Value-adding Generation and Assessment Model (VGA) for Construction Projects

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***Abstract*—The term of value is the critical key for lean thinking, which is generated through a fulfillment of customer demands. Tackling the complexity between the project execution and value generation, using the classical way of management is a kind of challenge. Therefore, the optimization of the Value-adding generation is the core focus by this research, in which, a new understanding framework for rebuilding the conventional structure of Value-adding system into a new Value-adding Generation and Assessment model (VGA) is evolved. The mechanism of this model is to cause the value to flow across construction process in the best achievable sequence and rate through different conversations. These conversation are value design, mapping, analysis, adjust mapping, and processing and assessment, which are interchangeably accomplished. In addition, the VGA model framework is be characterized in terms of the principles that guide thinking and action, the functions, and the methods used to apply these principles and perform these functions. The development of the VGA model suggests a push towards a new understanding of the value-adding generation assessment process in construction projects. It further contributes to an efficient implementation of lean construction vision of completing projects with minimum Non-Value-adding activities 'waste' and maximum value.**

***Index Terms*—value-adding, generation, assessment, lean, construction project**

I. Introduction

The lean way of thinking allows companies to specify value, line up value creating actions in the best sequence, conduct these activities without interruption whenever someone requests them, and perform them more and more effectively. In addition, it is advocated that value is the critical starting point for lean thinking, and can only be defined by the ultimate end customer [1]. Thus, from the quality perspective, value is generated through a fulfillment of customer needs and requirements; accordingly, it is often impossible to measure the absolute value. However, in practice, the relative value sounds sufficient to be measured [2].

In construction, the form of value should be in different way defined, generated and assessed. Lean construction is a way of management to minimize waste of materials, time, and effort, in order to generate the maximum possible amount of Value-adding. LPS©, the essential play maker in the Lean construction delivery system, builds a new cooperative, transparent environment between people, system, and resources, in order to reduce variability and as a consequence optimizes the Value-adding that be delivered to the customer. So, the value in construction cannot be generated at any interruption of the flows of people, information, equipments, material, work priority, safe external conditions, and safe space.

Obviously, it is hence quite challenge for the project teams to tackle the complex relationship between the project execution and value generation, using the classical way of management. The main reason, behind this failure of generating value, results from the focus on delivering the project just on time and budget, without considering how to generate the expected benefits of their implementation. Hence, maximizing Value-adding at the project level is not tangible because of inhabitation of individual contractors from innovation, coordination as well as stifling cooperation, and rewards for rethinking out of box for a good ideas and improving the performance [3].

II. Problem Statement

Almost researches have discussed the value concept and value stream mapping as well. In addition, the generation of value internally and externally has also been pointed out. Nevertheless, the criticism of such endeavors is how the positive opportunities in None-Value-adding activities could be exploited to be add value. In addition, the assessment approaches of Value-adding still either intangible through the process, or just performed only through the customer satisfaction and PPC of the project, without any specific measurement tools. The contradiction has been revealed in such way of assessment; whereas the researches have reached a consensus on the fact that the Value-adding generation process is commonly delivered through the internal team of project to the end user, the evaluation process of the Value-adding has only been considered as the external-item of the process and neglecting the internal team value-based perceptions. Beyond this flawed point of Value-adding assessment, the generation of Value-adding just focuses on the qualitative analysis of the process flow to specify the Value-adding and Non-Value-adding activities [4]-[8]. The deficiency of such technique is to prevent the action of re-thinking about

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Non-Value-adding activities to reanalyze the good opportunities in such activities to be ready for generating and thus maximizing the Value added. Lean philosophy deploys tools, knowledge and techniques to generate Value-adding as maximum as possible. To effectively match the heart of lean philosophy for a continuous improvement, even though the elimination of the Non-Value-adding is a crucial purpose for the management level, the more important is the ability of increasing positive chances in Non-value-adding.

Hence, the key-point focused by this research work is to close to the answer of how the optimization of the Value-adding generation be increasingly established? In order to move a step forward towards the significant solution of the raised problem, this research discussed a new understanding framework for rebuilding the conventional structure of Value-adding system into a new Value-adding Generation and Assessment model (VGA). The mechanism of this model is to provide a set of continuous improvement conversations, in order to cause the Value to flow across construction process in the best achievable sequence and rate.

III. Literature Review

The concept value is so far ambiguous, although over twenty centuries, the concept of value has been discussed. The meaning of true value was debated by Plato and later Aristotle. Aristotle defined the true value as intrinsic to the natural end the item serves. Thus, based on this definition, a connection between value generation and the real purpose of outcomes has been established [9]. Unlike such definition, value in construction can be understood in terms of achieving the project purpose. Furthermore, it is explicitly quite challenge of tackling the generation of value in a form of measuring the achievement of outcomes to be come up with metrics for tracking changes [3].

El-Bibany *et al.* (1997), described a Value-adding Functional Analysis Model V-FAM, through three main categories: Design and construction performed by internal workforce, Construction services, and finally project management. The main goals of the V-FAM were to identify the Value-adding project management functions, and how to integrate these functions with the organizational processes in order to arrive at a continuous improvement of the construction process. Through this model, the Authors discussed that the Value-adding functions can be afterwards reorganized into a new processes that reduce decision uncertainty using change criteria. Eventually, El-Bibany *et al.* presented that, at last stage, the organization needed to be redesigned for assigning the new functional responsibilities. Improvement concepts like team and network-based management.

In 2005, Emitt *et al.* pointed out that the realization to define waste was meaningless without being able to specify the best way for optimizing the delivered value. They hence explained that optimization of the term of value had a direct proportionality relationship to both of productivity and resources availability. The relationship-based investigation was how much value was got out of resources investment. So, they summarized almost essential parameters, playing the vital role in value generation, into a couple of question, what was Value? And Value to whom? The most notable argument of categorizing value was thereby approached into external and internal value as illustrated in Fig. 1. The former kind of value was regarding the customer value as well as the value the project should end up with, whereas the latter value was the value generated by and between the participants of the project team (i.e., Architect, Engineers, Contractors, and Workers), who is responsible for generating the former external value and delivering to the customers [10].

A year later, Koskela and Ballard showed that the value generated to the construction Process is a function of client demands and subjected to project constraints, e.g. time, costs, ….etc, as formulated in (1).

$$Value = \mathbb{F}\sum_{i=1}^{i=n} C_d \quad \Big|_{\sum_{k=1}^{k=m} P_c} \tag{1}$$

where C_d is the client demands, n is nr. of demands, P_c is project constraints from one k constraint i.e Time, to m constraints.

A qualitative causal-loop diagram was developed in 2012 by Han et al. to provide a clear explanation, as depicted in Fig. 2, of how both Value-adding and Non-Value-adding are generated throughout the construction process. Such causal-loop argued the fact that design changes often involve an increase in the scope of work and increase Value-adding requirements (nodes 9 and 10 in Fig. 2. In addition, interruption and rework, errors and changes may result in significant productivity loss (nodes 11, 12, and 13 in Fig. 2. Therefore, additional effort for compensation the loss of value added is needed, which increases the total effort and duration (nodes 2 and 14) of the project. Furthermore, prolonged overtime often decreases worker morale and thereby lowers productivity (nodes 20 and 21). The policy of overlapping was further represented as another widely adopted technique for schedule acceleration (nodes 22 and 23). Furthermore, they introduced a system dynamic-based model for identifying and quantifying non-value-adding efforts NVAE triggered by changes and errors [6] Tillmann *et al.* 2013 alerted that the key managerial aspects that influence the support of value pursuit are: performance update, measuring the achievement outcomes, interdependency among projects, action for changes, and team collaboration. Hence, they identified three vital steering dimensions for pursuing value as: stakeholders that are responsible for defining and pursuing value, process-purposeful acting, and evaluation value generated to be accordingly actions adjusted.

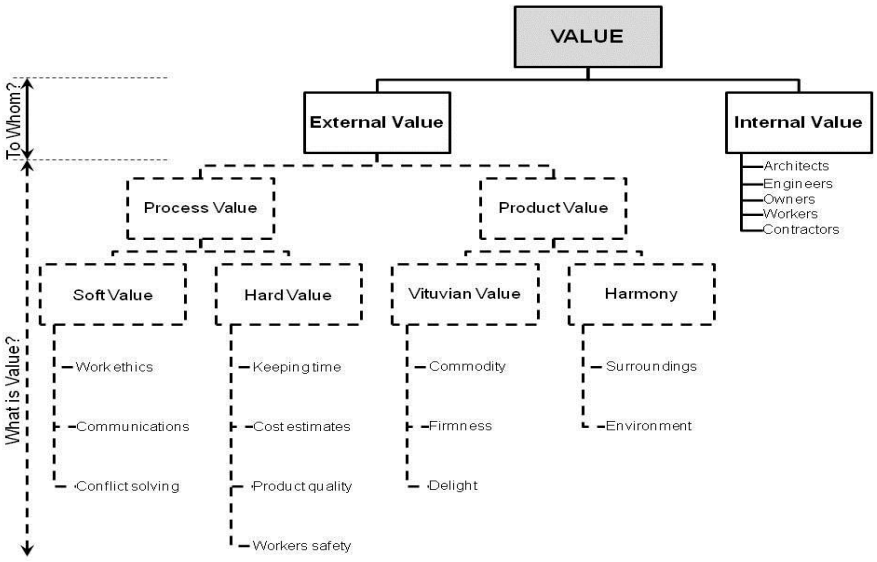

Figure 1. Value generation WBS

Reviewing previous endeavors concludes that almost have just focused who the customers are and how their demands should be captured, e.g. [1, 3-6, 8-14]. Besides, the literature review reveals the lack of a mechanism of how the value-adding generation should be flow. The sequential phases' description of the value-adding generation process has been implicitly demonstrated as well as the assessment process.

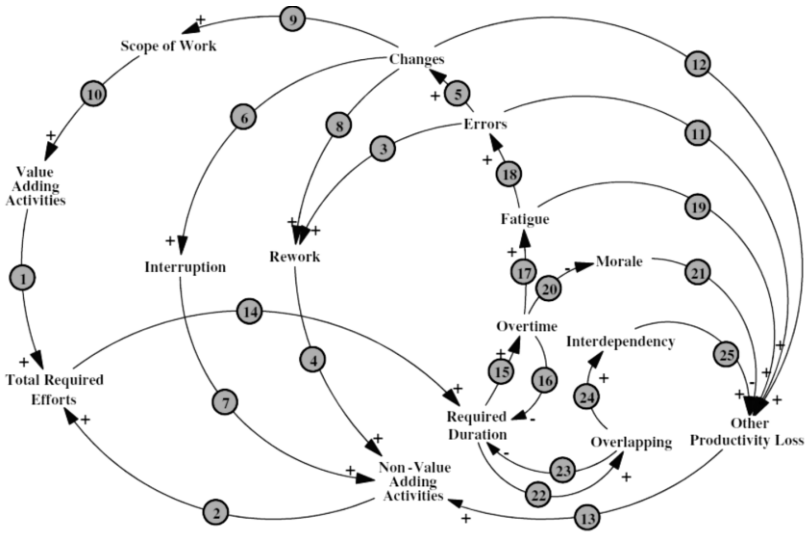

Figure 2. Value-adding and non-value-adding causal-loop model [6]

IV. VGA Model Framework

Through this section, the foundational concept of the framework of the VGA model is described. Admittedly, it is impossible to get a complete predictability of a process's output; otherwise, the process would generate no value. Therefore, variability explicitly plays a different role in performance of any process as opposed to construction that consequently need for appropriate generative processes [15]. Based on this fact and to match the dynamic nature of construction projects as well, the VGA model framework can be characterized in terms of the principles that guide thinking and action, the functions, and the methods or tools used to apply these principles and perform these functions as follow:

- Map in greater detail as you get closer to generate the value.
- Stream value map collaboratively through the internal and external requirements.
- Identify, reveal and release constraints as well as exploit good opportunities of non-value-adding activities.
- Make ready value-adding activities in backlogs
- Errors control and Committing
- Feedbacks and lessons learned

Fig. 3 illustrates a new understanding framework of the value generation and assessment process through five interchangeable conversations.

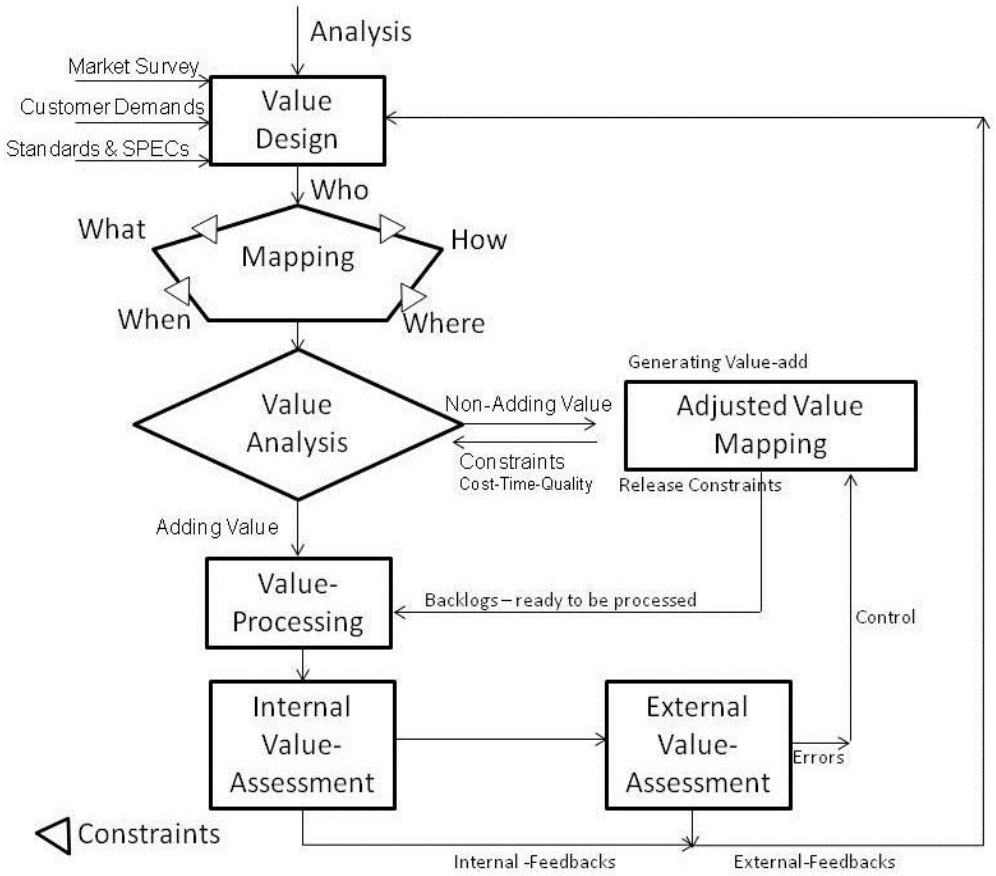

Figure 3. The framework of value-adding generation assessment VGA-model

A. Conversation I: Design

The first stage of the VGA model framework commences of the value design phase, where the customer value landscape is considered and reflected in the conceptual design alternatives in prior to proceed in the execution process. In this conversation, the stakeholder and customer demands are analyzed for mapping the interests in the project. In this first conversation, the customer takes contact to the value generation system. All stakeholders (i.e owners, the operation and management organization, and the society typically represented by authorities) are preferable to be participated in mapping the value [10]. In addition, this step requires recognition of feedbacks from the various other stages that makes the VGA framework be non-sequential at times.

B. Conversation II: Mapping

In order to perform this phase of the VGA model, five important dimensions for pursuing value should be identified: Who, How, Where, When and What. Moreover, it is crucial in this conversation to reveal all initial constraints emerging these different dimensions, set the goals and objectives, and eventually to engage the mapping team. The key of the first dimension is to engage stakeholders that are responsible for defining and delivering value. Hence, this engagement should be established in adequate work environment to enable people to work effectively and efficiently together for achieving project value proposition. Besides, it allows them to adjust their actions according to the value propositions to arrive at achieving the project target at an optimum value [3]. For the second dimension of How, the best utilization of available resources is increasingly analyzed to be successfully arrived at. Time analysis, resources allocation, scheduling and responsibilities distributions are considered through the other dimensions of this phase.

C. Conversation III: Analysis

The outcomes of the value mapping are fed to the value analysis conversation, where, the value-adding and the non-value-adding activities are in details represented. Thus, the activities become easily separated into the value stream, which is the focus of value-adding of attention, and the none-value-adding is waste. The thinking here is that the non-value-adding activities are often preparatory or tidying up to the value-adding activities and are related to people, equipments, or workplaces that are used for generating the value-adding activities. As a result, the ready value-adding activities are directly processed.

D. Conversation IV: Adjust Mapping

In general, non-value-adding activities are resulted from analysis of macro-level, micro-level, or both together. In the Macro-level analysis, the negative impact

of external factors (i.e. weather, and orders change...etc.), are considered. Unlike the macro-level, the micro-level analysis focuses on specifying unnecessary activities (i.e. waiting, moving, and handling….etc.). The latter analysis assists in a better understanding of the level of non-value-adding activities, in order to find area of potential improvement. Nevertheless, such analysis provides insufficient flexibility to deal with the variations triggered by diverse construction conditions [6]. Therefore, the conversation of adjusted value mapping plays a vital role in VGA framework to be more dynamic and matching the construction nature.

Instead of avoiding the non-value adding activities, they are reanalyzed at the time of construction according to the actual circumstances. This phase supports a lean thinking of processes control to bring the managerial practices in order to provide different contributions to solve the problem in hand. Actions be taken through this conversation are to exploit any possible good opportunities represent in the storage of non-value-adding activities. Problems and constraints are reconsidered as the existed real givens through the construction process. In addition, adjustment of the value-adding map from these non-value-adding are demonstrated according to the dynamic nature of construction that is clearly not constant. Based on the LPS mechanism, the exploited opportunities in the non-value-adding activities come up to a workable backlog to be ready for value generation processing.

Besides improving the conventional value generation process by adjusting value mapping and exploiting all possible good opportunities in non-value adding activities according to the actual execution conditions, involvement of both internal and external value is additionally considered. Increasing efficiency of the value-adding generation process can be achieved by increasing the involvement degree of all value generation participants. The participatory is not only by involving in designing activities and flows to reduce waste, but also the appropriate assessment approach for value-adding delivered to both customers and project team should be established. Such participatory strategy for project users and team together can facilitate the meeting of project goal requirements as well as customers need, and ensure efficiency for delivery of project services or products, which can consequently decrease waste and generate more value to the end-user [4].

E. Conversation V: Assessment

Furthermore, the tools used for evaluating the value-added both internally and externally should be match with the nature of perception. Namely, the perception of value is individual and personal, and is therefore subjective [10]. The error, resulted from the assessment process, presents the gap between the target value and achieved value which will be the new input in the adjusted mapping of value to be controlled through the model in order to solve the errors and increase the value-add. Unlike errors, feedbacks from the successfully value-adding that be generated are fed to the next value-adding generation process in order to sustain the continuous improvement of the process.

V. Conclusion and Recommendations

The improvement strategy behind the development of the VGA model suggests a push towards a new understanding of the value-adding generation and assessment process in construction projects. So, the developed model contributes to an efficient implementation of lean construction vision of completing projects with minimum non-value-adding activities 'waste' and maximum value. The conversations of both value assessment at time and adjusted value mapping are playing a vital role in generating a proactive process matching the degree of variability in construction projects. The developed VGA model in addition supports the involvement of internal project team as well as customers not only in an assessment discipline, but also early in designing activities and flows to reduce waste.

Additional research needed to study the ability of integration of the VGA model concept as a part of construction process. This framework should be further developed into practical tools that could be used in projects to assist both project delivery team and customers to understand, assess, and describe the value-added that is desirable and to design and control the value-adding generation process in such a way the optimal level of value-adding is reached.

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