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## Implementation of Target Value Design (TVD) in building projects

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### Abstract

One of the main objectives of Lean Construction is the generation of value for all building project stakeholders. Based on this approach, value can be generated by reducing the cost of products or services delivered and/or by improving the performance or satisfaction of participants involved in the project. The Target Value Design (TVD) is a Lean tool that enables the design to meet such an important purpose.

The objective of this article is to present a protocol for the implementation of the TVD during the Project Definition and the Lean Design in building projects with a particular emphasis on office and housing construction.

For such purpose, a Value Stream Mapping is presented including the most important areas intervening in a building project. Through the use of flow charts, the various stages and activities are shown from the point in which the project idea arises up to the stage where plans and technical specifications are submitted. These charts display the moments when the best opportunities take place to add value by eliminating waste, reducing lead time, optimizing costs, and/or improving the quality of products. Along with the charts, a cost structure following the same sequence as that of the design process is also shown, which allows economic valuations at any stage of process development. This prevents the frequent need for re-work that results from having such cost available just at the end of the whole design process.

The contribution of this study is to provide the project design team with this protocol together with its corresponding cost structure. We are sure this will be useful for promoting the TVD implementation during the Project Definition and Lean Design phases, which may be subject to improvements or customized for each project case.

Keywords: target value design, target costing, lean construction, cost planning, architecture

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### 1. Introduction

During the construction project definition and design phases, there are great opportunities to generate value for the benefit of all project participants; however, our experience in this field shows that these opportunities are not being taken advantage of.

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This problem arises because designers develop their work flow in an isolated way and with very little interaction; they work sequentially and; finally, because some designers ignore the detailed work of their other colleagues. A work flow mapping of each design area will be helpful as a protocol in order to avoid rework, and it will identify the times when information exchange is necessary to maximize value. Additionally, a construction cost structure with a similar pattern will permit to make economic valuations at early stages, thus ensuring the objective cost and objective value of the project.

In order to understand what the TVD is, it is important to know what the Value Stream Mapping and the Target Costing are. They are defined as follows.

## 2. Value Stream Mapping (VSM)

The Value Stream is a set of interconnected actions—either adding value or not—that are necessary to manufacture a product or perform a service [1]. As stated by Rother and Shook [2], the Value Stream Mapping is an essential tool for identifying and understanding the production chain. Furthermore, the VSM aims at enabling the identification of waste sources such as excessive inventories, reworks, lack of information in the process, activities that do not add value, as well as unnecessary work [3]. Likewise, the VSM helps to identify opportunities for improvement and further actions to generate value [4].

The main objective of the VSM is to visually show how the production system under study works. The use of this tool helps to visualize the flows within the system going beyond the analysis of its processes separately. Instead of only showing any loss in the system, it indicates the source of it, and contributes to connect Lean concepts and techniques, which eventually prevents the use of Lean tools individually without adopting the philosophy in the organization [1]. A VSM is developed in the following three stages:

- Preparation: At this stage, the mapping limits and team are decided. Here, it is important to ensure the company has a clear understanding of the client's needs and what value means to him [5].
- Implementation: The current value stream or chain mapping is conducted during this stage. Here, it is very important to set the objectives leading to the elaboration of the VSM, in other words, what outcome is expected and what can be improved. Simple symbols should be used in order to make the process easy to understand.
- Follow-up: At this stage, an ideal value stream map is proposed, as well as the process to achieve such value [5].

## 3. Target Costing (TC)

Target Costing (TC) is a management tool that involves putting in order, adjusting, and assembling the activities of the organization and their relevant costs in order to achieve a profit level in accordance with the targets set by the Management Department [6]. Understanding the TC is an essential step to know how the Target Value Design works since the TVD results from the TC adjustment to construction [7].

This approach includes radical changes when compared to traditional costing. First of all, the market is the element that directs cost planning. Second, design plays a very important role in projects, aiming at preventing losses and waste in the whole design and implementation processes. Finally, costs are determined by multidisciplinary teams, and suppliers start having a significant role at early stages of the project [6]. This relationship is clearly explained through Equation 1 proposed by Clifton et al. 2004 [8]:

$$\text{Target Cost} = \text{Target Price} - \text{Target Margin} \quad (1)$$

In Figure 1, presented by Feil, Yook, and Kim [9] as an interpretation on Worthy's article [10], we can see in a schematic form the differences in cost management existing in the American and the Japanese approaches, which in the practice represent the differences between traditional costing and Target Costing. Here, we can clearly observe how the application of the TC avoids the loop that traditional costing would lead to if the estimated cost, after the design, were too high.

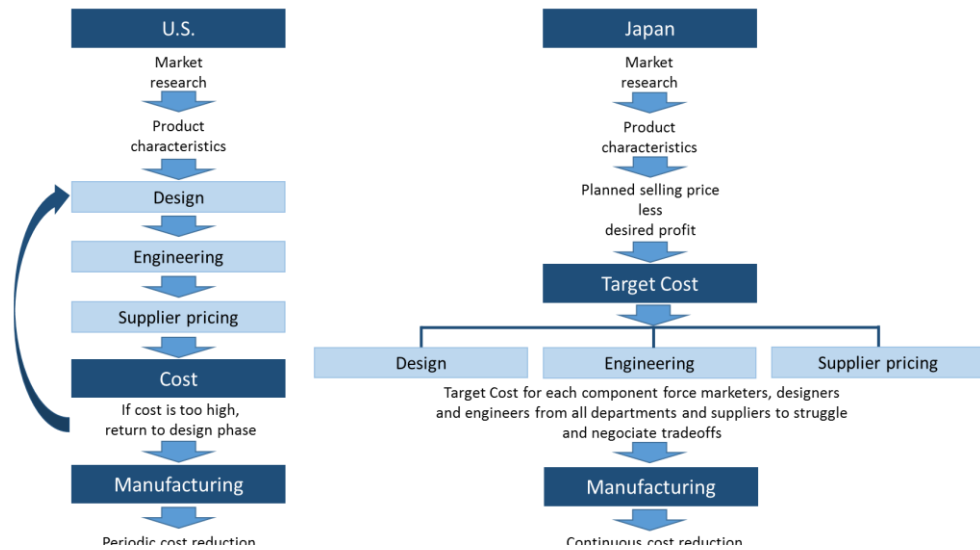


Figure 1. Traditional Costing vs. Target Costing [9]

#### 4. Target Value Design (TVD)

In 2000, Nicolini et. al. [11] elaborated a report on the application of Target Costing in construction. Unfortunately, the attempt to use this tool in the United Kingdom failed due to defects concerning some business practices and cost estimations, which were very inaccurate [12].

A TC application correctly adapted to construction was not registered until 2004 with Ballard and Reiser’s work in the United States. In 2007, the term Target Value Design (TVD) was adopted by Hal Macomber, Greg Howell, and Jack Barbeiro to refer to the Target Costing adjustment to construction [7].

The TVD is defined by Ballard as a management practice whose purpose is to generate the maximum value according to an objective cost fixed at a price below the market value [13]. The TVD is also a method for continuous improvement and waste reduction [14]. Another definition states that “the principal idea of the TVD is to make from the client’s value (considering design, cost, schedule, and constructability criteria) a design driver, consequently reducing waste and satisfying or even exceeding the client’s expectations” [7].

Josh Bronitsky, from DPR Construction (an American Company that has successfully conducted projects using TVD for Sutter Health), refers that the TVD consists in the correct design at the lowest real cost, delivering the maximum value possible to the client [15].

#### 5. Cost and Value

The Institute of Value Management defines Value by using the equation below:

$$\text{Value} = \frac{\text{Function}}{\text{Cost}} \quad (2)$$

In some cases, this equation is purely an economic relation, as it generally occurs when the value analysis is conducted by investors. In some other cases, this relation is predominantly subjective, and it is estimated based on the perception of function and cost, which happens when the value appraisal is determined just in an intuitive way by users [16]. We could also say that, according to this equation, the same relation may be applied with the concepts of Target Value, Target Cost, and Target Function and that any improvements in the last two will maximize value for the benefit of the participants involved.

In order to achieve this added value, the following can be done: a) Optimize costs, for example, by modifying the architectural floor plan of a building to reduce torsion and, therefore, the amount of steel, which would generate value for the investor. b) Improve function, for instance, by devising a better room layout for the same cost, which will add value for the user, and c) Enhance or improve the cost–function relation, for example, by standardizing the beams to make the forms easier, which would result in a more convenient cost of this activity and would generate value for the contractor, at the same time, it would improve the aesthetics of rooms, maximizing value for the user.

The TVD objective is to generate value, which is highly feasible especially during both the Project Definition and Design phases. To achieve this purpose, the article includes a VSM containing data and activities managed by the various specialists in the design team, where moments for required information exchange among the team members are identified. In this way, isolated advance, cost loss and time waste due to rework, and, most importantly, missed opportunities for adding value are prevented.

In that respect, literature on the work sequence of each project area has been collected, and the first diagrams were devised to be validated and/or complemented through interviews with companies and/or professionals involved in each of the project design areas.

## **6. VSM of the design process in construction projects**

G. Rioja [17] proposes an Architectural Design process, which has been complemented with diagrams of the Project Definition presented by Orihuela, Orihuela, and Ulloa [18]. The sequences have been extended and validated with interviews to different experienced architects.

A. Blanco [19] and G. Otazzi [20] include in their Structural Design and Calculation books some sequences that have been extended with further details and have been validated through interviews to civil engineers involved in structural calculation work.

In relation to the Design of Plumbing and Electromechanical Installations, we were not able to find formal literature on the processes and sequences for building projects; therefore, according to the regulations and standards of these areas, we have developed the first diagrams that have been validated by some plumbing and electrical engineers dedicated to construction project development.

Concerning the building project costing, there are various methods for classifying costs. Some systems classify them based on material similarities; some others consider the construction sequence; while others take into account the areas of specialization, etc. However, these classifications do not permit to make a reliable costing at early phases of the project in order to compare it with the objective cost. Generally it is made only when the design is practically completed, being an obstacle in the implementation of the TVD concept.

Ergo, the classic sequence followed by construction projects is similar to the American approach shown in Figure 1. This means that the architecture is developed first, and then the information is shared with the rest of the project areas that have had very little interaction. Costing, on the other hand, is calculated with the final building plans.

## **7. Design protocol for construction projects to promote the TVD**

Figure 2 shows a proposal for a communication protocol to be used among the most important areas of the construction project design. According to this protocol, each information exchange between project areas is intended to promote opportunities for adding value and reducing waste, consequently avoiding the rework for all the participants involved in the project, especially investors, final users, contractors, planners, and key suppliers.

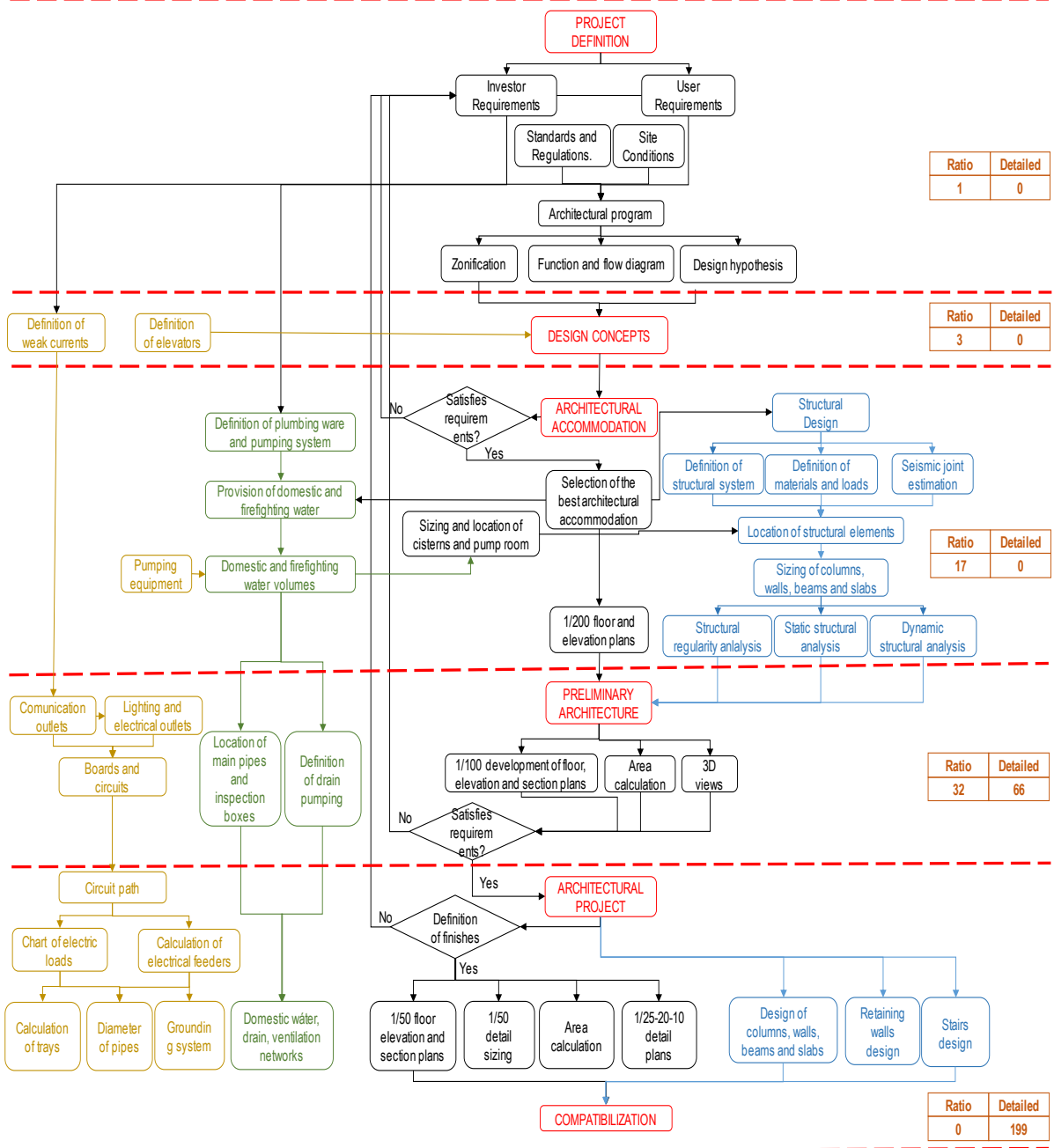


Figure 2. Design process protocol for construction projects to promote the implementation of the TVD.

It is important to point out that, due to the complexity and nature of the activities basically cognitive as the design process, we consider that this protocol is not suitable for using it with the VSM typical symbols, which are more adjustable to processes implying physical production processes. However, for devising the diagrams presented, the VSM concepts are of vital importance.

Additionally, a cost breakdown structure is presented, and its items are put together so that the costing can be determined as each project phase develops. Once the project definition is completed, these phases become consolidated as phases that we have named as follows: Design Concepts, Architectural Accommodation, Preliminary Architecture, and Architectural Project, after which the Lean Supply Chain and Lean Execution would take place.

## 8. Conclusions

This article presents an information protocol to be used during the Project Definition and Project Design stages by the most important areas in a building project focusing on office and housing construction.

We believe that the appropriate data transfer or exchange indicated in this protocol in the form of a value stream map will reduce frequent waste generated at the design stage, thus preventing “negative iterations” and consequent reworks, all of which will result in time and cost saving, as well as in the generation of added value for both project planners and investors.

The required information given by the final user, investors, plus the regulations and site conditions displayed on the map that should be clear before starting the architectural design concept will enhance the quality of Project Definition. This will lead to the generation of added value especially for final users and investors. In addition, further information shared by structural, plumbing, and electromechanical engineers will also improve the project constructability and, as a consequence, value will be maximized for the contractor and/or investor.

On the other hand, the cost structure suggested in the article enables a progressive economic valuation that will be continuously improved as the project develops. This will prevent the characteristic error of having costs at the end of the project design, which often results in re-processes to obtain the target cost.

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