critical information streams necessary for effective decision-making. These results support the findings of Kandananond (2012), and Imetieg and Lutovac (2015) on the benefits of MRP technology. Also in line with Samaranayake (2012) and Madapusi and Souza (2012) that the MRP can provide the following benefits: planning of materials and resources, scheduling of operations for various units; and provides critical information streams necessary for effective decision-making.

Table 1: MRP technology related tasks and level of usage across the industries

Manufacturing and retailing industries						**Construction industries**				
		Manufacturing		Retailing		Construction				
Percentage Identification		80%		40%		20%				**Benefits accrue to construction by the interviewed respondents**
Tasks in Manufacturing and Retailing		100%	% Level	100%	% Level	100%	% Level	Tasks in Construction		
								Sub tasks	Main tasks	
1	Demand forecast	80	17.7	40	8.9	5	1.1	Material demand on site Labour demand on site Equipment demand on site Plant demand on site	Demand control	Reduced inventory, quick, real and effective treatment of scheduling problems, provides critical information streams necessary, lessening cost of production
2	Sales forecast	40	8.9							
3	Material forecast	80	17.7	40	8.9	6.7 1.5		Material on site Order management Material to be used	Stock control	Better resource planning and reduced inventory level
4	Production forecast	60	13.3					Labour output Plant output	Production output control	Improve the production scheduling, capacity planning, inventory management, and lessening cost of production
5	Product forecast	40	8.9	40	8.9	20	4.4	Program of work	Product output	Efficiency of a supply chain system, quick, real and effective treatment of scheduling
6	Competitors forecast							Bidding	Procurement	
7	Advertisement forecast							Invitation for tender Submission of tender Tender evaluation and report	Procurement process	
TOTAL		300	66.5	120	26.7	31.7	7			

Figure 1 shows that, the total usage of the tasks using the MRP technology were: 300%, 120% and 31.7% in the companies and projects studied in the manufacturing, retailing and construction industries respectively, each occupying proportion of 66.5%, 26.7% and 7% in the three industries respectively. This means that utilization of the MRP technology in the five projects examined for forecasting is very low when compared to the companies in the manufacturing and retailing industries.

Conclusion and Recommendations

The technological aspect of construction logistics, most especially the forecasting is over looked, and little is understood in the Nigerian construction industry. This research assessed how MRP technology could be utilised from the manufacturing and retailing industries background to improve the forecasting processes of construction logistics.

The research found that 80% and 40% of the observed companies in the manufacturing and retailing industries respectively, adopted the MRP technology for forecasting purposes (For material forecast, demand forecast, product forecast and production forecast). Only 20% (one project) of the observed construction projects adopted the MRP technology for forecasting in the following: 5% for demand forecast (demand control), 6.7% for material forecast (Stock control), and 20% for product forecast (product output). Based on these findings, it can be concluded that the MRP technology is not well used in the construction projects when compared to the manufacturing and retailing industries. Therefore, the MRP technology, could be utilised to improve the following tasks in the construction industry: Demand control: material, labour and equipment and plant demand on site; Stock control: material on site, order management, and material to be used; Production output control: labour output and plant output; and Procurement process: bidding process, invitation to tender, submission of tender, tender evaluation and report. It is also concluded that the ultimate benefit that could accrue to the construction industry for the utilization of the MRP technology for forecasting purposes is achievement of full forecasting-efficiency gains in construction. To this end, the Nigerian construction industry should leverage on this in order to create the best ways of handling the MRP technology to improve the forecasting logistics systems of the construction process.

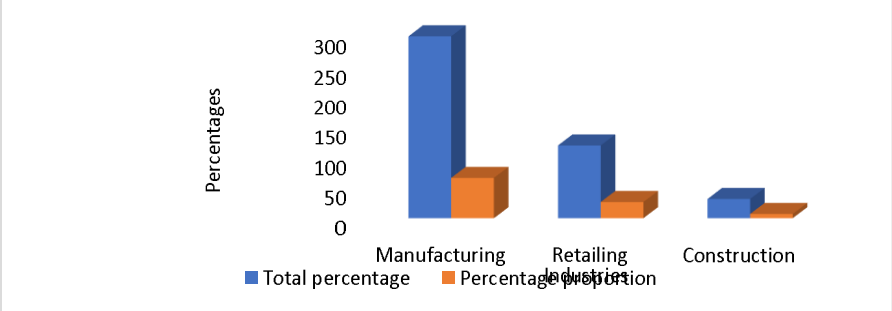

Figure 1: Level of usage of MRP technology across the industries
Source: Researcher's analysis of data, 2018.

References

Ahuja, V., Yang, J., & Shankar, R. (2009). Study of ICT adoption for building project management in the Indian construction industry. *Automation in Construction*, *18*(4), 415–423. https://doi.org/10.1016/j.autcon.2008.10.009

Basu, R. (2011). *Managing Project Supply chain*. England: Gower Pubishing limited.

Bayraktar, E., Demirbag, M., Koh, S. C. L., Tatoglu, E., & Zaim, H. (2009). A causal analysis of the impact of information systems and supply chain management practices on operational

performance: Evidence from manufacturing SMEs in Turkey. *International Journal of Production Economics*, *122*(1), 133–149. https://doi.org/10.1016/j.ijpe.2009.05.011

Bhandari, R. (2016). Impact of Technology on Logistics and Supply Chain Management. *IOSR Journal of Business and Management*, 19–24. Retrieved from www.iosrjournals.org

Bienstock, C. C., Royne, M. B., Sherrell, D., & Stafford, T. F. (2008). An expanded model of logistics service quality: Incorporating logistics information technology. *International Journal of Production Economics*, *113*(1), 205–222. https://doi.org/10.1016/j.ijpe.2007.03.023

Braun, A., Tuttas, S., Borrmann, A., & Stilla, U. (2015). Automated progress monitoring based on photogrammetric point clouds and precedence relationship graphs. In *Pages 1-7 (2015 Proceedings of the 32st ISARC, Oulu, Finland* (pp. 1–7).

Bruckmann, T., Mattern, H., Spengler, A., Reichert, C., & Malkwitz, A. (2016). Automated Construction of Masonry Buildings using Cable- Driven Parallel Robots. In *33rd International Symposium on Automation and Robotics in Construction* (pp. 1–8).

Dim, N. U., Ezeabasili, A. C. C., & Okoro, B. U. (2015). Managing the Change Process Associated with Building Information Modeling (BIM) Implementation by the Public and Private Investors in the Nigerian Building Industry. *Donnish Journal of Engineering and Manufacturing Technology*, *2*(1), 1–6.

Duiyong, C., Shidong, J., & Mingshan, S. (2014). Engineering construction project site logistics management, *6*(7), 353–360.

Efendigil, T., Önüt, S., & Kongar, E. (2008). A holistic approach for selecting a third-party reverse logistics provider in the presence of vagueness. *Computers and Industrial Engineering*, *54*(2), 269–287. https://doi.org/10.1016/j.cie.2007.07.009

Equere, E., & Tang, L. C. M. (2010). Dearth of Automation : The Consequences in Nigeria Construction Industry. *Journal of Automation*, *unspecifie*, 101–107.

Gadde, L. E., & Dubois, A. (2010). Partnering in the construction industry-Problems and opportunities. *Journal of Purchasing and Supply Management*, *16*(4), 254–263. https://doi.org/10.1016/j.pursup.2010.09.002

Giovanis, A. N., Tomaras, P., & Zondiros, D. (2013). Suppliers Logistics Service Quality Performance and its Effect on Retailers' Behavioral Intentions. In *The 2nd International Conference on Integrated Information Suppliers Procedia - Social and Behavioral Sciences* (73, 302–309). https://doi.org/10.1016/j.sbspro.2013.02.056

Guest, G., Namey, E., & Mitchell, M. (2013). *Collecting Qualitative Data: A field manual for applied research*. California: Sage Publication.

Hälinen, H.-M. (2015). *Understanding the concept of logistics cost in manufacturing*. University of Turku. Retrieved from internal-pdf://4.31.220.66/

Imetieg, A. A., & Lutovac, M. (2015). Project scheduling method with time using MRP system: A case study: Construction project in Libya. *The European Journal of Applied Economics*, *12*(1), 58–66. https://doi.org/10.5937/ejae12-7815

Irizarry, J., Karan, E. P., & Jalaei, F. (2013). Integrating BIM and GIS to improve the visual monitoring of construction supply chain management. *Automation in Construction*, *31*, 241–254. https://doi.org/10.1016/j.autcon.2012.12.005

Kandananond, K. (2012). A comparison of various forecasting methods for autocorrelated time series. *International Journal of Engineering Business Management*, *4*(1), 1–6.

https://doi.org/10.5772/51088

Langeley, C. J., Coyle, J. J., Gibson, B. j., Novack, R. A., & Bardi, E. J. (2009). *Managing Supply Chains: A logistics Approach* (8th Ed.). Canada: LEAP Publishin Services.

Leedy, P., & Ormrod, J. (2014). *Practical Research: Planning and Design (10th ed.)*. London: Pearson Education Limited.

Liu, Z., Li, Y., Dai, W., & Zhang, R. (2013). Current situation and countermeasures of port logistics park information construction School of Management and Information Systems , Victoria University (Australia) Abstract : Purpose : Improve work efficiency of logistics park department , and drive th. *J Ou r Nal of I Nd Ustr Ial En Gin Eeri Ng an d Mana Gem Ent*, *6*(1), 227–236.

Madapusi, A., & Souza, D. D. (2012). International Journal of Information Management The influence of ERP system implementation on the operational performance of an organization. *International Journal of Information Management*, *32*(1), 24–34. https://doi.org/10.1016/j.ijinfomgt.2011.06.004

Samaranayake, P. (2012). Aircraft maintenance planning and scheduling : An integrated framework. *Journal of Quality in Maintenance Engineering*, *18*(4), 432–453. https://doi.org/http://dx.doi.org/10.1108/13552511211281598

Samuel, K. S., & Ondiek, O. G. (2014). Inventory Management Automation and The Performance of Supermarkets in Western Kenya. *International Journal of Research in Management & Business Studies (IJRMBS 2014)*, *1*(4), 9–18.

Sardroud, J. M. (2010). Integrated Advance Data Storage Technology for Effective Construction Logistics Management. In *27th International Symposium on Automation and Robotics in Construction (ISARC 2010)* (pp. 89–98).

Sardroud, J. M., & Limbachiya, M. C. (2010). Effective Information Delivery at Construction Phase with Integrated Application of RFID , GPS and GSM Technology Effective Information Delivery at Construction Phase with Integrated Application of RFID , GPS and GSM Technology. In *Proceedings of the World Congress on Engineering 2010 Vol I WCE 2010, June 30 - July 2, 2010, London, U.K.* (pp. 1–8).

Sarkar, B., Gupta, H., Chaudhuri, K., & Goyal, S. K. (2014). An integrated inventory model with variable lead time, defective units and delay in payments. In *Applied Mathematics and Computation*, *237* (pp. 650–658). https://doi.org/10.1016/j.amc.2014.03.061

Soliman, M., & Karia, N. (2015). Enterprise Resource Planning (ERP) System as an Innovative Technology in Higher Education Context in Egypt. *International Journal of Computing Academic Research (IJCAR)*, *4*(5), 265–269.

Sullivan, G., Barthorpe, S., & Robbins, S. (2010). *Managing construction logistics* (1st Ed.). United Kindom: John Wiley and Sons Ltd.

Türkeli, B., Ariburnu, A., & Vayvay, Ö. (2010). Innovative Strategies for Logistics Processes. In *In Service Science and Logistics Informatics: Innovative Perspectives . IGI Global* (pp. 1–20). https://doi.org/10.4018/978-1-61520-603-2.ch001

Voigtmann, J., & Bargstädt, H. J. (2010). Construction logistics planning by simulation. *Proceedings - Winter Simulation Conference*. https://doi.org/10.1109/WSC.2010.5679012

Wu, F., Yeniyurt, S., Kim, D., & Cavusgil, S. R. T. (2006). The impact of information technology on supply chain capabilities and firm performance : A resource-based view. *Journal of Industrial Marketing Management*, *35*, 493–504. https://doi.org/10.1016/j.indmarman.2

005.05.003

Zellner, D.-K. J. (2008). The Position of the Logistics Service Provider within the Supply Chain and the Achievement of Dominance through Customer Relationship Management. Unpublished PhD thesis Janus Pannonius University