

IMPLEMENTING A VALUE BASED APPROACH TO CONSTRUCTION

Stephen Emmitt, Anders Kirk Christoffersen and Dag Sander

Technical University of Denmark, NIRAS and MT-Højgaard, Denmark

Abstract

Value is *the* end-goal of all construction projects and therefore the discussion and agreement of value parameters is fundamental to the achievement of improved productivity and client/user satisfaction. The word 'value' tends to be used rather loosely in daily practice. Similarly, terms and interpretations vary within construction management literature. The aim of this paper is to put forward a number of definitions that may be used in a common language for discussing and implementing value. Value creation and value delivery are clearly defined within a four-stage model that maps key process functions. Mapping the process provides a framework in which to highlight the differences between value-based management, value management and value engineering activities. The concept of external and internal values is also introduced. The model described is being implemented on pilot projects in Denmark, by consultants NIRAS and contractors MTHøjgaard. The model is grounded in extensive practical work and underpinned by theoretical constructs.

Keywords: Communication; Culture; Lean Construction; Value based management.

INTRODUCTION

Lean Construction has been a topical subject in Denmark since consulting engineers NIRAS and contractors MTHøjgaard introduced the methods in Denmark in 1998/99 in an urban renewal project in Copenhagen. Since then lean thinking has spread to a growing number of companies, universities, clients and unions forming the subject of academic debate and being implemented in a variety of ways. The growing interest of the conceptual thinking behind lean lead to the creation of Lean Construction Denmark, initiated and promoted by the Danish Technological Institute with assistance from the Lean Construction Institute. Lean Construction Denmark forms the basis for achieving a common understanding, a common language, and a forum for improvement and evolution of future application. Lean construction was originally interpreted very narrowly, represented by the Danish term *trimmet byggeri* (trimmed building), which relied almost entirely on the early 1990 experiences from the project Sophienhaven in Hillerød (Buildinglogistics #1 and #2, 1993 and 1994) using logistics, primarily in the flow of materials and activities, and the Last Planner System (Ballard, 2000) and the seven flows (Koskella, 2000). Over the last three to four years the thinking has evolved and moved further up stream to include the entire design and construction process in the lean approach. The realisation was that without being able to specify the best value for the client it is meaningless to define waste. Such developments should also be set against the Danish emphasis on (project) partnering as the 'solution' to the sector's problems. This has resulted in some confusion of terminology and mixing of terms and concepts, without a clear understanding of what partnering or lean really means. Similarly, the manner in which partnering concepts and lean ideals interact, if they do at all, needs further exploration. Our aim in writing this paper is not to argue for a theory for lean construction, nor is it to argue for a best practice model. Instead the paper aims to

describe a value-based approach taken by a large consulting company and contractor working towards the realisation of a common goal to improve the building process. Critical evaluation of the methods described has not yet commenced.

THE VALUE UNIVERSE

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 helping to avoid unnecessary and costly changes/re-work loops later in the production process. This is the case in lean manufacturing, where considerable effort is put into the design and planning stages before production starts, and where considerable attention is given to customer values and the implementation of a zero defect production process. Early planning stages consume considerable amounts of resources, but when production starts there is complete certainty because everything has been meticulously planned, hence saving considerable resources downstream. We argue that this should be the case with construction. There are many differences between manufacturing and construction activities, but that does not mean that the same approach and philosophy cannot be applied to the process. This means giving more time to the early phases and subsequently shortening the construction phase.

In Denmark a value-based building process model has been developed through a series of trials, starting with the HABITAT consortium managed by NIRAS (Bertelsen, 2000) and further evolved in the publication *The Client as the Changing Agent* (Bertelsen et al. 2002), based on experiences from HABITAT and a pilot project William Demant Dormitory in Lyngby (Christoffersen et al. 2003). The approach is that the lean philosophy (minimising waste, maximising value) should be applied as early as possible. It is here that decisions concerning value, design, procurement routes, timescale and budget conspire to set the scene for everything that follows (in line with the ideals promoted and popularised by Womack *et al*, 1991; Womack and Jones, 1996). Combined with a clear set of values the briefing exercise (also known as ‘programming’ in Denmark and ‘architectural programming’ in the US) and early design operations can be managed in such a way as to reduce downstream uncertainty and associated waste.

If value is as crucial to define as we think, we need to answer the questions: (1) Value to whom? And (2) what is value? Both questions are difficult to give a precise answer to. Is it the value to the owner, the user or the society we mean, or maybe even the value to the architect, engineer or contractor? And in what time perspective do we define value, when we construct, when we use or when we demolish and recycle? We could also ask if value is only connected to the building (product) or is it also connected to the processes that lead us to the product?

Value to whom?

This question becomes increasingly difficult to answer as we investigate the interests of the participants in a project. Going back to the definition of productivity, it must be the client/customer/society that defines the value. We tend to spend our money where payback is highest, and so usually it is the buyer who decides what is most valuable, not the participants of the delivery team (e.g. architect, engineer and contractor). Clearly the delivery team members have values as well, but they are (or should be) concerned with

delivering the best value to their client, otherwise (in a perfect market) the client will look elsewhere. So we separate the value of the interests into:

- External value, which is the client/customer value, and the value that the project should end up with and the delivery team focusing on achieving.
- Internal value, by and between the participants of the delivery team.

This definition helps differentiate between values of the client and values of the delivery team, and these are not to be confused. It gets increasingly complicated when we investigate the external value because the definition of the client is not clear. The client often represents a lot of different stakeholders (the users, the investor, the owner etc.), and furthermore when we build we affect our neighbour and the surroundings (city/landscape etc.) and these stakeholders all have a different set of values and levels of interest in the project. When we know that the perception of value is subjective and individual, and that it changes over time, how do we map the values and satisfy all the stakeholders? The ‘thinking’ of values in the process method reflects the client complexity and provides the background for further investigation of the client complexity. When we go through our value-based method, we have in mind the value landscape represented by:

- Stakeholders (owner, user and society).
- Time perspective (when we design and construct, when we use and then recycle).

What is value?

The distinction between client values as the focus and end goal of our efforts and internal values of the delivery team is made as mentioned above. The external value is separated into (i) process value and (ii) product value. Process value is about giving customers the best experience during the design and construction of the project. It comprises:

- ‘Soft values’ such as work ethics, communication, conflict solving etc. between the client and the delivery team.
- ‘Hard values’ such as the delivery teams ability to keep agreed time limits, cost estimates, quality of the product and workers safety etc.
- Values that come from the actual design and construction process. As an example of this kind of value, renovation works in a kindergarten could be used to teach the children about safety, creativity etc and thus generates process value that might not have been evident when the project started out. Learning from participating in the process is another value in this category.

The soft and hard values are, when agreed between the client and the delivery team members, defined as the partnering values for the project. In this sense partnering has meaning and is an essential part of the value universe. It is all about how to work together, and how to keep agreements between the client and the delivery team. Internal values of the delivery team are of course present and influence the manner in which the actors work together. Product values are mainly derived from Vitruvian values (firmness, commodity and delight), combined with harmony with the surroundings, environmental issues and buildability. These can be broken further down in a value tree, not to lose the overview, but to make sure that the client is guided through the entire value spectrum. Thus the delivery team can map the client values in the best possible way. Product and process values can interact, and especially when the product becomes visible, it could mean changes in the values or rather the interpretation of the values.

An important factor in the approach described in this paper is the establishment of common values, or at least the discussion between the stakeholders of the ‘value universe.’ Getting to know each other and thus establishing common values and/or knowing why values differ between the stakeholders is crucial to the method. Often the result of the value work will be the best compromise between stakeholders. Establishment of common objectives and common values are important objectives in the drive for greater cooperation and reduced conflict in construction projects (e.g. Kelly & Male 1993). Value is *the* end-goal and therefore the establishment of value parameters at the outset of a project are key to the achievement of improved productivity and client/user satisfaction. The purpose of this paper is not to try and define value in an academic sense, nor to present a tight definition of the term. In practice the term value is used very loosely, and we will retain that approach in this paper. The word value has two characteristics (Christoffersen, 2003):

- 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
- Values will change over time

We view value as: an output of the collective efforts of the parties contributing to the design and construction process; central to all productivity; and providing a comprehensive framework in which to work. Value must be established before doing anything else. Emphasis is on value creating activities as the initial framework for the entire building process and thus the reduction of waste in the later value delivery phases. We are concerned with value-based management and the control of values, primarily through value management in the early stages of the project and through value engineering to deliver value in production.

Value thinking throughout the entire building process

A new understanding of the building process based on value thinking has emerged from the work and projects performed in Denmark. The process model separates the value thinking into two mental phases: Value Design, where the client value landscape is found and reflected in the conceptual design alternatives before entering the ‘production phase’ of the process. Value Delivery, where the best design alternative that maximizes the client/customer value is transformed into a production design and constructed with the aim to deliver the specified product in the best way and with minimal waste. Transformation between value design and value delivery is through the formal contract phase. Throughout the process the opportunity to learn through feedback exercises (loops) is used.

Central to the value-based model are a series of creative workshops, which have their roots in value management (see Emmitt et al 2004). Figure 1 shows a simple line of workshops, starting with the agreement of common process values followed by client intentions and discussion of abstract ideals and working through to a complete set of information prior to commencement of production. Niras refer to this as the ‘Walt Disney Model’ in recognition of the filmmaker’s approach to process management. The term ‘workshop’ is used, although in practice this will comprise a series of workshops that deal

with a particular issue, or value stage, which continue until agreement has been reached. Flexibility in programming is required to accommodate uncertainty in knowing how many workshops will be required. When problems with understanding and attitudes exist, additional workshops are convened to help explore the underlying values and tease out creative input. Thus from the very start the whole process is consensus based. Bringing people together and facilitating workshops is time consuming and expensive, but proven to be cost effective over the life of the project. The workshops are an essential tool to maximise value and to reach agreement, which helps to reduce uncertainty in production and reduce waste. Different cultures will exist from concept through to production and the workshops provide a vehicle for the addressing potential difficulties. Workshops are also continued at the production phase to better involve the sub-contractors.

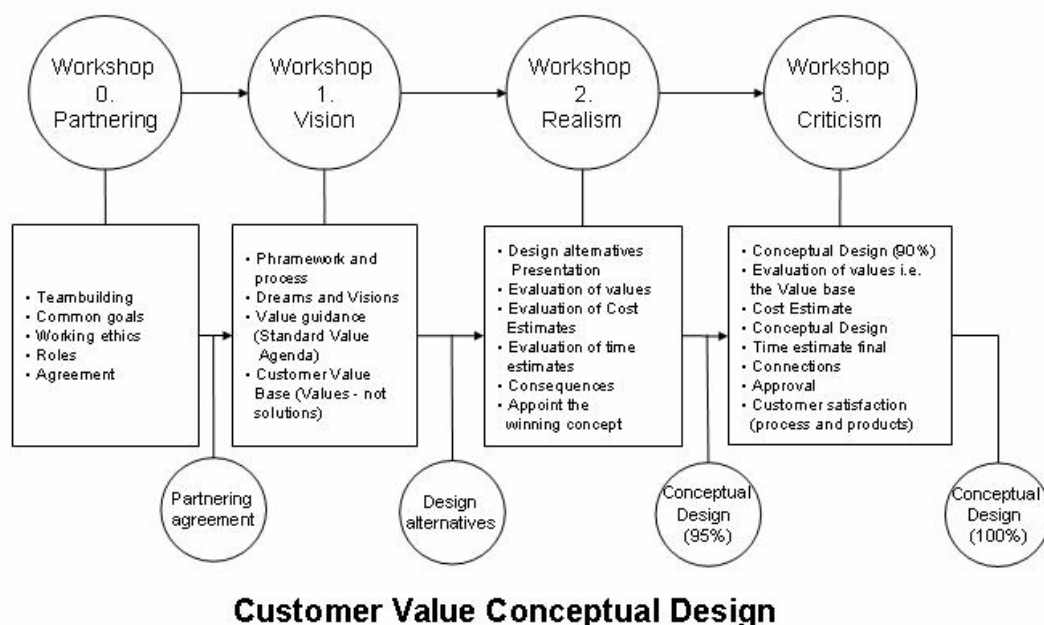


Figure 1. Creative workshop model (Value design phase)

Workshops are seen as ‘value generators’ (or value drivers) and are concerned with problem framing. Delivery of client value is achieved between the main workshops, where the problem solving takes place. Design alternatives are presented on the realism and criticism workshops reflects the client values. Project team meetings are used between the formal workshops to discuss and agree progress. The number of participants present in the meetings varies between projects and stages, however numbers typically range from between 15 and 30 people, although the organisational format can be changed to accommodate more people if necessary by dividing into sub-groups. It is a ‘demand’ of the project philosophy that the entire panel of participants is in place from the start to the finish. Using the journey metaphor the design and construction process is a change process (and a learning process as well), driven by the workshops. A standard value

agenda is used as a framework for decision-making in the workshops. The ‘basic value structure for buildings’ is based on the six key areas of value; Beauty; Functionality; Durability; Suitability (for the site and the community); Sustainability (respect for the environment); and Buildability. This value hierarchy addresses the primary project objectives and breaks them down into further sub-objectives as part of an iterative process carried out within the workshops. Each area is explored until the value parameters have been mutually agreed through the use of the Value Tree. Tools like quality function deployment (QFD) can also be used to weight options (values) in a decision matrix to help find the solution that provides the best value. A process facilitator guides participants through the discussion of values in a systematic and objective way.

VALUE DESIGN

Customer Needs

In this phase the client is ‘alone’ in making their first thoughts of the project needs. Here it is important to address the client organisation and make a stakeholder analysis, in order to map the interests in the project. In this phase, the basic values of the client organisation can be mapped, together with the contractual framework represented as time and cost budgets. This mapping helps to form the basis of a value-based design brief.

Contact

Here the client takes contact to the delivery system in the way that reflects the preferred basic organisation of the project. From a value perspective it is preferable that all stakeholders (including representatives from the owner, the user, the operation and management organisation, the society – typically represented by the authorities) are present and that all competences in the delivery system (architects, engineers, contractors and suppliers) are also present – but of course seen in the context of the actual project.

Workshop 0: (Partnering) Building effective relationships

The function of the preliminary workshop is to bring various actors together to engage in socialising and teambuilding activities. The intention is to build the communication structures, the system architecture for the project, thus allowing actors to engage in open and effective communication during the life of the project, the architectural dialogue. In addition to setting the stage for the events that follow the ‘outcome’ of the first workshop is the signing of a partnering agreement between the participants. This confirms the process values for cooperation on the project.

Concept

Client need (represented with all chosen stakeholders) is specified and formulated into a basic value document. This document is a specification of client needs, not solutions. The conceptual design shall then seek to reflect these needs. All actors are influenced and equally interdependent on others for the realisation of tasks and projects within the temporary social arrangement of the project. Interconnectivity places additional pressures on the ability to communicate and share information and knowledge. Interpersonal communication, intra-organisational and inter-organisational communication is particularly pertinent to the establishment of an effective project communication network, and also for enabling learning to take place within the project, helping to improve the end value on this and subsequent projects.

Workshop 1: Vision

This workshop is concerned with discussion of basic product values and the establishment of product value parameters. It is not possible to know the values in depth at the start of a project, so workshops are primarily concerned with exploring values and establishing a common vision. Knowledge and experience from other projects is brought into the workshop, for example facilities management values to better inform the whole life approach to design and construction. The main focus of the effort is the establishment of client values (value-based parameters); on the basis that the better these are known the better the team can deliver. Collective dialogue helps to explore and develop relationships that can (or conversely cannot) develop into effective and efficient working alliances, essentially the preparation for the construction of efficient communication networks. Critical connections between decision-making are explored so that everyone is certain before going into production, thus reducing downstream uncertainty. The result of Workshop 1 is the establishment of basic values for the project; a very pragmatic document that does not contain any drawings. These values are prioritised.

Workshop 2: Realism

Workshop 2 aims to discuss how the basic project values may be fulfilled by presenting various design alternatives that reflect how they meet the basic value parameters, while at the same time addressing the contractual framework of the project – time and cost. Project economy is consequently introduced here along with restraints imposed by, for example, authorities and relevant codes. A number of alternative proposals are worked through and ranked according to value. Architects are encouraged to produce at least three schemes that can be presented and discussed at the workshop. During the realism phase normally at least two to three workshops are required, simply because there is a lot of material to work through. The basic project values and project economy are respected in this process and any changes justified within the value parameters. The outcome of the realism phase is the selection of the ‘best suited’ proposal.

Workshop 3: Criticism

This workshop(s) is designed to criticise the proposed design solution chosen in the previous workshop. The solution is criticised; is it really the ‘best’ solution? Could it be ‘better’? Detailed discussion is centred on the chosen solution and its improvement within the value parameters. Uncertainty and urgency is high on the agenda prior to the scheme entering the production phases. Client (stakeholders) satisfaction with the process value and the product value is measured on the base of the partnering agreement and the basic product value parameters. Then the project is approved for production and the contractual delivery specifications fixed.

TRANSFORMATION FROM VALUE DESIGN TO VALUE DELIVERY

Contract

This transformation (signing of the contract) is executed when the Value Design work is complete, i.e. when the mental phase of the stakeholders and the delivery team participants has evolved to a stage where everybody agrees that no more/no better value can come out of the project, or alternatively when no more time is available. The focus

changes from value design to value delivery where minimising waste in the delivery process is essential and value engineering activities are executed.

VALUE DELIVERY

Value Delivery comprises the final (detail) design and the construction of the project introducing ‘production thinking’ as well as the knowledge and experience from using (consuming) the building.

Construction

In this phase production of the agreed project is the focus, and the client plays a less active role. A lot of decision making still remains related to production activities, which are dealt with by the main contractor, working closely with the sub-contractors. The client role (supported by professional advisors) is to deliver detailed decisions as scheduled and to check that the specified value is delivered. Client and delivery team common process values (partnering values) are primarily concentrated on fulfilling contractual terms (time, cost, quality and accidents rates etc.) but of course still with respect to the ‘soft’ process values agreed earlier. Internal values of the organisations and persons working together in the delivery team are used to achieve a common focus when working on project delivery. In order to achieve an optimal communication between the participants in the delivery team, a series of production workshops is executed focusing on waste reduction in the process as well as in the product by value engineering activities and by introducing logistical tools, e.g. last planner. The production workshops are:

Workshop 4: Design planning

In this model it is here that there is a shift in thinking, as the more abstract work turns into production information. Values are concerned with delivery. The designers, contractor and sub-contractors interface most here as value management techniques turn more toward value engineering and a process management tool, Last Planner in a modified version, is introduced to help guide the planning of the process and results in a process layout of the design process similar to the process plan in construction. This approach was taken for the first time on the DELTA project and deemed a successful innovation it was used on NIRAS’ project for additional office space in their Allerød headquarters and in MTHøjgaard’s Gefion project in Frederikssund.

Workshop 5: Buildability

Here the focus is on improving the constructability of the project, while trying to reduce waste in the detailed design and construction phases by having the designers and the foremen/craftsmen meet with this specific value in mind giving their input to improving the design or focus it on the competences of the actual production capability and capacity.

Workshop 6: Planning for execution

These workshops involve interaction between the main contractor and the sub-contractors. A process plan is produced that helps to map the various production activities and help identify missing information. Information flow is an important consideration at this stage in the workshop model. On completion of the construction schedule, in an ideal world, the information should be complete and there should be ‘no scope’ for uncertainty of the delivered value at the production phases.

Control

The Control activity represents the finalisation of the project ready to be handed over to the building owner and the users going into the Consume phase of the project. The Control is executed with two goals in mind. First, to check that the product is perfect without any errors: second, to check that the product fulfil the client value specification agreed upon when writing the product delivery contract.

Consume

This phase is not discussed in this paper, other than to note its importance for feedback into future projects. It consists of facility management and operational & management activities, which help to give the knowledge and input to the experience loop. This forms part of the Value Design process on the next project and forms part of the experiential learning/knowledge transfer between projects.

CONCLUDING COMMENTS

Improvements brought about by the model have been confirmed in an independent study carried out by the Danish Building Research Institute, which found improved performance across a whole range of performance parameters (By og Byg, 2004; SBI, 2005). The model provides a simple design management tool that employs a value-based approach and incorporates the lean thinking philosophy. The creative workshops encourage open communication and knowledge sharing while trying to respect and manage the chaotic nature of the design process. Cooperation, communication, experience and learning as a group contributing to the clarification and confirmation of project values. Further work is required to investigate the effectiveness of, for example, the workshop method in terms of the realisation of group goals. In particular, the role of the workshop method in promoting and delivering creative solutions would be a logical extension of the research. So too would some reflection on lean production systems thinking in the detailed design phase. It is the intention of the authors that ongoing pilot schemes will be researched in an objective manner in an attempt to measure the success of the approach outlined here. A new project ('Telefonvej') using the process model by NIRAS and MTHøjgaard will be independently monitored and evaluated.

References

- Ballard, G. (2000) *The last planner system*, PhD thesis, University of Birmingham, UK.
- Bertelsen, S; Fuhr Petersen, K and Davidsen, H (2002), *Bygherren som forandringsagent – på vej mod en ny byggekultur* (The Client as Agent for Changes – Towards a New Culture in Building), Byggecentrum, Denmark.
- Bertelsen, S. (2000) *The Habitat Handbook*, Danish Ministry of Industry and Commerce, Copenhagen.
- Buildinglogistics #1 (1993), NIRAS/Danish Ministry of Housing, Copenhagen.
- Buildinglogistics #2 (1994), NIRAS/Danish Ministry of Housing, Copenhagen.
- By og Byg (2004) *Evaluering af forsøg med trimmet projektering og trimmet byggeri*, Report number 421-047, Jan 2004, By og Byg, Statens Byggeforskningsinstitut, Hørsholm.
- Christoffersen, A. K. (2003a) 'Value control in the building process', presentation at the *LCI Congress*, Blacksburg, Virginia, 21.07.2003.

- Emmitt, S., Sander, D. and Christoffersen, A. K. (2004) 'Implementing value through lean design', *Proceedings of 12th Annual Conference on Lean Construction (IGLC)*, Helsingør, Denmark, pp. 361-374.
- Kelly, J. and Male, S. (1993) *Value Management in Design and Construction: the economic management of projects*, E & FN Spon.
- Koskela, L. (2000) *An exploration towards a production theory and its application to construction*, VTT, Espoo, Finland.
- SBi (2005) Journal no. 421-042, May, Hørsholm, Denmark.
- Womack, J.P., Jones, D.T., & Roos, D. (1991) *The Machine That Changed the World: the story of lean production*, Harper Business, New York.
- Womack, J., and Jones, D. (1996) *Lean Thinking: banish waste and create wealth in your corporation*, Simon & Schuster, New York.