

Improvement of Housing Delivery Schedules: *A Lean Construction Approach*

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ABSTRACT

This paper is the result of research examining the possible implementation and integration of lean construction (LC) principles into the housing construction sector of Trinidad and Tobago (T&T). However, this sector has been burdened with cost and schedule overruns, and poor quality houses. Lean construction (LC) is a new theory of construction management, which aims to identify various construction wastes and eliminate or reduce these construction wastes.

The main objective of this research study is to improve housing delivery schedules by application of lean tools and techniques to the construction sector. In this regard, initially the study focused on identification of various construction wastes such as delays in approvals, poor supervision, and irregular cash flows. Then the study attempted at transformation of the local housing delivery process using value stream mapping (VSM) approach and highlighted the need for removal of non-value adding activities from the selected housing projects.

The benefits of the proper implementation of LC techniques in construction organizations are both tangible and intangible. In this regard, the Construction Industry Research and Information Association reported an increase in productivity ranging 16-40%, and substantial decreases in lead times. In this regard, apart from achieving greater construction quality and customer satisfaction, this study proved that the timely application of LC tools will result in better usage of resources, such as labour, material and time.

Keywords: Housing Industry, Lean Construction, Delays, Delivery Schedules, Value Stream Mapping.

1. INTRODUCTION

The public housing in Trinidad and Tobago (T&T), a developing country, is vital as large segments of the population are either renting or live in subnormal housing. The Ministry of Housing cites the need for more than

150,000 new housing units. Projects of the state's main housing construction executing agency, the Housing Development Corporation (HDC), were found to be poorly planned, poorly executed, and in immediate need of improvement to their delivery and management systems (Uff Commission, 2010).

This research explores avenues for improvement to the current systems of delivery by the implementation of LC principles and practices.

2. LEAN CONSTRUCTION

Lean "a philosophy that when implemented reduces the time from customer order to delivery by eliminating sources of waste in production flow" (Bhasin and Peter Burcher, 2006; Chowdary and George, 2012).

The five processes for implementation of lean techniques are as follows (Picchi and Granja, 2004):

1. Identify Value to End-Customer
2. Map the Value Stream
3. Create Flow by Eliminating Waste
4. Establish Pull
5. Seek Perfection

LC is a move away from traditional construction delivery methods. This change is accomplished by the removal of non-value adding activities, leading to lower costs, better value for the customer and better utilization of resources in the construction process (Howell and Ballard, 1998).

2.1 APPLICATION OF LEAN CONSTRUCTION IN HOUSING

Residential construction with its cyclic nature, and high production rate, provides the closest analogy to the automotive manufacturing industry. This makes it conducive to the implementation of the lean tools of standardization, VSM, and other lean tools into the construction process.

3. RESEARCH

The proposed methodology for conducting the research was qualitative and quantitative. The quantitative methods used include questionnaires, an analysis of housing project data and onsite operations surveys in order to obtain data for construction of VSM. Qualitative methods included the intensive review of written works on the subject matter found in journals, books, case studies, and other sources.

From the review of relevant project data, various issues affected the efficient delivery of housing units were found and grouped as either Organizational Constraints or Individual Project Constraints. **Also, the critical** construction problems highlighted by study participants were selected for the application LC techniques to mitigate or minimize these problems.

3.1 VALUE STREAM MAP

For the VSM, the data for the tasks were tabulated with regards to the scheduled task duration (cycle times) adapted to construction, resource allocation, value added time, lead times, and change over time.

By studying the Current State VSM (CVSM), and the activities in operation, a Future State VSM (FVSM) is developed, minimizing the wastage observed in the CVSM as far as reasonably and practically possible.

4. DISCUSSION

The three main generators of waste were identified as; delay in approvals, poor supervision/direction, and irregular cash flow. Lean integrated solutions or mitigation means were presented for these main transgressors.

The VSM process showed that very little time could be reduced from the scheduled time allocated for the tasks, because the actual time for processes (Value Added Time) did not vary by a substantial amount from the scheduled durations. Most waste occurred in the time observed between the execution of one task, and the time for another to start (Lead Time). An attempt was made to reduce lead times in transitioning from CVSM to FVSM. All the lead times were reduced to the lowest possible time necessary.

Ballard and Koskela (Ballard and Koskela, 1998) mentioned a few guidelines for designing in LC. These are integrated into a delivery model for public housing at every stage, from pre-design, design, construction, closeout and post-construction.

5. CONCLUSION

This research showed that there will undoubtedly be an improvement, and advantages gained, by coupling LC with traditional techniques to reduce delivery time and

minimize wastage and reduce instances of poor quality in public housing construction.

Instances of lean implementation within the construction industry have been very successful. Tangible benefits such as, an increase in productivity from 16-40%, a decrease in refurbishment lead time by 25%, and a decrease in pre-construction lead times by 48%, have been obtained from LC techniques. Intangible benefits are also derived in, organizational improvements, decreased wastage, improvements in communication, improved team dynamics and skills transfer, and better supplier partnering (Construction Industry Research and Information Association, 2003).

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