

## PROJECT DELIVERY

## KEYWORDS

- Target Value Design • Target Cost • Value Stream Mapping
- Integrated Project Delivery • Lean Construction.

# TARGET VALUE DESIGN

A different way of approaching  
the constructive process in Spain

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## • ABSTRACT •

The knowledge and deepening of the Lean Construction methodology, as well as its practical application in the construction industry in Spain, can produce great benefits and the general improvement of a process that continues to be anchored in anachronistic procedures for too long. It is necessary to divulge this methodology with greater intensity, so that once known, and with its positive effects in the matter of the Triple Constraint: Cost, time and quality, proven in other countries, will be applied in a generalized way in ours. We look at this article in a technique belonging to Lean Construction: Target Value Design. Like many other techniques Lean parts from its application in Toyota, in this case of Target Cost, and was used in the 70s by Taiichi Ohno with the name of Genka Kikaku, producing very good results for the Company in the matter of productivity and profitability. As with other Toyota Production System techniques, it was later incorporated to Lean Construction as Target Value Design to bring greater Value to the customer within a fixed Cost. We will see how the Target Cost can become the center of the project and the construction of the building to reach the values required by the client.

## 1. INTRODUCTION

The Spanish construction industry requires great improvements in its efficiency and productivity. Of all the economic sectors, it is one of the lowest performance measured in terms of Gross Value Added (GVA) per hour worked.

According to the BBVA Research Report of April 2016 on the Real Estate Situation in Spain: "The first thing to note is that the growth rate of productivity in the construction sector has historically been lower than in the rest of Spanish economy."

Although, according to the same Report, this is not an exclusive case of our economy: "However, what is common in all countries is that the productivity growth of the construction sector is historically lower than the rest of the economy. At this point, growth accounting reveals how in almost all countries construction has grown by accumulating productive factors, especially employment and non-productive capital, and not by developing new technological processes."

The evolution of this sector is very slow throughout the world and is anchored in paradigms of the past, not in new technologies or processes, which modify the current status. It consists of repeating again and again obsolete methods, before rethinking what we could do again with the technology we have. We assume with absolute naturalness that this is irremovable and we cannot think of any improvement.

The McKinsey & Company Report published in October 2016 on "The Digital Future of Construction", indicates, among other things, a major need for improvement at the sector: "Transparency and risks sharing in contracts. Habits are difficult to change, and a habit is to view contracts as opportunities for confrontation to avoid risks. Instead contracts should be tools that allow a fair exchange of risks and rewards that will help both parties success. This will happen if contracts clearly define responsibilities and allow owners and contractors to share the benefits of adopting technological and process innovations."

Another source, in the same way, is the article published in Time magazine about the challenges that the Trump Government will face for the next ten years in improving built infrastructures in the United States (Della Rocca, Duvall, and Palter, Time Magazine April 10th, 2017), also based on a McKinsey & Company Report indicates: "Productivity in the US construction sector is lower today than it was in 1968, while other major industrial sectors experienced impressive improvements. We need a national effort that systematically unlocks productivity by applying innovations."

About other countries, we can add the article in The Economist, stressing the same approach (The Economist August 17th, 2017): "The problem of productivity in the construction sector and how governments can catalyze the change: Since 1995 growth in the construction industry in France and Italy has declined by one-sixth, and in countries such as Germany or Japan, construction productivity has remained static during the same period. Only a few builders in the world are experimenting with 3D printing, drones, laser scanners or remote-controlled cranes."

When all these publications insist on technological innovations, processes, and a method of exchange of risks and rewards, are clearly indicating the necessary application of Integrated Project Delivery (IPD) and Building Information Modeling (BIM) in construction (AIA California Council 2007, 2014, AIA Minnesota University, 2012). Both techniques representing collaborative work and sharing all project information openly among all team members.

As we have said, in this article we are going to try another technique contained within the Lean Construction methodologies, but which is directly related to the IPD (Mathews and Howell, 2005), with collaborative methods, representing an innovation in the approach of constructive process and affecting the improvement of the productivity and the efficiency of which the sector is so needed, as we have seen before. This is: Target Value Design.

## 2. WHAT IS TARGET VALUE DESIGN?

Based on Lean Construction principles as an evolution in the construction of the Toyota Production System (TPS) (Koskela, 2000), we can establish that the basis of a Lean application is collaboration, trust, willingness to learn and continuous improvement (Mossman, Ballard and Pasquire, 2013), all this is the origin of Target Value Design, (TVD).

TVD seeks to achieve the highest value for the client as the main objective of the design and construction of the building. According to Professor Glenn Ballard of the University of Berkeley, California, USA, 2005, TVD is: "A management practice whose objective is to generate the maximum value for the client, at a fixed target cost, below the market price, and at the same time a method of continuous improvement and reduction of waste". Other writers such as Daria Zimina of Loughborough University, Leicestershire, UK, 2012, define it as: "A driver of design that seeks the highest value for the customer in terms of design, cost, schedule and constructability, and by this mode reduces waste, satisfying and even surpassing their expectations". Therefore, in both definitions we see that there are two basic factors of TVD, which are: Customer Value and Target Cost. Consequently, to deepen its study we must analyse both concepts.

First, Customer value is a relationship between the customer's perception of satisfaction with the result obtained and the perception of the customer's cost (Ballard and Reiser, 2004). To know what adds value or not for the client in a process, we must make an analysis of it, seeing all its steps and phases and identifying those tasks that may or may not be necessary, which we see are not necessary, or are not in the extent in which they are carried out, can be eliminated or modified to suit the effectiveness of the process. All of this is another Lean technique called Value Stream Mapping (VSM) or Value Chain Mapping (Rother and Shook, 1999) that we will discuss later.

As for the objective cost, we must go back to the origins of Lean Construction, to its starting point in the industry, since from the industrial application and in particular in the TPS adapted its principles to the construction. According to Jeffrey Liker in his book "The Toyota Way", 2004, this Company established as one of its fundamental principles of automobile

production Target Cost (TC) and, ultimately, TVD is the application of Target Cost to construction (Rother and Shook, 1999). Toyota analysed each and every one of its costs and made its suppliers do so, in order to adapt to the established target cost, which would determine the selling price of their cars, but always from a point of view of providing value to the customer and without reduce the quality of the product.

### 3. VALUE STREAM MAPPING

We will deepen in knowing how we can proceed to reach greater Value for the client and of which techniques we can serve to reach it. For this we will start from the principles of Lean Construction methodology. The management of processes under the Lean philosophy means, according to Professor Greg Howell of the University of Berkeley, California, USA, in his speech. at the 7th meeting of the 1999 International Group for Lean Construction (IGLC):

- Have a set of clear objectives.
- Focus on maximizing performance for the client at the project level.
- Simultaneous design of both the product and the process.
- Apply production controls throughout the life cycle of the project.

As we see, the concepts expressed broaden and develop the Project Definition of the Project Management Institute (PMI) in its PMBOK Guide 5th Edition, 2013<sup>1</sup> on what is a Project: "A Project is a temporary effort that is carried out to create a unique product, service or result. This means that:

- It has a defined beginning and end, so a project is something temporary.
- It represents a certain volume of work that requires a given type of organization; otherwise it would not be an effort.
- It is not a routine job, it does not follow normal procedures because there is something that makes it unique.
- Creates a result, which can be a product, a service or a result."

Obviously the PMBOK 5th Edition, 2013, refers to Projects in general, not specifically to construction, but to any Project of the nature or productive sector you want: Information Technology, financial, chemical, construction etc., it is because the PMBOK Guide is a standard, a basic conceptual framework of good practices that allows to manage, in a homogeneous and grouped way different business processes (Brioso, 2015). Therefore, to make the Construction a Lean process we should aim to: Minimize the peculiarities that this industry has, related to its production on site, tending to use techniques of the manufacturing industry. This means increasing the use of prefabrication, ensuring that most of the components of the construction come from the factory, not only the individual components such as awnings, facades, structures, etc., but also more complex units such as sanitary zones, kitchens, or why not? the complete housing. And on the other hand, develop and apply techniques appropriate to the dynamism of construction. Therefore, change traditional planning by Last Planner System, use Target Value Design, Integrated Project De-

livery and Building Information Modelling (Mossman, Ballard and Pasquire, 2010), in short, all Lean Construction techniques.

To achieve this, it is necessary to begin by doing an in-depth analysis of the way in which we work. The applicable technique is the so-called Value Stream Mapping (VSM) (Rother and Shook, 2003), it will first lead us to study construction as a process flow and start visualizing all the actions of the value chain of a Project and their flows, beyond analysing a process each time.

VSM is to identify what contributes Value to the customer from the design stage, identifying the waste present in the chain to eliminate them, and even the source of such waste, as well as opportunities for improvement and future actions that generate Value. It will help us to see the losses and use a common language to find the processes that are productive and those that are not, will also make evident the decisions about the flows of the activities of the production chain and will be the basis of an implementation plan of the same once it has been purified.

For its application we will make a previous diagnosis of the current situation, which will reveal the inefficiencies that exist and a future diagnosis that reflects the proposed improvements. VSM is an effective tool to simultaneously improve productivity and eliminate losses in construction (Rosenbaum, Toledo and Gonzalez, 2014).

### 4. TARGET COST

Within the production strategy that Taiichi Ohno was implementing in Toyota with the TPS in 1970, the Target Cost was used under the name of Genka Kikaku (Liker, 2004). Toyota's application of this technique is explained below: After establishing through market studies, what is the price that a final consumer is willing to pay for a car of certain characteristics, and always seeking to offer the highest possible quality, you get the Target Price of sale. Next, the commercial margin (Target Margin) that the manufacturer wants to obtain for that product is estimated and consequently the Target Cost (TC) is obtained by deduction. If this first rough approximation is initially feasible, a Business Plan and Feasibility Study or Feasibility Study of the Business Plan is elaborated. For this purpose, this Business Plan is analysed in various specialized workshops, such as: Initial, Values, Design and Restrictions. These workshops consist of specialized work teams that analyse the product from each of the different points of view.

After this analysis, the following coordination workshops are held: One to identify misalignments between values, design and constraints, and another to align values, design and constraints, some of the team members may be part of these workshops reviewed or be different people. And only once this analysis has been made, after concluding its conclusions, the TC is established and begins the design stage, with this as a condition of the project, the TC will be immovable throughout the production process, discarding all the solutions of design or execution that cause the Target Cost to be exceeded.

### 5. THE TARGET VALUE DESIGN SYSTEM

According to Josh Bronitsky, Project Manager at DPR Construction, in

Denver, Colorado, USA.<sup>2</sup>, TVD seeks: "The lowest cost, the right design and the maximum value defined by the owner." This philosophy is once again coincident with that of PMI, since one of the Knowledge Areas of the PMBOK 5th Edition, 2013 is precisely the management of stakeholders, which includes all necessary steps to identify the individuals, groups or organizations that may affect or be affected by the Project. The stakeholders' expectations, and their impact on the project, their impact and their needs are analysed, and appropriate management strategies are developed to involve them and to establish effective communication with them throughout the life cycle of the project (Soler Severino, 2013).

Comparing with the traditional method used in construction, the TVD application consists of the following, starting with Macomber, Howell and Barbeiro, 2007:

- Instead of estimating based on a detailed design, design based on a detailed estimate.
- Instead of evaluating the constructability of a design, design what can be built.
- Foster innovation.
- Apply a greater effort as soon as possible, which will lead to a lower cost.
- Know perfectly what the client expects and how much he is willing to pay for it.
- Communicate in a transparent way to all team members the results obtained in savings in relation to the Target Cost (TC).
- In general share the good and bad news about the development of work with all members of the team.
- The whole effort of the team must be fixed in locating Value to boost it and losses to eliminate them.
- Work in an Integrated Big Room, where efforts and achievements are shared.
- Build virtually with BIM to test the ideas before hiring the work and repeat, if necessary, the tests, eliminating the losses.
- Design and then evaluate with BIM to compare with Target Cost (TC).
- Make repetitive mapping of processes looking for continuous improvement (VSM).
- Make Pull Planning with Last Planner System.
- The golden rule of TVD is that the Target Cost

can never be exceeded for any reason.

If we compare with the Traditional Method starting from Pons Achell, 2014, we can say that in this:

- Cost is a consequence of design.
- The work is started by means of an Estimated Budget, which is never known whether it will be fulfilled or not.
- Since the beginning of the work there is a total adherence to the solutions designed without thinking about its cost.
- It is designed first and then calculated the cost of what has been designed (what is in the plans).
- The landlord is provided with cost estimation tables, which vary as the work progresses, usually upwards.
- Design efforts are wasted as costs, constructability and customer preferences are late for the designer, who must adapt the design to the work in progress.
- Construction costs are high due to the "protection mattresses" that the contractor puts in the offer, raising prices and design flaws.
- Change orders and additional items are presented frequently because errors are detected late, usually on site.
- The number of queries that the contractor makes to the designers increases, since he knows the Project when he must execute it.
- All this leads to relationships in the team becoming adverse and there are frequent disputes between designers, contractor and property.

On the other hand, in TVD based again on Macomber, Howell and Barbeiro, 2007:

- Cost is an important entry that conditions the design in the project phase.
- From the beginning of design, information is shared frequently among all members of the team and their opinions are collected.
- It is based on a rapid estimate based on the BIM model and the design is refined until reaching the Target Cost.
- Multiple solutions are produced on

the BIM model to compare its value and cost.

- A permanently updated development diagram is available so that the various stakeholders involved in the project can see their evolution.
- It contemplates the project always and for all the members of the team under the responsibility of all, a teamwork and collaborative one.
- The objective cost is the common objective of the whole team.
- Engineering of different disciplines and constructability condition the design, there are no surprises on site.
- Despite the contingencies that may arise in all this process, the objective cost is never lost.

To apply TVD, it is very important that all team members believe in the collaborative culture, just as with IPD, however, it is necessary to differentiate both concepts, IPD is a project management system (Matthews and Howell, 2005), while TVD is a management tool or practice. A project management system like IPD can be broken down into three main elements: Project Organization, Operating System and Commercial Terms.

TVD belongs to the Operating System category, it is not necessary to opt for a relational contract for its implementation, but to align objectives it is advisable to have at least a shared profit and loss mechanism (Lichtig, 2008), such as the Integrated Form of Agreement (IFOA), which Lichtig defines. When all parties involved in the team share gains and losses as well as responsibilities, it is when real collaboration occurs, aligning common goals and interests is what most can help to achieve the TC.

The application of TVD requires what is called a Cluster organization consisting of several working groups led by each one of them by a Leader Cluster that commits itself to the team as a whole to carry out the task entrusted to its group. Each one of them must arrive at the own objective cost that has assigned its task. In turn, the Leaders of each cluster are integrated into a group called Core Group or Integrated Group, which coordinates all the tasks of the Project and checks the progress of the project in relation with the total CT of the Project.

According to Hal Macomber, Greg Howell and John Barbeiro of the Lean Project Consulting company in Bloomington, Indiana, USA.<sup>3</sup>, 2007, the nine basic practices of TVD are:

1. "Engage deeply with the client to establish

<sup>1</sup> The 6th Edition of the PMBOK has just been published on September 5th., 2017, which has not yet given time to analyze, but in these concepts, coincides with the 5th Edition.

<sup>2</sup> DPR Construction is one of the United States Construction Companies which most uses Lean methods in construction and in particular TVD and IPD.

<sup>3</sup> Company that based on the academic knowledge of its components is specialized in the implementation of TVD processes in buildings.

objective value.

2. Focus the design effort on learning and innovation.
3. Design for a detailed budget.
4. Plan and re-plan the project in a collaborative way.
5. Design the product and process simultaneously.
6. Design and detail in the sequence that the internal customer needs.
7. Work in small and diverse groups.
8. Work in "Big Room".
9. Perform continuous retrospective analysis of the entire process according to the design sequence."

## 6. TARGET VALUE DESIGN IN PRACTICE

While there are some previous lower level experiences, the first major construction project in which Target Cost was applied is a North Sea Oil Platform in 1996 for British Petroleum (BP), resulting a success, which has been documented by Terry Knott, a journalist specializing in the industry, in his book "No Business as Usual. An extraordinary North Sea Result", 1996, commissioned and published by the company BP. Later, Professor Davide Nicolini also documented another experience with CT in the UK in 2000, but this case was not as successful as it could not be fully applied (Nicolini, Tomkins, Holti, Oldman, and Smalley, 2000).

The first documented example of successful application of TC in USA, was the St. Olaf College Covered Sports Field in Northfield, Minnesota, USA. Made in 2001-2002 by the Boldt Construction Company and referred to by its Engineer Paul Reiser and Professor Glenn Ballard in an article published in 2004. Since this Field was built based on a donation from the family of a student, the School was particularly interested in staying within the Target Cost and being accountable to the donors. This was achieved through collaborative development with TC.

The first time it was applied as Target Value Design according to Lean Construction principles was in 2005 for the construction of the Sutter Eden Medical Centre in Castro Valley, California, USA. This Hospital was developed using Integrated Project Delivery, Target Value Design and Building Information Modelling, with great success. This is a building of 21,550 m2

*\*Sutter Health is a powerful American healthcare group that since this implantation realizes all its buildings applying lean construction methodologies for the good results obtained.*

built with a target cost of 230,000,000 US \$ and a 30% execution time reduction over the estimate for a facility of this type in California.

It was very important for this implementation, as for all subsequent in Sutter Health, the strong support of Digby R. Christian, Project Delivery Director of the group, who after the good results obtained in this experience has become an advocate of the methodology in all kinds of international forums, giving lectures on the subject, as well as adopting it as the usual work form of the Sutter Health Group, for the construction of its various hospitals, offices and all types of buildings. In this case, the parties involved in the design and construction management team were 11, among them the architects: Devenney Group Ltd. Architects, an integrator of the Lean-BIM Project: Ghafari Associates and the Construction Company DPR Construction, to the which we mentioned earlier.

The most important measures for the implementation of Lean Construction adopted were:

- The agreement came from an Integrated Form of Agreement (IFOA) based on the one written by Will Lichtig in 2005.
- The team was divided into several groups or Cluster existing a Core Group that coordinated all actions.
- The ownership was involved in the entire development from the outset, the decisions of the Core Group were taken by consensus and in case of a tie decided ownership.
- Each Cluster had to reach the Target Cost assigned to it, every two weeks the Total Cost of the building was updated, adopting the corrective measures necessary in case of deviation from the Total Target Cost, which were sent to each of the groups for its application.
- In addition, Sutter Health developed a Risk and Opportunity Registration process, which the Core Group periodically evaluated and shared with all team members, this has constituted an interesting repository of lessons learned in the experience that has been used in later ones.

With the adoption of Lean Construction (Mossman, Ballard and Pasquire, 2013) the objectives were achieved, customer satisfaction was also achieved and the target cost was

maintained. This case has been analysed in depth by the Project Production Systems Laboratory (P2SL), Laboratory of Systems of Project Production, University of Berkeley, California, USA, in an interesting study. P2SL's Target Value Design Research Group was created in 2009 to study the design and construction of hospital projects in California, which use TVD and IPD. The purpose of the studies undertaken by this group is to analyse the problems that arise in these Projects, and to obtain a record of lessons learned to improve the process. Several studies have been carried out in previous years, such as: Sutter Castro Valley (Budget: US \$ 230 million), Sutter Alta Bates (Budget: US \$ 220 million) and USCF Mission Bay Medical (Budget: US \$ 750 million).

New buildings are being studied to analyse in this same sense, which indicates the importance of the implementation of TVD and IPD in the construction in USA and the desire is to deepen and expand the use of these techniques in that Country. It is not only the Sutter Health Group who applies them, but many other high-level economic and efficiency companies such as Autodesk or Biogen Chemicals do it, and more and more organizations are adopting the same based on their magnificent results.

## 7. CONCLUSIONS

Target Value Design is a Lean Construction Operating System that seeks the highest value for the customer from a fixed Target Cost that will be immovable throughout the entire design and construction process of the building. Therefore, the Value for the client and the Cost Objective are their fundamental points of support.

The work team should consider the project as a whole and as a shared responsibility that it will be developed collaboratively, even if in an operative way it works in several groups or Cluster, everyone will be able to have all the information of the Project in an Open Books format.

In order to achieve the pre-set objectives, the BIM modelling of the building will be a basic aid tool, which will make it possible to carry out various tests of the building in the pre-construction phase and to easily develop the verification of the cost of the building, as well as its deviation from the Target Cost during the construction, to adopt the necessary measures, which lead to its alignment prior to the beginning of the work.

Parallel to the design of the building will be also considered the construction process, to improve not only in the definition of materials but also in the

way of execution. This will be the true Value Engineering that will be done with TVD. Keeping the Target Cost as the centre of the entire process will be required the adoption of project solutions that will help to keep it unmoved.

While it is not necessary for TVD to be developed together with IPD, it is true that all participants in the building design and execution team must be willing to do so in a collaborative way, this working philosophy is fundamental to applying Lean Construction and Target Value Design, collaborative methods are what allow us to achieve common goals and feel involved in the joint task.

To know in depth what brings Value or not to the client it is necessary to apply

the technique of Value Stream Mapping and to analyse the whole process to eliminate what is unnecessary or what it is in the measure in which it was being applied, in an iterative way and not stop only in the design phase, but also be applied in the execution phase. The concept of Value for the client must be permanently updated, considering its involvement in the Project.

Parallel to achieving the Target Cost, the focus should also be on eliminating waste and inefficiencies in the design and construction process. This is the purpose of implementing Lean Construction, eliminating losses or Muda as it is said in Toyota, while with TVD we improve the Value which we deliver to the customer and maintain the proposed Target Cost. ♦

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