5.0 Conclusion & Recommendations

This chapter concludes the overall study that has been conducted with regard to Lean Construction Systems and Tools by evaluating and comparing the objectives set against results that have been achieved in this study. At the end of the chapter, few recommendations for further research will be highlighted.

5.1 Conclusion Based on Findings

Questionnaire Part 1: conclude that respondents are not knowledgeable of Lean Construction thus unable to comment precisely whether Lean Construction will improve operation performance.

Nevertheless the respondents are aware of the Systems & Tools being used in daily construction operation, however the practice and extent of efficiency is in doubt due to the fact that purpose of each Systems and Tools has yet to be fully conceptualize.

Questionnaire Part 2: conclude that repondents perceive some improvement on operational performance thus Lean Construction, Systems and Tools is feasible in Malaysia Construction Industry.

Furthermore a rather strong Positive Correlation of 0.65 between Question 3 Lean Construction Systems & Tools Knowledge and Question 4 Operational Performance Improvement are observed as per enlisted in Table 9 and Table 10.

Q3 Knowledge Q7 Improvement Mean	Master Schedule, Weekly Work Plan, 6 Week Look-ahead	Reverse Phase Scheduling	Percent Plan Complete	Increased Visualization	Tool-box Meeting	First Run Studies	The 5s Process	Fail Safe for Quality and Safety	Design for Buildability	Just-in-Time	Enterprise Resource Planning
Knowledge	3.70	3.00	3.65	3.50	3.00	3.30	3.80	3.95	3.95	3.65	2.85
Improvement	4.30	3.70	3.85	4.30	4.00	4.10	4.30	4.30	4.10	3.70	3.30

Table 9: Knowledge & Improvement Mean Response Summary

Q3 vs Q7: Correlation	*Knowledge*	*Improvement*
Knowledge	1	
Improvement	0.6589	1

Table 10: Correlation between Knowledge & Improvement Mean Response

This suggest that further Operational Performance improvement may be achieve if Lean Construction Systems and Tools are fully conceptualize through education and training.

Questionnaire Part 3: show that majority of respondents age group is between 30 years to 39 years. They are mostly educated and have attained graduate status. They have work in the construction industry for at least 5 years and above. Most of the respondent although are Engineer, but carry out duties and responsibilities equivalent to a Assistant Project Manager on site thus their feedback is valid and reliable.

5.2 Evaluation on Research Objectives

In order to assess whether the study has successfully achieved its objectives, critical examination on each aspects of research achievement need to be performed against the objectives. Every achievement recorded becomes a critical point in this study evaluation. Critical examinations are as follows:

Objective 1: To migrate the Lean Manufacturing Principles, Systems and Tools into the construction process.

Objective 1 has been achieved through Chapter 2.5, Lean Construction Systems and Tools, whereby Lean Construction Systems and Tools has been discussed and explained in details with reference to Systems and Tools of Lean Production in the Manufacturing Industry.

Objective 2: To explore suitable Lean Construction Systems and Tools for the Malaysian construction industry.

Objective 2 has been identified as suitable as some of the Lean Construction Systems and Tools are recognized by respondents in the Daily Construction Operation as per evaluation in Chapter 4.0, Question 3 and further justified by Objective 3.

Objective 3: To evaluate the influence of Lean Construction has on operational performance in term of Quality, Time and Cost in Malaysian construction industry.

Objective 3 has been evaluate by respondents that there is an improve in operational performance in term of quality, time and cost with the implementation of Lean Construction Systems and Tools as per evaluation in Chapter 4.0, Question 7.

5.3 Evaluation on Research Hypotheses

This section is intended to answer the test hypotheses with the findings highlighted. The research hypotheses is to assess the influence of Lean Construction Systems and Tools has on operational performance.

Hypotheses 1, H1:	Lean Construction Systems and Tools improve operational performance.
Null Hypothesis 1, H_o1:	Lean Construction Systems and Tools do not improve operational performance.

The findings from the survey questionnaire data in relation to this hypothesis support that the Lean Construction Systems and Tools improve operational performance in term of quality, time and cost.

The findings are describe in Chapter 4.3, Questionnaire Part 3, with enlisted Figure 8: Question 7 Ratings Summary and Table 7: Question 7 Descriptive Statistic Summary and further conclude in Chapter 5.1, Conclusion, Questionnaire Part 3 with enlisted Table 8: Understanding & Improvement Mean Response Summary and Table 9: Correlation between Understanding & Improvement Mean Response.

5.4 Recommendations Based on Findings

This study has revealed that the Lean Construction Systems and Tools improve operational performance in term of quality, time and cost. It is highly recommended that the Malaysia Construction Industry adopt and apply Lean Construction to achieve sustained competitiveness thus long term economic goals can be met at the national level.

The ideal scenario would be a national initiative led by government body, Construction Industry Development Board (CIDB), to educate construction industry player of Lean Construction borrowed from the Lean Production in the manufacturing industry which has seen dramatic improvements in productivity and quality, while reducing cost and lead times since early 20th Century until to-date.

Furthermore the underlying potential for operational performance improvement is huge with findings showing low understanding or knowledge of Lean Construction by respondent relative to those in the manufacturing industry.

5.5 Recommendations for Further Research

It is proposed that a qualitative research whereby operational performance in term of Quality, Time and Cost could be quantify with financial figure to support and strengthen Lean Construction benefits and encourage integration in the Malaysia Construction Industry.

Furthermore there are few topics that deserve further investigation in order to advance knowledge in this area.

Replication and Pilot Studies in Malaysia

Generally, there is a need of replication and pilot studies on different sector of construction industry such as residential, commercial, factory, power plant and etc. Therefore this shall ascertain integration of Lean Construction in Malaysia Construction Industry improve operational performance for all sector.

Integrative implementation of Lean Construction

Integrative implementation of the Lean Construction in practice is crucial to attain desire operational performance improvement. Hence further research is require to develop Lean System, Tool or Technique suitable for construction industry implementation, furthermore financial figure representative of operational performance improvement shall proof construction industry players worthiness of integration.

Longitudinal Analysis

This study the construction firm operational performance with the integration of Lean Construction over a period of time. How construction firm leverage on Lean Construction to achieve competitive advantage, diverse its operation and strengthen its market position.