

# VALUE IN CONSTRUCTION FROM A LEAN THINKING PERSPECTIVE: CURRENT STATE AND FUTURE DEVELOPMENT

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## ABSTRACT

At present, the concept of Value has been included in many theories and management tools applied to the construction industry. Despite a continuing effort of researchers to define or develop a common understanding of this concept, this work has not advanced sufficiently to provide a universal theory of Value to apply in the construction industry as a whole.

This paper investigates the conceptual notion of Value from a Lean Thinking (LT) perspective with the aim of developing a framework for understanding Value from this and how Value has been used in the construction industry. Historically, in most definitions of the concept of Value three main parameters (cost, time, and quality) converge, in construction many authors place these parameters in an economic perspective in which “Value for Money” dominates. At present, LT applied to the construction industry has demonstrated the potential to add Value from the very early stages of a project. Therefore, the focus of LT in construction is extended beyond the on-site project delivery and into the earlier processes such as design and supply chain integration. The work described in this paper forms part of a larger study aimed at understanding how construction delivers Value to the society as a whole, and why this concept should be incorporated into.

## KEY WORDS

Lean thinking, value, lean construction, quality, waste.

## INTRODUCTION

Through the years, the Value concept has been included in many theories and management tools related to construction projects, for example: Value Theory, Value Engineering, Value Management, Lean Thinking, etc. Despite an ongoing effort of researchers to define or develop a common understanding of Value from a conceptual and practical perspective, this work has not progressed sufficiently to provide an

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universal Theory of Value to be applied in the construction industry as a whole. “The concept of value is probably the most difficult to approach in the new way of managing construction projects” (Bertelsen and Koskela 2004:6). Since the early 1960’s, the construction industry has recognized the importance of the concept of Value to achieve successful results and customer satisfaction “The goal of any building project is to deliver value to the client organisation, and in order to do so the building project and its processes must be of value to all project participants. Thus the understanding of value in building is an important part of building management.” (Wandahl 2005:21). Although the construction industry has seen continued improvement many opportunities for a step change remain: “the industry still continues to under-perform, generally due to a continued lack of design and construction process integration, a lack of focus on quality and customer value, poor contractual relationships and a general lack of understanding as to why poor performance continues, or how improvements might be achieved.” (Leong and Tilley 2008: 757-8).

As a result of multiple studies aimed at improving performance of construction projects, the LT philosophy defined as a five-step thought process (Womack & Jones 2003) has been acknowledged as an important informing idea for Lean Construction. Based on high performing Japanese business practices, Lean Thinking has deep roots in the Quality management and control philosophies of Deming, Juran and Crosby. Toyota is the exemplar organisation whose influence has transformed manufacturing around the world. (Drew et al. 2004: 5). The Toyota experience allows construction to be seen from another perspective. Thus, Womack and Jones’ (2003) five basic principles of specify value, identify value stream, flow, pull and perfection provide a base line for understanding Value from a LT perspective.

Based on the research developed by Koskela since 1992, the Lean Thinking philosophy has become a contemporary concept of theory and practice. Currently, academics and construction practitioners use and develop this concept in order to improve results achieved in different projects around the world, many reporting back via the International Group for Lean Construction–IGLC ([www.iglc.net](http://www.iglc.net))<sup>1</sup>.

In this way, LT applied to construction projects delivers continuous improvement across the entire process by understanding and delivering Value for the customer and will improve current performance. At present the focus of LT in the construction industry has not been fully extended beyond the on-site project delivery, thus there is an important opportunity to expand Lean Construction experience to early stages of a project, where the biggest opportunities to add Value are generated. “Lean construction literature has mainly focused on dealing with problems and challenges that arise on the construction site. We argued in our earlier work that this was missing the point. To take a holistic and integrated approach to the design and construction of buildings within a lean framework means getting everything right at the start—or at least getting the customer values as right as possible—thus trying to avoid unnecessary and costly changes/re-work loops later in the production process.” (Emmitt et al. 2005: 58). “Lean thinking is argued to lack an adequate conceptualization of production, which has led to imprecise concepts, such as the term of “value”.” (Koskela 2004:24)

Based on literature review, this Paper will present:

- An overview of the conceptual notion of Value from the LT perspective and as used in the construction field; and
- The relationship between Value, waste, and quality and how they have been used in current practices from the LT perspective in the construction field.

## **NATURE OF THE CONCEPT OF VALUE IN THE CONSTRUCTION FIELD**

Within literature it is possible to find numerous definitions and expressions associated with the conceptual definition of Value applied to the construction industry. Since the early 1960's, theories such as VE, VM, LT, etc. have discussed this concept with varying impact on construction, but despite this high level of discussion a general definition which shows a clear and global understanding has not been found; therefore, the concept of Value continues to be a rich field to explore as a consequence of its multiple features, unclear definitions and various parameters.

To facilitate the comprehension of the concept of Value, it is necessary to understand its origin. Arising in early Greek philosophy, Value has been understood as a property of goods or services; more recently this understanding has been discussed and recognized as a mistaken point of view. Nevertheless, the idea continues to be part of our thinking. Thus, "Engineers and economists alike see value in terms of the features that product or services has" (Shillito and De Marle 1992: 3). From the Greek perception of this concept arises the subjective and dynamic nature of Value: Properties and features of products or services vary personally according to the objectives of customers or stakeholders and are defined within a social and economical context which changes across time.

Just as the Greek philosophy has contributed to the concept of Value, Smith (1776) differentiated two definitions of this concept, thus Value was divided into "value in use" and "value in exchange" closely related to "Utility Value" and "Market Value". In this way, Smith's classification has been broadly discussed and the concept of "esteem value" has been introduced to complement Smith's contribution. So, according to Kelly et al. (2004) the definition of these concepts arose from the relationship between Value, function, cost and worth or Value, function, cost and quality. Following Smith's previous work, Ricardo argues that "The value of a commodity, or the quantity of any other commodity for which it will exchange, depends on the relative quantity of labour which is necessary for its production, and not on the greater or less compensation which is paid for that labour." (Ricardo 1917:4). In 1886, Marx theory of labour also included the concept of "value in use" and "value in exchange" and from this work it becomes more evident the relationship between money and value. "The first chief function of money is to supply commodities with the material for the expression of their values, or to represent their values as magnitudes of the same denomination, qualitatively equal, and quantitatively comparable. It thus serves as a universal measure of value. And only by virtue of this function does gold, the equivalent commodity par excellence, become money." (Marx 1886:94). Therefore, until now, the concept of Value has been mainly associated to monetary terms, where the ratio cost/benefit is broadly applied.

Aimed at understanding the nature of Value, current theories such as Value Based Management (VBM) have added the management of personal values to improve project performance and achieve better results. VBM aims at changing the common vision of value from the company's perspective, which consider that "Value is created only when companies invest capital at returns that exceed the cost of capital". Thus, VBM focus on values and on "how companies use them to make both major strategic and everyday operating decisions" (Koller 1994: 87). In addition, Wandahl and Bejder (2003) introduced the concept of VBM to Lean Construction.

The concepts of Value and values have been often misunderstood, and the differences between them continuing in an ongoing debate. Therefore, it is important to underline that "One is not the plural of the other. Values are inherently subjective because they frame the judgements made by individuals or organizations. Value, on the other hand, relates to assessments about products and can be subjective if they remain internalized within an individual or an organization, or objective if they are expressed. In the latter case, Value assessment and measurement can inform management action...Our values are the principles by which we live. They are the core beliefs, morals and ideals of individuals and are reflected in their attitudes and behaviours in society." (Thomson et al. 2003: 337).

According to the last references, it is possible to have a brief idea of several perspectives which have included the concept of Value from its objective or subjective nature. The concept of Value in construction has been mainly focused on its objective nature. More recent theories and management tools applied to construction projects have arisen and recognised the importance of the subjective nature of Value. Current design practices have been oriented to create and deliver Value from the customer's perspective and theories such as VM, Lean Design Management, Customer Value Management etc. give a relevant role to the participation of main stakeholders from the beginning, action which is considered one of the most important task to deliver Value and satisfy customer needs.

As an example of the last, Christoffersen (2003) underlined two main Value characteristics which recognised the subjective and dynamic nature of Value:

1. The perception of value is individual and personal, and is therefore subjective. Indeed, agreement of an objective best value for a group will differ from the individuals' perception of value, and
2. Value will change over time.

The difficulty of identifying a global definition of Value is evident from the literature. The lack of ability to identify a common definition means that current theories and management tools define Value according to their own interests. Thus Value is delivered according to each author's perspectives and mainly focused on the delivery of Value at project level.

## **THE CONCEPT OF VALUE FROM THE PERSPECTIVE OF LT APPLIED TO THE CONSTRUCTION INDUSTRY**

Through the years, LT in the construction industry has been mainly associated with activities oriented to reduce waste. especially waste on site. Thus, it is recognised that

there is a lack of research from early stages of projects, where significant opportunities to add Value exist (Emmitt et al. 2004 & 2005). However, current practices have demonstrated that LT goes far beyond simple waste reduction aiming rather at continuous improvement across the entire process by understanding and generating Value for the customer. LT “not only does cut costs and improve quality, but also stabilises operations and matches supply with demand. It even promises to end firefighting for good and establishes the necessary conditions for continuous improvement” (Drew et al. 2004:2). Thus, LT is considered “... a revolution -it isn’t just about using tools, or changing a few steps in our manufacturing process -it’s about the complete change of our businesses.” (Melton 2005: 662).

In order to better understand the concept of Value from the perspective of LT it is important to study the perspectives of the manufacturing and construction industries. At present it seems the application of LT within construction misses the opportunity to add Value in early stage of projects, conversely in Lean manufacturing “considerable effort is put into the design and planning stages before production starts, and where considerable attention is given to customer values and implementation of a zero defect production process.” (Emmitt et al. 2005: 58).

According to Womack and Jones (2003) Value is present in manufacturing product development activities and, therefore, Value is also attributed to materials, parts or products, etc. Womack and Jones (1996) define value as: “a capability provided to a customer at the right time at an appropriate price, as defined in each case by the customer.” (cited in Thomson et al. 2003: 338). In this way, Koskela analyses the five principles of LT and argues that “value is here used to mean materials, part of product” (Koskela 2004: 29). Also, Koskela recognised deficiencies in these principles related to conceptualization and maximization of Value. “Unfortunately, the frequent use of “value” among the principles, also conceals the fact that very little is said on how to maximise value. Simply, the Authors are using imprecise and unsystematic terms, due to lack of explicit conceptualization” (Koskela 2004: 29-30). In this way, it is important to underline that the concept of Value from LT perspective applied to the construction industry, has been mainly associated to product delivery, and therefore, in spite of current practices which include the subjective nature of Value, collective understanding of Value from LT perspective continues to be associated to objective and measurable parameters, such as quality, cost, and time.

LT practices aim at understanding customer requirements through collaborative processes. Outside customers that pay for final products are considered as important as inside customers or project participants who are involved in building processes (Tapping and Shuker 2003). In this way Emmitt et al. (2005) classified Value as Internal and External, where Internal Value is associated to the participants in projects such as architects, engineers, project managers etc., while External Value relates to clients. Other authors also underline the LT role in the construction industry oriented to delivering internal an external value through its principles. “A fundamental aim of Lean Construction is to aid in the delivery of external value by managing the internal value generation process” (Björnfot and Stehn 2007: 35). This description of a LT perspective provides a step towards the development of a universal Value theory.

In order to deliver what clients want, some Authors underline the relationship between LT and the concept of Value. So, “Lean Thinking starts with the customer

and the definition of value” (Melton 2005:664), besides it is argued that “value is created by the producer.” From a customer perspective it is important to underline the work of Deming (1994) cited in (Leong and Tilley 2008: 765-6), they argue that “If the NEXT customers were to be identified right from the start and appropriate measures put in place (potentially triggering payment), the chances of delivering a project on time, on budget and to the customers requirement will be greater.”.

Today the need to develop products according to clients needs is more widely recognised. This vision changes the traditional point of view of managers who decided what the client wanted and, therefore, if clients were not satisfied, they managed variables in relation to costs and characteristics (Womack and Jones 2003). Current researches have therefore been focused on delivering value from customer perspective. Projects “must start with a conscious attempt to precisely define value in terms of specific products with specific capabilities offered at specific price through a dialogue with specific customers” (Womack and Jones 2003:19). Additionally, other authors argue that “The first and primary concept of lean is to determine what you need to produce specifically in terms of quantity and delivery requirements; in other words, determine the actual number of parts you need to produce each day. This is not just a calculation; it means understanding your customer’ ordering patterns.” (Tapping et al. 2002:27).

Finally, it is important to know that even though LT practices have been mainly focused on production activities as a result of the close relationship between the concept of Value and physical results, the concept of Value is considered a critical parameter in order to meet customer and clients needs and in this sense, the importance of different stakeholders involved in construction projects can be recognised “One of the core ideas of Lean Construction is that the process of designing and producing a construction product should progress continuously and create value for both the customer and the delivery team.” (Lennartsson et al 2008:541).

## **PARAMETERS ASSOCIATED WITH THE CONCEPT OF VALUE FROM A LT PERSPECTIVE APPLIED TO THE CONSTRUCTION INDUSTRY**

### **VALUE AND WASTE REDUCTION RELATIONSHIP**

From the perspective of LT, the concept of Value can easily be associated to waste reduction. Thus, waste is defined as “specifically any human activity which absorbs resources but creates no value” (Womack and Jones 2003:15); “...anything that adds cost but not value” (Drew et al. 2004:15); “Value generation is defined as meeting client requirements while minimizing waste” (Forgues et al. 2008: 435). According to Macomber and Howell (2004), understanding waste is a condition to understand Value. In this way it is important to know that the definition of waste is mainly associated with production processes of on site activities in the construction industry, but this gives rise to an information deficit about waste reduction in the early stage of projects, where their impact is more significant for final results (Alves and Tsao 2007; Formoso et al. 2002).

According to LT, adding value and reducing waste are two important activities to deliver products that satisfy clients needs. “Value management in Lean production is

an attempt to maximize value and eliminate waste reduction” (Bae and Kim 2007:314). An important feature of building projects is that their characteristics change as customer perception changes. This iterative process generates waste into processes from design to final occupancy (Björnfot and Stehn 2007). This provides the strongest argument for considering clients and stakeholders requirements in early stage of projects in order to satisfy their needs and increase final satisfaction. “A large amount of waste in the value chain is due to lack of coordination among these agents. The identification of the main flow and its leaders is very important, to understand the cooperation that is necessary for the lean transformation” (Picchi 2000:2).

Finally, in spite of the close relationship between Value and waste, it is recognized that Value is not a consequence of non-wasteful processes. Thus, Koskela argues “A product with a wonderful value may be produced in a most wasteful process. On the other hand, a product with a clearly deficient value may be produced in a most waste-free-process. Unfortunately, there is not such handy and direct connection between waste and value as indicated in Lean Thinking.” (Koskela 2004: 29).

### **Value and Quality Relationship**

The concepts of Value and quality are easily misunderstood. The close relationship between both to satisfy customer needs could be the origin of this mistake. In this way, LT as a philosophy applied to the construction industry and its management tools has focused mainly on delivering Value through assurance of product attributes, where quality has been associated with satisfying customer requirement, thus, LT experience achieved in the management of quality by the construction industry has been influenced by authors such as Juran, Deming, Shingo, etc, and different management tools such as Six Sigma, TQM, QDF, etc. have been investigated in international forums of LT to satisfy customer and stakeholders requirements. Thus, it is evident that there is a close relationship between Value and quality in current LT practices “...quality is delivered considering both the perception of value by the customer and other stakeholders, and defect reduction (e.g. Design for Manufacturing and constructability analysis).” (Owen et al. 2006:62).

LT applied to the construction industry must to solve particular features of building projects whose conception and development are totally different to manufacturing process where quality can be included from the beginning. “Manufacturers can estimate returns on investment because they can determine in advance what price customers will be willing to pay for a product with given features and quality characteristics. In construction, each product is typically designed and constructed for one customer only, and that customer must, almost always, be intimately involved in the project development and delivery process.” (Ballard 2006:78). In this way, “Lean Construction aims to apply the concept of lean production to the construction industry in order to improve efficiency and quality.” (Cuperus 2001:10).

Nowadays, products should be delivered to satisfy customer and stakeholder needs. Throughout the IGLC forum, Value has been mainly associated with quality and cost. Therefore, maximum Value is achieved through products which satisfy customer and stakeholder needs, delivered at the best price and quality. “Lean

construction philosophy deals with the production process and aims at the adoption of methodologies that allow for the attainment of favourable results in terms of generation of aggregate value to product, without implying cost increase or quality loss.” (Shimizu and Cardoso 2002:2).

Experience throughout international forums such as IGLC, shows the close relationship between quality and Value, most of the research developed considers quality as a requirement of customer and stakeholder to achieve Value. Therefore, it is certain that different management tools have been based on this close relationship and the use of the concept of quality in early stage of project such as design. Participation of customer and stakeholder in the design stage it is consider a key task to deliver value. “Client involvement during the design phase is common practice in construction.” (Owen 2006:62)

- Lean Design Management (LDM): “...the introduction of “lean production” principles to the process of design—has been promoted as a new paradigm by which the design process can be made more efficient and better quality outcomes achieved.” (Tilley 2005:283). “...LDM approach definitely has the potential to significantly improve the way the design process is managed, increase client and end user value and minimize waste in the construction process through better quality design and documentation.” (Tilley 2005:292)
- PULL and CONWIP (constant work in process): “Experience tells us that some organizations view project delivery as gambling. Sometimes you get lucky and win, sometimes you lose..... As part of the design of these production systems, the paper explains how the application of PULL and CONWIP techniques can drastically improve value delivered (quality, safety, time and cost).” (Arbulu 2006: 216)
- Target costing: “...is not only a tool for managing costs, but a strategic approach for development of new products, that aims to reduce costs, ensuring quality, reliability and other attributes that will add value to the customers.” (Jacomit et al. 2008: 601)
- The product offer: “...is specified and detailed from customer requirements (Value) but managing customer value through the product offer forces the customer to lock their options to a specific technical platform (building system) offered by the producer. Locking customer options allows the producers to be in control of a stable value generation process where customers are allowed flexibility through selected add-ons and options such as façades, apartment layouts and interior finishing. Consequently, value is specified by specific product for specific customers, which enables stability.” (Björnfot and Stehn 2006:38-9)
- Quality management, TQM or QFD: “Methods, managing and balancing values, are used in construction research and applied practically, e.g., from quality management, TQM or QFD. Internal values for the delivery teams (expectations from stakeholders in design, the way projects are organised and managed in the construction phases, etc.) and external values for the customers (material and equipment quality, design quality and handovers, etc.) must be captured, realised and delivered.” (Lennartsson et al. 2008: 542).



## PREVIOUS EXPERIENCE OF LT AROUND THE CONCEPT OF VALUE

Important research around the concept of Value has been developed by numerous authors in the context of international forums such as IGLC providing different perspectives according to the point of view of different researchers. Therefore, it is difficult to find a broad definition which reflects a clear and global understanding of the concept of Value applied to the construction sector. From a LT perspective, Value has been mainly associated with something physical linked to project development; as a result design activities in early stages have focused on achieving measurable attributes to satisfy customer needs. Authors such as Emmitt et al. (2004) have contributed to deliver Value and improve productivity in design activities (Lean Design Management).

In order to better understand different perspectives associated with the subjective nature of the concept of Value, current practices have been oriented to satisfying customer needs through stakeholders' participation. Thus stakeholders' values play an important role in order to achieve successful results. Ballard (2006) has been working in the adoption of a model of project definition with a Value generation perspective. This new model gives relevant importance to stakeholder's values. Other authors such as Wandahl and Bejder (2003) have given significant importance to values into organizations, thus, these authors have introduced VBM to the IGLC forum. At present, customer satisfaction is a critical concept in project development and Value generation. In this way Kärnä and Junnonen (2005) have investigated the relationship between these concepts. In the field of projects with social impact, Leite et al. (2005) introduced LT theory in social housing projects in Brazil, future research will be developed by Lima et al. (2008) in the field of client requirement. It is important to underline the previous work carried out by Miron and Formoso (2003) in the field of client requirement management from early stage of projects.

Other authors have contributed to the understanding of the concept of Value from LT perspective applied to the construction industry. In this way, Koskela (2000) introduced the T-F-V model. "The TFV model shows that construction should be understood as a generation of value for the client. This takes place through a series of processes; forming a workflow drawing on transformations delivered by the trade contractors under a contractual arrangement with the client – either directly or through a general contractor." (Bertelsen and Koskela 2002:5). Another important contribution has been made by Emmitt et al, who argue that the concept of Value in the construction field is grouped into internal and external value. Following this division, external value is separated into process and product value, thus, process value include "Soft Values" and "Hard Values." In the last group the relationship between Value and quality is evident. "Hard values' such as the delivery teams ability to keep agreed time limits, cost estimates, quality of the product and workers safety etc." (Emmitt et al. 2005:59). According to Björnfot and Sardén (2006) external value is demonstrated, when customer receive the precise product according to the price and quality established".

## CONCLUSIONS

As is evident, the experience achieved through international forums such as IGLC is ample. Thus, the study of different perspectives in the construction field is a key step to open new opportunities to deliver Value in future research. The task described in this paper forms part of a larger study aimed at developing the concept of Value from a social perspective, current theories and management tools have been focused at project level and lose the opportunity to deliver Value to the society as a whole. As a result of multiple perspectives of the concept of Value numerous definitions and applications have been discovered in the literature review. For this reason, it is considered that before investigating new tendencies, it is necessary to better understand the concept of Value from an overall perspective. In this way, this paper shows theoretical results obtained from literature review of LT perspective, where International forums such as IGLC play an important role into academia.

Based on the experience achieved by LT in the construction industry, it is possible to verify the current concern about a clear definition and understanding of the concept of Value. At present, Value definition changes according to projects features and authors perspectives. Therefore, it is not possible to find a general understanding of this concept to be applied in the construction industry as a whole. Considering the concept of Value from a LT perspective within the construction industry, it is possible to conclude that:

1. Despite several definitions and perspectives associated with the concept of Value, at present it is not possible to find a general understanding, which can be applied to project aimed at delivering Value to society as a Whole
2. The experience of LT along international forums such as IGLC has mainly based on delivering Value within on site activities, where Value is generally associated to delivering products which satisfy customer needs
3. Parameters such as waste and quality have been associated to the concept of Value. However, a clear relationship between them does not exist
4. Delivering Value to the society as a whole is considered an important perspective for future development and LT can contribute to future theories. It is important to recognise that LT goes far beyond simple waste reduction aiming at continual improvement across the entire process by understanding and generating Value for the customer.

Finally, development of new theories which include the concept of Value must start with a complete understanding of this concept from different perspectives. Otherwise, delivering Value to the society as a whole is an impossible task to be achieved.

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