

# Review of Material Supply Chain Management during Pre-construction Phases in Malaysia

Loh Yong Seng<sup>1</sup>, Salman Riazi Mehdi Riazi<sup>2\*</sup>, Mohd Nasrun Mohd Nawi<sup>3</sup>, Radzi Ismail<sup>4</sup>

<sup>1, 2\*, 4</sup>*School of Housing, Building and Planning, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia*

<sup>1</sup>johnsonloh12@hotmail.com

<sup>2\*</sup>salman.riazi@usm.my

<sup>4</sup>radzi@usm.my

<sup>3</sup>*School of Technology Management and Logistics, University Utara Malaysia, 06010 Sintok, Kedah, Malaysia*

<sup>3</sup>nasrun@uum.edu.au

**Abstract**— Construction materials play significant role in construction industry which therefore requires fully attention when creating project plan. Materials form a large part in total cost of construction project. The absence of materials when needed is one of the main causes of loss of productivity in a worksite. Current materials management practices in the construction industry are performed on fragmented basis with many problems faced when managing material supply chain, especially during pre-construction phases. These problems are the main root that causing performance-related problems such as delay in material ordering and receiving, low productivity, cost and time overrun, conflict and disputes. Thus, this paper reviews and discusses the activities and problems faced in material supply chain management during pre-construction phases. It also reasons out on the potential of SCM to be the way forward for improving problems of construction industry (i.e. material supply chain management). A series of in-depth literature review was conducted towards digging the relevant points towards achieving the aims of this paper. In the end, it was clear that material supply chain practices at pre-construction phases are still at below optimum level and that SCM literatures strongly support of it being the potential saviour.

**Keywords**— *Construction Industry, Malaysia, Material, Pre-construction, Problems, Supply Chain Management*

## 1. Introduction

Supply Chain Management (SCM) is a concept originating from the supply system by which Toyota was seen to coordinate its supplies and manages its suppliers. The basic concept of the SCM includes tools like Just-In-Time (JIT) and logistics management. The current concept of the SCM is somewhat broader but still largely dominated by logistics [1]. Construction Supply Chain (CSC) is involved in all the construction process, from the demands by the client, conceptual design, construction and maintenance and organizations, which are involved in the construction process, such as owner, designer, general contractors, subcontractors, suppliers, consultants, and so on [2].

Nowadays, materials management practices in the construction industry are performed on fragmented basis with poor communication and no clearly established responsibilities between the parties involved. The highly fragmentation is a result of the separation of design and construction, lack of coordination, poor communication and so on [3]. These will cause many negative impacts, such as time delay, cost increases and owner dissatisfaction. Efficient management and control of material plays a key role for successful completion of projects. Materials account for a big part of project cost. Some studies concluded that materials account for around 50%-60% of the project cost [4]. Therefore, material supply chain management approach used on building projects

has a relationship with the scheduled completion time of the projects.

Malaysian development industry has been grumbled by poor execution; which have prompted duplication of work, long endorsements and work time, absence of straight forwardness and surging costs [5]. This partly is due to lack of understanding and perception about material supply chain management.

Supply chain management has provides many benefits to construction industry, such as effective asset usage [6], enhanced acquisition, execution, adaptability [7], cost sparing, increase clients 'satisfaction [8] and so on. The procedure of materials administration ought to coordinate buying, speeding up, and stock control. An all around oversight materials administration framework can add to the cost viability of a project [9].

## 2. Definition and Concept of Supply Chain Management

SCM made its presence through the Toyota Production System [10] aimed at surging efficiencies in inventory and also the supplier interfaces [11]. The high-paced business revolution has encouraged the evolution of SCM [12] with adaptations progressing from being "within organization" [13] to "between organisations" [14], therefore improving the overall business model of organisations.

SCM concepts have been evolving throughout the years with variety of opinions attempting to express the meaning behind this new concept. [15] advocated that SCM is an extension of past management advancement involving the amalgamation of good practices such as Total Quality Management (TQM), Business Process Redesign (BPR) and Just-in-Time (JIT) while [16] held on the notion that SCM is beyond merely logistics.

According to [17], "*SCM prescribes organizational restructuring and extending achievement throughout organizations. It is a philosophy that proposes improvement in the organization's operation by including the elements of integration,*

*coordination, communication, information and control systems to create more value out of every process*" (p. 41-42). This "fifth generation innovation" [18] holds onto collaboration as its "key" [7] with joint efforts extend at all level of the supply chain towards achieving best value out of every process and stages.

SCM manages the administration of assets in form of material and information, over an arrangement of associations that are incorporated into the outline and the creation procedures [19]. The goal of supply chain management is to have the capacity to have the right items in the correct sums and amounts at the opportune spot at the right minute at most minimal measure of cost. SCM looks over the entire supply chain, instead of pretty much rather than precisely at the accompanying component or level, and expects to grow straightforwardness and game plan of the production network's coordination and design, paying little mind to practical or corporate points of confinement [20].

## 3. Construction Supply Chain Management

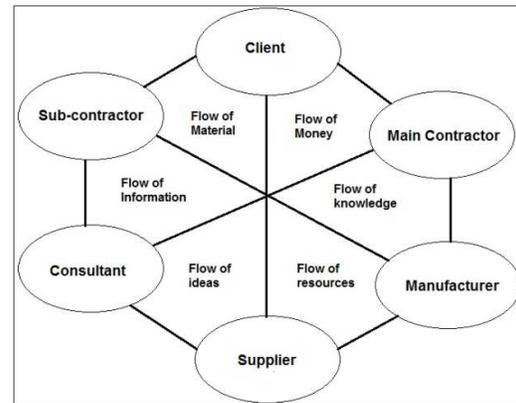
SCM in construction has been a hotly discussed topic. Its significance of SCM in construction industry has led to it being discussed and defined in various angles over the past decades (see [21]. Nevertheless, many authors still regarded these definitions as inadequate [22], [23], [24] probably due to the infancy of SCM. However, [25] proposed a definition which entailed all SCM elements such as its philosophical aspect, approaches, the accomplishment of its endeavours as well as the route in which the concept takes to create value and sustain itself. The definition that was proposed by these authors was as follows:

*"SCM is an innovative and revolutionary managerial approach which involves a working culture change and a voluntary initiated agreement for integration and synchronization of two or more inter-dependent members within variety of organization level and boundaries as well as range of inter-linked construction life-cycle processes (initiation to handover). It promotes joint effort and strategy on all activities which are underpinned by mutual trust, responsibility, benefit and risk sharing based on a long-term perspective on*

relationship. Value is achieved through optimization and management of processes, resources, core competencies, talent, information, power and technology within the supply chain towards accomplishment of a set of shared objective and goals, enhance competitive advantage, breaking down any discontinuities and meeting distinctive client needs. Consequently, jointly agreed benchmarks, targets, expectation and values are put in place for continuous improvement efforts and are supported by aligned incentive schemes towards sustaining the endeavour” [25].

Towards better explaining Construction SCM, this paper selects an illustration proposed by [17] (refer Figure 1) which clearly illustrates how integration and synchronization happens in CSCM. Based on the Figure 1, the Client, Main Contractor, Sub-contractor, Consultant, Manufacturer and Suppliers represents as the Main Supply Chains of construction projects where they have to synchronize to collaborate, coordinate and communicate effectively between themselves to ensure that projects runs smoothly. Within their integration, happen the flow of information, ideas and knowledge towards providing their best to the project while the flow of material, resources and money reflects the teamwork that should happen to ultimately ensure that client’s end product is realized.

Poor performances within the construction industry worldwide enhances the need to change practices and [26] believed that up to 40% time-saving is possible should contemporary approaches be embraced; for example SCM (see [18]). While many studies has come forward to recommend SCM (see [27], [28], [29]), some had also doubted over its applicability in construction (see [30], [31])) which may have been driven by the

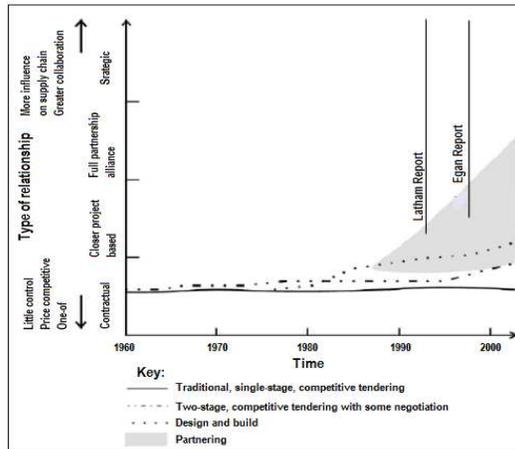


**Figure 1.** A Network Structure of Construction Supply Chain Management (Adapted from: [17])

industry’s hesitant to get out of their comfort zone in term of embracing new technologies [32]. However, [33] stressed that the only difference between construction and production is their output, but beyond that, they both are a still type of production. This was in line with claims by [34] that construction and manufacturing industry shares the same logistic and purchasing operations.

Realizing the needs, calls for change in construction industry has been made. Focus was placed on enhancing levels of collaboration, integration, communication and coordination [35] which is very much what SCM also looks at (i.e. see [7]). Many countries has also follow suit in making “Calls for Change” such as in Australia, Sweden, Finland, Hong Kong, Norway, Singapore and the United Kingdom [35] including Malaysia [5]. Recent trends in term of relationship boundaries has also supported the construction industry’s move towards SCM (refer Figure 2).

Based on Figure 2, traditional practices existed since the mid 1960’s before the industry starting to value the need for negotiation on other aspects besides focusing on price alone. When Design and Build made its presence towards the end of 1980’s, it was evident that the importance of value-for-money has been realized and that collaborative efforts have also been taken seriously. The industry then started to realize that to improve efficiencies, higher level of synchronization and integration is needed, which then led to the emergence of two famous UK Government reports namely [36] and [27] which clearly promoted the essence of SCM



**Figure 2.** Types of Relationships in the Construction Industry (Adapted from: [18])

philosophy to be injected into the construction industry practices. After that, further promotion of SCM in constructions emerged (e.g. [29]) and later, the Malaysian initiative through one of its thrusts in CIMP 2006 – 2015 [5].

#### 4. Phases in Material Supply Chain Management

A conceptual structure for the Material Supply Chain Process (MSCP) was produced by [9]. Five particular stages that contain in the material supply chain process were recognized, which are: Bidding Phase, Sourcing Phase, Materials Procurement, Construction Phase, and Post Construction Phase. The pre-construction phases consist of bidding phase, sourcing phase and material procurement phase.

##### 1. Bidding Phase

In this phase, material administration process starts from the time that the temporary worker gets the drawings and particulars. The materials departure and distinguishing proof methodology is the underlying stage in this stage and incorporates perceiving the materials and also any novel determinations or exceptional materials to be used as a station for the project.

##### 2. Sourcing Phase

This stage consolidates the decision of true blue suppliers and producers. The decision of suppliers is essential and the temporary worker needs to watch that the supplier is reasonable of conveying the right material, for instance: sort,

quality and amount and when the material is required, for instance, the date determined.

##### 3. Material Procurement Phase

This stage fuses material requesting and accelerating; it is viewed as critical to the accomplishment of a material administration process. The individual in charge of getting the material or the gaining office, on account of a major development organization, it is compulsory to ensure that the right materials in the correct sums are passed on. The individual dependable likewise required checking for the release dates at which the material is required and to clearly show the conveyance times and the zone of conveyance to the supplier.

The pre-construction stage has been considered as the most problematic and critical parts of the construction sector. Without a good management and control at this stage, the construction processes cannot occur effectively [37]. Therefore, the focus need to be given in pre-construction phase on the current practices and problem faced in material supply chain management during pre-construction phases.

#### 5. Practices of Material Supply Chain during Pre-Construction Phase

According to [9], he mentioned few construction material management practices during pre-construction phases in supply chain management, which are: identifying the needed materials for each item once you receive the project's drawings and specifications; estimating the quantity of the needed materials per each item; and selecting the winner supplier based on lowest prices.

Besides that, [3] pointed out some material supply chain practices during pre-construction phases, such as: identifying the needed materials for each item once you receive the project's drawings and specifications; using software packages or computer applications such as Microsoft Excel for preparing the estimation; establishing prices database for the materials from the previous implemented projects in order to be used for preparing the estimate for future projects, verifying the prices used in the estimate prior to submitting the bid; scheduling a meeting that includes the

project manager and the construction team to re-estimate the project quantities once you win the bid; requesting quotations from different suppliers in order to get reasonable good prices; negotiating the prices directly with the suppliers; verifying that the supplier is capable of delivering the right materials; recording of the usage and inventory of material; verifying the availability of requested materials in your stocks before requesting any materials from suppliers; following up the status of the ordered materials to make sure the delivered materials comply with the specifications, and within the timeframe specified; requesting materials directly by the field personnel; ordering 100% of the estimated items quantities at once; ordering the estimated item quantities as per the work progress on the site and requesting a submittal of material sample from the supplier or manufacturer and approving it by the Engineer prior to materials delivery.

[38] also mentioned some of these practices, such as: verifying that the supplier is capable of delivering the right materials; the preparation and monitoring of material timetable; recording of the usage and inventory of material, employment of security measure of material on site, performing material difference analysis; plan a detailed material plan and coordination of material and following up the status of the ordered materials to make sure the delivered materials comply with the specifications, and within the timeframe specified. [39] further added that it is important to plan a detailed material plan and coordination of material during pre-construction phases.

## **6. Problems Faced in Managing Material Supply Chain during Pre-Construction Phase**

There are many problems faced in managing construction material supply chain during pre-construction phases. The shortage of required materials in local market is one of the common problems faced in managing material supply chain [40], [41], [42], [43], [44]. Improper material application also one of the common problems that faced by the construction parties [45], [46], [47].

According to [48], they mentioned that the problems faced included: incomplete drawings and details are missing; incomplete proposals; and

having too many suppliers and do not have information about them. [39] agreed that inadequate planning in construction projects and time-spent investigating non-qualified suppliers are the problems that usually faced. [49] mentioned that the problems that usually faced are: unclear definition of the objectives wanted from the owner and suppliers; unclear between plans and specifications; incorrect submittals by the suppliers, fluctuation in the cost of building materials; and inaugurate bills of materials.

[46] pointed out several problems, such as: difficult in tracking the materials; improper material application; the types of materials that need to buy; the quantity of material that need to order; unpredictable weather condition; and when to order the material. According to [2], the problems faced when managing material supply chain consists of: lack of understanding of the objectives wanted from the owner and suppliers; lack of communications between the parties involved; fluctuation in the cost of building materials; lack of understanding of the subcontractors and suppliers problems and inadequate information exchange.

Besides that, unclear between plans and specifications; unavailability of required material in local market; late procurement of materials and late approval of submittal by the supervisor engineer are the common problems usually faced during managing construction material supply chain [40]. Based on [41], the problems that mentioned are: the type of material that need to buy; the quantity of material that need to order; shortage of required material in local market; unpredictable weather condition and when to order the construction material.

## **7. Conclusion**

The existence of problems and inefficiencies with the Construction Supply Chain generally and Material Supply Chain specifically has been evident over recent times. A good management of materials assumes a key part in the successful completion of a project. The control of materials is a critical and imperative subject for each organization and ought to be managed and planned effectively for successful completion of a project. Materials make up about 50%-60% of the total project cost [4] therefore effective material supply

chain process is very important for the success of every construction project and can be the deciding factor between a successful project and a project full of delays and claims. Supply Chain Management has time over time been suggested as the way forward for construction industry problems (i.e. material management) thus it is vital that this contemporary practice to be embedded in material management practices during pre-construction phases and that suitable alternatives, tools and techniques are utilized so that the problems at following stages (i.e. post-construction phases) can be minimized thus leading to success in all projects. With proven success cases from implementation of SCM ideology and tools on projects such as the British Airport Authorities (see [50]) and Heathrow T5 project (see [51]), further supports the positive influence SCM can make should it be imparted in the construction material management practices, especially during pre-construction stage where the project prepares itself to take on fluidly during the undertaking of actual works at site.

### Acknowledgments

The authors would like to thank the Universiti Sains Malaysia Short-term Grant (Grant Number 304/PPBGN/6313279) for supporting this research.

### References

- [1] Vrijhoef, R., & Koskela, L. (2000). The four roles of supply chain management in construction. *European Journal of Purchasing and Supply Management*, 6(3), 169-178.
- [2] Xue, X., Wang, Y., Shen, Q., & Yu, X. (2007). Coordination mechanisms for construction supply chain management in the internet environment. *International Journal of Project Management*, 25(2), 150-15.
- [3] [3] Al-Shorafa, A. A. (2009). A Framework for Construction Materials Supply Chain Process in the Local Construction Industry. MSc thesis, Islamic University of Gaza.
- [4] [4] Bernold, L. E. & Treseler, J. F. (1991). Vendor Analysis for Best Buy in Construction. *Journal of Construction Engineering and Management*, 117(4), 645-658.
- [5] Construction Industry Master Plan Malaysia (CIMP) 2006-2015. (2007). *Construction Industry Development Board Malaysia (CIDB)*. Kuala Lumpur, Malaysia: CIDB.
- [6] Dubois, A., & Gadde, L. E. (2000). Supply strategy and network effects—purchasing behaviour in the construction industry. *European Journal of Purchasing & Supply Management*, 6(3), 207-215.
- [7] Horvath, L. (2001). Collaboration: the key to value creation in supply chain management. Supply Chain Management. *An International Journal* 6(5): 205 – 207.
- [8] Cheng, J. C., Law, K. H., Bjornsson, H., Jones, A., & Sriram, R. (2010). A service oriented framework for construction supply chain integration. *Automation in construction*, 19(2), 245-260.
- [9] Perdomo-Rivera, J.L. (2004). *A Framework for a Decision Support Model for the Supply Chain Management in the Construction Industry*. PhD thesis, Virginia Polytechnic Institute and State University.
- [10] Shingo, S. (1988). *Non-stock production*. Cambridge: Productivity Press.
- [11] Cutting-Decelle, A. F., Young, B. I., Das, B. P., Case, K., Rahimifard, S., Anumba, C. J., & Bouchlaghem, D. M. (2007). A Review of approaches to supply chain communications: From manufacturing to construction. *ITcon*, 12, 73- 102.
- [12] Harland, C. M., Lamming, R. C., & Cousins, P. D. (1999). Developing the concept of supply strategy. *International Journal of Operations and Production Management*, 19(7), 650-673.
- [13] Morledge, R., Knight, A., & Grada, M. (2009). *Construction supply chain management: Concept and case study*. Oxford: Blackwell.
- [14] Christopher, M. (2005). *Logistics and supply chain management: Creating value adding networks* (3rd Ed.). New York, NY: Financial Times Prentice Hall.
- [15] Van Der Veen, J., & Robben, H. (1997). Supply chain management: an Overview. *Nijenrode Management. Review*, 6, 62-75.
- [16] Cooper, M. C., Lambert, D. M., & Pagh, J. D. (1997). Supply chain management: More than just a new name for logistics. *The International Journal of Logistics Management*, 8(1), 1-14.
- [17] Mehdi Riazi, S. R. (2014) *The use of supply chain management to reduce delays as result*

- of pre-construction deficiencies in Malaysian public sector construction projects.* PhD thesis, Queensland University of Technology.
- [18] Saad, M., Jones, M., & James, P. (2002). A review of the progress towards the adoption of supply chain management (SCM) relationships in construction. *European Journal of Purchasing and Supply Management*, 8(3), 173–183.
- [19] Tucker, S. N., Mohamed, S., Johnston, D. R., McFallan, S. L., & Hampson, K. D. (2001). Building and construction industries supply chain project (Domestic). *CSIRO-Department of Science and Resources. June BEC Doc, 1(214)*, 1-51.
- [20] Cooper, M. C., & Ellram, L. M., (1993). Characteristics of supply chain management and the implications for purchasing and logistics strategy. *The International Journal for Logistics Management*, 4(2), 13-24.
- [21] Croom, S., Romano, P., & Giannakis, M. (2000). Supply chain management: An analytical framework for critical literature review. *European Journal of Purchasing and Supply Management*, 6(1), 67-83.
- [22] Agapiou, A., Flanagan, R., Norman, G., & Notman, D. (1998). The changing role of builders merchants in the construction supply chain. *Construction Management & Economics*, 16(3), 351-361.
- [23] Akintoye, A., McIntosh, G., & Fitzgerald, E. (2000). A survey of supply chain collaboration and management in the UK construction industry. *European Journal of Purchasing and Supply Management*, 6(3-4), 159-168.
- [24] Love, P. E. D., Li, H., Irani, Z., & Faniran, O. (2000). Total quality management and the learning organisation: A dialogue for change in construction. *Construction Management and Economics*, 18(3), 321-332.
- [25] Mehdi Riazi, S.R., & Lamari, F. (2013). Public sector project delay: the Malaysian perspective and the way forward. In *Proceedings of the 19th CIB World Building Congress, Brisbane 2013: Construction and Society*. Queensland University of Technology.
- [26] Mohamed, S. (1996). Options for applying BPR in the Australian construction industry. *International Journal of Project Management*, 14(6), 379–385.
- [27] Egan, J. (1998). Rethinking construction: The report of the construction task force. *DETR, London*.
- [28] Barker, R., Hong-Minh, S., & Naim, M. M. (2000). The terrain scanning methodology: Assessing and improving construction supply chains. *European Journal of Purchasing and Supply Management*, 6(3-4), 179-193.
- [29] Strategic Forum (2002). *Rethinking construction: Accelerating change*. Consultation paper. London: Strategic Forum for Construction.
- [30] Wild, A. (2002). The unmanageability of construction projects and the theoretical psycho social dynamics of project. *Engineering, Construction and Architectural Management*, 9(4), 345-351.
- [31] Kim, J., & Wilemon, D. (2003). Sources and assessment of complexity in NPD projects. *R&D Management*, 33(1), 15-30.
- [32] Holzer, D. (2007). Are you talking to me? Why BIM alone is not the answer. In K. Orr, & S. Kaji-O'Grady (Eds.), *Proceedings of the Fourth International Conference of the Association of Architecture Schools of Australasia*.
- [33] Heizer, J., & Render, B. (2005). *Operations management* (7th ed.). Upper Saddle River, NJ: Pearson Education.
- [34] Ahmed, S. M., Azhar, S., & Ahmad, I. (2002). Supply chain management in construction: Scope, benefit and barriers. *Delhi Business Review*, 3(1).
- [35] Love, P. E., Irani, Z., & Edwards, D. J. (2004). A seamless supply chain management model for construction. *Supply Chain Management: An International Journal*, 9(1), 43-56.
- [36] Latham, M. (1994). *Constructing the team: Final report of the government industry review of procurement and contractual agreements in the UK construction industry*. London: HMSO.
- [37] Hassan, F., Isa, M. H., Mat, M. C., Ithnin, Z., & Sapisey, Z. (2009). *Report on defects during defect liability period for public hospital projects in Malaysia*, Kuala Lumpur, Malaysia.
- [38] Hamzah, A. R. & Al-Idrisyi. (1994). A Perspective of Material Management Practices in a Fast Developing Economy: The Case of

- Malaysia Construction Management and Economics, Vol. 12, pp. 413-422.
- [39] Kaming, P. F., Olomolaiye, P. O., Holt, G. D., & Harris, F. C. (1997). Factors influencing construction time and cost overruns on high-rise projects in Indonesia. *Construction Management and Economics*, 15(1), 83-94.
- [40] Assaf, S. A., & Al-Hejji, S. (2006). Causes of delay in large construction projects. *International journal of project management*, 24(4), 349-357.
- [41] Koushki, P. A., & Kartam, N. (2004). Impact of construction materials on project time and cost in Kuwait. *Engineering, Construction and Architectural Management*, 11(2), 126-132.
- [42] Sambasivan, M., & Soon, Y. W. (2007). Causes and effects of delay in Malaysian construction industry. *International Journal of Project Management*, 25(5), 517-526.
- [43] Sweis, G., Sweis, R., Hammad, A. A., & Shboul, A. (2008). Delay in construction projects: The case of Jordan. *International Journal of Project Management*, 26(6), 665-674.
- [44] Abdul-Rahman, Hamzah and Al-Idrisyi. (1994). A Perspective of Material Management Practices in a Fast Developing Economy: The Case of Malaysia. *Construction Management and Economics*, 12, 413-422.
- [45] Ogunlana, S. O., Promkuntong, K., & Jearkjirm, V. (1996). Construction delays in a fast growing economy: Comparing Thailand with other economies. *International Journal of Project Management*, 14(1), 37-45.
- [46] Ubaid, A.G. (1991). Factors affecting contractor performance. PhD thesis, King Fahd University of Petroleum and Minerals.
- [47] Aibinu, A.A & Jagboro, G.O. (2002). The Effect of Construction Delays on Project Delivery in Nigeria Construction Industry. *International Journal of Project Management*, 20(8), 593-599.
- [48] Navon, R., & Berkovich, O. (2005). Automated materials management and control model. In *Construction Research Congress 2005: Broadening Perspectives* (pp. 1-9).
- [49] Mansfield, N. R., Ugwu, O. O., & Doran, T. (1994). Causes of delay and cost overruns in Nigerian construction projects. *International journal of project Management*, 12(4), 254-260.
- [50] Brady, T., Davies, A., Gann, D., & Rush, H. (2006). Learning to manage mega projects: The case of BAA Heathrow Terminal 5. In: *IRNOP VII Project Research Conference 2006*, 11-13 October 2006, Xi'an, China.
- [51] Potts, K. (2009). *Construction supply chain management: Concept and case study*. Oxford: Blackwell.