

Rapid Lean Construction Concept (RLCC)

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Abstract. There is a need to take a holistic approach to reviewing the factors impacting the construction industry performance. Improvements need to be implemented by all parties along the entire construction flow for lasting transformation to occur. Therefore, advance construction methods have to be considered for this new era in delivering project. Enhancement the speed of the construction process flow is the vital to build a sustainable local or foreign construction industry that is poised to compete with the global players. Construction players should have in mind that all the steps in construction should have template or process flow. By establishing this flow, construction process will improve regards to stabilizing work flow and efficiency. An intensive literature and survey among construction players created a process flow that can be as guideline to produce better working environment which contribute to time reduction and lean construction. This paper addresses the discussion on the development of the Rapid Lean Construction Concept (RLCC) whereby the usage of lean construction towards time reduction in construction phase will be explained. RLCC is a tool developed by this research to help the industry to map the construction process towards achieving time reduction with minimum non value-adding activities for the achievement of project delivery. It consists of new concept for construction process flow and the identification of waste occurs on the processes. Also additional data for time reduction achievement and advantages criteria along the construction process clearly stated on that conceptual model.

Keywords: Construction process flow, rapid construction, lean construction, RLCC

1. Introduction

Delay and cost overruns are the rule rather than exception in the construction industry. Lack of constructability in the construction phase generating the failure of handing over project due to ripple effect which creates delay and disruption throughout the entire organization are the largest contributors to the state rule. Because of that, there is a need for improved coordination and performance of the building construction process flow. Means to analyze plan and manage by minimizing the waste and maximizing value. The construction process involves many parties and thus, special focus should be on the interrelated tasks of the numerous parties such in communication and interfaces. In the building construction industry to increase competitiveness, demand from many companies continued effort to develop new methods and tools, in which the design for quality, cost, constructability and reliability play an important role. The planning and management of construction process flow has historically focused upon traditional methods of planning. Little effort is made to understand the complexities of the construction process. The main concern of this paper covered the modeled of overall building construction process systematically creating a general state of art model that covers the construction from early stage till completion by minimizing waste in time reduction manner.

2. Objectives

The aim of this paper is to establish efficient construction process flow that aiming in time reduction. To achieve the above aim, the following objectives have been identified:

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1. Explore the current construction process flow;
2. Identify the needs for construction process flow improvement; and
3. Develop new construction process flow model that aiming in time reduction and minimizing waste (Rapid Lean Construction Concept).

3. Methodology

To achieve the objective, intensive literature review was done to evaluate the current problems that occur in conventional construction process flow. Then, the practices using IDEF0 process model was referred and improvement aspects were identified and suit to the new process model called Rapid Lean Construction Concept (RLCC) that focus in delivering construction phase with time reduction factor and waste elimination. RLCC establishment will show the advantages and the successes of this paper and conclusion drawn up.

4.0 IDEF₀ Construction Process Model

In 1994, the Technical Research Centre of Finland (VTT) launched the three-year research programmed which was implemented in the construction industry and could be translated as “Systems Engineering in Construction”. The programmed consist of construction process models in detailed with reference of traditional method. The common aim is develop a theoretical foundation, systematic methodology, tools and knowledge for continuous improvement of the construction process. The work reported in this model is part of “Construction Process Models” project. The entire project has developed:

- i. Conceptual models of the construction process;
- ii. Computerized modeling and browsing tools;
- iii. Reference models on practical construction processes; and
- iv. Means to accelerate and improve construction processes.

The main focus in modeling has been on activities and their interconnections and the information flows between them. Therefore, the IDEF₀ method was employed since it most often used for that purpose. In this method activities are represented by boxes which are connected by arrows representing interfaces of interconnection between the boxes. IDEF₀ is based on the Structured Analysis and Design Technique (SADT) (Marca & McGowan, 1986). On the other hand, the IDEF family consists of a few modeling methods. Chung (1989), also found the method best for this purpose. Due to the need for improved co-ordination of the interrelated tasks of numerous parties to the process, the means to focus on communication and interfaces and to manage the overall building process level have to be developed. Especially, since most of the development work done so far focuses on just parts of the process and is made for and from the viewpoint of individual parties. Moreover, the problems associated with traditional modes of operation have also been recognized, which along with increasing competition, is forcing companies to develop new products and forms of service. These developments will increase the multiplicity of the construction process. The consequence will be delivery entities and responsibilities that vary from one project to another, and thus management of building procurement and the integration of different parties will become even more important. Ndekugri and Mccaffer (1988), said that total integration is a gargantuan task that requires concerted effort at an industry-wide level and even with the industry’s best efforts it can be achieved only in stages and over a long period. They also point out these features of the task demand the use of a structured analysis, design and development methodology. It is not enough simply to mimic currently practiced procedures. Chung (1989), again remarks that due to the fragmented nature of the industry, the co-ordination among project members is ineffective and results in the loss and duplication of information. As if the presented need for a systematic approach to tasks, responsibilities and data transfer were not enough, it also seems to us that in the future greater emphasis on individuality and technical systems requiring different kinds of specialization will lead to increasingly demanding project. IDEF₀ employs both natural and graphic languages to convey the meaning of a particular process (Karhu et. al., 1994).

The implement building task describes the entire construction process that yields a building that corresponds to the client’s goals. The resources input of the task includes materials, products, services, time and money. Task control is based on project documentation which contains the plans and goals that define the end product and limiting conditions for erecting the building. The mechanism of the task is indicated to

ensure the viewpoint of the model. This process model describes the new building construction project from the viewpoint of the main implementer of the production process from the arrival of the invitation to tender till the end of the final guarantee inspection. All the preceding subtasks of the production process also serve the attainment of the result for build subtask. The subtask involves all the activities connected to physical construction. The handover phase of the project produces a ready-to-use building which is the goal of the entire building process. The handover phase is intended to ensure that the technically ready building meets all set goals. This research was look into the IDEF₀ construction flow as the guidance and framework of the study. The purpose of the flow in construction is to bring the physical construction to completion. All that has been done earlier in the production process is aimed at implementing this task. Its intention thus, is to produce a product (building) that conforms to the plans that are based on the client's needs. The task divides into five parts:

1. Earth and foundation works;
2. Foundation structure and frame;
3. Complementary internal components/structures, fixtures and equipment;
4. Finish internal surfaces; and
5. Building services.

The subtasks of construction include the preparation of the work area for various work phases, such as erection of scaffolding and making machinery operational. Cleaning of the work area after the work phase is also considered a subtask of these tasks.

5. Analysis

The Rapid Lean Construction Concept (RLCC) is a unique conceptual model using the integration of rapid construction concept and lean construction to achieve more efficient construction process. The model work as a guideline in construction process to achieve time reduction and eliminating non value-adding activities that always occur in construction phase whereby it can evaluate the perception for leanness related to the pursuit of the lean construction philosophy and shorter activities time to pursuit of time reduction concept. A categorised evaluation scheme along this model provides easy visualised results. Research framework for RLCC is to integrate rapid construction and lean as theoretical combination into conventional construction in achieving time reduction for construction activities. Rapid construction itself cannot stand alone as a philosophy because it more towards concept. A concept is a cognitive unit of meaning or an abstract of idea. It sometimes defined as a unit of knowledge built from other units which act as a concept which is construction. Therefore, it has to merge with another strong philosophy such lean construction to make RLCC unique enough and practicable to suit in construction sector.

It is a reactive act on traditional construction process flow to deliver a control quality that meet client expectation which being subjective and hard to measure. RLCC can be defining as a systematic approach to deliver a project with minimum wastage in time reduction manner. The application of RLCC in construction requires the evaluation of new measurements such as cycle time, waste, value and variability. To realize the concept, innovative construction method and Industrialised Building System (IBS) should be incorporated to perform the concept. Performance as applied to on-site activities or associated activities is a broad, inclusive term encompassing four main elements namely, productivity, safety, timeless and quality. When applied in its more general definition to on-site and off-site activities it involves additional aspects. Behind the time reduction factor, elimination of waste is on other side to produce the smoothness of the flow. Adoption of innovative construction method and IBS in RLCC will make a successful of the concept. Innovative construction should produce a quality product which meets capital cost, lifecycle cost and time expectation as well as client satisfaction requirements. RLCC conceptual model shown in figure 1.

Innovative construction defines as construction involves the use of special materials and/or methods (Montana Department of Transportation, 2009). It is involves the use of special materials or techniques that reduce construction time. These practices can either shorten overall construction time or make it possible to do work during short term closures during off-peak construction times. Meaning to say, innovative construction has an element of schedule pull which is the principle of lean construction. Innovative construction is due to market driven innovation (Rantakokko, 2007). It is a new process with a new

organizational structure to create a new concept for success in the market. As this is a rapidly evolving area, newly emerging techniques and materials must continuously be developed. IBS method is different from the conventional construction method. Known for its benefits in terms of shorter construction time, saving in labour, material saving, better quality control, immunity to weather changes and the cost factor, IBS method illustrates a different approach to the construction method commonly used (Warszawski, 1999). It offers an alternative to the existing conventional building system. Among one of the most important characteristics of IBS method is the components are prefabricated off-site. Prefabrication system of construction means breaking a whole housing unit into different components such as the floors, walls, columns, beams, roofs, etc. and having these components separately prefabricated or manufactured in modules or standard dimensions in a factory. IBS method emphasizes on prefabrication concept. Firstly, the design stage is carried out where the IBS components are designed according to specifications. Then, the components are prefabricated at factory, where components of IBS are manufactured according to specified dimensions and specifications. Quality-controlled and highly aesthetic end products through the processes of controlled prefabrication and simplified installations has maintained and ensured the quality of work in the construction industry. The IBS components are then transported to the site from the factory for assembling process. At site, the IBS components are assembled accordingly with the assistance of a crane. The reduction of construction waste with the usage of the standardized components and less in-site works provides a cleaner site due to lesser construction waste. Finally, the final unit of the building is finally assembled and ready for occupation. IBS method offers a new concept in terms of speed of construction, and it clearly shows many other benefits as compared to the conventional construction method.

6. Conclusion

The general view of the construction process is that it is an ordered, linear phenomenon, can be organized, planned and managed top down. The frequent failure to complete construction projects on schedule planned give rise to a thinking that the process maybe not is as ordered and predictable in its nature it may be look. The overall focus on time has an impact on adoption of technology in the construction process flow itself. The practice give better value through improved delivery times, higher quality output, more efficient use of resources and less waste. Rapid lean construction process flow focus on delivering construction phase with minimum wastage in time reduction manner. The RLCC conceptual process model is suitable for construction players to suit into the industry. The practical used of IBS was an input to realize this concept. IBS implementation in construction industry is well known and established. To get rapid construction process with minimum wastage, this concept should be an approach to be practiced widely for construction improvement.

7. References

- [1] Technical Research Centre of Finland-VTT (Zhong, Q., Mathur, K. and Tham, K.). A Construction Process Model by Using Design/IDEF. *CIB Workshop on Computer integrated Construction*. Finland. 1994.
- [2] Marca, D. and McGowan, L. Structured Analysis and Design Technique. *McGraw Hill*. New York. 1986.
- [3] Chung, E. K. A Survey Process Modelling Tools. *Technical Report No. 7*. Department of Architectural Engineering. Pennsylvania State University. U.S, 1989.
- [4] Ndekugri, I. and McCaffer, R. Management Information Flow in Construction Companies. *Journal of Construction Management and Economics*. Vol 6. No. 4. 1988. pp: 273-294.
- [5] Karhu, V., Hannus, M., and Pellosniemi, J. *Product Model Based Architectural Design of Prefabricated Construction*. Finland. 1994.
- [6] Montana Department of Transportation. *Standards for Design and Construction*. USA. 2009.
- [7] Rantakokko, M. Innovative Construction and Nordic Cooperation. *Eurekabuild Workshop*. Nordic Innovation Centre. 2007.
- [8] Warszawski, A. Industrialised and Automated Building System. Technion-Israel Institute of Technology. Spon. 1999.

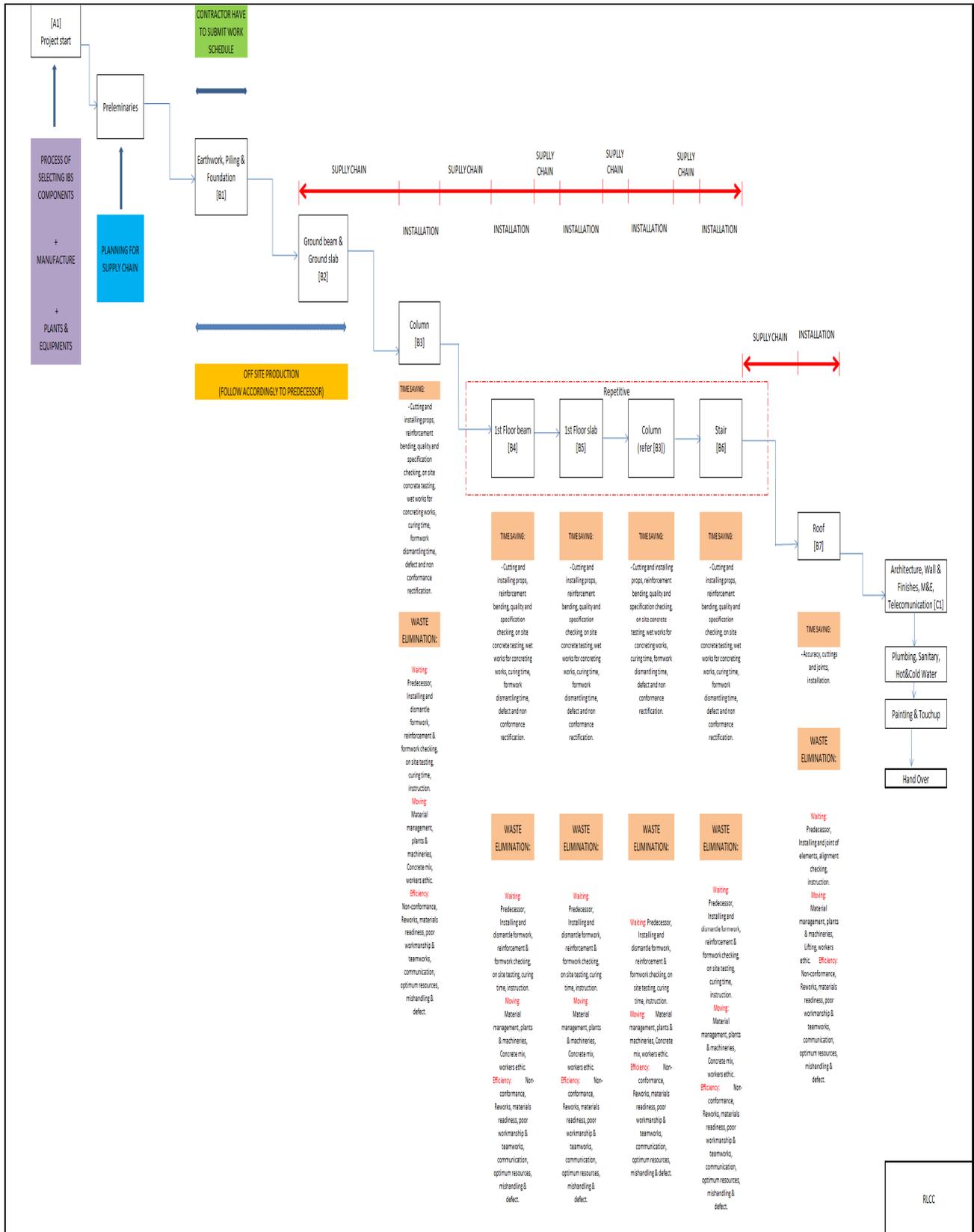


Fig. 1: Rapid Lean Construction Concept (RLCC) as construction process flow.