INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 12, Issue 10, (2022) E-ISSN: 2222-6990

A Review of Current Lean Approach Practice in the Industrialised Building System (IBS) of the Malaysian Construction Industry

Suryani Ahmad[1], Qhairulsyakirin Salim[1], Siti Akhtar Mahayuddin[1], Zarina Alias[2], Mohd Rofdzi Abdullah[1]

[1]Department of Built Environment Studies and Technology, Faculty of Architecture, Planning and Surveying Universiti Teknologi MARA, Perak Branch, 32610, Seri Iskandar, Perak, Malaysia, [2]Centre of Construction Studies, Faculty of Architecture, Planning and Surveying Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v12-i10/14832 DOI:10.6007/IJARBSS/v12-i10/14832

Published Date: *20* October 2022

Abstract

The presence of the Industrialised Building System (IBS) has a significant effect on Malaysian economic growth, especially in increasing labour productivity, however, its growth regularly fluctuates. Hence, in 2015, Malaysia Corporation Productivity (MPC) promoted a lean approach to IBS as one of the strategies for labour productivity enhancement. Therefore, extensive literature reviews regarding the current implementation of the lean approach mainly in IBS have led to the purpose of this study. Relevant published journals and proceedings in the range of 2015 to 2022, including governing bodies' reports were synthesized from the findings that were searched through online databases. The findings revealed that JIT is a common practice in IBS mainly used in logistic management. This shows that the current implementation of the lean approach in IBS is not holistically implemented and limited application of other strategies such as *Kanban*, Value Stream Mapping (VSM), Benchmarking, and so forth. The unavailability of guidelines on how to use the lean approach coupled with a lack of knowledge and awareness leads to misconceptions regarding lean. In addition, limited literature has discussed its solutions, which this study intended to accomplish. The significance of this study to shows that could be a starting point for IBS production to learn how to think like a lean in a comprehensive way and align with IBS' mission and vision.

Keywords: Lean Approach, Industrialised Building System, Labour Productivity, Construction Industry, the Current Implementation

Introduction

The construction sector contributed 4.5% of the national gross domestic product which plays important role in Malaysia's economic growth (CIDB, 2020b). The blueprint by Malaysian Construction 4.0 Strategic Plan 2021-2025 explained that the government carries a mission to

transform the construction sector into smart construction (CIDB, 2020a), which comprises building design, construction, and operation that incorporate digital technologies, and industrialized manufacturing techniques. One of the arising industrialised manufacturing technologies planned by the Malaysian government is introducing the Industrialised Building System (IBS).

Although the adoption of IBS in Malaysian construction practices has accelerated over the years, there are a few setbacks that still arise such as lack of mechanisation and modernisation utilisation, lack of labour expertise and experience, and dependencies on foreign laborers as well. The setbacks above persist until now (Ali et al., 2018; Amin et al., 2017; CIDB, 2015). These supported through a recent research conducted by Al-Aidrous et al (2021) and Alawag et al (2021) revealed that the acceptance level of IBS are still low level. The decreasing acceptance level of IBS could be affected due to covid pandemic outbreak where the movement control order takes place. Notwithstanding, the findings found that the construction stakeholders are aware of the significance of IBS, however still doubtful regarding the actual use of IBS. Thus, the flawed execution of IBS in Malaysian Construction Industry (MCI) arise to unnecessary non-value added (NVA) and decreased labor productivity (CIDB, 2020a). Due to that matter, inspired by the success of the manufacturing sectors which obtained full benefits due to lean approach practice, had capture wide interest of IBS stakeholders to explore lean. Certainly, by adopting of lean approach practice in IBS production deem to be able to boost the labor productivity (Noor et al., 2018).

As stressed out by Ahmed and Wong (2018); Noor et al (2018), lean approach practice has been proven to be effective solution to overcome the setback as well as reduce NVA occur in IBS production. Utilisation of IBS incorporates with lean tools deem to be improved labour productivity where minimisation of NVA, optimisation of resources, value to client's satisfaction, excellent managerial and efficient work processes will be achieved. Thus, report from Malaysia Productivity Corporation (Corporation, 2016) pointed out that one of the initiative for labour productivity enhancement that they recommended are using lean approach. The author added that becoming lean means efficiency and effectiveness of entire production system such as material planning, management, optimise time and resources, eliminates or minimise NVA and improves quality in line with IBS stakeholders' mission.

In doing so, several strategies in implementing lean approach practice to IBS production must be executed and well plan. As discussed by Korb and Ballard (2018) that to add lean approach in working practice require continuous improvement which persistently breaks through all the setback. In addition, with continuous improvement will makes the lean possible to achieve. Therefore, this study aims to provide a comprehensive literature review regarding the current implementation of lean approach practice in IBS mainly in the production. Even though Saygili et al. (2019) explained there is a significant gap in lean approach in construction practice for developing countries. However, due to encouragement by the MCI, perhaps the strategies have been executed, thus bridging the gap of lean approach practice in IBS production.

Methodology

The study analysed 29 literature reviews related to IBS in MCI, and searched from various electronic database such as Scopus, Web of Science and Emerald. A quality assessment on extracted literatures were conducted from the year of 2015 to 2022 only. This assessment limits the literature extracted to be aligned with the recommendation of MPC to incorporates lean in IBS since 2015. Synthetised of data collected were conducted to identify useful information in each literature and group the literatures into related themes as the findings and presented in a narrative form. In the discussion section, identification of connections between literature and research gap were discussed. Lastly, concluding remarks regarding the findings from discussion and recommendation for future study were presented. Figure 1 shown the process of research methodology is carried out.

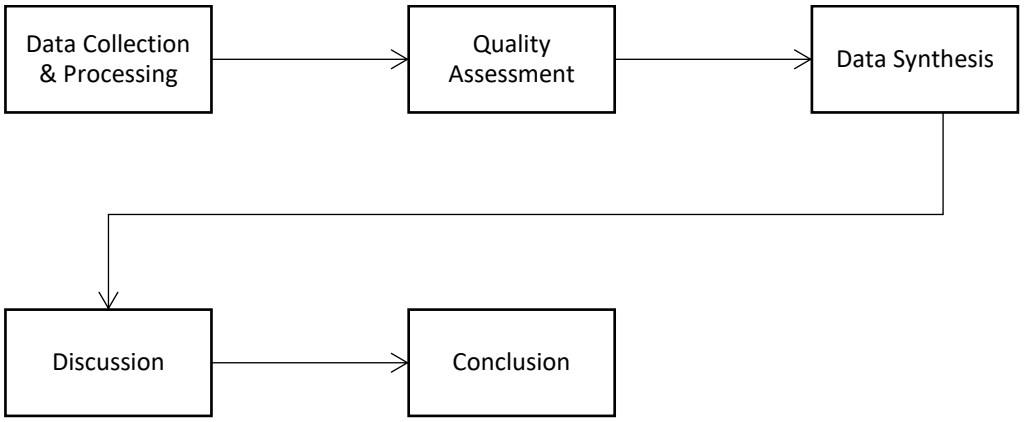

Figure 1 Research Methodology Process

An Overview of Lean Approach

Definitions of Lean Approach

There are several definitions refer to lean approach which describe its application in industry by selected researchers are as follows:

1. Koskela (1992) defines as “Advantages of the new production philosophy in terms of productivity, quality, and indicators were solid enough in practice in order to enhance the rapid diffusion of the new principles”.
2. Howell (1999) defines as “Lean construction is much like the current practice as the goal of better meeting customer needs while using less of everything”.
3. Diekmann et al. (2004) defines as “Lean construction is the continuous process of eliminating waste, meeting or exceeding all customer requirements, focusing on the entire value stream and pursuing perfectionist”.

The above definition is fundamental aspect in lean philosophy. Lean approach is a set of technical methodology that focuses on waste or also known as NVA elimination and meeting client’s requirements by establishing an explicit set of goals in delivery process, work performance, simultaneous product design and process and also management of product starting from design to delivery. Adapted from lean production also known as manufacturing, lean construction aims to achieve highly productive processes by value maximisation, waste elimination, continuous improvement and focus on process and flow with aims to meet client’s satisfaction and sustainable construction environment (Ahmed & Wong, 2020; Al Hattab & Hamzeh, 2017; Jamil & Fathi, 2016). In doing so, several challenges faced construction stakeholders as elaborated below.

Challenges of lean approach practice in the Construction

Although lean approach was considered as an advanced technique in construction. However, without knowing on how lean approach is implemented, it will create multi-level of challenges as stated by Pan and Pan (2022). The challenges regarding of lean approach in construction were identified and summarised in Table 1 which divided into five (5) categories.

Table 1
Challenges in lean approach practice in the construction

Challenges	**Description**	**Authors**
Managerial	Inadequacy of involvement from management that caused problems with supply chain and integration on organisational level.	Abubakar et al., 2015; Ahmed & Sobuz, 2020; Marhani et al., 2021
Financial	Improper financial planning and underpayment that caused high turnover. Lack of incentives and motivation from the government. Risk aversion due to poor financial planning.	
Educational	Absence of holistic implementation due to lack of technical skills and knowledge on lean. Barrier due to education	
Technical	Imperfect designs due to disagreement within team members. Incompetent to adopt lean tools. Fragmentation issues within the industry inhibit effective implementation of lean	
Human	Misconceptions of lean and fear of adopting new practices. Lack of cooperation and teamwork within the workforce.	

Marhani et al (2021); Pan and Pan (2022) revealed the knowledge regarding lean amongst construction stakeholders still at infancy stage and challenging to practice in their workplace. This is because, majority of construction stakeholders did not fully understand the terminology or appropriate of lean tools to be applied in their workplace. Hence the implementation of lean approach practice is not thoroughly explored (Ghannoum et al., 2019). He added, disconnection between knowledge and actual execution may cause confusion from the industry player's side to embrace a lean way of thinking. Supported by Christensen et al (2019) concluded that unsynchronization between knowledge and actual

execution in lean will pose a threat to the construction practices. Therefore, the need of synchronization in lean were extremely important. Despite the challenges raised in lean approach practice, the greater benefits of lean should be spread with best practice examples. Obviously, huge benefits obtained through lean approach practice and tend to be discussed below.

B*enefits of lean implementation in the construction*

There are many benefits that obtain by construction stakeholders in implementing lean approach practices as shown Table 2.

Table 2
Benefits of lean approach practice in construction

Benefits	**Description**	**Authors**
Managerial	Improve level of productivity by improving safety and health of work practices. Continual improvement of the construction process can be achieved. Use as a measuring tool for review and correction purposes to ensure that the problem encountered is solved by its root and to prevent recurrence.	Ahmed & Wong, 2018; Marhani et al., 2021; Pan & Pan, 2022
Financial	Waste or NVA elimination is able to cut overall construction cost. Lean helps in increase of profit margin and market share.	Ahmed & Wong, 2018; Marhani et al., 2021; Pan & Pan, 2022; Rosarius & García De Soto, 2021
Educational	Allow the key players to identify problems in the work process at activity level, and hence continuous improvement can be executed. Knowledge on LC enables industry players to plan work processes with right execution of lean in their practices.	Ahmed & Wong, 2020; Marhani et al., 2021
Technical	Utilisation of resources is optimised. Work activity and product design used the least amount of energy to improve the economic output.	Marhani et al., 2021; Pan & Pan, 2022; Rosarius & Garcia de Soto, 2021
Human	Staff empowerment in taking actions and promotes creativity in order to increase project integration. Encouragement for workers to attain sustainability in everyday practices.	Marhani et al., 2021

Successful contributions of lean approach in MCI are established and reviewed in several literatures. The benefits of lean in the MCI can only be reaped if it is implemented correctly. Lean approach is a great technical tool to be incorporated in MCI, nevertheless effective

strategies need to be planned and well-managed prior to incorporation of lean in construction practices mainly in IBS (Bashir et al., 2015; Marhani et al., 2021). Hence, several strategies for excellent implementation of lean are discussed afterwards.

Strategies of Lean Approach Practices

Effectiveness of lean approach in construction practices can be ensured if it is executed with proper strategies. Several strategies on how to implement lean effectively in construction are tabulated in Table 3.

Table 3
Strategies of lean approach practice in construction

Strategies	**Description**	**Authors**
Managerial	Improvement in integration and communication between stakeholders by establishment of common goals and thus able to gain full trust from each stakeholder.	Ahmad et al., 2019; Ahmed & Wong, 2020; Bashir et al., 2015; Marhani et al., 2021
Financial	Government support in terms of incentives with implementation of lean in practices. Financial allocation from contractor or client for incorporation of lean in construction.	Ahmed & Wong, 2020; Bashir et al., 2015; Marhani et al., 2021
Educational	Equipped staff and stakeholders with ample knowledge of lean by provision of training programs. Introduction of lean syllabus at institutional level. Improve awareness of the benefits and needs of lean by dissemination of lean material such as journals or magazines amongst staff.	
Technical	Incorporation of lean tools were empirically investigated (Waste management and combining lean with recycling). Integration of organisation from different disciplines.	Ahmad et al., 2019; Ahmed & Wong, 2020; Bashir et al., 2015; Marhani et al., 2021
Human	Establishment of problem-solving teams comprising lean-competent staff. Lift off the fear of work culture change by simplifying the language of lean so staff can understand. Gradual lean implementation rather than one-off way to ensure that lean application is more embraceable.	Ahmed & Wong, 2020; Bashir et al., 2015; Marhani et al., 2021

Further discussion that addressed the aim of this study current implementation of lean approach in IBS, an example of lean practices that can be inspired in other countries were elaborated. These two sections can be used as testimonials and benchmark for MCI stakeholders to apply lean in their working practice.

Current Implementation of Lean Approach Practice in IBS of MCI

In 2015, MPC had suggested in order to boost labour productivity, one of the solutions by implementing lean in their working practice mainly in IBS production. Due to that, several research such as Asri et al (2016); Jamil and Fathi (2016); Ahmed and Wong (2018, 2020) revealed that incorporates of lean approach in IBS production will improve the system in terms of design, workplace wellbeing and increase productivity by removal of NVA activities. Likewise, Ismail (2018) also concluded that implementation of lean approach into IBS practices ultimately improve efficiency from the aspect of facilities layout, logistics and erection.

Currently, the common practice of lean strategies applied in IBS is Just-In-Time (JIT), which improve logistic management system (Ahmed & Wong, 2020; Asri et al., 2016; CIDB, 2020b). Apart of that, these studies also demonstrate that using of JIT tools reduced NVA and construction time, efficient for materials management. Nevertheless, JIT also able to improve inventory management control. For example, a study done by Ahmad et al (2019) illustrates on how JIT integrates with Kanban able to kept the inventory at minimum level with optimise output and control flow. The studied also revealed that instead of 14 activities in the existing work process, a total of eight (8) activities deemed to be value added. In fact, the number of labourers can be reduced from seven (7) to five (5) with similar output. The authors also suggested to used problem-solving framework to understand the root of causes occur in IBS production as a starting point before lean strategies apply.

Recent studied by Abidin et al (2022) explored other lean strategies based on integration of values stream mapping (VSM) concept and benchmarking that aligned with essential lean methods JIT, continuous Improvement and total productive maintenance in IBS Production. The findings found that the overall IBS production performance increased 4% in a total factor productivity. The authors concluded integration of VSM and optimising benchmarking approach able to identify NVA and gained a better understanding of strengths, weaknesses that effect changes. Both approaches are more effective strategies in lean approach practice, however, it is depending on the extent to which lean successfully implemented.

Meanwhile, Wong et al (2020) had conducted on the impact of Building Information Modelling (BIM) on construction productivity in terms of labour. The author stressed out that with lean and BIM full benefits obtained to construction stakeholders by alleviating coordination issues, quicken the process, reduction of overall construction cost, act as monitoring tool for projects that are complex, increase the level of safety in the construction, reduce NVA. BIM also reduced the number of activities on site, as the manufacturing parts are done off site and thus less coordination needed on site. However, further studied need to be done to evaluate the impact of BIM and lean on labour productivity. Thus, tracking the actual productivity of IBS Production is recommended.

Other studies done by several researchers (Asri et al., 2016; Nasrollahzadeh et al., 2016; Noor et al., 2018; Yunus et al., 2017) discussed regarding lean approach in IBS, by explaining on critical success factors, drivers and challenges. They concluded that the lean approach practice is vital to improve in IBS performance. However, they have not explicitly discussed on how the strategy of lean could be applied for improving the overall IBS in MCI context.

Only two studies conducted by Abidin et al (2022); Ahmad et al (2019) had discussed on how lean strategies can be practiced by understanding the present state of work process in IBS mainly production also able to distinguish value added and NVA activities. On the other hand, understanding the root of the problems are essential for lean approach practice.

Through the literature review above, several research has been undertaken in identifying the barriers, critical success factor and drivers of lean implementation, however the practical study on how to overcome these barriers and utilise these drivers in IBS is still lacking which crucial action and strategies by the MCI and IBS production are needed.

Conclusion

It was found that the implementation of lean approach in IBS mainly in production are still infancy stage. Therefore, urgently attention and effective actions to ensure that adoption of lean thinking in IBS is moving forward. Even though current implementation of lean approach practice in IBS commonly focused on JIT that improve logistic and inventory control management. Nevertheless, lack of studied had discussed on integration JIT with other lean strategies such as *Kanban, VSM* and benchmarking were resulted optimisation output and control flow. On the other hand, lean offers great potential of increasing labour productivity to the IBS based on the success of lean in manufacturing sector as an example. Besides that, some of IBS stakeholders are unaware that they are currently practising lean, this circumstance shows that complete understanding of underlying principle of lean in construction is still scarce among them.

The absence of guideline for IBS stakeholders to practise lean in their organisation hinders the effective adoption of lean. The knowledge on which lean tools that are best suited for every unique IBS demand is still currently lacking. However, the understanding of lean approach is not only focus on method and tools, but the employees as well, those who using it. Employees is the key to the high performance of lean approach practice by giving them flexibility use of their knowledge and skills, build trust, allow knowledge sharing opportunities, recognitions, incentive, and rewards for the ideas contributes from employees. The lean indicators as previously mentioned before could motivate employees to commit lean in their work practise, due to support by their organisation. Hence, an effective training that focuses on the fundamentals of lean in IBS practices by including theoretical and practical knowledge will help to promote the adoption of this approach even more. It can be seen a huge contribution with lean approach practice in IBS, where transparency, creativity, continuous improvement that cooperate with positive relationship between organisation and IBS employees occurs. Thus, further research should be carried out especially the guidelines on how to start implement lean approach practise and able to distinguish between NVA and Value added that are the core principles in lean.

Acknowledgement

Special appreciation is owed to Universiti Teknologi Mara under MyRA grant (600-RMC/GPM LPHD 5/3 (056/2021).

Corresponding Author
Suryani Ahmad
Senior Lecturer, Department of Built Environment Studies and Technology, Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, Perak Branch, 32610 Seri Iskandar, Perak.
Email : surya586@uitm.edu.my

References

Abidin, M. H. Z., Leman, Z., Yusof, Z. A. M., & Khalil, A. (2022). Lean Impact on Manufacturing Productivity: A Case Study of Industrialized Building System (IBS) Manufacturing Factory. *Jurnal Teknologi*, *4*, 65–77.

Ahmad, S., Soetanto, R., & Goodier, C. (2019). Lean approach in precast concrete component production. *Built Environment Project and Asset Management*, *9*(3), 457–470. https://doi.org/10.1108/BEPAM-02-2018-0051

Ahmed, S., & Sobuz, M. H. R. (2020). Challenges of implementing lean construction in the construction industry in Bangladesh. *Smart and Sustainable Built Environment*, *9*(2), 174–207. https://doi.org/10.1108/SASBE-02-2019-0018

Ahmed, M. E. A. M., & Wong, L. S. (2020). The Strategies of Lean Planning at selected Construction Sites in Klang Valley, Malaysia: A Structural Equation Modeling Approach. *Jordan Journal of Civil Engineering*, *14*(3), 359–375.

Ahmed, M. E. A. M., & Wong, L. S. (2018). Assessment of lean construction practice at selected construction sites in Klang Valley. *International Journal of Engineering and Technology*, *7*(4), 125–130. https://doi.org/10.14419/ijet.v7i4.35.22340

Al-Aidrous, A. H. M. H., Rahmawati, Y., Yusof, K.W., Baarimah, A. O., & Alawag, A. M. (2021). Review of Industrialized Buildings Experience in Malaysia: An Example of a Developing Country. *IOP Conference Series: Earth and Environmental Science*, *682*(1). https://doi.org/10.1088/1755-1315/682/1/012003

Al Hattab, M., & Hamzeh, F. (2017). A Process-Social Perspective for Understanding Design Information flow. *Lean Construction Journal*, *2017*, 1–11.

Alawag, A. M. M., Alaloul, W. S., Liew, M. S., Al-Bared, M. A. M., Zawawi, N. A. W. A., & Ammad, S. (2021). The Implementation of the Industrialized Building System in the Malaysian Construction Industry—a Comprehensive Review. *Proceedings of the 3rd Interntaiotional Conference on Separation Technology, Lecture Notes in Mechanical Engineering*, *January*, 3–16. https://doi.org/10.1007/978-981-16-0742-4_1

Ali, M. M., Abas, N. H., Affandi, H. M., & Abas, N. A. (2018). Factors Impeding the Industrialized Building System (IBS) Implementation of Building Construction in Malaysia. *International Journal of Engineering and Technology*, *7*(4), 2209–2212. https://doi.org/10.14419/ijet.v7i4.17863

Amin, M. A. M., Abas, N. H., Shahidan, S., Rahmat, M. H., Suhaini, N. A., Nagapan, S., & Rahim, R. A. (2017). A Review on The Current Issues And Barriers of Industrialised Building System (IBS) Adoption in Malaysia's Construction industry. *IOP Conference Series: Materials Science and Engineering*, *271*(1). https://doi.org/10.1088/1757-899X/271/1/012031

Asri, M. A. N. M., Nawi, M. N. M., Nadarajan, S., Osman, W. N., & Harun, A. N. (2016). Success Factors of JIT Integration with IBS Construction Projects – A Literature Review. *International Journal of Supply Chain Management*, *5*(2), 71–76.

Asri, M. A. N. M., Nawi, M. N. M., Saad, R., Osman, W. N., & Anuar, H. S. (2016). Exploring

Lean Construction Component for Malaysian Industrialized Building System Logistics Management—A literature Review. *Advanced Science Letters, 22*(5), 1593-1596. doi:10.1166/asl.2016.6696

Bashir, A. M., Suresh, S., Oloke, D. A., Proverbs, D. G., & Gameson, R. (2015). Overcoming the Challenges Facing Lean Construction practice in the UK Contracting Organizations. *International Journal of Architecture, Engineering and Construction*, *4*(1), 10–18.

Christensen, R., Greenhalgh, S., & Thomassen, A. (2019). When a business case is not enough, Motivation to work with lean. *Lean Construction Journal*, 121–130. https://doi.org/10.24928/2019/0146

CIDB. (2015). *Construction Industry Transformation Programme 2016 - 2020*.

CIDB. (2020a). *Construction 4.0 Strategic Plan 2021-2025.pdf*.

CIDB. (2020b). *Road Towards Productivity Excellence: Productivity of Building Construction Using Industrialised Building System (IBS) : CIDB Technical Publication No :209*.

Corporation, M. P. (2016). *23rd Productivity Report 2015/2016*.

Diekmann, J. E., Krewedi, M., Joshua, B., Stewart, T., & Won, S. (2004). Application of Lean Manufacturing Principles to Construction. In *The Construction Industry Institiute, The University of Texas*. http://www.leanconstruction.org/media/docs/lcj/V2_N2/LCJ_05_011.pdf

Ghannoum, C., Antar, S., Daoud, Y., & Hamzeh, F. (2019). Are construction clients ready to lead the lean initiative? *Lean Construction Journal*, *105–120*, 105–120.

Howell, G. A. (1999). What is lean construction. *7th Annual Conference of the International Group of Lean Construction*, *7*(July), 1–10. http://www.leanconstruction.org/pdf/Howell.pdf

Jamil, A. H. A., & Fathi, M. S. (2016). The Integration of Lean Construction and Sustainable Construction: A Stakeholder Perspective in Analyzing Sustainable Lean Construction Strategies in Malaysia. *Procedia Computer Science*, *100*, 634–643. https://doi.org/10.1016/j.procs.2016.09.205

Korb, S., & Ballard, H. G. (2018). Believing is Seeing: Paradigms as a focal point in the lean discourse. *26th Annual Conference of the International Group for Lean Construction: Evolving Lean Construction Towards Mature Production Management Across Cultures and Frontiers*, *1*(July), 177–186. https://doi.org/10.24928/2018/0208

Koskela, L. (1992). Application of The New Production Philosophy to Construction. In *Center for Integrated Facility Engineering*.

Marhani, M. A., Othman, N. A. S. M., & Ismail, N. A. A. (2021). Issues and Impact of Lean Construction Implementation in The Malaysian Construction Industry. *International Journal of Sustainable Construction Engineering and Technology*, *12*(3), 258–268.

Nasrollahzadeh, T., Marsono, A. K., & Tap, M. M. (2016). Critical Success Factor for Industrialized Building System Process Protocol Map by Lean Construction management. *Journal of Civil & Environmental Engineering*, *06*(05). https://doi.org/10.4172/2165-784X.1000247

Noor, S. R. M, Abdullah, A. H., Yunus, R., & Nagapan, S. (2018). Insights into the Adoption of Lean Management in Industrialised Building System (IBS) implementation :The Drivers and Challenges. *International Journal of Engineering and Technology*, *7*(3.23), 22–31. https://doi.org/10.14419/ijet.v7i3.23.17253

Pan, W., & Pan, M. (2022). Rethinking Lean Synergistically in practice for Construction Industry Improvements. *Journal of Engineering, Construction and Architectural Management*, *201309160046*. https://doi.org/10.1108/ECAM-04-2021-0346

Rosarius, A., & De Soto, G. B. (2021). On-site Factories To Support Lean Principles and Industrialized Construction. *Organization, Technology and Management in Construction*, *13*(1), 2353–2366. https://doi.org/10.2478/otmcj-2021-0004

Saygili, M., & Tokdemir, O. B. (2019). Research Development of Lean Construction Journal: A Bibliometric Analysis. *Lean Construction Journal*, *2019*, 47–63.

Wong, J. H., Rashidi, A., & Arashpour, M. (2020). Evaluating the Impact of Building Information Modeling on the Labor Productivity of Construction. *Building*, *10*(66), 21.

Yunus, R., Noor, S. R. M., Abdullah, A. H., Nagapan, S., Hamid, A. R. A., Tajudin, S. A. A., & Jusof, S. R. M. (2017). Critical Success Factors for Lean Thinking in the Application of Industrialised Building System (IBS). *IOP Conference Series: Materials Science and Engineering, 226*. doi:10.1088/1757-899x/226/1/012045