THE CLIENT AS A COMPLEX SYSTEM

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ABSTRACT

Construction is a process of delivering value to the client through a temporary production system, which consists of elements shared with other projects. The completed work is a one-of-a-kind product assembled at a temporary production facility, the site. This is a very complex production system that has been studied extensively over a number of years. Some members of the International Group for Lean Construction (IGLC) have recently used the complexity point of view to try to understand this system and to create guidelines on how to better manage it. The production system is, however, only one part of the process.

The other part, and one worthy of more extensive investigation, is the client. The term 'client' tends to imply a person or a well-defined body of persons that act as a single entity. In the majority of projects this is not the case. The 'client' is a representative for a number of—often conflicting—values, interests and time perspectives. A closer look can reveal that the client is just as complex as the production system.

This paper examines the characteristics of the client as well as the customer-supplier relationship in the built environment, where a better understanding of client complexity may help to deliver value to a wider range of stakeholders.

KEYWORDS

Client, Complexity, Stakeholders interests, Value, Design

INTRODUCTION

Even though the construction industry is one of the most important sectors in most economies the nature of its production is very little investigated. Koskela (2000) presents a comprehensive theory for the nature of the construction process, something manufacturing industries have had for more than a hundred years. Koskela's understanding of construction is based on the same ideas as that for manufacturing, where the nature of production is seen from three viewpoints: A chain of transformations, a flow of work, and a generation of value for the customer. The work of Koskela identifies these three perspectives and uses them to better understand the construction process. Koskela also demonstrates how most construction management principles are based on the transformation perspective only (Koskela and Howell, 2002). On the other hand Bertelsen and Koskela (2002) report how the three perspectives can be used in practice to manage the construction process with a focus on managing flow through formalised process management. Emmitt et al (2004) report experiments in managing value generation through a design process that has as its basis the understanding of the construction as a complex system.

The complexity understanding of the construction process was introduced in the International Group for Lean Construction by Bertelsen (2002) and was further studied in Bertelsen (2003a and b) and has since then been a useful supplement to Koskela's theory in the understanding of construction management (Abdelhamid 2004). However, this new understanding of the construction process mainly looks at one half of the construction process—production.

Womack and Jones (1996) highlighted the objectives of lean production as maximizing value for the customer and minimizing activities that do not generate value, i.e. waste. This has

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proven an effective principle in practice but in the setting of construction it raises two questions—Who is the customer? And what is value?

Without understanding the customer, the concept of value is undefined, and without a tangible concept of value, waste is even more intangible.

The route to a leaner construction process should thus begin with a deeper understanding of the nature of the customer—or more precisely the client, but surprisingly this has not been the case. Of approximately 400 papers presented at the twelve annual IGLC conferences none has dealt in depth with this half of the construction process and less than a dozen have looked at the value aspect.

Thus this paper addresses these questions—hitherto unexplored in relation to construction:

- Who is the client?
- How may the client value be understood?

We argue that even though the term "client" appears to indicate a single person or a well defined group of persons or an entity, each client is naturally a very complex system[3]. The construction production system may be complex, but the client is even more so, and this may be a major cause of much of the complexity in the construction process.

The paper begins with a brief discussion of the nature of the client. It then reviews the nature of complex systems and their behavioural characteristics and along the way comments on client behaviour from these perspectives.

THE NATURE OF THE CLIENT AND CLIENT VALUE

Most construction organisations tend to take it as a given that the client is a well defined entity and that this entity has some very clear and well defined value parameters, which can be expressed in clear terms at the outset of the design process.[4] In practice the 'client' is a rather complex phenomenon—true the client's representative may be one or two people, but they are no more than representatives charged with doing a job—rarely are they themselves the investors, owners and users of the building. This makes the capture and communication of 'client value' particularly difficult to achieve in practice. A small number of textbooks have addressed the client briefing stage, but they too tend to rely on relatively simple definitions of the client and/or holistic terminology and descriptions.

Looking closer at the nature of the client, one may identify behind the façade an organisation, which during the project execution should represent the interests of three distinct client groups—the owners, the users and society. These three groups of interest each value different things at different times in the life of the building. The predominant focus is on when the building is completed and taken into use, where the classic Vitruvian perspectives: firmitas (durability), Utilitas (usefulness) and Venustas (beauty) may be used as expression of the primary view of each of the three groups. But there exists also the perspective of the value of the building in the future or for future users, and the value while the building is being designed and erected—the often overlooked value associated with the construction process. Table 1 presents this system of value parameters with some examples of the kind of value.

To add to this complexity, value is a matter of personal opinion, which can and does change over time. Value can thus not be measured or expressed and communicated explicitly but must be learned and understood through a process, which can best be understood through a learning metaphor (Green, 1995). This gives rise to numerous wicked problems[5] during the construction process—not least during the initial design stages—which can be seen a symptom of the complexity of the process.

The prevailing understanding of construction as an *ordered* process is completely wrong. This misinterpretation may be the root-cause of the problems construction management meets again and again in practice. Bertelsen (2003a and b) discuss the view of the construction process, the construction production system and construction site cooperation as *complex*. Using the term 'emergent' often seen in complex systems literature one may argue that the construction process is an emergent phenomenon used by an emergent system in an emergent setting. This paper argues that it is a process for an emergent customer as well. In other words: the construction process is

3 This is true even when the client is a single family — the client is not just the family; there are local zoning/planning laws that bring in the local community at the very least and building codes that are part of the client too. Now scale that up to a factory, office, school, ….

4 In using the term value we need to conceptualise it differently for the three kinds of stakeholders. The owner obviously considers it of value that his investment is well protected, the users look more on the value of use, society looks for the aesthetic value mainly.

5 *Wicked problems* are problems without an objectively 'best' solution. A wicked problem can therefore be worked with infinitely but in most cases the work stops when time or money runs out—or when the participants loose their interest in the problem. (Simon, 1969)

Table 1: Examples of Value Perspective in Construction

	Owner	User	Society
Primary Vitruvian Perspective	Firmitas (durability)	Utilitas (usefulness)	Venustas (beauty)
During Construction	Respect for cost and time Errors and accidents	User involvement Schedule	Noise Dust Traffic hindrance
When finished	Capital value Cost of operation and maintenance Durability	Flexibility for initial use Indoor climate, lighting Looks, landscaping Safety	Architecture Compliance with surroundings Environmental aspects
In the Future	Long time investment	Flexibility for future use	Landmark Aging in beauty

the interplay between two very complex emergent and highly dynamic systems: the client and the construction process.

COMPLEX SYSTEMS

Even though the world has always been rich in complex systems, at least since the Renaissance, Western engineering and management has dealt with this world from a rational perspective only. Newton's mechanics was the basis for this understanding and reductionism showed its usefulness again and again—understanding the parts in detail gives a firm understanding of the whole.

It was not until the first half of the 20th century, when quantum mechanics emerged and called for a statistical approach to some parts of physics, that anyone challenged this approach in earnest and showed that there are systems that cannot be understood by looking at their details only. Around the same time it became clear that treating the world as a collection of linear systems, the approach in most sciences, might be a great mistake.

However, only a few had any concerns about this until the end of the century when the propagation of personal computers from the mid 1980s onwards started a revolution in thinking in a number of disciplines. Nonlinearity was no longer an issue for mathematicians but an easy matter of a few lines of code, and a new world opened up. Chaos (Lorentz 1972, 1993), fractals (Peigten 1986), strange attractors, self-organization and emergence became household terms. Gleick's very popular book *Chaos* (1987) opened the eyes of many, and the complexity approach spread into a large number of scientific fields.[6] Even with the growing popularity of complexity as evidenced in papers, reports and dissertations, there was no generally accepted textbook on the nature of complex systems. Well worth reading, Waldrop's accessible book *Complexity* (1992) is the most common reference, but we prefer the more systematic explanations found on the web pages of Lucas (2005) as our starting point in understanding complexity.

CHARACTERISTICS OF COMPLEX SYSTEMS

According to Lucas, complex systems are generally characterized by:

- Autonomous agents—that is elements that may act on their own
- Nonlinear relations—that is relations between the agents, which are not simple and linear but characterized by feed back loops
- Non-uniform parts (agents and relations)—that is that the agents as well as their relations are not the same all over the system

Do these characteristics apply to clients? Clients have many interests that they are trying to satisfy—in construction it is easy to recognize the autonomous agents in the many kinds of interest taken care of by the client. The concept of non-linearity may be new to many but in any practical setting this is the expression of the feed back loops, which are fundamental parts of our daily life. That the parties in the construction process in general—and in the case of the client in particular—are non-uniform goes along with above the understanding of the nature of the client. Thus it can be argued that the client is indeed a complex system.

Lucas (2005) lists 18 axioms about complex systems that include the above three. The remaining fifteen can be named as complex systems' behaviour and these fifteen can further be divided into three groups:

- **General behaviour of complex systems**: looking at the system's organisation

6 Indeed, the complexity digest reports more than fifty papers and articles *every week*

- **Evolutionary behaviour of complex systems**: looking at the system's learning and development
- **Connective behaviour of complex systems**: looking at the *relations* between the parts instead of the parts themselves—c.f. reductionism

Although Lucas' *Quantifying Complexity Theory* (2004) may be a more fruitful instrument for an analysis of complex systems (albeit also more difficult to apply) Lucas (2005) is used here for the first analyses of client complexity. Lucas (2004) should be considered for future work.

The Lucas (2005) axioms will be used in the following analysis of client complexity, where each subsection will be initiated by a brief quotation (in italics) from Lucas (2005).[7] The objective of the analysis is two-fold. First, to look at the client to see whether all or most of the characteristics can be found in a typical client system, second, to initiate a better explanation for the client's often irrational behaviour—as seen by construction professionals, which will initiate new ways to cooperate during projects.

GENERAL BEHAVIOUR OF COMPLEX SYSTEMS

In our review of the available literature we were unable to find any real attempt to understand the nature of the client, for example, his/her behaviour and his/her whims. As a direct reaction to this lack of relevant material we have confined our analysis in this section to that based on our combined experiences of construction projects. We hope that this, somewhat personal, reflection may help to shape some of the issues associated with client complexity. Readers experienced in dealing with construction clients are invited to reflect on their own experiences and add to the complexity characteristics. The objective is not only to prove that the typical construction client shows all the behaviours expected in a complex system but also to provide a way of understanding, often irrational, client behaviour.

Table 2 tabulates the general behavior of complex systems.

EVOLUTIONARY BEHAVIOUR OF COMPLEX SYSTEMS

Table 3 tabulates the general behavior of complex systems.

CONNECTIVE BEHAVIOUR OF COMPLEX SYSTEMS

Table 4 tabulates the connective behaviour of complex systems

CONCLUSION

Even though Lucas' statements about the behaviour of complex systems may not be complete it can be argued from the brief analysis above that the client in construction indeed should be seen as a complex system.

This brings us to the conclusion that as the client is a complex system, the client's often (apparently) irrational behaviour is to be expected.

There is, in our view, a need to engage in more scientific research into client complexity and the manner in which it colours the decision making process we know as the design and subsequent construction of buildings. We hope that this paper will go some way in starting appropriate debate and subsequent research projects. This process may lead us to:

- A new understanding of the client-construction system cooperation in the generation of value and how this cooperation should be organized
- A new understanding of the concept of partnering as a learning collaboration between the client and the construction team.
- A new point of view on the architectural competition as an instrument in forming partnerships because the architectural competition in its traditional format has as an underlying assumption that the client's value parameters can be expressed in a document and be interpreted by the architects without further dialogue.
- A new understanding of why the construction industry is not meeting client expectations or, rather, the reason the construction team often acts on their own understanding of what is value for the client
- A new approach to project management, where value management gets a place in its own right alongside contract management and production management as proposed by Bertelsen and Koskela (2003).

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7 For further studies the reader is invited to visit http://www.calresco.org/lucas/philos.htm (It is suggested that the reader substitute Lucas' term 'part' (or parts) by the term 'participant' (or participants)

Table 2: General behavior of complex systems

Lucas's axiom (Lucas 2005)	*Summary*	Comment
Non equilibrium	*The system operates far from equilibrium since it takes energy from its environment*	The construction client is a body of persons representing a broad and most often very dynamic group of stakeholders and in this the client brings new ideas into the process all the time. This group of people are in dialogue among themselves and with their constituency. This is both an iterative and a learning process not dissimilar from the design process And as the designers learn and communicate their ideas they influence the agenda and the dialogue within the client community.
Unpredictability	*The system is chaotically sensitive to its initial conditions*	If we understand design as a learning process, it is obvious that the client—from the construction team's point of view—must be unpredictable. You change your preferences along with your learning. Even more important is that small differences in the outset, say in one or a few of the participants' priorities or feelings may lead to a completely different outcome of the whole process.
Attractors	*The system has multiple dynamic attractors—it can be stable for a while, but not permanently.*	This characteristic may be hard to argue but as experienced project managers we have again and again seen that the design brief stabilizes itself, albeit for a shorter or longer period only, after which a search for new different preferences may break out again.
Phase changes	*The feedback may lead to sudden jumps to another (relatively stable) phase*	The above stable situation is often characterized having the client expressing one rather precise understanding of the project, but then all of a sudden we have seen him expressing a complete new set of ideas.
Instability	*Over the long term step changes or catastrophes occur.*	This is an interesting—and very important —point of Lucas. In complex systems breakdowns occur and very often learning follows. Some breakdowns may be large but most are small. Both authors have experienced clients who will not tolerate mistakes. The 'perfect' linear process was sought for and the briefing and conceptual design processes were executed in a very disciplined way. However, when the breakdown occurred later —and it did—it was much deeper than it would have been if small errors had established a learning system. Bak (1996) argues that such behaviour is an integral part of a complex system's nature and that errors in complex systems therefore should be seen as a vital part of the system's learning and thus avoiding catastrophes. Essentially an argument for more open communication and trust between the actors, which should be brought into the design of a better client briefing—and client management—process.

Table 3: Evolutionary behaviour of Complex Systems

Lucas's axiom	*Summary*	Comment
Downward causation	*A system is made up of its parts—and the parts are affected by the emergent properties of the whole system*	Any client system has a number of sub-clients representing different interests and these sub-clients change their behaviour/requirements as the process progresses: they learn during the process from their dialogue with the other sub-clients and construction professionals.
Co-evolution	*The parts may evolve in conjunction with each other in order to fit into a wider system*	It is often seen, and experienced by both authors, that bringing the different sub-clients together for the purpose of the project may lead to evolution as participants learn about each other. They are essentially a group to serve a common purpose and the project may, if properly conducted, help to bring about mutual understanding and the evolution of group goals. A point explored more fully in Emmitt & Gorse (2003).
Mutability	*Random internal changes may occur in the system*	This is what we should expect whenever dealing with a group of humans. They change their mind and often as a phase transition between two otherwise stable states.
Self reproduction	*The system can replicate itself*	This point deals with the phenomena that we often copy behaviour and operating methods from each other. But it also deals with the fact that a successful client organisation may be copied in the next project just as the project organization may be. However, this not a sure way to another success because of the system's general unpredictability through its sensitiveness to initial conditions, where small differences do not stay small.
Self modification	*Parts can change their associations or connectivity freely*	Our client is a representative of a number of stakeholders and these stakeholders are not just a group of individuals but a network, which along with the process changes its behaviour.

Table 4: Connective Behaviour of Complex Systems

Lucas's axiom	*Summary*	Comment
Emergence	*System properties are higher level meta-systemic functions of the system*	When dealing with construction clients and understanding the client as a system of sub-clients it is often seen that the interaction of these parts generates the system behaviour just as much as the sum of the individual participants. A heterogeneous group of stakeholders often acts differently from the way they would have behaved on their own
Non standard	*The system is heterogeneous and allows varying associations over time*	Just one brief look back at the nine-perspective model of the client (Table 1—three groups of interest in each of three time frames) shows clearly that this characteristic may apply to the client. The groups' conceptualisation of value and their priorities are different and may often be in conflict but may also at some points be shared for a while, e.g the common interest by the owner and the user in keeping the project on time and budget.
Undefined values	*The meaning of the system's interface with its environment is not specified at the outset*	This characteristic is interesting in looking at the client. The client as the person or the group of persons making the formal decisions may have explicit values but in their interaction with the stakeholders and environment their values may change quite dramatically as the project develops. Public hearings and the general opinion make the role as client quite undefined when it comes to the issue of values for all the stakeholders that should be represented in the process. Indeed, one may argue here that the client value becomes an emergent phenomenon.
Fuzzy functions	*The overall function (purpose) of the system is co-evolved*	Even though the function of the client may be modelled in the nine perspectives matrix, the role to be played by this undefined agent in the construction process is rather unclear. He is the one to make decisions, but how will he operate in undertaking this role?
Fitness	*The distribution of choices can be modelled using the concept of fitness landscapes*	The concept of fitness landscapes is an interesting one in relation to the design process where the client plays his most important role, as it explains how development processes moves along towards an optimum—a peak—in the fitness landscape but also how the process can be stranded at local optima (Kauffman, 1993, 1995). This is an often seen phenomenon in construction—the client 'falls in love' with one particular solution, which may not be the best one for any other point of view than that the client likes it, which by the way goes nicely with the nature of value.

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