

Housing delivery in Nigeria and the opportunity for offsite manufacturing

Shaba James Kolo, Farzad Pour Rahimian^{*}, Jack Steven Goulding

Grenfell-Baines School of Architecture, Construction and Environment, University of Central Lancashire, Preston, UK

Abstract

The problem of housing delivery is of great concern in many countries of the world. This problem is especially prominent in developing countries and Nigeria is not an exception. In Nigeria, this challenge has been magnified as a result of a myriad of issues, not least, a high population growth rate, shortage of necessary skills, disintegrated supply chain etc. Seminal literature has evidenced that offsite manufacturing (OSM) can help improve housing delivery efforts both in terms of quantity and quality. The aim of this research was to investigate the current housing delivery problems in Nigeria in order to evaluate the feasibility of adopting OSM within this market. To achieve this, the study conducted substantial literature review to: explore the benefits of OSM, identify the problems of housing delivery in Nigeria and explore different dimensions and the issues that can be associated with using OSM in Nigeria. The results revealed that there are a good number of benefits promised by OSM; notable among these are: less wastage on site, faster construction time, quality improvement and reduction in wet trades. Moreover, some of the problems of housing delivery in Nigeria included: skills shortages, reliance on conventional construction techniques, slow pace of construction, and low quality of housing. The study also showed that adoption of OSM has been quite useful in other countries facing the similar issues of housing shortage, e.g. Malaysia. As such, this study posits that OSM could be applied in Nigeria to address many of these issues. However, it is argued here that in order to address the problems of housing delivery in Nigeria, it is important that further study is conducted to explore certain angles of its impacts in the context of Nigeria in accordance – especially considering the myriad of socio-cultural, technological, economic and political factors.

Keywords: housing delivery, housing shortage, Nigeria, offsite manufacturing

1. Introduction

Nigeria currently has a population over 140 million, and this figure is increasing at an annual growth rate of about 3.2% (Ayedun & Oluwatobi, 2011). The country has a very large and ever-increasing housing deficit which stood at approximately 8 million housing units in 1991 and at about 16 million housing units currently (Nkah, 2013; Subair, 2013). The problem of the housing deficit in Nigeria is a result of rapid growth in population, skills shortages, the high cost of building materials, logistical challenges etc. (Makinde, 2014). Consequently, there is a wide gap between housing demand and housing supply in Nigeria (Ademiluyi, 2010; Kabir & Bustani, 2009; Ukwayi *et al.*, 2012). There is work going on to reduce the current housing deficit in Nigeria but there is still so much work that needs to be done. In the UK for instance, several reports have advocated change within the built environment. Notable among these reports are the Latham report of 1994 (Constructing the Team) and the Egan report of 1998 (Rethinking Construction). As a result, the construction industry was challenged to view construction as a manufacturing process (Wolstenholme, 2009). This call for change is not however peculiar to the UK only. In Nigeria, there have been suggestions that emphasis should be laid on other forms of construction such as prefab building (Nkah, 2013). In the opinion of some experts in the Nigerian construction industry, to solve the problem of inadequate housing, there is the need for a shift from the conventional systems of construction to a more adaptable and faster way of construction. As such, 'Dry Construction' has been recommended by these experts (Ashkin, 2013; Dada, 2013). Dry Construction is described as a method of construction where majority of the components of the building are pre-fabricated off site and brought to site for assembling (Dada, 2013). As identified by (Azman *et al.* (2010); Blismas *et al.* (2010); Experian and SamiConsulting (2008); Fussell *et al.* (2007)), there are opportunities for greater use of offsite manufacturing in the area of housing delivery. In other countries like UK, USA, Japan, Scandinavian Counties, Australia, New

^{*} Corresponding author. Tel.: +44 (0) 1772 89 3215; fax: + 44 (0) 1772 892916
E-mail address: FPour-Rahimian@uclan.ac.uk

Zealand, Malaysia etc, (OSM) has been adopted as a means of improving construction processes and also to improve housing delivery efforts (Blismas *et al.*, 2010; Goodier & Gibb, 2005; McGraw-HillConstruction, 2011; PrefabNZIncorporated, 2013).

2. Problems of Housing in Nigeria

Housing (adequate shelter) is seen world-wide as one of the basic necessities of life and a pre-requisite to the survival of man and it is also important to the welfare, survival and health of individuals (Ademiluyi, 2010). As opined by Olayiwola *et al.* (2005), housing remains one of the best indicators of a person's standard of living and his or her place in the society. In spite of the high importance given to housing, it is unfortunate that only 10% of Nigerians who desire houses can afford to acquire it either by purchase or personal construction, this is very low compared to 72% USA, 78% UK, 60% China, 54% Korea and 92% Singapore (Ayedun & Oluwatobi, 2011). The problem of housing in Nigeria is caused by a number of factors (Emmanuel, 2012; Kabir & Bustani, 2009; Subair, 2013). Among these problems are; rural-urban migration, high cost of materials, inadequate regulatory and legal environment affect housing development, poor housing finance structures, skills shortage, limited diversity in construction processes and over reliance on cement (Adenuga, 2013; Makinde, 2014; Suleiman, 2013). Notable among these problems are:

Akinmoladun and Oluwoye (2007) noted that the origin of housing inadequacy in Nigeria was as result of high population growth rate experienced in the country which exceeds the rate of economic growth experienced in the country. This high population growth rate causes an increase in the demand for shelter and efficient supply and distribution of basic amenities and services for the city dwellers. In most urban centres in Nigeria, the problem of housing is not only restricted to quantity but also to the poor quality of available housing units (Kabir & Bustani, 2009). There are strong indications that OSM has the capacity to deliver housing units at a faster speed and with higher quality compared to traditional construction (Arif *et al.*, 2012a; Blismas & Wakefield, 2009; Lu, 2009). For instance, in UK, aside from the fact that there was a move for change in the construction industry, OSM came into prominence after World War I (Taylor, 2009). However, if OSM to be adopted in Nigeria, it is essential for barriers like the lack of guidance, paucity of information, negative image etc. to be address. These issues have been cited by several authors (Goodier & Gibb, 2005; Jaillon & Poon, 2008). In addition, Chan and Dainty (2007), noted the problem of skills shortage within the construction industry has been recurring over the past 30 years. This issue of skills shortage exists in almost all parts of the world to varying degrees, in the studies conducted by CIOB (2008) and Schäfer (2010), in U.K and Germany respectively, it was identified that skills shortage existed in those countries. In the Nigerian context, Ayedun and Oluwatobi (2011) identified skills shortage as one of the problems hampering the effective delivery of housing. One of the drivers to the uptake of OSM identified was skills shortage (Arif *et al.*, 2012a; Blismas & Wakefield, 2009; Gibb & Isack, 2003). OSM takes away most of the construction processes to a controlled environment (factory), as such the number of operatives needed a reduced since minimal work is done on site.

Ayedun and Oluwatobi (2011) observed that the Nigerian Construction Industry as a whole is guilty of not accepting new technologies. This is also similar to the U.K construction industry (Nadim & Goulding, 2010). With the call for the shift from the conventional system of construction to a more adaptable and faster way of construction (Dada, 2013), it is important for the Nigerian housing sector to put modalities in place for OSM to be incorporated into its fold. Adopting this method will not be an easy one as there are barriers associated with the uptake of OSM identified in other countries where OSM is used (Arif *et al.* (2012a); Fussell *et al.* (2007); Goodier and Gibb (2005); Jonsson and Rudberg (2013); Pan *et al.* (2004); Rahman (2013); Zhai *et al.* (2013)). Housing delivery in developed and developing countries of the world are faced with many challenged, in the case of developing countries like Nigeria, the problem is higher compared to developed countries. The population of the world is increasing at an enormous rate and most of this increase is expected in developing countries (Ademiluyi, 2010). With this kind of statistics, it is important for developing countries to think of the way forward with regards to housing delivery.

3. Offsite Manufacturing and the Opportunity for its adoption in Nigeria

There are various terms and acronyms associated with OSM. They include OSM, manufactured construction, offsite construction (OSC), offsite production (OSP), pre-assembly, prefabrication, modern methods of construction (MMC) etc and these terms are all used interchangeably (Arif & Egbu, 2010; Goulding & Arif,

2013; Goulding *et al.*, 2014; Taylor, 2010). For the purpose of this study, it will be referred to as OSM. Nadim and Goulding (2010), argued that, offsite manufacturing falls under the broad umbrella of Modern Methods of Construction (MMC). Over the years, quite a number of definitions have been used to describe offsite manufacturing (Taylor, 2010). OSM can be defined as processes that incorporate prefabrication and pre-assembly to produce units and or modules that are then transported to site and positioned to form a permanent work (Emmitt & Gorse, 2010; Gibb, 1999; Gibb & Isack, 2003; Jaillon & Poon, 2008). In the opinion of MBI (2010), offsite manufacturing refers to any part or aspect of a construction process that is carried out in a controlled condition away from the actual site where the building is or will be situated. But Gibb and Pendlebury (2006), went a step further and defined OSM as a term used to describe a range of applications where structures, buildings or parts are manufactured and assembled away from the site before they are finally installed into positions. In a nutshell, offsite manufacturing involves moving operations that are traditionally completed onsite to a manufacturing environment (Gibb & Pendlebury, 2006) and this in turn improves the quality, customer satisfaction, efficiency, predictability of delivery timescale and sustainability of project (Nadim & Goulding, 2010). Several benefits are obtainable from the use/adoption of OSM. These benefits have been categorized into sustainable benefits and process and objective based benefits. These benefits were highlighted in the works of (Arif *et al.* (2012a); Arif and Egbu (2010); Boyd *et al.* (2013); Gorgolewski (2003); Jaillon and Poon (2010); Pan *et al.* (2004); Taylor (2010)). The benefits of offsite manufacturing are highlighted in Figure 1. Gorgolewski (2003) identified the sustainable benefits of OSM, they are: 1) Less Impact on the Surroundings; 2) Reduced Level of Defect; 3) Less Waste in Manufacture; 4) Transportation; 5) Greater Efficiency in the use of Resources, Both Materials and Labour.

Pitt *et al.* (2009) asserted that 40 per cent of all UK waste (including greenhouse gas emissions) is produced by the construction industry. It has also been observed that most of these wastes generated from construction sites are deposited in landfills (Gorgolewski, 2003). Also, it was observed that, about 13 per-cent of materials delivered to sites are never used and are therefore turned into waste(Gorgolewski, 2003). In the case of Nigeria, as opined by Ajayi *et al.* (2008), a large volume of waste is generated in an average Nigerian site. It was found out that most wastes were generated from demolition works on site and material handling. To reduce waste generated on site, based on a research conducted by WRAP (2007), it was observed that between 70 per cent and 90 per cent of waste reduction could be achieved with the use of OSM (depending on the particular OSM process being adopted). Also, it is easier to gather and recycle waste generated from OSM than it is when using traditional construction method (WRAP, 2007). Also, with regards to the project objective and process, there are many benefits obtainable (Figure 1).

In the opinion of Gibb and Pendlebury (2006), “time is a big-plus for offsite”. The time spent on the site depends on the amount of factory produced components and those produced traditionally (Taylor, 2009). Construction time is normally affected by material shortage, skills shortage and bad weather conditions. In the case of OSM, these issues have been tackled because most the building components are manufactured in factories and transported to site, this drastically reduces the amount of time spent on site (Taylor, 2009). As a result of the short time spent on site, it is easier to predict completion dates and also access restricted site areas, for example airport closures and school holiday (Gibb & Pendlebury, 2006). As identified by Taylor (2009), the issues of material shortage and weather were also found to be similar to Nigeria, as argued by Taylor (2009) to tackle these issues, the use of OSM can be adopted, this will help reduce the overall time spent on projects. In the works of (Arif *et al.* (2012a); Blismas and Wakefield (2009); Gibb and Isack (2003); Lu (2009)), it was observed that one of the most important benefits of OSM was time, i.e. reduction in the time spent on site and faster pace of delivery of projects.

OSM is believed to be more expensive than more established techniques (traditional method) NationalAuditOffice (2005). But Gibb and Pendlebury (2006) argued that, savings from OSM can be achieved in the areas of cost certainty and reduced risk, less overall life cycle costs, better quality of building which will in-turn lead to reduced maintenance cost, reduced preliminaries and site overhead, reduced construction time which can result in cost benefit from early occupation of the property. In the opinion of WRAP (2007), based on research conducted, it was observed that savings can be achieved in the use of OSM as a result of reduction in waste of building materials especially bricks. In Nigeria were sandcrete blocks are generally used, incorporating OSM will go long way in reducing waste on site.

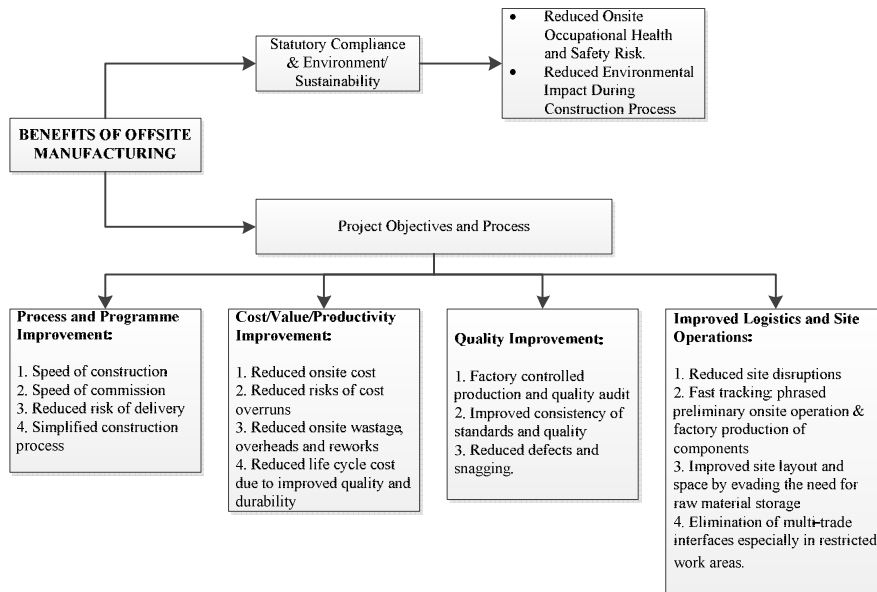


Figure 1. Benefits of OSM (Fussell *et al.*, 2007)

In the opinion of the National Audit Office (2005), OSM meets the three quality requirements of durability, whole life cost and performance. In the works of (Arif *et al.* (2012a); Fussell *et al.* (2007); Gibb and Isack (2003)), based on researches conducted in India, Australia and UK respectively, it was realised that achieving greater quality was one of the major benefits of OSM and also one of the key drivers to its adoption in those countries. Quality can better be achieved within a factory and also products consistency can be better achieved while working in a controlled environment (factory) (Gibb & Isack, 2003). The problem of housing in Nigeria is not only in terms of quantity but also quality (Olayiwola *et al.*, 2005), as such adopting OSM will improve housing delivery efforts in terms of quantity and quality. Reduction in wet trades, site disruptions and having more certainty over the control of projects, was found to be an important benefit of OSM (Gibb & Isack, 2003). A good example cited by Gibb and Isack (2003) is, working in a prison, where contractors have to be escorted to and from their site and all employees have to be properly scrutinised, but if OSM is adopted, the amount spent on security will be reduced as less time will be spent on site by the contractor. Also in the case of airports, roads and rail projects, site access and working space are normally limited; as a result, OSM was seen to be of great benefit. OSM is a construction technique that has been adopted in a good number of countries for different reasons. In Nigeria, the current housing deficit demands that housing units need to be provided at a faster pace and from the experiences of other countries, OSM can deliver housing units faster and with superior quality compared to traditional construction.

4. Discussion

There are numerous factors hindering housing delivery in Nigeria (Emmanuel, 2012). One of the factors identified was high population growth (Akinmoladun & Oluwoye, 2007). As a result of rapid increase in population, there is pressure on the available housing stock. As stated by (Arif *et al.* (2012a); Gibb and Pendlebury (2006); Lu (2009)), time is a big plus for OSM, as such the use of OSM in the Nigerian housing sector will help increase the rate of housing delivery. There are suggestions that OSM can save the time spent on construction by between 30 – 50% compared to traditional construction technique (MBI, 2010). Another problem of housing delivery in Nigeria as identified by Ayedun and Oluwatobi (2011) was skills shortage. The current situation in Nigeria suggests that there is a shortage in manpower necessary for adequate delivery of the needed housing units. One of the drivers to the uptake of OSM in some countries as found by (Arif *et al.* (2012a); Blismas and Wakefield (2009); Gibb and Isack (2003)) was skills shortage. Since OSM requires fewer tradesmen (Blismas & Wakefield, 2009), its adoption will eliminate the problem of skills shortage. The issue of unwillingness to innovate is one that is associated with the construction industry all over the world, Ayedun and Oluwatobi (2011) identified this problem with the Nigerian construction industry. OSM is a construction technique that is being used in a number of countries as various countries have found different reasons to

incorporate OSM into their construction processes. For OSM to be adopted in Nigeria, effort needs to be put by all the stakeholders involved. Whilst it is important to acknowledge the benefits associated with OSM, there are some barriers that have been found to hinder its uptake (Arif *et al.* (2012a); Fussell *et al.* (2007); Goodier and Gibb (2005); Jonsson and Rudberg (2013); Pan *et al.* (2004); Rahman (2013); Zhai *et al.* (2013)). Some barriers that have been found to be hindering the uptake of OSM include; negative image, reluctance to innovate, perception of stakeholders, perceived higher cost, quality etc. Goodier and Gibb (2005) identified negative image as one of the barriers to the uptake of OSM; and for the Nigeria housing sector to adopt OSM, it will need to present a good image about OSM. Arif *et al.* (2012b) suggested that the OSM industry should focus more on visualisation and simulation technologies as a means of creating awareness on OSM. This way, when people see what is achievable using OSM, it is easier for it to be accepted. Notwithstanding this, the uptake of OSM is influenced by the perception of housing developers as to the advantage and disadvantage of OSM (Pan *et al.*, 2004). The issue of perception does not only lie on the developers, surveyors are also not familiar with OSM, as such, they do not really understand how to assess such properties (Pan *et al.*, 2004). Also, customers/clients are not really aware of what OSM is all about and as a result, they are more inclined to follow the traditional method of construction (which stifles OSM adoption). Given this, if OSM was to be adopted in Nigeria, it is important that such bodies as the Nigerian housing sector (and other allied professionals), critically reviews extant literature and seminal reports where OSM is already in use elsewhere.

5. Conclusion

With the housing deficit of approximately 17 million housing units, there is an exigent need to address this imbalance. From the experiences of other countries, OSM has the potential of improving housing delivery in terms of quantity and quality. Even though OSM has extolled many benefits, it is important to also note that there are barriers that have been found to hinder its uptake in other countries. For the Nigerian housing sector to incorporate OSM into the sector, it is important to learn from the experiences of other countries that have already incorporated OSM. Also, the government should try to encourage research and development in the area of improving housing delivery efforts in order to procure policies that will move the housing sector forward and help reduce the housing deficit.

References

- Ademiluyi, I. A. (2010). Public Housing Delivery Strategies in Nigeria: A Historical Perspective of Policies and Programmes. *Journal of Sustainable Development in Africa*, 12(6), 153 - 161.
- Adenuga, O. A. (2013). Factors Affecting Quality in the Delivery of Public Housing Projects in Lagos State, Nigeria. *International Journal of Engineering and Technology*, 3(3), 332 - 344.
- Ajayi, O. M., Koleoso, H. A., Soyingbe, A. A., & Oladiran, O. J. (2008). *The Practice of Waste Management in Construction Sites in Lagos State; Nigeria*. Paper presented at the The construction and building research conference of the Royal Institution of Chartered Surveyors, Dublin Institute of Technology, Ireland.
- Akinmoladun, O. I., & Oluwoye, J. O. (2007). An Assessment of why the Problems of Housing Shortage Persist in Developing Countries: A Case Study of Lagos Metropolis, Nigeria. *Pakistan Journal of Social Science*, 4(4), 587 - 598.
- Arif, M., Bendi, D., Sawhney, A., & Iyer, K. C. (2012a). State of offsite construction in India-Drivers and barriers. *Journal of Physics: Conference Series*, 364(1), 012109.
- Arif, M., & Egbu, C. (2010). Making a Case for Offsite Construction in China. *Engineering, Construction and Architectural Management*, 17(6), 536 - 548. doi: 10.1108/09699981011090170
- Arif, M., Goulding, J., & Rahimian, F. (2012b). Promoting Off-Site Construction: Future Challenges and Opportunities. *Journal of Architectural Engineering*, 18(2), 75-78. doi: 10.1061/(ASCE)AE.1943-5568.0000081
- Ashkin, R. (2013). *Innovative Building Technologies – The Social Housing Angle*. Paper presented at the Housing Africa 2013, Abuja, Nigeria, 14th August 2013. <http://gemsigeria.com/wordpress/wp-content/uploads/2012/12/Innovative-Building-Technologies-Housing-Africa.pdf>
- Ayedun, C. A., & Oluwatobi, A. O. (2011). Issues and Challenges Militating against the Sustainability of Affordable Housing Provision in Nigeria. *Business Management Dynamics*, 1(4), 1 - 8.
- Azman, M. N. A., Ahamad, M. S. S., Majid, T. A., & Hanafi, M. H. (2010). *Perspective of Malaysian Industrialized Building System on the Modern Method of Construction*. Paper presented at the 11th Asia Pacific Industrial Engineering and Management Systems Conference, Melaka, Malaysia, 7 – 10 December 2010. <http://www.apiems.net/archive/apiems2010/pdf/MM/427.pdf>
- Blismas, N., & Wakefield, R. (2009). Drivers, constraints and the future of offsite manufacture in Australia. *Construction Innovation*, 9(1), 72-83. doi: 10.1108/14714170910931552.
- Blismas, N., Wakefield, R., & Hauser, B. (2010). Concrete prefabricated housing via advances in systems technologies: Development of a technology roadmap *Engineering, Construction and Architectural Management*, 17(1), 99 - 110. doi: 10.1108/09699981011011357
- Boyd, N., Khalfan, M., & Maqsood, T. (2013). Off-Site Construction of Apartment Buildings. *Journal of Architectural Engineering*, 19(1), 51-57. doi: 10.1061/(ASCE)AE.1943-5568.0000091

- Chan, P. W., & Dainty, A. R. J. (2007). Resolving the UK construction skills crisis: a critical perspective on the research and policy agenda. *Construction Management and Economics*, 25(4), 375-386. doi: 10.1080/01446190600863152
- CIOB. (2008). Skills Shortages in the UK Construction Industry. Berkshire: Chartered Institute of Building.
- Dada, A. (2013, February 4, 2013). Housing deficit: Experts canvass new construction system, Newspaper, *The Punch*. Retrieved from <http://www.punchng.com/business/homes-property/housing-deficit-experts-canvass-new-construction-system/>
- Emmanuel, J. B. (2012). "Housing Quality" To the Low Income Housing Producers in Ogbere, Ibadan, Nigeria. *Procedia - Social and Behavioral Sciences*, 35(0), 483-494. doi: <http://dx.doi.org/10.1016/j.sbspro.2012.02.114>
- Emmitt, S., & Gorse, C. (2010). *Barry's Advanced Construction of Buildings* (2 ed.). Chichester: Wiley-Blackwell.
- Experian, & SamiConsulting. (2008). 2020 Vision – The Future of UK Construction (pp. 87): ConstructionSkills.
- Fussell, T., Blismas, N., Wakefield, R., Bullen, P., Sher, W., Bird, R., & Brotherhood, S. (2007). Offsite Manufacture in Australia (pp. 82). Brisbane, Australia: Cooperative Research Centre for Construction Innovation.
- Gibb, A. (1999). *Off-site fabrication: prefabrication, pre-assembly and modularisation*: Wiley.
- Gibb, A., & Isack, F. (2003). Re-engineering through pre-assembly: client expectations and drivers. *Building Research & Information*, 31(2), 146-160.
- Gibb, A., & Pendlebury, M. (2006). Buildoffsite Glossary of Terms. from Buildoffsite http://www.buildoffsite.org/pdf/BuildoffsiteglossaryV1.3revised_july06.pdf
- Goodier, C., & Gibb, A. (2005). Barriers and opportunities for offsite in the UK. *Abdul Samed Kazi (ed). Systematic Innovation in the Management of Project and Processes, cib Helsinki International Joint Symposium*, 144 - 158.
- Gorgolewski, M. (2003). Offsite fabrication. *Green Building Magazine*, 12.
- Goulding, J., & Arif, M. (2013). Offsite Production and Manufacturing – Research Roadmap Report. *CIB Publication 372*, 43.
- Goulding, J., Pour Rahimian, F., Arif, M., & Sharp, M. D. (2014). New offsite production and business models in construction: priorities for the future research agenda. *Architectural Engineering and Design Management*, 1 - 22. doi: 10.1080/17452007.2014.891501
- Jaillon, L., & Poon, C. S. (2008). Sustainable construction aspects of using prefabrication in dense urban environment: a Hong Kong case study. *Construction Management and Economics*, 26(9), 953-966. doi: 10.1080/01446190802259043
- Jaillon, L., & Poon, C. S. (2010). Design issues of using prefabrication in Hong Kong building construction. *Construction Management and Economics*, 28(10), 1025-1042. doi: 10.1080/01446193.2010.498481
- Jonsson, H., & Rudberg, M. (2013). Classification of production systems for industrialized building: a production strategy perspective. *Construction Management and Economics*, 1-17. doi: 10.1080/01446193.2013.812226
- Kabir, B., & Bustani, S. A. (2009). *A Review of Housing Delivery Efforts in Nigeria*. Paper presented at the ISA International Housing Conference, University of Glasgow, Scotland, September 1st - 4th. http://www.gla.ac.uk/media/media_129767_en.pdf
- Lu, N. (2009). *The Current Use of Offsite Construction Techniques in the United States Construction Industry*. Paper presented at the Construction Research Congress.
- Makinde, O. O. (2014). Housing Delivery System, Need and Demand. *Environment, Development and Sustainability*, 16(1), 49 - 69. doi: 10.1007/s10668-013-9474-9
- MBI. (2010). Improving Construction Efficiency & Productivity with Modular Construction (pp. 1 - 16). Charlottesville, Virginia, USA: Modular Building Institute.
- McGraw-HillConstruction. (2011). Prefabrication and Modularization: Increasing Productivity in the Construction Industry. In E. Fitch (Ed.), *SmartMarket Report*. Bedford, Massachusetts, USA.
- Nadim, W., & Goulding, J. S. (2010). Offsite production in the UK: the way forward? A UK construction industry perspective. *Construction Innovation: Information, Process, Management*, 10(2), 181 - 202. doi: 10.1108/14714171011037183
- NationalAuditOffice. (2005). Using modern methods of construction to build homes more quickly and efficiently. Victoria, London: National Audit Office.
- Nkah, V. (2013). Nigeria's housing deficit: Balancing the equation. *The Economy*.
- Olayiwola, L. M., Adeleye, O., & Ogunshakin, L. (2005). *Public Housing Delivery In Nigeria: Problems And Challenges*. Paper presented at the World congress on Housing, Pretoria, South Africa <http://repository.up.ac.za/bitstream/handle/2263/10438/Public%20Housing%20Delivery%20In%20Nigeria%20Problems%20And%20Challenges.pdf?sequence=1>
- Pan, W., Dainty, A. R. J., & Gibb, A. G. F. (2004). *Managing innovation: a focus on off-site production (osp) in the UK housebuilding industry*. Paper presented at the 20th Annual ARCOM Conference, Heriot Watt University, Edinburgh, Scotland
- Pitt, M., Tucker, M., Riley, M., & Longden, J. (2009). Towards sustainable construction: promotion and best practices. *Construction Innovation: Information, Process, Management*, 9(2), 201 - 224. doi: 10.1108/14714170910950830
- PrefabNZIncorporated. (2013). Prefab Roadmap: A Way Forward for Prefabrication in New Zealand (2013-2018) (pp. 1 - 29). Wellington. New Zealand: PrefabNZ Incorporated.
- Rahman, M. (2013). Barriers of Implementing Modern Methods of Construction. *Journal of Management in Engineering*, 0(ja), null. doi: doi:10.1061/(ASCE)ME.1943-5479.0000173
- Schäfer, D. (2010). Skills shortage threatens German engineering. *Financial Times*. Retrieved from <http://www.ft.com/cms/s/0/3a782956-4c05-11df-a217-00144feab49a.html#axzz2qWFObVxF>
- Subair, G. (2013). Nigeria has N59trn housing deficit *Nigerian Tribune*. Retrieved from <http://www.tribune.com.ng/news2013/index.php/en/news/item/25657-nigeria-has-n59trn-housing-deficit.html>
- Suleiman, M. (2013). Nigeria: Stakeholders Identify Factors Against Affordable Housing, *Daily Trust*.
- Taylor, M. D. (2010). A definition and valuation of the UK offsite construction sector. *Construction Management and Economics*, 28(8), 885-896. doi: 10.1080/01446193.2010.480976
- Taylor, S. (2009). Off-site Production in the UK Construction Industry - A Brief Overview: Buildoffsite.
- Ukwayi, J. K., Eja, E. E., Ojong, F. E., & Otu, J. E. (2012). An Assessment of Housing Delivery in Nigeria: Federal Mortgage Bank Scenario. *Canadian Social Science*, 8(6), 68 - 74.
- Wolstenholme, A. (2009). Never Waste a Good Crisis: A Review of Progress since Rethinking Construction and Thought for the Future (pp. 31). Warwick House, London: Constructing Excellence.
- WRAP. (2007). Current Practices and Future Potential in Modern Methods of Construction (pp. 1 - 21). Banbury, Oxon: WRAP.
- Zhai, X., Reed, R., & Mills, A. (2013). Factors impeding the offsite production of housing construction in China: an investigation of current practice. *Construction Management and Economics*, 1-13. doi: 10.1080/01446193.2013.787491