OPEN BUILDING/ LEAN CONSTRUCTION EVALUATION OF A CASE IN BRAZIL

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ABSTRACT

Open Building and Lean Construction are concepts that can be described in generic terms. Their practical applications depend on different circumstances, such as differences in culture, economy, project type and size, location, and moment in time. This paper explores the application of Open Building and Lean Construction in the Brazilian context. First the generic aspects of Open Building and Lean Construction are characterized as complementary concepts. Open Building aims to structure the process of constructing and managing the built environment along lines of decision-making, thus creating capacity for future change. Lean Construction aims to reduce waste by focusing on creating value for the customer.
A building project typical for the Brazilian construction industry is analyzed. Per project different clients can be identified, all demanding their specific values to be created. For example, the investor is the contractor's client, whereas the end user is the client of the investor.

An Open Building inspired breakdown of the process and building costs suggests that the base building can be built for 57% of the total construction costs. Decisions about the remaining part can be postponed, thus saving on interest costs and can be built according to the end user's demands, thus saving on reworks.

In the final analysis the paper suggests to identify different Lean Construction inspired values that can be connected to different Open Building inspired decision-making parties. They in turn connect to sets of building parts, such as base building, fit out and furniture.

KEY WORDS

Open building, Chain of value for clients, Conversion, Behavior, Future value, Complexity.

INTRODUCTION

Open Building and Lean Construction are strategies that can complement each other. They both have their origins in the Fifties of the twentieth century; they reacted to the deficits of mass production and are both third wave strategies. According to Toffler (1980) every society passes different stages. The first wave is the agricultural society, the second wave is the industrial society and the third wave is the information society. Characteristic to the second wave is that it generates mass solutions for mass problems. In manufacturing it resulted in mass production of many goods, the car industry being the most prominent example. Mass housing was the construction equivalent of the second wave. In post war Europe there was a great demand for housing accommodation. Experiences of mass production, refined by the war industry, were applied to housing production. Little attention was given to the quality of the built environment; the emphasis was on quantity of dwelling units, rather than their quality.

In 'Supports, an alternative for mass housing', Habraken (1961) observed 'that the natural relationship between user and built environment was broken' and expressed his concerns about the well-being of its inhabitants, because they had lost the control of own territory. He proposed a three tier building process separating the urban fabric form the base buildings ('supports') and the base

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buildings with empty shells from its fit outs ('infill'). This would create conditions for the user to control, decorate, look after, maintain and defend their domain. Since the levels of decision-making mentioned have their own dynamics and life cycles, this in turn creates conditions for unknown future change and adaptation.

The layered built environment reflected the levels of decision making in post war democracies. He gave guidelines how to design supports and infills, coordinated, yet separated by a system of dimensional and positional co-ordination. He laid the groundwork for what was later called Open Building.

Anywhere except in the Netherlands, modular co-ordination was applied as a means to streamline production. Habraken (1961) used it in order to separately design supports and infills. He was aware of its technical implications and he advocated separate industries for base buildings and fitting them out. Van Randen (1978) further explored the technical implications of separating support and infill. Every decision in the design and construction process will finally result in an activity of connecting parts on the building site. He coined this process of decision-making by many parties involved, 'the Spaghetti Effect'. If in the power game of parties, one piece it pulled, the whole plate begins to move.

He suggested that if the connections of parts 'the building node' are well structured in terms of dimension and position, the battleground of parties becomes more transparent, thus creating conditions for flow in construction.

Lean Construction is based on the Toyota Production System and thus has its origins in the Fifties as well. Rather than altruism, the need to survive in post war Japan forced Toyota to organize a flexible production process that banishes waste and creates value for the end user. Establishing market pull is reflected in Toffler's 'prosumer', the consumer producer that gives direction to service providers such as the manufacturing industry. In second wave mass production, products were made for anonymous clients and consequently consumers buy goods, made by anonymous producers. Toffler (1981 p. 277) suggests that the modern consumer contributes to the new goods and services as well by unpaid labour. The effects of the third wave prosumption present itself in the construction industry by DIY activities at the fit out level. If it is not a do-it-yourself activity, at least it is a decide-it-yourself activity as can be seen in the way kitchen and bathroom are fitted out according to the user's demands. In both DIY meanings work has been removed from the traditional investor driven contractors task towards consumer driven trades.

Open Building and Lean Construction are generic concepts. Their practical applications depend on different circumstances, such as differences in culture, economy, project type and size, location, and moment in time. Open Building and Lean Construction can be connected. The base building ('support') can be seen as one batch and the fit-out ('infill') as another. The values to be created are pulled by parties, belonging to the different levels of decision-making. The institutional client, such as a housing corporation or in this case the investor, 'pulls' the base building demands and the end user pulls the fit-out demands. De-coupling pulls reduces uncertainty,

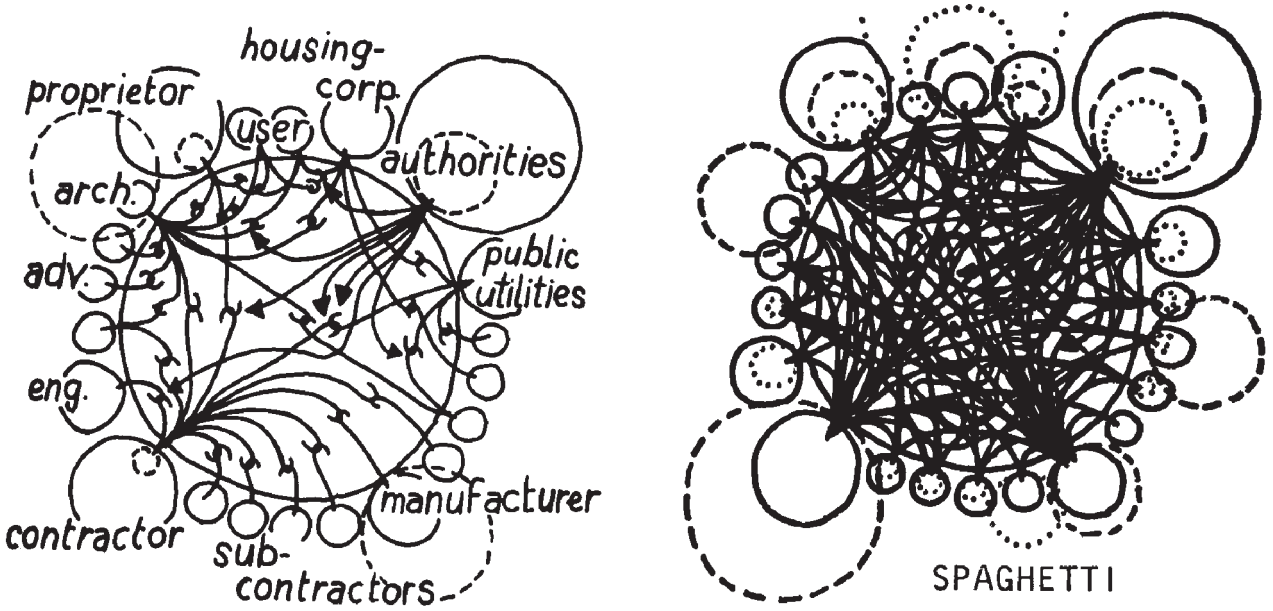

Figure 1: Van Randen's Spaghetti effect

therefore risks. The concepts of Open Building and Lean Construction are applied to analyze a Brazilian case.

DEFINITIONS IN THE BRAZILIAN CONTEXT

In order to set the focus on the Brazilian case, its special context needs to be discussed first. The construction industry by its nature has its own dynamics and it products are static by definition. The buildings in turn have to serve a dynamic market and an unknown future. Although this observation is valid anywhere, every culture, economy and climate has its special features. The construction industry in Brazil faces a set of negative indicators, such as an unstable economy, high inflation, decreasing exchange rate of the national currency (pegged to the US dollar) a high unemployment and a high crime rate. Although this may change in the future, these are constraints that have to be dealt with. The inertia of the construction process cannot serve such a volatile society; therefore new ways need to be explored.

Let us first define process and project and product, not only in the traditional way, but as a means to create value as well. Inspired by Dretske (1988), process can be seen as a series of actions that are performed in order to achieve a product or a particular result. The process finishes if and only if the product is done or a particular result is achieved. Thus, this definition includes construction as a special process. Like all processes it has a beginning and an end. All projects in this sense are processes of conversion to something better: they create value. A project is an enterprise, carefully planned, proposal scheme or design. In simple cases a process coincides with 'project'. However, in construction, it is not uncommon that a process includes a network of projects and subprojects, all with their own players, interests, aims and hidden agendas. All projects should create value. In terms of 'lean', this means that ideally value should be created in favor of the end user, since he picks up the bill. Traditionally a project has an aim (projected value), resulting in a product. Third wave projects include a multitude of products that create value in new combinations. (Figure 2).

The process of constructing projects involves many parties, all with their specific roll and interests. This can easily evolve in an unpredictable Spaghetti of interests. The institutional investor is the client of the construction partners. The end users, buyers or tenants are the investor's clients. Value needs to be created for the client, who is interested in a quick turn over of the new property. If a seller's market turns into a buyer's market, a quick turn over becomes uncertain. In that case the created value should be attractive to the end user. This can conflict with the client-desired value in a profitable seller's market. The spaghetti of forces at work gets even more complex by changing values under way.

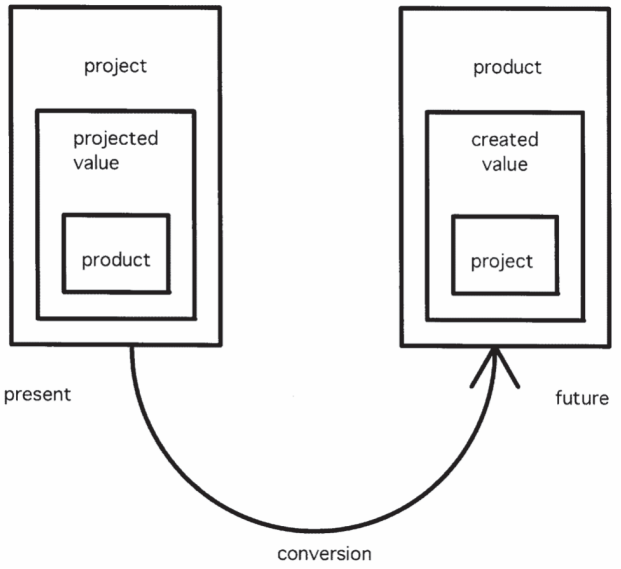

Figure 2: The process of construction

In traditional construction we are used to focusing our attention on completing the project. Lean production teaches us that we have to tailor our activities to the user, in order to banish waste. Construction is more complex than production, because there are more parties who have a supplier—user relationship, thus introducing different, sometimes conflicting ideas about value. But who is the end user? Is it the first buyer or the future buyer after the value of real estate has increased? The future owner does not appear in the spaghetti of interests, but other parties do.

This means that the project must satisfy or attend different meanings of value. If we look at Table 1 we will see these different meanings of

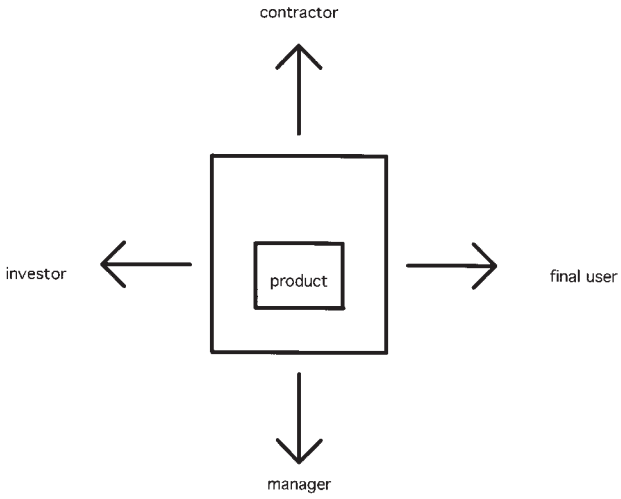

Figure 3: Conflicting value perceptions

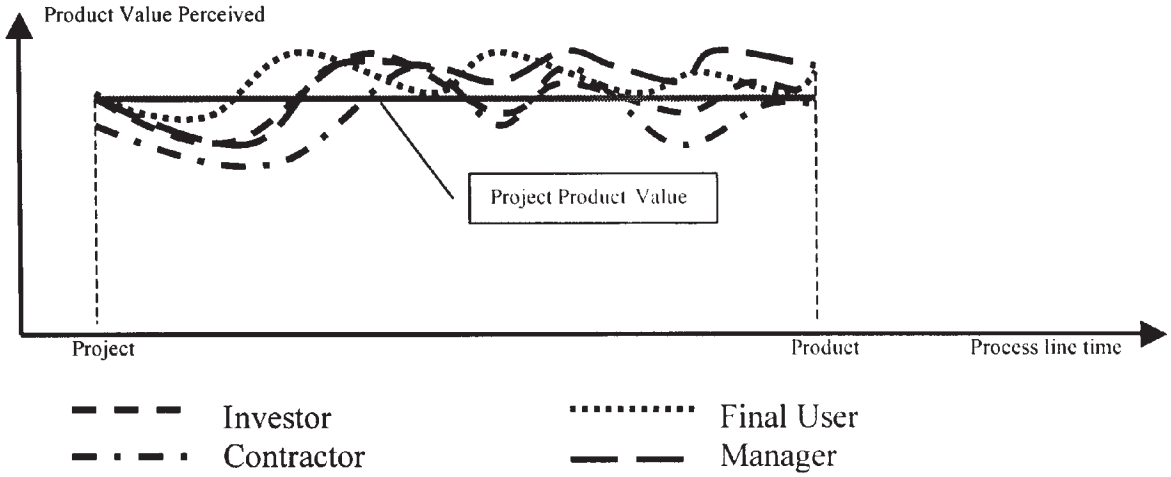

Figure 4: Project and product value

value perceived by the main parties of the project. These different perceptions in turn can conflict with each other.

Table 1: party and value

Party	Value
Client	Profitability, low risk, quick turn over
Manager	Reduction of interference, reliable indicators to feedback and feed forward, keep the flow in line with the different perceptions of value
Contractor	Profitability, low dependency to other contractors, high flow in authorizations allowing him to complete his task
Final User	High optimalization and utilization of the space according to his needs, market prices

The volatile Brazilian construction context makes it hard to accomplish all values mentioned at the same time in the same project. Obviously we are trying to achieve different possibly conflicting values, by streamlining one process. This will serve one value only or a compromise on all. Neither of these options is lean.

The construction of the apartment building, which is used as a case to develop these thoughts, took a different approach. Instead of tuning process to value, it was decided to translate conflicting values in specifications for the product. If all parties concerned (from investor to dweller) see their needs satisfied in the specifications of the product, we then can design the process and let it flow. A bunch of in time fluctuating value expectations cannot be managed satisfactory, however if is there is agreement on the end terms, there is a straight reference to optimize the flow of the process (Figure 4).

When the client's demands were clear and fixed it was easy to determine the process to make a project into the final product.

Recent experiences in Brazil demonstrated that a lot of wasted effort is required to readjust the process to changing demands, while the process is underway.

At the start of the project it was felt that the quickly changing economics of Brazil could change the housing demand, thus the specifications of the project. In other words, the client's perception of value could change overnight. Under these new circumstances, the traditional method from project through process to product with fixed values does not work anymore. Instead of following changing and conflicting values, values were created that can serve changing demands. This was quantified with indicators that show chasing changing values wastes a lot of energy, while open-ended values can be reached in a straight line. It was noted that the extra energy was not even applied to transforming the product let alone adding value, it was wasted on adjusting the process to changing circumstances only.

In this example, energy was considered to be the total effort to complete the process. It includes financial, technical and behavioral resources and their interactions (Figure 5).

Creating new controls and indicators in order to keep pace with changing values add to the complexity of the construction process, asking for yet more controls and indicators. It has become a vicious circle that spins out of control. It has the characteristics of the Principle of Incompatibility: 'As the complexity of a system increases, our ability to make precise and significant statements about its behavior diminishes until a threshold is reached beyond which precision and significance (or relevance) become almost mutually exclusive

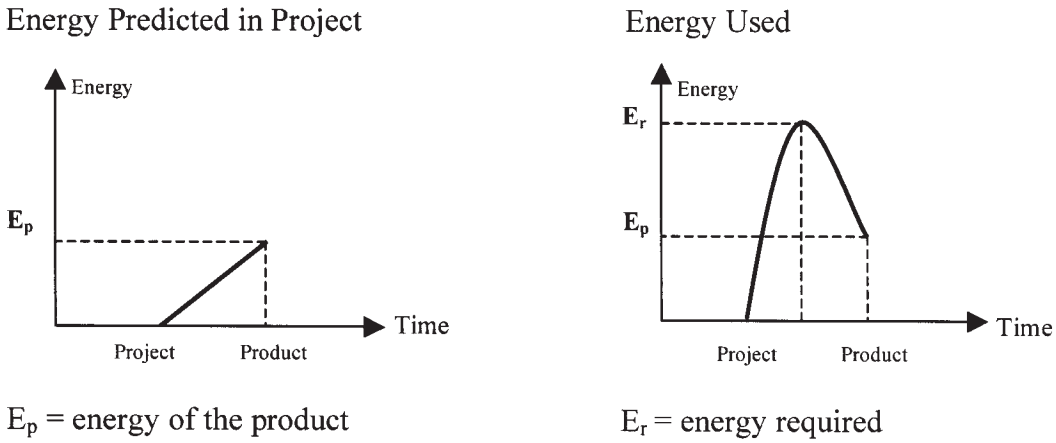

Figure 5: E_p = energy of the product, E_r = energy required

characteristics (...)' (Kozko 1994). A corollary principle may be stated succinctly as, 'The closer one looks at a real problem, the fuzzier becomes its solution.' (Zadeh 1965).

A BRAZILIAN CASE

Traditionally, the product cannot handle new client values if they do not fit within the values predicted from the outset. And if they don't fit, misfits can be solved with small modifications. However, they do not address the problem of constant change and cannot be more than cosmetic only. This is illustrated by a project in Brazil that failed. Six years ago, investors decided to develop an apartment building with 120 m2 two room units on an upmarket location in Sao Paulo, targeting at the newly rich young urban professionals. When the dot-com market collapsed, the demand disappeared and the units were too expensive for clients looking for a two-room apartment. Since the units could not easily be converted to three or four room apartments, the investors had to take considerable losses.

When the development of two new apartment buildings was initiated, we had learned from the example mentioned. The parties involved were extremely worried about the unpredictability of the market and the dynamics of client's perception of value. It was then decided to take a different course. We learned that creating unwanted value and then try to talk clients into it does not work. We therefore had to design a project that can adapt to changing values. This is an intelligent project, in terms of intelligent systems based on fuzzy logic, systems that learn and change according to new values.

The new project was inspired by the concept of Open Building. Building parts with different life cycles and belonging to different decision making parties should be decoupled, yet coordinated. In this case the fit-out of the apartments were technically decoupled from the base building, by mounting all ducts and services under the structural floor, above a false ceiling. Initially it was thought to fit out the apartments after they were sold. However, the investors did not like the idea, having to sell unfinished apartments. Therefore they demanded to have the unsold apartments finished anyway. Decoupling the load bearing construction and fit-out turned out to be a strong selling point, when the apartments were finally sold. They could be modified according to the demands of the new dwellers at 20% of the usual costs of adaptation.

CONCLUSION

Lean Construction and Open Building are generic Third Wave concepts that can be applied wherever and whenever relevant. These concepts are based on the appreciation of the complexity of the construction process, caused by many stakeholders and decision-making parties who relate to each other in spaghetti like network. Open Building has made the importance of control over one's territory explicit, Lean Construction describes the objective of the construction process in terms of creating value. Cross-fertilization of these concepts help us to understand how we can deal with different and shifting values as the aim of the same process. Desired values on the urban fabric level, the level of the base building and the fit out quite likely differ. Simultaneously they serve different parties: the community, the institutional client and the citizen/end user, with their different time scopes. In the final analysis, all decisions and actions result in connecting parts. If we can control (decouple yet co-ordinate) these connections in terms of position, dimension and interface, we cannot only free the different levels of decision making from interference, but also different disci-

plines. We can identify different values of different parties and can connect them to a group of building parts, such as base building and fit-out. This is the theory. In the Brazilian case it got a hands on interpretation and it has resulted in a profitable projects, for the investor, the contractor and the owners as well. In the Brazilian case it got a hands on interpretation and it has resulted in a profitable projects, for the investor, the contractor and the owners as well. But what is new and what can we learn? In 1914 Le Corbusier developed the Dom-ino house for rebuilding the destroyed villages on the battlefields of Northern France. It was a system of columns and slabs, to be finished with additional systems (Leupen 2002). Very much Second Wave: a mass solution for a mass problem, and not 'lean': it optimized on the process rather than on the use of the product, the value for the end user. Not 'open' either: it was a sub division along the lines of technical systems, not along lines of decision-making. It is fair to say that the Brazilian case is not the ultimate in terms of Lean Construction or Open Building. It nevertheless shows how these concepts can be applied low key, thus leading the way for future projects.

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