

ASSESSMENT OF THE POTENTIAL BENEFITS AND BARRIERS TO ADOPTING LEAN CONSTRUCTION PRINCIPLES BY CLIENT ORGANISATIONS IN NIGERIA

IBRAHIM Muhammad Laminu^{1 *}, AHMADU Hassan Adaviriku², MUHAMMAD Ahmad Sani³, SHEHU Ismail Umar⁴, NENSOK Mohammed Hassan⁵

^{1*} Department of Quantity Surveying, Federal University Birnin Kebbi (FUBK), Nigeria.

^{2&3} Department of Quantity Surveying, Ahmadu Bello University (ABU), Zaria, Nigeria.

^{4&5} Department of Building, Federal University Birnin Kebbi (FUBK), Nigeria.

Correspondence: im.laminu@fubk.edu.ng

ABSTRACT:

The principles of lean construction are designed and intended to minimise waste throughout the construction process, thereby delivering greater value for money to the Client. However, the potential benefits and barriers to adopting lean construction principles by the Client's organisations in Nigeria have not been established, which is critical towards successful implementation. Thus, this study identified and assessed the potential benefits and barriers of adopting lean construction principles by client organisations in Nigeria. Quantitative research approach was adopted and questionnaires were distributed to the respondents. The target respondents are TETFUND beneficiary institutions. 67 copies of the questionnaire were distributed and 67% (45 copies of the questionnaire) were retrieved. The data collected was analysed using descriptive statistics that includes: frequency tables showing percentages, mean and Standard Deviation (SD). Maximise productivity and reduced waste are the most significant potential benefits of adopting lean construction principles by the client sector in Nigeria. While Poor planning, Inadequate resources, Corruption practices, Lack of awareness programmes and Lack of design constructability are identified as the major barriers of adopting lean construction principles. The Study reveals that the client sector of the Nigerian Construction Industry (NCI) acknowledges the potential benefit of adopting Lean Construction principles even though the barriers identified will hinder the successful implementation. However, there is need for more capacity building programmes and awareness campaign on the concept of lean construction principles in Nigeria. All stakeholders concerned should consider integrating lean construction into the tertiary education curriculum because of its importance and benefits to the construction industry at large.

KEYWORDS: Client Organisations, Lean Construction Principles, Lean Concept, Tertiary Institutions, TETFund.

INTRODUCTION

Lean Construction (LC) is defined as a way of managing work, reducing waste and adding value in construction (Howell & Reed, 2007). The idea of applying the lean production principle to construction was analyzed by some of the researchers in the Construction industry since 1990s (Salem, Solomon, Genaidy & Luegring, 2005). LC differs from present traditional construction management practice, it is generally based on production management principles, and it gives better result in all kinds of projects (Salem *et al.*, 2005). According to Aigbavboa *et al.* (2016) and Kasimu *et al.* (2019), the Lean Construction Principles (LCP) have been established as means of minimizing the waste in the process, duration, cost and labour of construction projects. Mohammed *et al.* (2019) described LCP as means of delivering value to the customers and eliminating things that do not add value to clients. Hence, LC is seen as an alternative approach that could significantly improve effective project delivery in the Construction Industry, thereby reducing waste and increasing productivity and added value.

In attempt to ascertain successful implementation and effectiveness of the LCP, researchers conducted studies on LCP in some countries like Brazil (Silva and Cardoso, 1999), Chile (Alarcon & Ashley, 1999), the UK (Common *et al.*, 2000), Singapore (Dulaimi & Tanamas, 2001), Abu Dhabi (Raid, 2012), Malaysia (Muhammad *et al.*, 2013), Turkey (Algan & Yasemin, 2013), and Nigeria (Ahiakwo *et al.*, 2013) and India (Gowtham & Sivakumar, 2017). However, effective implementation of Lean Construction Principles (LCP) critically depends on the readiness of the Construction Industry to adopt the Concept as well as identifying the potential benefits and barriers of adopting the LCP. With this, it is important for the Nigerian construction industry to equally explore widely, the benefits of lean construction, in order to attain the best practice and also to improve service

delivery process in the Construction Industry (Olamilokun, 2017).

Olamilokun (2017) investigated the readiness of Nigerian construction related professionals (Consultants) to adopt lean construction principles, while further studies by Owoseni (2017) and Mohammed *et al.* (2019) assessed the readiness of the Nigerian building contracting (construction) firms. Ibrahim *et al.* (2024) also conducted a study to assess the Client's organisations in adopting LCP.

Adoption of LCP can only be achieved when all the sectors of the Nigerian Construction Industry (NCI) have a fair level of awareness and stake to adopt it. Yet, the perception of the Client's sector of the NCI on the benefits and barriers to adopt lean Construction principle is not known which is very critical towards successful adoption LCP. Hence, this constitute a gap in knowledge which this study sets out to fill.

LITERATURE REVIEW

Lean Construction: Concept and Principles

The Concept of Lean construction was derived from the Toyota Production System, which focuses on creating value for clients while minimizing waste throughout the construction process. Key principles include value identification, waste elimination, continuous flow, pull-based production, and continuous improvement (Howell, 1999). Unlike traditional construction methods, lean construction fosters collaboration and flexibility, enabling teams to adapt to project changes efficiently. LCP are one of such innovative processes that bring about the much needed continuous improvement and desired change in the construction industry (Olamilokun, 2015).

In developed economies, lean construction has gained traction due to its proven benefits. Countries like the United States and Japan have successfully integrated lean principles into their construction projects, resulting in improved efficiency and cost

savings (Ballard & Howell, 2013). In contrast, developing nations face unique challenges, including limited access to advanced technologies and inadequate training programs.

The adoption of LC in Nigeria is still in its infancy. This makes it very critical to investigate the factors that will facilitate and those that will hinder the successful adoption of LCP by the stakeholders' organizations and the entire construction industry

Potential Benefits to Adopting LCP

LC has led to considerable improvement in the performance of CI professionals, particularly in design, construction and facility management (Olamilokun *et al.*, 2017). The application of lean methodologies has shown potential to enhance project delivery by streamlining workflows and fostering collaboration among stakeholders involved in construction projects (Hamzeh *et al.*, 2019). The benefits arise from the core lean principles seeking to minimize waste and optimize efficiency throughout the construction processes. LCP is seen as drivers/facilitators that can help the building industry to improve its productivity by ensuring effective communication and collaboration among all project stakeholders from inception to completion of building projects (Salem *et al.*, 2005). Several LC related studies have been reported, especially those that have to do with its success stories and inherent benefits (Olamilokun *et al.*, 2017). However, this study adopted eight (8) potential benefits for adopting LCP in Nigeria, identified by Olamilokun *et al.* (2017) and Owoseni (2017), which are:

- i. Improved design;
- ii. Improved health and safety;
- iii. Improved quality, fewer defect;
- iv. Greater customer satisfaction;
- v. Maximise productivity;
- vi. Reduced cost and inventory;
- vii. Reduced waste;

- viii. Reduced project schedule;

Barriers to Adopting LCP

Studies have identified several barriers, including, poor planning, corruption, a lack of technical expertise, insufficient awareness, and cultural resistance to change (Olamilokun 2015 & Owoseni, 2017; Aisha *et al.*, 2019; Nwaki *et al.*, 2021; Ogunbiyi *et al.*, 2021). However, Olamilokun *et al.* (2017) and Owoseni (2017) revealed that the barriers hindering the adoption of LCP can be classified into six broad categories, they are: Management issues, Financial issues, Educational issues, Government issues, Human attitudinal issues and Technical issues. This study adopts these broad classifications of barriers to conduct assessment of barrier factors to adopt LCP by the clients' organisation in Nigeria.

METHODOLOGY

Quantitative research approach was adopted due to the nature of the research problem and the data needed which requires data from many respondents in an economical and fast way. TETFUND beneficiary Tertiary institutions are the target population of this study. A list of the tertiary institutions that are TETFUND beneficiaries was obtained from the TETFUND website www.tetfund.gov.ng in March 2024 which shows that there are 200 institutions that are TETFUND beneficiary in Nigeria. For this research, a total number 67 was arrived as the sample size using Kish (1965) sampling formula. Purposive sampling technique which is a non-probability sampling technique was used in selecting the client organizations that are beneficiaries of TETFUND, taking note of ease of access to getting data, limited resources (time and budget) and logistical constraints, in addition to that not all the institutions have enough experience/projects to provide reliable answers to the question especially new established tertiary institutions.

Structured questionnaire was used to collect data for the study. The questionnaire consists of two sections (section A and B). Section A consists of general information about the respondent which include: Category of Institution affiliation, Years of experience, Respondent's position and the Respondent's work section. While Section B consist the potential benefits and barriers for the adoption of lean construction principle, all to be assessed based on the Likert 5 points scale 1 to 5 where 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree and 5 = strongly. Respondent are required to assess the potential benefits and barriers for the

adoption of lean construction principles based on the client perspectives.

The data collected was analyzed using descriptive statistic with statistical package for social sciences (SPSS) software. Section A of the Questionnaire was analysed using Frequency and Percentage Tables. While in Section B, mean score and relative ranking of individual grouping were used to analyze the potential benefit and barriers of adopting lean construction principles by the selected TETFUND beneficiary institutions.

RESULTS AND DISCUSSIONS

Results and findings

Demographic profile of respondents

Table 1: Questionnaire Survey response rate

Status	Frequency	Percentage (%)
Questionnaires retrieved	45	67.16
Questionnaires not retrieved	22	32.84
Questionnaires distributed	67	100

From Table 1, a total number of 67 questionnaires were distributed; a total number of 45 were retrieved constituting 67.17% of the distributed questionnaires and a total number of 22 questionnaires were not retrieved amounting to 32.84% of the total number of questionnaires distributed. However, according to Moser

and Kalton (1971)'s assertion, the result of a survey could be considered as biased/not reliable and of little significance if the return rate was lower than 30-40%, the number of questionnaires completed and returned for this research were therefore considered adequate for analysis.

Table 2: Respondent's Category of Institution

Institution's Category	Frequency	Percentage (%)
Federal Universities	21	46.67
State Universities	5	11.11
Federal Polytechnics	2	4.44
State Polytechnics	8	17.78
Federal College of Education (FCEs)	5	11.11
State College of Educations	4	8.89
Total	45	100

Table 2 shows the respondent's institution, 46.67% of the respondents were from federal universities, 11.11% of the respondents were from State Universities, 4.44% were from Federal Polytechnics, 17.78% of the respondents were from State

polytechnic, 11.11% respondents were from Federal College of Educations and 8.89% of the respondents were from State College of Educations. This indicates that the responses cut across the different

categories of institutions that benefit from TETFund interventions.

Table 3: Respondent's years of experience

Years of Experience	Frequency	Percentage (%)
0 - 5	21	16
5 - 10	5	53
10 - 15	2	20
15 - 20	8	4
Over 20 years	3	7
Total	45	100

Table 3 shows the years of experience of the respondents, 16% of the respondents are within 0 to 5 years of experience, 53% of the respondents are within the years of experience of 5 to 10 years, 20% of the respondents are within the years of experience of 10 to 15 years, 4% of the

respondents are within the years of experience of 15 to 20 years and 7% of the respondents are of over 20 years of experience. This shows that responses were sourced from respondents with requisite experiences.

Table 4: Respondent's position in the institution

Respondent's Position	Frequency	Percentage (%)
Top Management	13	28.89
Middle Management	20	44.44
Low Management	12	26.67
Total	45	100

Table 4 also shows the position of the respondents, 28.89% of the respondents are from the top management, 44.44% of the respondents are from middle management and 26.67% of the respondents are from the

low management. This highlights that the responses represent the perceptions of staff at all levels of management in the Tertiary institutions.

Table 5: Respondent's work section in the institutions

Work section of respondents	Frequency	Percentage (%)
Procurement Unit	8	17.78
Physical Planning Unit	20	44.44
Estate Department	16	35.56
Others	1	2.22
Total	45	100

Table 5 shows the work section of the respondents, 17.78% of the respondents' works at procurement unit, 44.44% of the respondents works at physical planning department, 35.56% of the respondents' works at the estate department and 2.22% of the respondents work section were unspecified. This ensures that the data collected reflects the perceptions of the different work sections/departments/units involved in managing and executing construction projects in tertiary institutions.

Potential Benefits to the adoption of Lean Construction Principles by the client sector

Under section B of the Questionnaire, respondents were asked to assess potential benefits of adopting LCP by the client sector in the NCI, using a Likert 5 points scale (where: 1 to 5 where 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree and 5 = strongly). The extent of agreement of respondents were represented

in table showing mean score, standard deviation and ranking.

Table 6: Potential benefits to the adoption of lean construction principles by the client sector of the Nigerian construction industry.

S/No.	Potential benefits of lean Construction principles	Number	ΣFx	Mean	Std. Deviation	Ranking
1	Maximise productivity	45	152	3.38	1.19	1
2	Reduced waste	45	149	3.31	1.08	2
3	Improved health and safety	45	144	3.2	0.89	3
4	Reduced cost and inventory	45	144	3.2	1.32	3
5	Improved quality, fewer defect	45	143	3.18	1.25	5
6	Greater customer satisfaction	45	141	3.13	1.16	6
7	Improved design	45	132	2.93	1.19	7
8	Reduced project schedule	43	124	2.88	1.1	8

As shown in this Table 6, the respondents ranked maximize productivity, reduced waste, improved health & safety and reduced cost & inventory as the most important potential benefits of adopting lean construction principles in the NCI. Maximise productivity has the mean of 3.38 and standard deviation of 1.19, reduced waste has the mean of 3.31 and standard deviation of 1.08, improved health and safety has the mean of 3.20 and standard deviation of 1.32, reduced cost and inventory has the mean of 3.2 and standard deviation of 1.32, improved quality and fewer defects has the mean of 3.18 and standard deviation of 1.25 and greater customer satisfaction has the mean of 3.13 and standard deviation of 1.16.

Barriers to the adoption of Lean Construction Principles by the client sector of the Nigerian Construction Industry

Respondents were equally asked to assess barriers of adopting LCP by the client sector in the NCI, using also a Likert 5 points scale (where: 1 to 5 where 1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree and 5 = strongly). The extent of agreement of respondents were represented in a table showing mean score, standard deviation and ranking.

Table 7: Barriers to the adoption of Lean Construction Principles by the client sector of the Nigerian Construction Industry

S/No.	Barriers	Number	ΣFx	Mean	Std. Deviation	Ranking
Management Issues						
1	Poor planning	45	149	3.31	1.04	1
2	Inadequate resources	45	138	3.14	1.09	2
3	Absence of long term planning	45	139	3.09	1.12	3
4	Use of substandard components	44	135	3.07	1.15	4
5	Lack of supply chain integration	45	134	2.98	1.12	5
6	Lack of client and supplier involvement	44	131	2.98	1.13	6
7	Inadequate preplanning	45	132	2.93	1.16	7
8	Lack of time for innovation	45	131	2.91	1.06	8
9	Poor communication	44	128	2.91	1.07	9
10	Delay in decision making	45	130	2.89	1.15	10
11	Poor project definition	44	127	2.89	1.08	11
12	Lack of top management support and commitment	45	129	2.87	1.08	12
13	Materials scarcity	45	129	2.87	1.16	12
14	Long implementation period	44	125	2.84	0.94	14
15	Poor procurement selection strategies	44	125	2.84	1.16	14
16	Unsuitable organizational structure	43	122	2.84	1.04	16
17	Lack of customer focus	45	127	2.82	1.07	17
18	Lack of steady/work engagement	44	122	2.77	1.08	18
19	Delay in materials delivery	43	115	2.67	1.11	19
20	Lack of Equipment	45	119	2.64	1.15	20
Financial issues						
1	Corruption	45	149	3.31	1.47	1
2	Inadequate projects' funding	45	145	3.22	1.38	2
3	Inflation	44	141	3.20	1.30	3
4	Lack of incentives and motivation	45	132	2.98	1.32	4
5	Implementation cost	45	125	2.78	1.18	5
6	Risk aversion	45	121	2.68	1.18	6
7	Poor professional wages	45	116	2.58	1.22	7
Educational issues						
1	Lack of awareness programmes	45	137	3.04	1.17	1
2	Inadequate exposure to requirements for lean implementation	45	133	2.96	1.33	2
3	Lack project team skills	45	128	2.84	1.28	3
4	Difficulty in understanding concept	45	127	2.82	1.30	4
5	Lack of holistic implementation	44	124	2.82	1.19	5
6	Inadequate knowledge	45	123	2.73	1.19	6
7	Lack of understanding	45	122	2.71	1.29	7
8	Lack of information sharing	45	122	2.71	1.39	8
9	Lack of technical skills	45	121	2.69	1.18	9
10	Lack of training	45	118	2.62	1.17	10
11	High-level illiteracy	45	111	2.47	1.1	11
Governmental issues						
1	Professional wages	44	126	2.86	1.23	1
2	Corruption practices	44	126	2.86	1.29	2
3	Inflation	44	123	2.80	1.27	3
4	Government bureaucracy	45	125	2.78	1.24	4
5	Inconsistency in policies	45	124	2.76	1.35	5
6	Lack of social amenities and infrastructure	43	117	2.72	1.20	6
7	Unsteady price commodities	45	122	2.71	1.08	7
8	Materials unavailability	43	114	2.65	1.13	8
Technical issues						

1	Lack of design constructability	45	135	3.00	1.07	1
2	Lack of agreed implementation methodology	44	131	2.98	0.98	2
3	Poor performance measurement strategies	45	132	2.93	1.07	3
4	Lack of prefabrication, uncertainty in supply chain	45	125	2.78	1.04	4
5	Incomplete designs	45	124	2.76	1.07	5
6	Lack of buildable designs	45	116	2.58	1.16	6
Human attitudinal issues						
1	Lack of cooperation	44	131	2.98	1.27	1
2	Leadership conflict	44	130	2.95	1.22	2
3	Lack of teamwork	45	132	2.93	1.16	3
4	Poor understanding of client's brief	42	122	2.90	1.34	4
5	Lack of self-criticism	45	127	2.82	1.07	5
6	Poor leadership	45	127	2.82	1.43	5
7	Misconceptions about lean practice	45	126	2.80	1.27	7
8	Poor housekeeping	45	125	2.78	1.18	8
9	Lack of team spirit	45	122	2.71	1.14	9
10	Fear of unfamiliar practices	45	122	2.71	1.20	9
11	Lack of transparency	45	119	2.64	1.26	11
12	Seen as too complex and alien	45	118	2.62	1.25	12
13	Cultural change	45	112	2.49	1.01	13
14	Over enthusiasms	45	110	2.44	1.08	14

Table 7 shows the respondents ranked poor planning, inadequate funding, absence of long term planning and use of substandard component as the most significant management issues related barriers; poor planning with 3.31 mean and standard deviation of 1.04, inadequate resources has the mean of 3.14 and standard deviation of 1.09, absence of long term planning has the mean of 3.09 and standard deviation of 1.12 and use of substandard components has the mean of 3.07 and standard deviation of 1.15. Corruption, inadequate project funding and inflation are ranked as the most important financial issues related barriers to the adoption of lean construction principle, corruption has the mean of 3.31 and standard deviation of 1.47, inadequate project funding has the mean of 3.22 and standard deviation of 1.38 and inflation has the mean of 3.20 and standard deviation of 1.30. Lack of awareness program was ranked as the most important educational issues related barrier of adopting lean construction principles, lack of awareness program has the mean of 3.04 and standard deviation of 1.17. Lack of design constructability was ranked as the most important barrier for the adoption of lean

construction principles by the respondents, lack of design constructability has the mean of 3.00 and standard deviation of 1.07.

Discussion of results

The results revealed that maximise productivity, reduced waste, improved health & safety and reduced cost & inventory are the most significant potential benefits of adopting lean construction principles by the client sector of the Nigerian Construction industry. Owoseni (2017) findings established that maximise productivity, reduced waste, greater customer satisfaction were ranked to have the highest benefit in adopting lean construction principles in the Nigerian building contracting firms while Olamilokun (2015) concluded that reduced cost and less waste, as well as improved safety and health are the two most important benefits of adopting lean construction principles in the Nigerian construction industry. It can be deduced that reduced waste is the most agreed potential benefit of adopting lean construction in the NCI. Likewise, there is agreement between clients and consultant

that productivity will be maximised with proper adoption of lean construction.

Concerning the barrier factors that will hinder adoption of LCP in the client's sector, this study revealed that: Poor planning, inadequate resources, Absence of long term planning and Use of substandard components are the most important among the management related barriers. This aligns with the findings of Aisha *et al.* (2019) that ranked poor planning as a major barrier for adoption LC. Olamilokun (2015) ranked poor planning as the second major barrier factor under management issues. Thus, it can be said that there is general agreement across the consulting and contracting firms as well as clients' organisations that poor planning is a major hurdle that will hinder adoption of LCP in the NCI.

Corruption, Inadequate projects' funding and Inflation are the most important among the financial related barriers. This also supports the findings of Olamilokun (2015) and Aisha *et al.* (2019) which ranked corruption as the most critical barrier factor for adopting LC in Nigeria. Hence, corruption continues to be a major threat that hinders innovation and improvement in the NCI, therefore, all concerned institutions must avert corrupt practices to ensure advanced and sustainable growth of the NCI.

Lack of awareness programmes, inadequate exposure to requirements for lean implementation, and Lack project team skills are the most highly rated educational related barrier to the adoption of LCP in clients' sector organisations. Lack of awareness programmes emerging as the most critical educational related barriers aligned with the assertion of Aisha *et al.* (2019) that the adoption of LC in Nigeria is still in its infancy and further supports the recommendation of Aisha *et al.* (2019) that there should be more awareness campaign by tertiary institutions and professional bodies through seminars, workshops, and trainings, to enlighten relevant stakeholders more about the LCP. Therefore, there is

need for more awareness campaign on the importance of adopting LCP in Nigeria.

With regards to government related issues, there seems to be a differing perception by the client sector of the Nigerian construction industry as this study revealed poor professional wages as the most significant barrier hindering the adoption of lean construction in Nigeria. This is in contrast with the perceptions of consultancy firms (Olamilokun, 2015) and building contracting firms (Owoseni, 2017) that both identified inconsistency in government policies as the major barrier that will hinder adoption of lean construction in Nigeria.

In terms of Technical related barriers, lack of design constructability, lack of agreed implementation methodology and poor performance measurement strategies are the most critical barrier factors identified by the survey respondents. Olamilokun (2015) and Owoseni (2017) further pointed out that inaccurate and incomplete designs are another major setback in adopting lean construction when relating to technical issues, while this study revealed that the client sector sees lack of constructability as the major barrier for adopting lean construction in terms of technical related issues showing a contrary perception between the private sector (consulting & contracting firms) and the public sector (clients organisations). However, but sectors jointly agreed that lack of agreed implementation methodology and poor performance measurement strategies are critical technical related barriers in terms of adopting LCP in the NCI.

And lastly, lack of cooperation, leadership conflict and lack of team work were identified as the major Human attitudinal related barriers to adopt LCP by clients' sector organisations. Olamilokun (2015) outlined: Misconceptions about lean practice, fear of unfamiliar practices and seen as too complex and alien as the most critical human attitudinal barriers for adopting LCP by consulting firms in Nigeria. Thus, there is entirely differing views between the consulting firms and

clients' sector organisations in terms of human attitudinal barriers to adopt LCP in Nigeria.

This study have further affirmed that poor planning is a major hindrance in adopting lean construction in Nigeria as earlier identified by literature by both Olamilokun (2015) and Owoseni (2017). There is also synonymous agreement that corruption is a major significant factor that pauses a threat in adopting lean construction in Nigeria when relating to financial issues. So also, this study have further confirm that lack of awareness of lean concept hinders adoption of lean construction in Nigeria.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The Study reveals that the client sector of the Nigerian Construction Industry (NCI) acknowledges the potential benefit of adopting Lean Construction principles. Maximise productivity; reduced waste, improved health & safety and reduced cost & inventory were identified as the most significant potential benefits of adopting Lean Construction Principles in NCI. The barriers that will hinder the successful implementation of Lean Construction Principles in the NCI were also identified by the Client's sector of the Industry. These barriers cut across management, educational, financial, governmental, technical and human attitudinal issues. Therefore, there are ranges of different barriers that halt successful implementation of Lean Construction Principles in Nigerian Construction Industry.

Recommendations

Based on the findings of the study, it is recommended that:

- i. Nigerian tertiary institutions and professional regulatory bodies should consider integrating lean construction into the tertiary education curriculum because of its

importance and benefits to the construction industry at large.

- ii. There is need to strengthen top management commitment towards adopting and integrating LCP into project procurement, planning and execution.
- iii. In terms of addressing human attitudinal barriers, there is urgent call for change-management campaign programmes that will help in shifting mindsets as well as emphasizing collaboration and continuous improvement.
- iv. Government should advocate for policies that will promote LCP adoption, e.g. inclusion in public procurement criteria.
- v. Further research should be conducted in other project contexts within the NCI to assess the adoption of LCP.

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