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Work Structuring and the Feasibility of Application to Construction Projects in Vietnam

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***Abstract*—**Design should be viewed concurrently by three ways as transformation, flow and value generation. An innovative approach to solve design – related problems is described as the integrated product - process design. As a foundation for a formal framework consisting of organizing principles and techniques, Work Structuring has been developed to guide efforts in the integration that enhances the development of operation and process design in alignment with product design.

Vietnam construction projects are facing many delays, and cost overruns caused mostly by design related problems. A better design management that integrates product and process design could resolve these problems. A questionnaire survey and in – depth interviews were used to investigate the feasibility of applying Work Structuring to construction projects in Vietnam.

The purpose of this paper is to present the research results and to illustrate the possible problems and potential solutions when Work Structuring is implemented to construction projects in Vietnam.

***Keywords*—**integrated product – process design, Work Structuring, construction projects, Vietnam

I. Introduction

SINCE the end of 20th century, the Transformation – Flow – Value generation (TFV) theory of production has been developed. TFV concept is resulted from the combination of T, F and V concepts. TFV also provides a theoretical foundation for design [1]. When the design process is conceived with TFV view, design delivers not only a good engineering product but also what the customer needs and without waste. Therefore, Ballard et al. argued that design process must anticipate every delivery phase, and all considerations about product development processes have to be determined in intimate conjunction with product design [2]. It is needed to integrate design of product and process. Integration here is in relation to the process and content of information/knowledge, between and within project stages, and of all technologies/tools used in the product development process. That also involves upfront requirements analysis by multidisciplinary teams and early consideration of all lifecycle issues affecting a product [3]. Therefore, integrating of product and process design can improve the quality of design and eliminate changes.In fact, integrated product – process design is a challenge [2]. Tsao et al. explored some barriers stand in the way of the effective integration of product and process design in construction projects: (1) it relies on the initiative and ability of project participants to pull from a wealth of knowledge or experience, (2) project participants may hesitate to make a recommendation that improves overall project performance, especially if it adversely impacts their own work, and (3) an owner's contracting approach may limit funds during the early stages of project development, so project participants lack the resources needed to develop a range of innovative alternative product and process designs [4]. They also explained that construction industry needs a formal framework consisting of organizing principles and techniques to guide efforts in product and process design integration [4].

The investigation of practitioners' attitudes toward applying Work Structuring as a foundation for a formal frame work for product and process design integration to construction projects in Vietnam is the most important part of this research. Confirmation of the feasibility is as an initial step to bring a new approach in construction management into Vietnam.

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II. Work Structuring

A. Background

Since the mid – 1990s, Lean Construction has emerged as a new concept, both in the discipline of construction management and the practical sphere of construction [5]. This term was coined by the International Group for Lean Construction [6]. A result from the application of Lean Production principles and practices to construction [7], Lean Construction is an approach trying to manage and improve construction processes with minimum cost and maximum value by considering customer needs [8].

In 2000, Lean Construction Institute developed Lean Project Delivery System (LPDS) to guide the implementation of Lean Construction on performance of projects. LPDS consists of 13 modules illustrated in Fig.1 as the following. With LPDS model developed by Lean Construction Institute [9], the project is structured and managed as a value generating process including Project Definition, Lean Design, Lean Supply, Lean Assembly and Use. Each phase of the project overlaps with the adjacent phases indicating the need to incorporate interests of subsequent phases. The system uses feedback loops that are incorporated at every level, dedicate to rapid system adjustment. That means learning loops and continuous improvement. Post – Occupancy Evaluation (POE)

is the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time. It also involves in LPDS to link the end of one project to the beginning of the next.

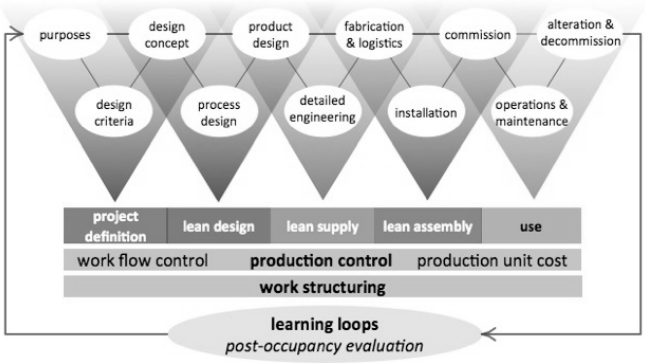

Fig. 1 Lean Project Delivery System [18]

In Lean Construction, design process is conceived in TFV view and is understood as encompassing not only "product design" but also "process design" [5]. Therefore, product and process design modules are involved in Lean Design and integrated.

To integrate product and process design throughout the project development process, Work Structuring is a module in LPDS along with Production Control. Ballard introduced this term as a foundation for a formal framework for product and process design integration [10]. He also identified Work Structuring as "the development of operation and process design in alignment with product design, the structure of supply chains, the allocation of resources, and design-for-assembly efforts" with the goal of making "workflow more reliable and quick while delivering value to the customer" [9]. Therefore, the scope of Work Structuring is extended "from an entire project delivery system down to the operations performed on materials and information within that system" [5].

B. Work Structuring and Work Breakdown Structure (WBS)

Project planners typically use a WBS to decompose a project into work packages (WPs) to create a framework for project planning, scheduling, and controls [11]. This technique of traditional, non – lean project management is derivative from transformation thinking, which ignores interaction between activities, effect of dependence and variation, hence reveals the inadequacy with the purpose and complexity of work structuring as conceived within the LPDS [2].

Based on Transformation – Flow – Value generation thinking, Work Structure differs from WBS in the functions it performs and the questions it answers. Project decomposition helps planners visualize a project as a collection of manageable pieces. Thus, Work Structuring might begin with decomposition by using WBS as a tool but then adjust the WBS to identify resource dependencies between elements of work at different levels of detail [4]. The significant difficulties between Work Structuring with Lean principles and Work Breakdown Structure (WBS) introduced by Project Management Institute in PMBOK 4th, 2008 [12] are shown out in the TABLE I as below.

TABLE I
COMPARISON OF WORK STRUCTURING AND WORK BREAKDOWN STRUCTURE

	Work Structuring	**WBS**
Theory	Based on Transformation – Flow – Value generation theory	Based on Transformation theory
Function(s)	Developing operation and process design in alignment with product design, the structure of supply chains, the allocation of resources, and design-for-assembly efforts	Organizing & defining the total scope of the project
Output(s)	Project execution strategies, project organizational structures, operations designs, Master and pull schedules	A deliverable – oriented hierarchical decomposition of the work

C. Outputs of Work Structuring

Work Structuring produces a range of outputs including: project execution strategies; project organizational structures, including configuration of supply chains; operations designs include work elements at various structural levels and process flow diagrams; master schedules; and phase schedules [5].

Master schedules are limited to phase milestones, special milestones, and long lead items [5]. Their functions are to give us confidence that an end date and milestone dates are feasible; develop and display execution strategies; identify and schedule long lead items; and divide the project into phrases, identifying any special milestones of importance to client or other stakeholders.

Phase schedules, also called "pull schedules", are based on targets and milestones from the master schedules and provide a basis for look-ahead schedules [9]. These schedules are produced by the team that will do the work, using a backward pass, making float explicit, and deciding as a group how to use float to buffer uncertain activities [5].

D. Process of Work Structuring

Lean Construction Institute recommended Work Structuring as a complex process [7]. It includes the following sub-processes, which generally occur in the order listed: (1) Chunking, (2) Sequencing, (3) Releasing, (4) Decoupling and (5) Scheduling.

Chunking: It is decomposition of wholes into parts. Both product and process are decomposed into chunks. WBS might be used as a tool in chunking.

Sequencing: It determines the order in which chunks at the various work structure levels are processed.

Releasing: It provides rules and criteria that specify the conditions in which chunks of work move between production units.

Decoupling: Decoupling buffers are necessary when work flows cannot be synchronized. This occurs when there is a variation in processing or delivery rates, differences in rates,

or the way in which work is batched for moving or processing changes from one production unit to the next.

Scheduling: Schedules are outputs of Work Structuring. The Lean Construction principles applicable to schedules are:

Limit master schedules to phase milestones, special milestones, and long lead items.

Produce phase schedules with the team that will do the work.

E. Tools and Techniques for Work Structuring

1. Five Whys (5 WHYs)

The strategy for fixing the system is to eliminate the root cause to avoid repeat occurrence [13]. The "five whys" is a quality management technique of problem solving that tries to find the root cause of a problem. Once a problem occurs, workers should ask and answer why it occurred at least five times in succession until they identify an actionable root cause. This technique is an integral part of the Toyota Project delivery system [14] that became known as "Lean production" in the United States. It is also a useful technique in Lean Construction tool set. 5 WHYs is a good way to address the problems of non - integrating product and process design and elicit alternative ways of structuring work without being constrained by contractual agreements, traditions, or trade boundaries [4].

2. Cross-functional Teams

As a foundation for a formal framework for product and process design integration [10], Work Structuring should be jointly assigned to the entire production team, including design, supply, and installation specialists. Otherwise, integrating specialty contractors and design specialists into a team might effectively produce a design which satisfies what the customer needs without waste. Thus, cross-functional teams, a group of people with different functional expertise working toward a common goal, are organized particularly for Work Structuring and Lean Design. These organizational units are aimed to involve downstream players in upstream decisions, alternate between all-group meetings and task force activities, create and exploit opportunities to increase the value in every phase of the project [2]. Cross-functional teams are key tools for Work Structuring to improve the integration of product and process design.

3. Pull Scheduling

Pull techniques and team planning are recommended by Lean Construction Institute to develop schedules for each phase of work, from design through turnover. A pull technique is based on working from a target completion date backwards. Therefore, tasks are defined and sequenced so that their completion releases work. The rule of "pulling" is to only do work that releases work to someone else, thus eliminates the waste of overproduction. Working backwards from a target completion date eliminates work that has customarily been done but does not add value [9].

Team planning involves representatives of all organizations that do work within the phase. Pull Scheduling is used to do team planning. Purpose of this tool is to produce a plan for completing a phase of work that maximizes value generation and one that everyone involved understands and supports and to produce a plan from which scheduled activities are drawn into the look-ahead process to be exploded into operational detail and made ready for assignment in weekly work plans [9].

4. Process Flow Diagram

Process flow diagrams are useful tools for sequencing chunks because they visually display possible sequences. Diagramming involves deciding how to decompose the work into parts and also decisions about execution strategies/sequencing, release criteria, decoupling buffer location and sizing, and mapping process/supply chain. The goals of a process flow diagram include 1) grouping iterative tasks for joint assignment to the production units involved, and 2) structuring operations in continuous flow processes to distribute and simplify control [9].

5. Locating and Sizing Buffers

Buffering is a common practice in project planning. It has been promoted as an effective tool to reduce the impacts of production variations on the downstream process [15, 16]. Buffers are resource cushions such as money, time, materials, space, etc., and operate to provide cushion or shield against the negative impact of disruptions and variability [15, 17]. Furthermore, when buffers are used correctly, they provide the ability in adding reliability [18], smoothing a workflow [19] and increasing labor productivity [20].

There are different types of buffers needed to absorb correlative forms of variability. Alves et al. distinguish between two main categories [21]. They are passive buffers related to the flow of process and active buffers related to the operations where resources (either workers or machines) perform work on the product, i.e. excess capacity of labor and equipment.

Inventories and time are two types of passive buffers. Physical inventories may be categorized according to their position and purpose in a supply chain. Time buffers are used in project management to manage schedules. To serve the function of buffering downstream process from flow variation, Ballard and Howell distinguish between two types of inventories including plan buffers (inventories of workable assignments) and schedule buffers (materials, tools, equipment, manpower, etc.) [17].

Many projects are uncertain and complex, construction managers must learn to manage the work under conditions of variability [22]. Rather than being an alternate to better planning, researchers are studying how buffers can work effectively with planning strategies to help manage these difficult conditions. Thus, how best to locate and size buffers to desired performance are crucial issues in buffering.

F. Learned Lessons from Implementation of Work Structuring

Based on analysis of some projects and case studies, we have learned some useful lessons in using Work Structuring to achieve integrated product – process design.

5 WHYs is a good way to address the problems of non - integrating product and process design. These problems are

solved by trying and developing the "fixes" system. Considering, assessing the impacts of the fixes on design of supply chain, product, processes and operation and then combining them into alternative Work Structures represents the effort to improve the integration of product and process design.

All project participants have the opportunity to consider Work Structuring together and early enough in the process that would be best for the system. The owner, architect/engineer, and fabricators negotiate their resources with owner requirements to develop the product design. The contractors and architect/engineer negotiate standard work procedures and the product design to develop operation designs. The construction manager negotiates owner requirements and the sequencing preferences of various project participants to develop the project's overall process design. Therefore, different perspectives are considered in Work Structuring and also product and process design integration is improved.

Design-build model can allow the modifications to be made to the process design earlier in the design phrase but does not ensure integrated product and process design. Because of since contracts have already been signed, the constructors may choose to avoid questioning the design with the architect/engineer by assuming that work must proceed according to the original product design. Furthermore, constructors do not necessarily complain about site problems because (1) as contractually speaking, site problems may be considered theirs to resolve, (2) they may have more important problems to address, and (3) complaining might reflect poorly on their trade skill and pride.

Cross-functional team is a flexible model to provide the opportunities for early involving of key participants in design phase. The model is effective in monitoring design progress and solving problems.

To integrate product and process design, there is a defining the role of design integrator. The project manager needs to perform more than just a project management role. He must be also a design integrator from the start to end of the design phase.

Through Pull scheduling and process/supply chain mapping, the flow of design information and specifications from clients to construction process; and information of available material, labor, equipment is matched the flow of work performed. It means that product and process design is integrated. Therefore, customers are satisfied and wastes are eliminated by minimizing the variability of the process.

IT is an importance supporting tool for the project manager and cross functional team in improving integrated product and process design through Work Structuring.

III. Methodology

This research has adopted field survey methodology to investigate the feasibility of applying Work Structuring to construction projects in Vietnam.

A. Questionnaire Design

The questionnaire used to gather date was designed in accordance with the research hypotheses, objectives, questions, literature and archival records. Two kinds of questions were adopted including open and closed – ended questions with multiple-choice form. Likert Scale form (5 = Strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly disagree) was also utilized. The questionnaire was divided into three sections with 42 questions.

In order to fit into conditions in Vietnam construction industry, a pilot test was performed for improving the questionnaires. Group of respondents involved in this pilot test, including five experts in Vietnam construction industry and one professor from USA, who has much of experience in teaching construction engineering and management in Vietnam. These experts are two senior university lectures, one top manager of a construction company and also a professional project manager, one public owner, one contractor. All of them have at least twenty years of experience in construction industry. Their valuable comments were used to revise the questionnaire. The finished questionnaire was conducted for field survey.

The designed questionnaires were delivered to respondents face – to – face or by email. These issues mentioned in the questionnaire are quite new with Vietnamese practitioners. So an attached short report was sent with the questionnaire to let respondents understand more about Lean Construction and Work Structuring with Lean principles. At the end of the report, there was a small test, including 10 questions to check the understanding level of respondents. Both questionnaire and attached report were translated into Vietnamese.

B. Sample Selection

Key participants in a project were focused in the survey, including owners, members of the team projects from Project Management Units (PMUs), designers/consultants and contractors/subcontractors. In order to investigate the feasibility of a new method, the opinions of experts of construction management in Vietnam construction industry have an important role. Furthermore, to build good fundamentals for performing statistical analysis, sample included practitioners working at managerial positions – top managers of organizations, project managers, managers and vice – managers of functional departments, principal engineer or senior lectors from universities. They have worked in the construction field at least five years. Especially, some foreign organizations have many projects in Vietnam were taken account in this survey.

C. Questionnaire Analysis

The Statistical Package for Social Science (SPSS) version 16.0.1 and Microsoft Excel 2007 were used for data analysis. This analysis was performed for three issues as below.

1. Reliability

Reliability is the ability of a measure to produce consistent results when the same entities are measured under the correlative conditions [23]. It is utilized to validate a

questionnaire. In this research, SPSS and Cronbach's alpha, α were applied to measure the reliability of our questionnaire. Values of α around 0.8 are good.

2. Hypothesis Testing

One main hypothesis and three sub hypothesis were assumed. They were:

Main hypothesis (H1) - Work Structuring can apply in construction projects in Vietnam.

First sub - hypothesis (H2) – Poor level of design management is one significant cause of design – related problems in construction projects in Vietnam.

Second sub - hypothesis (H3) – A new approach is needed to improve design management in construction projects in Vietnam.

Third sub - hypothesis (H4) – A formal framework consisting of organizing principles and techniques is needed to guide efforts into integration of product and process design in construction projects in Vietnam.

One sample T-test of SPSS was used to test these hypotheses. For each hypothesis, there was a null hypothesis (H0) against an alternative hypothesis. According to the result of T – test if p – value or significant of the test is at $p \leq 0.05$, it can be concluded that the null hypothesis is incorrect. And then if μ - values (the mean of respondents of scores) are more than 3 based on the Likert Scale in the questionnaire (5 = Strongly agree; 4 = Agree; 3 = Neutral; 2 = Disagree; 1 = Strongly disagree), it means most of respondents' answers are more than 3 (5 = Strongly agree; 4 = Agree) so these alternative hypotheses will be accepted.

3. Correlations

ANOVA test of SPSS was used to assess correlations between project position and organization type characteristics of respondents and their opinions. According to the result of ANOVA test, if p – value or the important of the test is at $p \leq 0.05$, it can be concluded that there is a significant effect of respondents' characteristics on their answers.

IV. Data analysis and results

A. Questionnaire Delivery

The questionnaires were delivered to 24 organizations take part in Vietnam construction industry. They included three state management agencies, five domestic public companies, ten domestic private companies, three foreign companies and three universities. A total of 60 questionnaires were delivered by face to face and email. There were 44 questionnaires were returned. The average return rate was 73.33% (Table II).

TABLE II
Distribution of Delivery and Returned Questionnaires

Delivery	Questionnaires distribution	Responses	Response rate (%)	Proportion (%)
Face to face	25	25	100.00	56.82
Email	35	19	54.28	43.18
Total	**60**	**44**	**73.33**	**100.00**

B. Characteristics of Respondents

The research focused on these issues related to designing and design management. Hence, designers/consultants that directly perform design work and are responsible to the quality of design have top priority with 54.55%. Remaining 45.45% were given for other key stakeholders. Contractors who change technical drawings into real made up 13.64%. Owners whose needs are input information for designers, and decisions may result in chance in design, made up 13.64%. PMUs representing for owners in project management, made up 9.09%. And last 9.09% were specialists in construction management in Vietnam or foreign one has experience about Vietnam construction industry (Table III).

TABLE III
Distribution of Respondents' Project Positions

Project Positions	Frequency	Percentage (%)
Owners	6	13.64
PMUs	4	9.09
Designers/ Consultants	24	54.55
Contractors/ subcontractors	6	13.64
Specialists	4	9.09
Total	**44**	**100.00**

From Table IV to VII show the distribution of respondents' qualifications, working time, major fields of work, and job positions. All most principle engineers have work experience in the construction field from 5 to 10 years. However, there are some top managers involve in this group. It indicates an evidence of a new blood tend in the manager group in Vietnam construction industry. It is a positive sign that promises active receiving an advanced technique. All most top managers, managers of functions and staffs from state management agencies have work experience from 10 to 30 years. These experts in construction management have over 30 years of working in the construction field

TABLE IV
Distribution of Respondents' Qualifications

Qualifications	Frequency	Percentage (%)
PhDs	8	18.18
Masters	14	31.82
Engineers	22	50.00
Total	**44**	**100.00**

TABLE V
DISTRIBUTION OF RESPONDENTS' WORKING TIME

Working time (years)	Frequency	Percentage (%)
≤10	16	36.36
10 < & ≤ 20	14	31.82
20 < & ≤30	9	20.45
> 30	5	11.36
Average = 17.66 years	**44**	**100.00**

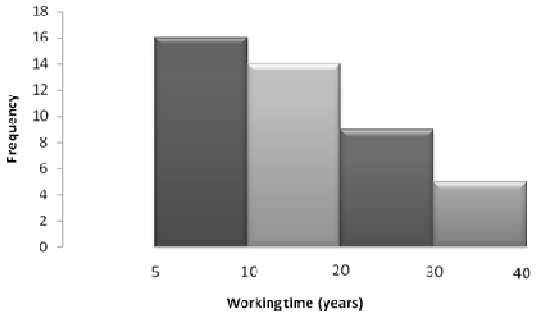

Fig. 2 Distribution of Respondents' Working Time

TABLE VI
DISTRIBUTION OF RESPONDENTS' MAJOR FIELDS OF WORK

Major field of work	Frequency	Percentage (%)
Civil construction	19	43.18
Building construction	16	36.36
Industrial construction	9	20.45
Total	**44**	**100.00**

TABLE VII
DISTRIBUTION OF RESPONDENTS' JOB POSITIONS

Job Positions	Frequency	Percentage (%)
Top Managers	15	34.09
Project Managers	5	11.36
Managers of functions	10	22.73
Principle Engineers	11	25.00
Professors	3	6.82
Total	**44**	**100.00**

Among the respondents, a half was mostly experienced in public projects, while remaining half were experienced in private projects. The respondents were involved in civil projects (43.18%), building projects (36.36%), and industrial projects (20.45%). This implies that the research is scoped in civil, building and industrial construction sectors. They are most important sectors in Vietnam construction industry and have top priority in support of the Government.

In order to assess the differences in attitudes of respondents working in various organization types, there were 34.09 % respondents from domestic public companies and 34.09% respondents from domestic private companies (Table VIII).

TABLE VIII
DISTRIBUTION OF RESPONDENTS' ORGANIZATION TYPES

Organization types	Frequency	Percentage (%)
State management agencies	5	11.36
Domestic public companies	15	34.09
Domestic private companies	15	34.09
Foreign companies	6	13.64
Universities	3	6.82
Total	**44**	**100.00**

Practitioners from foreign companies taking part in Vietnam construction industry were also focused. They are who have practiced foreign construction management methods in Vietnamese environment. The respondents in this group made up 13.64% among 44 ones. State management agencies have to inspect and approve investment reports, design records, etc. for public projects. They made up 11.36% among respondents. The remaining 6.82% are experts in construction management. They are also senior lectures from universities.

C. Level of Understanding

After reading the attached report and with clear explanation, respondents have essential information about Lean Construction and Work Structuring with Lean principles. It was indicated by the result of checking with 24.24% at good and very good; 47.73% at fair and 24.24% at the average level.

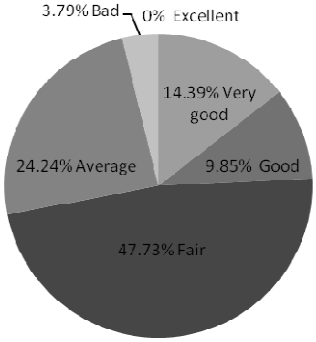

Fig. 3 Distribution of Respondents' Understanding Level

D.Statistical Analysis

Reliability analysis was run by SPSS 16.0.1 separately for four parts of the questionnaire. The calculated overall Cronbach's α values are from 0.902 to 0.968.

In hypothesis testing, calculated p values are < 0.05 and μ values > 3. That indicates that the null hypotheses are incorrect and rejected or most of the respondents agree with alternative hypotheses. So these hypotheses are accepted.

In the correlation analysis, there was not any correlation (p values > 0.05) between types of organizations where

respondents work for and the positions that respondents undertake in a project with their answers with question groups about the integrated product – process design and willingness of applying Work Structuring. There was a correlation (p values $\leq$ 0.05) between two these characteristics of respondents with their answers in issues of design – related problems and design management. Reason for this correlation is that each stakeholder takes part in a project as one role such as owner, designer or contractor. They have different attitudes toward design responsibility. However, almost recognize the important role of integrated product – process design not only to overall project performance but also to their objectives and goals. Based on their experience in the construction field, they believe that they can apply Work Structuring into their projects.

E. Results

The questionnaire data was analyzed and the detailed results are presented in Table IX as below.

TABLE IX
THE RESULTS OF THE QUESTIONNAIRES SURVEY

Topics	Results	Explanations
1. Using Cronbach'α to measure the reliability.	α 1 = 0.968; α 2 = 0.946; α 3 = 0.934; α 4 = 0.902;	α > 0.8 means the reliability is well.
2. Background of the respondents.	**Qualifications:** PhDs (18.18%); Masters (31.82%); Engineers (50.00%); **Working time (years):** < 10 (22.73%); 10 ≤ & < 20 (36.36%); 20 ≤ & < 30 (20.45%); ≥ 30 (20.45%); **Job position:** Top Managers (34.09%); Project Managers (11.36%); Managers of functions (22.73%); Principle Engineers (25.00%); Professors (6.82%); **Major field of work:** Civil construction (43.18%); Building construction (36.36%); Industrial construction (20.45%); **Level of understanding:** Good & very good (24.24%); Fair (47.73%); Average (24.24%); Bag (3.79%)	The result is representative.
3. Using T - test for hypothesis testing	**H1:** p < 0.05; μ > 3 **H2:** p < 0.05; μ > 3 **H3:** p < 0.05; μ > 3 **H4:** p < 0.05; μ > 3	Hypotheses are accepted.
4. We can apply Work Structuring to construction projects in Vietnam	Strongly agree 31.82% Agree 40.91% Neutral 18.18% Disagree 9.09% Strongly disagree 0.00%	Work Structuring can be applied to construction projects in Vietnam

V. FINDINGS

During the period of data collecting, questionnaire analysis and interview some experts of construction management, some important issues were found out as below.

Based on the interviews with experts and 86.36% respondents agree and strongly agree, the integration level of product and process design in construction projects in Vietnam is very low. Even Practitioners in Vietnam construction industry have already understood the importance of integrated design. There are some factors that hinder this integration. Influence level of these factors on the integration is shown in Table XI as following.

TABLE X
FACTOR STATISTICS

Factors	Mean	Std. Deviation	Rank
Insufficient awareness of project participants about design management issues.	4.4091	0.54210	1
Weak communication and weak teamwork.	4.0000	0.74709	2
Limited funds during the early stages of project development.	3.6136	0.53769	3
Insufficient project delivery system to pull downstream players involving in upstream decisions.	3.4318	0.97403	4
Insufficient ability of project participants to pull from wealth of knowledge and experience	3.3182	0.63878	5
The habit in design with the order of process design beginning after product design completed.	2.9773	0.40282	6
Insufficient investment for information technology to support for design work and design management.	2.4091	1.01885	7

Awareness of design management in this context is assessed with two aspects: awareness of physical nature of design and difficult managerial problems. Almost project participants believe that design and design – related problems are the responsibility of designers/ consultants while as defined above design is as a flow of information, composed of transformation, inspection, moving and waiting. Therefore, designers have to solve design problems alone and seem to be incompetence of integrating product and process design. All interviewed experts, and top senior managers noted that the inadequate awareness of project participants specially, owners' project team is the top cause of ineffectiveness and inefficiency not only in design management but also in overall project performance.Integrated product – process design can be performed according to the balancing of three-factor organization, communication and information technology. Communication will promote the free and speedy exchange of ideas, specifications, and processes. It will also encourage regular feedback from end users. However, the inadequate awareness of project participants is the first barrier of communication between them. Most important consequence of weak communication is that project participants may hesitate to make a recommendation, especially if it adversely impacts their own work. That is evident to cause weak teamwork.In

Vietnam, expenditure for design work is often calculated according to the norm enforced by Ministry of Construction and Ministry of Finance. This expenditure equals the Percentage (%) of total construction cost. In fact, the value that designers receive from a consultant contract is not corresponding to their effort and responsibility. So, they have not much enthusiasm for giving a range of innovative alternative product and process designs.Construction projects in Vietnam are primarily operated upon traditional project delivery system with the most common model is design – bid – build. The system is understood as the contractual structural of the project. Hence, this system pursuit the task of project delivery and neglect both value maximization and waste minimization. So, it separates the project participates by contracts, makes them hesitate to share their ideas and hinders them from pulling from wealth of knowledge and experience. Furthermore, it does not support to organize in cross – functional teams, key factor for success of integrating product and process design. Design – bid – build is impossible to pull downstream players involving in upstream decisions.The habit in design with the order of process design beginning after product design completed to seem not to cause the poor lever of integration in construction projects in Vietnam. (There are only 6.82% respondents agree with this factor). Almost respondents believe that actual problems are limited expenditure for design work and incompetence of designers. Designers often are incompetence in designing process while expenditure is tight. Hence, they design process without care or neglect and push this work for contractors.The local respondents think that insufficient investment for information technology is not the barrier of integration in their organizations. Based on their opinions, they understand that information technology is their advantage in competition. There are only 20.45% respondents who agree with this factor, but they are foreign engineers work for the foreign companies have projects in Vietnam. They may be not assessed exactly competence of Vietnamese consultants.

VI. Discussion

Work Structuring is new method and different from current understanding of design to project delivery system in Vietnam. In order to apply Work Structuring effectively in construction projects in Vietnam, it should do training and registration of Professional Engineers; improving competence of project team and awareness about the role of integrator; and implementing new contracting approaches in order to encourage communication, collaboration, teamwork and come to establish an integrated project delivery.

VII. Conclusions

Work Structuring with objectives and advantages promise to solve design-related problems and improve the level of design management in Vietnamese construction industry. By administering and analyzing a questionnaire survey, it is concluded that Work Structuring has the feasibility of applying to construction projects in Vietnam. Bulging design – related problems, low level of integrated product – process design, the need of a framework consisting of organizing principles and techniques to guide efforts in integrating, are motivations for applying Work Structuring to construction projects in Vietnam. In addition, Vietnamese practitioners are quite familiar with WBS, CPM tools. So, it is easier for them to get acquainted with Work Structuring in Lean Construction. Considering investment of information technology in consultant companies and ready – wittedly grasping new technology of Vietnamese designers are positive conditions to apply Work Structuring. The present research is limited to investigate the feasibility of applying Work Structuring to construction projects in Vietnam. In the future, case studies of Work Structuring should be operated for both public and private construction projects in Vietnam. These case studies will be aimed to investigate a standard practice of Work Structuring and find out difficulties and advantages of implementation in both public and private environment. That helps formulate a procedure for Work Structuring implementation and is to assess the effectiveness of Work Structuring practice and provides feedback on the procedure as well.

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