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Improvement Plan of Daily Work Accomplishment Index based Process Management based on Lean Construction Principles

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Abstract As construction projects become larger, process plans become more complex, and inadequate process management leads to waste of time and resources. Effective process management requires process management techniques that can identify problems inherent in the process, continuously improve, and reflect interdependent process characteristics. In the field, the day's details by work type and work status are to be entered in the work daily report. However, even when important information is written, it is not directly linked to the overall process management.

This study aims to propose specific process management and decision-making plan based on actual worker by visualizing and quantifying the information described in the existing work daily report. It is expected efficient process management to increase reliability and productivity through process management, which can increase the utilization of work daily reports and facilitates organic communication among participants.

Keywords: Process Management, Lean Construction, Work Achievement, Daily Work Plan, QFD

1. INTRODUCTION

1.1. Background & Purpose of Study

Construction work, since investment cost is high, construction period is long, and construction is carried out through various complicated processes, should be performed by careful and systematic process management before construction, which results in the success or failure of the construction work. However, in many cases, there are many difficulties in understanding status of the project and planning not to utilize specific management tools and techniques at the construction fields, The process chart, in many cases, is inconsistencies with actual processes in the field, since it is used only for submission to the orderer and for weekly meetings, and it is maintained until completion without changes and corrections in some cases. As a result, construction delays, and much time and resources are wasted in identifying and resolving the causes. To complement these problems and achieve efficient process management, process management technique is needed that can identify the problems inherent in the process and continuously improve and reflect the interdependent process characteristics.

In the case of a work daily report prepared in the field, details by work type such as required workforce, material, equipment, etc., and the work status should be entered on the same day. However, even if important information is written in the work daily report, it is used only for daily confirmation and reporting. There is also a limitation that the form is different for each company and there is no standardized form.

This study aims to propose specific process management and decision-making plan based on actual worker by visualizing and quantifying the information described in the existing work daily report.

This study aims to improve the utilization by preparing the work daily report linked to the daily work plan by applying the proposed model. In addition, it aims at efficient process management that can increase reliability and productivity

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through process management that facilitates organic communication among participants such as suppliers.

1.2. Scope and Method of Study

As construction projects become larger, process plans become more complex, and inadequate process management leads to waste of time and resources. It is important, above all, to increase the reliability of the process plan to solve these problems. (Ballard, 1999) Reliability in the process plan leads to stable process flow, productivity improvement, and quality improvement, and it is effective to apply Lean principle for this.

Therefore, this study intends to analyze the problems of the existing process management and propose the process management decision-making plan applying Lean principle as a plan to complement this.

The procedure and method of this study are as follows:

1) Study on existing process management and analyze problems.
2) Review the essence of efficient process management based on TFV(Transformation-Flow-Value) theory of Lean construction.
3) Consider QFD as a tool for organic decision making.
4) Propose process management process based on work accomplishment index. The details are as follows.
- Subdivision of work by work type
- Modification and utilization of existing work daily report
- QFD-based work accomplishment index model
- Work achievement evaluation and daily process management.
5) Conclusion and Expected Effect

2. PRELIMINARY STUDY

2.1. Study of Existing Process Management

The study to analyze and improve the process management status of the field has been carried out steadily, and the contents of the study are as follows.

Jung (2002), in 'Recent Trends in Process Management in Construction Projects,' analyzed lack of understanding of process management, inconsistency between the construction period planned on the process table and the actual construction period, difference between planned process schedule and actual construction process, etc. as the problems of process management. Also, he pointed out that proper process progress management is not being performed since the initial scheduled process table prepared for the orderer is not modified even if it is changed during the construction process and maintained until the completion.

Son (2006) identified the main problems of each field management through the status survey in 'Improvement of Field Management and Operation System of Apartment House Construction Work.' They analyzed the lack of coping with construction period delays caused by work flow variations such as climate and civil complaints, etc. the lack of understanding process management of subcontractors, etc. as the problems

Lee (2011) analyzed and surveyed process management work, the status and techniques in 'Study on Application of Process Management: Focusing on the Field.' Herein, they pointed out that actual process management could not be achieved due to coping after construction period delay, not advance preparation of construction period delay as the problems of existing process management.

They studied on work daily report for daily progress management in the construction field. The work daily report includes information on the resources input status such as materials, labor, equipment, etc. and work status by-work type.

Rusell (1993) maintained that it is necessary to accumulate and analyze performance information on construction works to be more specific than existing plan for the future plan for presenting and utilizing the construction period, construction cost, construction scope, etc. at the beginning of construction, and proposed the use of the work daily report as an important means of accumulating such performance information. In addition, he suggested that the information collected through the work daily report should be associated with process management and utilized, and that the existing work daily report process should be improved to do this.

Kim (2002) presented the direction of improved work daily report system to improve the productivity of the construction through information input / management centered on the partners. However, they did not provide effective tools to utilize the collected information.

Shiay (2003) mentioned the importance of work daily report because it can accumulate and utilize a lot of performance information through the existing work daily report, but pointed out the limitations of the work daily report written by hand.

Yoon (2007) pointed out that the work daily report is used as the basic data for the construction promotion, but does not maintain mutual compatibility, and it is difficult to grasp the present progress and to predict the completion time. However, there is limitation in that it is only as acquiring basic data necessary for establishing the standardization direction of the work daily report form.

Lee (2012) drew the operation status and problems of work daily report and presented its improvement plan, but did not present the plan to utilize with partners of the improved work daily report.

In process management, there are many cases where the actual work and the process schedule do not match, and the information of the work daily report is not utilized and it is only for the daily construction report.

In addition, there appeared to be little communication between partner when preparing a work daily report. Effective linkage between work daily report and process management is needed and communication plan among participants is required.

Table 1. Problems analysis of existing process management

	Problems	Analysis
Existing process management	Inconsistency of weekly process plan and actual process	Need to link daily work plan with process management
	Lack in review and management of work daily reports	Require effective utilization plan
	Lack of communication related to work daily report	Require communication alternatives among participants
	No reflection of work change	Require specific process management based on daily work

2.2. TFV Theory of Lean Construction

Lean means "no superfluous" or "oilless", as an advanced production and management philosophy to the goal of improving productivity, has been actively studied since its introduction as a new management method of construction. Lean construction is based on the basic concept of pursuing he greatest value and perfection by minimizing waste. It defines all activities to not create value as waste, and aims to eliminate waste, above all, to maximize the creation of value for the resources invested.

This theoretical approach concept of Lean construction is TFV theory(Koskela, 2000). Based on the Lean concept, construction production is viewed as three aspects: (1) Transformation for creating value, (2) Flow for eliminating non-value creation work, and (3) Value created through customer satisfaction, and each concept is not an independent but interdependent and complementary relationship.

From the point of view of transformation, construction production can be conceptualized as 'transformation of input to output'. From this point of view, efficiency of individual work for construction production becomes important, and it is possible to eliminate the waste by improving the efficiency.

From the point of view of Flow, construction production can be conceptualized as flow of materials and information. From this point of view, it is important to eliminate waste such as the reduction of non-value creation work, which is like improving the efficiency of work flow. Also, flow can be seen not only as flow within a work but also as flow among works. In this case, the reliability of work plan can be an important management factor. It is possible to prevent the unnecessary work plan, personnel, quantity and time from being wasted by establishing the amount of work that can be performed during the day based on the daily work plan. Work reliability can be measured with work accomplishment.

From the point of view of Value, construction production can be conceptualized as process of creating customer value by meeting customer' needs. In general, customers often refer to the ultimate customer - builder or orderer - in this case, the value of the customer can be improved by eliminating the loss of value. Also, if the customer is interpreted as a customer in production process, the customer of the preceding work becomes the following work. From this point of view, the value of the customer is to complete preceding work to start customer's work at the time the customer expected. In other words, it can be seen as improvement of stability through reduction of variation in manufacturing process and elimination of waste.

2.3. QFD(Quality Function Deployment)

QFD is a comprehensive quality management tool that is widely used in industry. It transforms the customer's requirements into the design characteristics of the product and then transforms them back into component characteristics, process characteristics, and finally specifications for production. The core of the QFD structure is how to design and produce products and services to meet customer needs, that is, structuring them using matrices by correlating objectives and means. Through this, it is to maximize customer satisfaction by fully reflecting the customer's requirements to products or services.

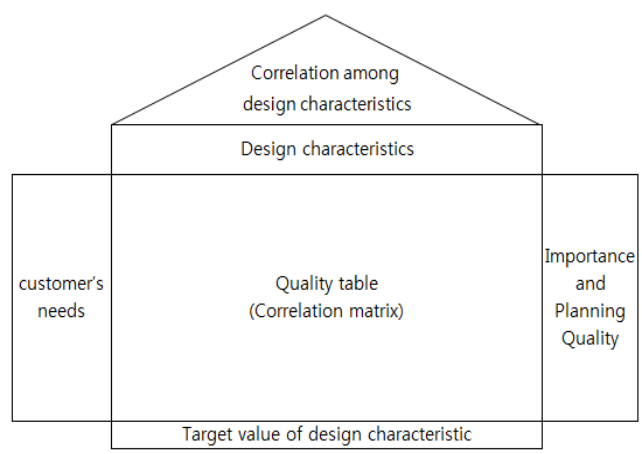

Figure 1. Concept diagram of existing QFD technique

In this study, previous studied TFV theory of Lean construction is applied to QFD. A series of QFD processes transform the customer's requirements (inputs) into quality elements (outputs) and organically analyze the relationship (flow) between quality elements (materials and information) and derive specific specifications (value) for production to meet customer's needs. Therefore, QFD can be used as decision-making tool for Lean-based process management.

3. PROCESS MANAGEMENT PROCESS BASED ON WORK ACCOMPLISHMENT INDEX

We propose the process management process based on work accomplishment index as specific decision-making plan focused on actual worker by visualizing and quantifying the information described in the existing work daily report. They write out the daily work report linked to the daily work plan, linked this to the

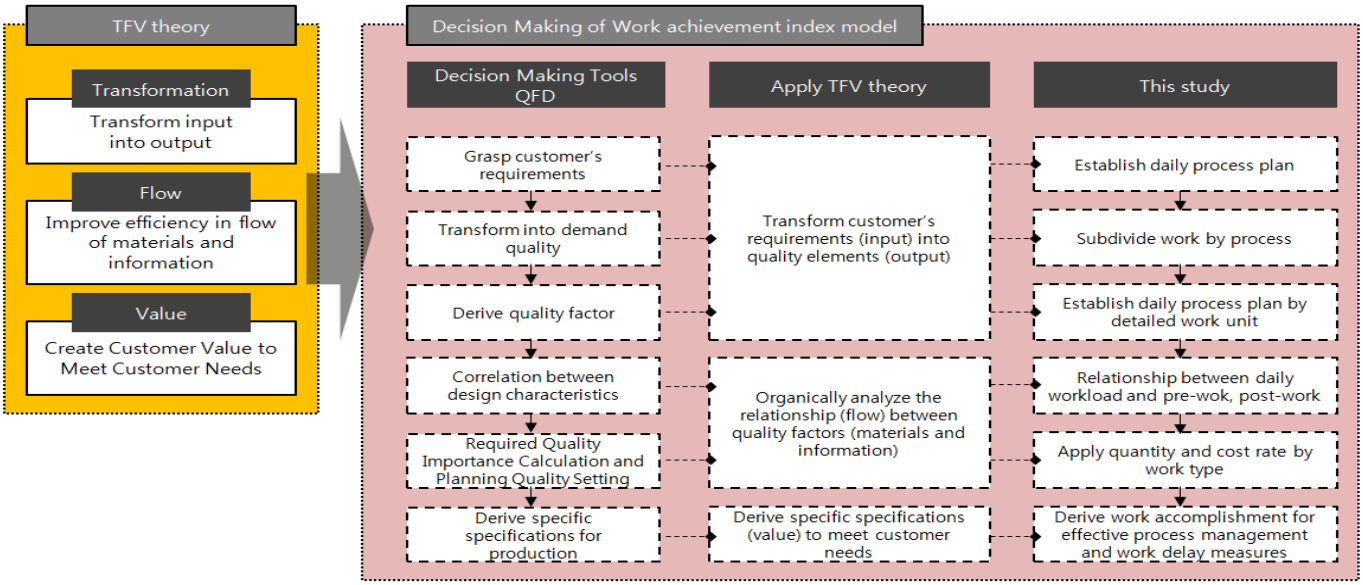

Figure 2. QFD application of TFV theory

QFD, and evaluate and manage the daily process. Based on the data visualized and quantified through QFD, they make an organic and continuous decision-making among the participants such as partners, perform the process management to improve reliability and productivity by reducing the waste and variation factors through this process.

1) Subdivide the work by work type of monthly process plan
2) Establish weekly process plan and daily process plan in detail work unit.
3) Perform work based on daily process plan.
4) Write out work daily report based on daily process plan.
5) Input the information of prepared work daily report into the work achievement index model.
6) Output the total process rate by applying daily work accomplishment and work accomplishment by company, the ratio by work type according to the work performance value by inputted detail work.
7) Identify output value and reasons for work delays and shortening, adjust and supplement daily process plan and weekly process plan.

4. WORK ACHIEVEMENT INDEX MODEL

The work achievement index model proposed in this study uses QFD as decision-making tool and applies the TFV theory of Lean construction to QFD as shown in Fig 2. It defines the detail work clearly and concretely, establishes the daily work plan considering pre-work and post-work with interdependent characteristics, and evaluates the work accomplishment. QFD, as tool for matrix analysis, makes organic evaluation and analysis of the elements constituting the work achievement index model possible. Continuous management of achievement leads to reduction of inherent and extrinsic variation factors, thereby improving reliability and quality and expecting stable process flow.

1) Detailed Works
   The detailed work items included in the daily process plan, and they should be written in worker-oriented language to easily understand.
2) Ratio
   Apply to the detailed work planned on a daily basis by applying volume by work type and cost ratio. Apply as a ratio to see the volume and cost contents written in simple numerical values in the existing work daily report to grasp the process progress.
3) Company Name (input personnel)
   Enter worker information by company. Enter company name, input personnel, and the names of personnel, and it is easy to confirm by work.
4) After the work, enter the work amount written in the work daily report based on daily process plan.
5) Output the total process rate by applying daily work accomplishment and work accomplishment by company, the ratio by work type according to the work performance value by inputted detail work.
6) Reasons for Delays and Shortening of Work
   Describe the reasons and causes of work delays for incomplete work. Work delays can be classified into 9 categories: plan changes, preliminary work, personnel, materials, equipment, weather, information, field conditions, and safety. Among these, preliminary work is item included in the work daily report, as work to be prepared in advance before work such as book confirmation and quantity planning.

Interdependency of pre, post-work:

◆ Needs to consider pre, post-work

Detail work by Subcontractor:

Input work performance value

Subcontractor / Detailed work by work type	Ratio(cost)	Subcontractor 1 (Input Personnel)	Subcontractor 2 (Input Personnel)	Subcontractor 3 (Input Personnel)	···	Subcontractor j (Input Personnel)	Work accomplishment	Reasons of work delays and shortening
Detailed work 1	c1			◆			p1	
Detailed work 2	c2						p2	
Detailed work 3	c3	◆					p3	
Detailed work 4	c4						p4	
Detailed work 5	c5						p5	
Detailed work 6	c6						p6	
Detailed work 7	c7						p7	
⋮	⋮						⋮	
Detailed work i	c i						pi	
		Detailed work 1	Detailed work 2	Detailed work 3	···	Detailed work i		
Daily work accomplishment by Subcontractor		d1	d2	d3	···	dj	Daily work accomplishment	
Accomplishment average cumulative value		s1	s2	s3	···	sj	Total process rate	

Figure 3. Work Achievement Index Model based on QFD

5. CONCLUSION

Construction project has a high level of uncertainty by step and interdependence among work. Therefore, productivity is significantly different depending on the variables.

(Temmelein et al., 1999). Therefore, these variables should be considered and reduced in the process plan, and the linkage of pre-work and post-work, resources, and restriction conditions should be considered to perform the actual work. In addition, the detailed plan should be established at the level of the actual worker. Therefore, this study proposed the work achievement index model as the process management plan that can identify the problems inherent in the process, continuously improve, and reflect the characteristics of interdependent processes.

The main conclusions of this study are as follows.

(1) As a result of analyzing the existing process management, it is analyzed that there is lack of communication among participants because daily work report and process planning management are performed separately and only formally not linked to each other. Even if this can cause delays and problems, it showed that they could not find where the problems originated, or it took a lot of time to find them. Also, it showed that they already missed a point of time to solve the problem or wasted a lot of resources

(2) It was proposed the direction to materialize the process plan as the detail work centered on actual worker, so that the worker could participate in the process management and improve the completeness of process.

(3) It was suggested the direction to standardize information described in existing work daily report by complementing to be written in linkage with daily process plan.

(4) It was proposed the plan to increase the utilization of work daily report.
It was proposed the plan to visualize and quantify the work achievement index model by improving the limitation of writing of the work daily report. It used QFD to enable matrix analysis by developing simple enumerated information of the work daily report. In other words, the items of the work daily report are directly applied to the items of the QFD based work achievement index model, and the daily work accomplishment and the process rate are derived, and the work is analyzed and planned. It becomes possible to grasp the flow of the process by enabling complex analysis in addition to checking and reviewing the information described in the existing work daily report. In addition, according to the evaluation results of the QFD-based work achievement index model, the daily work accomplishment is accumulated and the whole process rate is derived, while confirming and supplementing the work problems in detail on a daily basis. Thus, the accumulation of evaluation results of the work accomplishment index model facilitates overall process progress and completion prediction.

(5) The organic process management and decision-making among the participants, Through the actual worker-oriented process plan are possible, so that consideration and coping of variables in the process plan can

be made immediately.

(6) It can be used as a basis for selecting company in the future through accumulation of company evaluation scores of work achievement index model, and this motivation leads to improve the work completeness of the company.

(7) It is expected to improve the quality of construction by continuously managing the daily work accomplishment.

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