LEAN –IN- NIGERIAN CONSTRUCTION: STATE, BARRIERS, STRATEGIES AND "GO-TO-GEMBA" APPROACH

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ABSTRACT

Lean-in-Construction, which is alien to Nigerian construction process, offers valuable techniques to manage construction at improved workflows and minimal waste generation. This paper therefore examines the exportation of lean to the Nigerian construction process by exploring the practitioners' extent of knowledge and scope of application of lean techniques. However, the survey research involving ten companies via quota sampling technique and personal interviews is based on Toyota production principles only i.e. lean production. The paper reveals key strategies for absorption of lean with approaches to build and improve on JIT and concurrent design and construction in Nigeria. It therefore recommends these suggested-strategies for the entrenchment of lean in Nigerian construction process to combat waste generations and enhance workflows.

KEY WORDS

lean production, Nigeria, construction, barriers, approaches, waste minimization

INTRODUCTION

Construction wastes are excess resources used than required for construction production. Its incidence in Nigeria is high and also has negative impacts on Nigerian construction industry and environment (Olateju, 1997; Ademoroti and Ozo, 1993). However, several waste minimization strategies and models have been postulated from past studies such as waste management plan (Greenwood et. al. 2003; Poon et. al. 2004; McDonald and Smithers, 1998), Meta model (Garnett, 1999), waste management mapping model (Shen et. al. 2004), waste handling methods (Poon et. al. 2004; Motete et. al. 2003) and so on.

In this regard, lean-in-construction offers valuable and important capabilities such as value stream mapping, kaizen, and 5s and so on to enhance workflow and minimize waste generation. According to Dulaimi and Tanamas (2001), the application of lean techniques to construction eliminates non-value steps i.e. waste and better meet client's demands and dramatically improves the Architectural/ Engineering/ Construction (AEC) process and products. Interestingly, unlike Nigeria this has been used with significant benefits in countries like Singapore (Dulaimi and Tanamas, 2001), UK (Common et. al. 2000), Brazil (Silva and Cardoso, 1999), Chile (Alarcon and Diethelm, 2001) and so on.

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Lean production is a Toyota production principle, which focuses on mass production. The essence of this research is to endeavour to introduce it to the Nigerian construction process with the ultimate aim of reducing waste and alleviating its negative effects.

The key objectives are: to examine the possibility of the existence of lean in Nigerian construction process; to find out the level of knowledge and application of lean; to question the respondents on the best strategies to transfer lean to Nigerian construction and likely barriers; to find out the respondents' likelihood of implementing lean in future projects; and to examine the operation of just-in-time delivery (JIT) and concurrent design and construction in the companies and offer means of building and improving on them in Nigeria (i.e."Go-to-Gemba" approach).

LEAN PRODUCTION (LP).

Lean concept is a Western interpretation of the Japanese Production Philosophy in the car manufacturing industry (Bertelsen and Koskela 2005). Bertelsen (2002) posits that Womack et. al. (1990, 1996) introduced the concept to the western industry in 1990 and termed it Lean Production. The core concept behind LP is to enable the flow of value creating work steps while eliminating non-value steps (Dulaimi and Tanamas 2001).

Howell (1999) highlights lean production (LP) concepts as: identify and deliver value to the customer by eliminating anything that does not add value; organize production as a continuous flow; perfect the product and create reliable flow through stopping the line, pulling inventory, distributing information and decision-making; and pursue perfection by delivering on order a product meeting customer requirements with nothing in inventory. He states further that LP originated in Japan from the Toyota car production by Engineer Ohno when he realized that the mass and craft production of cars often give room to waste and defects in the cars produced. It was transferred to America when the Japanese extended their production base their. Engineer Ohno instructed workers to stop the line as soon as they receive any defective product or part from the upstream. This is contrary to the American plant where only the plant manager alone could stop the line. He recognized that reducing the cost or increasing the speed could add waste if variability was put into flow of work by the "improvement". Howell (1999) adds that this resulted into decentralization of decision-making and a simple system of cards or bins was used for controlling inventories to inform the upstream station the downs streams demand.

Similarly, Howell and Ballard (1998) identify five principles of LP with their correspondent concepts and the works of Picchi (2001),Pheng and Tan (1997), Horman (2001) submit on the concept of lean.

The lean production paradigm strongly relates process and operation but stresses their distinction. Process refers to the flow of products from one worker to another which can be improved by eliminating non value adding work while operations refers to the discrete stage at which a worker (or equipment) may work on different products (Shingo, 1988 cited in Formoso et al.2002).

Furthermore, Lean concepts' implications can be demonstrated in several ways. For example Alarcon and Ashley (1999) demonstrate the impact of variability and buffer size on project cost and schedules. They found out that projects with longer buffer size experience little increase in project duration when variability increases but they are more expensive with small variabilities; and that variability can significantly increase project costs (Al-sudairi et. al. 1999).

RESEARCH METHOD.

An interview schedule was prepared to educate the respondents on lean and then elicit the required in formation from them. The sampling technique used is quota system of 50-50 between private and public companies. A total of 10 companies were interviewed i.e. 5 private and 5 public. The findings are tabulated and frequency is used to analyze some of the data to achieve the research objectives. The interview schedule consists of three sections, which are:

1. History of lean production:

This is the educative section. The researcher talks briefly about the meaning, origin and operation of lean. Some of the techniques explained here to each of the respondents before questioning them are concurrent design and construction; project definition; collaborative design; design for buildability; pull scheduling; supplier managed inventories; just - in – time deliveries; multi skilled craft workers; last planner; supply chain management; effective management of primary services providers such as sub-contractors, consultants and suppliers; standardization; and decentralization.

2. General information about the respondents and their companies.

The companies' profile is shown in Table 1 while that of the respondents is shown in Table2.

Table 1: Organizations' Profile.

Nature	Type	Age (in years)	Projects executed in past 5 years	No. of Construction professionals
Contracting (4)	Private (5)	<5 (1)	1 – 5 (2)	1 – 5 (1)
Client organization (4)	Public (5)	6 – 10 (1)	6 - 10 (3)	6 – 49 (6)
Developers (2)		>20 (8)	>20 (5)	>49 (3)

Table 2: Respondents' profile.

Profession	Highest academic qualification	Pro. Grade of membership	Professional body	Position in company
Architecture (2) Building (2) Civil Eng. (5) Q. Surveying (1)	HND (3) B.Sc (4) M.Sc (3)	None (1) Associate (1) Graduate (3) Corporate (5)	NIOB (3) NIQS (1) NIA (2) NSE (4)	A.D. (2) S.M (3) Architect (2) C.M (1) M.D (1)

Note that NIOB means Nigerian Institute of Building; NIQS means Nigerian Institute of Quantity Surveying; NIA means Nigerian Institute of Architect; NSE means Nigerian Society of Engineers; AD means Assistant Director; S.M means Site Managers; C.M means Contract Managers; MD means Managing Director.

The profiles shown in Tables 1 and 2 reveal that the sampled companies are capable of implementing lean and most of the respondents can influence decisions in their various organizations. Hence, lean can be easily introduced into their companies if they understand and accept it.

3. Questions on lean related to the research objectives.

Some of the questions centers on: awareness of lean principles and techniques; rate of implementation of lean on a Likert scale of always, sometimes, rarely and never; method of procurement, storage system and sources of design; likelihood of implementing lean principles and techniques on their projects; suggestions on the best approaches to transfer lean principles and techniques to Nigeria construction process; likely problems to encounter in implementing lean; willingness to send their staff to participate in lean training and programmes.

FINDINGS AND DISCUSSIONS.

State of lean in Nigeria

Table 3 indicates that the level of knowledge/awareness is low. Only two out of the ten respondents signify that they have heard about lean stating that it can improve efficiency and productivity. Similarly, Table 4 reveals that lean is not implemented at all in Nigerian construction process. However, further questioning on their method of procurement, storage system and sources of design reveals that some of them practice: Just-in-time delivery of their materials and components on their project and; concurrent design and construction. This is further enhanced by the production of their design in house in some of the companies.

Table 3**:** Level of Awareness/Knowledge and Application of Lean

	Frequency
Yes	2
No	8

Table 4**:** Frequency of implementation.

	Frequency
Always	-
Sometimes	-
Rarely	-
Never	10

This finding indicates that the level of awareness and knowledge lean is low. However, there is the existence of some lean approach in the companies' processes e.g. JIT with concurrent design and construction but in conjunction with traditional approach.

Respondents' Likelihood of Implementing Lean Techniques on Their Projects.

The responses are indicated in Table 5. The Table reveals that seven of the respondents are interested in implementing lean. This is probably because of the negative impacts of waste on their organizations' profit,

image and competitiveness. Those who are indecisive are as a result of the stringent protocols in their organizations and they are not in the position to introduce anything new. The two of them are from public organization and they opine that introducing new idea into construction such as lean has to come from the State Governor. Access to the Governor is difficult because it is through the Special Adviser to the Governor. Also, most government projects are procured through contract system and contract award is politically motivated and so may not favour lean's introduction. Contract system is favoured in government projects because it allows corruption through inflating contract sum and is a way of rewarding their political loyalist hence lean may not be permitted. The Governor must understand and support lean. He must be committed to its implementation in government's projects. Decision taking and power is highly centralized in government service. Hence it may be easier to commence implementation of lean in private companies before encroaching into public companies.

Table 5: Respondents' Likelihood of Implementing Lean on their Projects.

	Frequency
Yes	7
No	1
Indecisive	2

It should also be noted that one of the respondents signified "No" stating that lean is too cumbersome and that our environment will not permit it.

Likely Barriers to Implementation of Lean.

The responses to this question produce the following problems grouped under seven sub-headings:

1. Skill and knowledge related:

This includes: lack of understanding of the concept; lack of technical skill among staff or professionals; non-engagement of new knowledgeable staff; high-level illiteracy among construction operatives; lack of training; and in consistency in operatives' training which will not enhance lean.

2. Management related:

This includes: centralization of decision; difficulty in getting top management support and commitment; and lack of project definition

3. Government related:

This includes: Government bureaucracy and instability.

4. Attitude related:

This includes: wrong motives; selfishness among professionals; lack of transparency; cultural problem in practice; corruption; lack of integrity; wrong attitude to change; lack of confidence in indigenous professionals leading to over reliance on expatriates; lack of team spirit among professionals; and arrogation of unnecessary power to the Architects.

5. Resources related:

This includes: lack of basic social amenities that can enhance implementation of lean; lack of equipment; and inadequate funding of projects.

6. Logistic related:

This includes: logistics' problems; delay in delivery; and scarcity of some materials.

7. Others:

Which include: inflation; lean may lead to additional cost because it is cumbersome & complex; peculiar nature of construction different from manufacturing; there must be storage (buffer); poor wages of professionals; unstable markets for construction; lack of incentives; and geographical factor may hinder concurrent design and construction.

As many as 36 problems in seven groups were identified. This finding also partly correlate with the discoveries of previous researchers on the barriers or problems of implementing lean (Dulaimi and Tanamas, 2001; Common et. al.2000; Garnett,1999)

Suggested StrategiesTo Take-Up Lean In Nigerian Construction.

The responses to this question suggest the followings strategies grouped under six sub headings:

1. Education and skill development:

This includes: enlightenment/training of staff at all levels on lean; engagement of skillful site operatives; competent/skillful professionals; introduction of lean concept to school curriculum; promotion of the concept to companies, professional bodies and major stakeholders; and active, basic and applied research on lean.

2. Management:

Which includes: decentralization of construction management to enhance workflow; and top management support and commitments.

3. Government:

Which includes: government reorientation in their approach to projects' execution; provision of basic infrastructure and enabling environment favourable to lean; establishment of standards for construction in Nigeria; favourable government policy; and professional bodies should work closely with the government to introduce lean.

4. Operations:

Which include: reduction in the usage of subcontractors; usage of precast element; usage of specialist contractors; and reliance on indigenous professionals.

5. Attitudinal change:

Which includes re-orientation of workers to eliminate nonchalant attitudes of government workers; and cooperation and team spirit among professionals.

6. Others:

Which include: good relationship with suppliers; adequate funding of projects; distribution of gains from implementation to all concerned; stability of construction markets; and synchronizing designs.

The respondents to take up lean in Nigeria suggested 24 approaches. This finding is partly similar to some of the suggestions of previous researchers on the implementation of lean (Howell and Ballard, 1998; Alarcon and Diethelm, 2001; Mecca, 1999; Common et.al. 2000).

Indication of Staff Participation in Training Programme on Lean.

The response to this is shown in Table 6. This is corroborating the finding in Table 5. This is an indication that lean is seriously needed to combat waste on Nigerian projects as the case in Turkey (Ballard and Polat, 2005). It also signifies the recognition of the importance of training and education to introduce lean.

Table 6: Indication of Staff Participation in Training Programme on Lean.

	Frequency
Yes	8
No	2

"GO-TO-GEMBA" APPROACH.

During the fieldwork, some of the respondents interviewed claimed to be practicing JIT and some concurrent design and construction. The author therefore decided to investigate their management process regarding these claims with a view to offer strategies to build and improve on them. This approach is reffered to as "Go-to-Gemba" approach.

Just-in-time (JIT).

Observations from the companies' projects reveal that:

1. This technique is not "practiced" for all materials and components.
2. There is a central storage, which is not on site from where those materials are supplied to the sites when they need them.
3. There is still the existence of some materials storage on site, excesses and offcuts. This is noted for steel, wood, and loose materials.

There are no specific suppliers for some materials e.g tiles .The companies even go out to make direct purchase at times and patronize of new suppliers. They also experience late deliveries and delays.

The following strategies are suggested for JIT in these construction sites:

- There must be a programme of work showing the sequence of work and the time when a particular activity will be done. Some of the construction companies have no programme of work before the commencement of the work, so they cannot determine the materials' and components' requirement ahead of time. The programme will aid them to know when certain materials will be needed and early contacts can be made. Problems in securing the materials at that time will come to light and if changes are required it will be done on time with the specifier. This programme should be drawn with the involvement and participation of all concerned with it including the suppliers.
- Preparation of materials' and components' requirement schedule and made available to all mapped suppliers and

component contractors by designated personnel. This will show the type, size and quantity of all materials early before project's commencement.

- Direct ordering from manufactures to enhance deliveries. Some of the manufacturers have transportation system to deliver their materials and components. They can also be approached to produce required size and shape to minimize off cuts.

Prefabrication of some components in a different yard prior to main construction by the companies. This will enhance reduction of wet trades on site, timely delivery and precise job done. Components such aluminium and woodwork can be produced by the company. Some foreign companies in Nigeria do this especially for concrete elements but it is not found in the indigenous companies.

- Penalty for late deliveries and rewards for timely deliveries. This must be part of the conditions of contract with various subcontractors and suppliers. The reward may not necessary be monetary but can be inform of repeat orders.
- Consistent and long term relationship with suppliers and component contractors.

Concurrent Design and Construction.

Investigation reveals that in an attempt for design and construction to take place simultaneously in some projects, there is delay in the supply of production documents. Constuction sites have had to wait for designers to meet up. Certain decisions are even taken on sites without design and some of these decisions lead to reworks when the design is finally ready. There is no control over the designers because they are external source and they have other workloads, which takes their time. So many design changes and revisions occur on sites, which are communicated verbally, or at times in sketches when these designs are done in a hurry. At times the designers, due to inexperience, lack of awareness of site conditions and lack of technology to build and maintain the design inform these changes. As a result, the companies are not deriving much benefits (if any at all) from their practice of concurrent design and construction.

The following strategies are suggested for concurrent design and construction in these construction sites:

Plan:

This entails the following:

Identify the specific aspect of the job that you want to use concurrent design and construction. You don't have to experiment with the entire project for a start.

- Map out the relevant personnel concerned with the implementation and get their consent and commitment. Involve them fully from the outset and let them understand what you want to do and your goal.

Engage requisite professionals in the implementation. Nigerian construction industry is filled with quacks and they enjoy high patronage than the professionals due to "reduced cost"(this is partly responsible for incessant collapse of buildings in

Nigeria). They must be eliminated because they can't even understand or encourage new idea. Most designs are copied by these quacks and illiterates and will not encourage concurrent design and construction.

The usage of in-house design and construction teams will enhance the flow. Designs are done independently and likewise construction without any collaboration and inputs from other members until site work in the Nigerian traditional construction process. This will be difficult for concurrent design and construction, which can be solved by in-house team that has a common goal.

- Time is of essence in this regard. Therefore every process must be timed and adhered to.

Envisage probable bottlenecks and reason out solutions for them.

Execution:

Implement your plan.

Evaluation:

Evaluate your result and make observations.

Monitoring:

This entails making necessary adjustments for improvement and ensure compliance; and enlarge your scope and repeat the process.
This process is modeled as shown in Figure 1 and referred to as PEEM route.

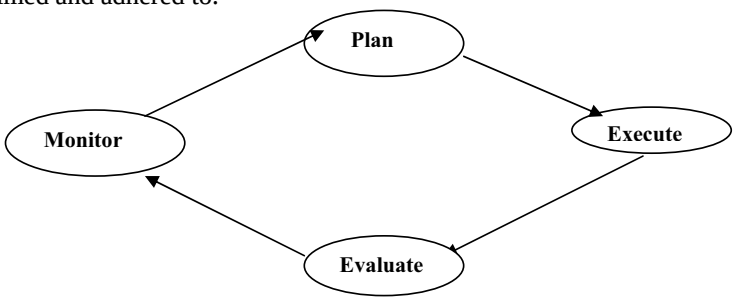

Figure 1:PEEM Route

CONCLUSION AND RECOMMENDATIONS

The study reveals that: the level of awareness and knowledge about lean is low; there is the existence of some lean approach in Nigerian construction companies' process with traditional approach; there is a high likelihood of the respondents' implementation of lean, similar result is achieved in the indication of staff's participation in lean training programmes; it may be easier to commence the implementation of lean construction in private companies before public companies. It also sheds light on: 36 likely problems in implementing lean in Nigerian construction companies; 24 suggested approaches to take-up lean in Nigeria; and approaches to build and improve on JIT and concurrent design and construction in Nigeria.

The study therefore recommends that: the approaches identified in this research are employed to take-up lean in Nigeria especially in private companies; Lean Construction principles and methods are studied;

test runs of not least Last Planner System™ are conducted and monitored; Professional bodies, researchers and institution of higher learning should embark on serious enlightenment/training programmes on lean to the Nigerian citizens and construction companies; and further research to examine the importance of these problems and approaches in taking up lean in Nigerian construction, this can result to modeling the approaches for effective take-up of lean in Nigeria.

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