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AUTOPOIETIC ORGANIZATION OF FIRM: AN ILLUSTRATION FOR THE CONSTRUCTION INDUSTRY

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Generally poor productivity, delays, low profitability and exceeded budgets are Common problems in modern construction management, however it seems that a basic obstacle lies far deeper in the understanding of a firm's fundamental mission, its existence. The main objective of this paper therefore is to examine the operational living of a construction firm and by doing that to reveal the key problem or the solution for a construction firm – its organization. A firm as a social system in which interactions between its constitutive components (employees) are surordinated to its maintenance (keeping a system alive) is an autopoietic social system. Two domains of external perturbations are uncovered to which a construction firm has to adapt (market driven and project driven perturbations). Constructed conceptual model of an autopoietic organization is based upon two necessary and sufficient operational domains that a firm has to create in order to become an autopoietic, adaptive social system. The first one is a domain of interactions between employees and other operationally external systems, which is representing an idea-generating domain of interactions. The second is employee's autonomous operational domain, which embodies employee's autonomy and individuality and represents a necessary condition for the establishment of an idea-generating domain. Finally, it is recognized that interactions within these four domains keep a construction firm alive.

Keywords: autopoiesis, learning organization, complex system

INTRODUCTION

The construction industry is facing multidimensional difficulties encountered while dealing with projects. Those difficulties have been thoroughly examined and well defined (Oglesby *et al.* 1989, Laufer 1982, Borcherding 1975,1980, Thomas 1987, 1990, Horner 1995):

- stagnating productivity in comparison to other industries
- the duration and budget are often exceeded
- poor organizational climate
- low profitability
- vulnerability to environmental changes; etc.

Most of the studies touch only the surface of the problems by studying only the consequences like delays, disruptions and poor productivity. With other words, they examine some particular projects and state general conclusions about the problems of the industry through a statistical evaluation of the obtained data. Still, some others are trying to model productivity and understand the ubiquitous complexity. There is no doubt that environmental changes (market and technology related) influence our every

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day activities but the construction industry is somehow not keeping up with them (Oglesby *et al.* 1989, Arditi *et al.* 2000). The present organizational behaviour within the construction industry is in a way diminishing the process of structural coupling with the environment (Love *et al.* 2000).In order to enhance the ability of the industry to compensate mentioned external perturbations and improve its performance we have to understand the nature of construction firms, their organization and be able to answer the following general questions:

- What is a firm?
- What keeps a firm alive?

The general objective of this paper is hence to present a new concept for better understanding of the organizational behaviour that can help us better cope the above difficulties. The assumption on which this work is based is that improper organizational behaviour represents the fundamental source of managerial problems and diminish our capabilities to enhance the industry's performance. In order to realize how can we get the most out of our organizations, we need to understand what are the relations that make them alive and maintain their external adaptability. Another hindrance that struck me recently is whether managers and hence construction firms want any changes at all. Despite all warnings from the academia nothing has really significantly improved in the last few decades. Two explanations can give answer to that. Either have we not been on the right track or we are facing a pure ignorance of the industry. And that is also another important reason why this paper is chosing an alternative way and tries to explain the most fundamental notion - firm's organization because it seems to be completely ignored.

ORGANIZATION

The general literature on management is using word *organization* but dooes not provide any clear definition. Three significant milestones designate the epistemological development of organization theory (Kast and Rosenzweig 1985, Pfeffer 1982):

- Classical theory of organization
- Behavioural and management science
- Systems and contingency theory

There is still no consensus over the scope of organization theory (Kast and Rosenzweig 1985), nevertheless some argue that organization is a function of human perception, recognizing our position in the world as observes (Gerloff 1985). Gerloff goes further in recognizing relations (rules, reporting relationships, procedural requirements, etc.) as the indicators of organization. The research in this area is in essence interfering with many different scientific disciplines like behavioural sciences (anthropology, psychology, sociology), social sciences (economics, political science and history), mathematics and statistics. While some scientists were interested in motivation of individuals and groups (Herzberg 1969, Maslow 1968, Mcgregor 1960), others were more prone to investigate the concept of organizational structures. Still others were concerned with structural changes within organizations, relations between strategy and size and so on (*see* Meindl, Stubbart and Porac 1996, Donaldson 1995). Nevertheless, the phenomena of an organization and its structural modifications are still nebulous. Proper understanding of these phenomena is indispensable, if we want to help the construction industry to improve its overall performance.

The idea for creating proposed theoretical foundations of organizational maintenance for construction firms is based on a theory of the organization of the living (Maturana and Varela 1972). They defined living systems as autopoietic machines that maintain their fundamental variable, their organization, constant. Furthermore, they define organization as a group of relations between components that define a system as a system of a particular kind. Hence, the presented organizational concept hypothesize that every firm (this is a general proposition) is a living social system, which interacts within its operational domain in the environment in which it exists.

Autopoiesis

The living system is defined as an autopoietic (*poiesis* = creation, production) machine (Maturana and Varela 1972):

> *" An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transormation and destruction) of components that produced the components which:*
>
> *(a) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them*
>
> *(b) constitute it (the machine) as a concrete unity in the space in which they (the components) exist by specifying the topological domain of its realization as such a network."*

Therefore, a network of processes of production of components from the above definition represents *autopoiesis* of the living system. It could also be defined as a self-maintaining, self-referring and circular organization but as the inventors of autopoiesis argue, such language does not permit us to state anything new. Autopoietic machines are homeostatic machines because they maintain their fundamental variable (their organization) constant (Maturana and Varela 1972). The opposites of the autopoietic machines are the allopoietic machines, which organization is also defined by the interdependent processes, however these are not producing the components that specify them as unities. The components of allopoietic machines are produced by some processes that are independent from the machine's organization, hence these processses are not maintaining the machine's organization. Machines in factories are allopoietic because they are produced by some other machines that are independent from them and because they produce components that are independent from their organization. As the consequence of the autopoietic organization, the following characteristics are inherent for the living systems (Maturana and Varela 1972):

- Autonomy; living systems maintain their organization, hence all the changes and all the processes conducted by them are subordinated to the maintenance of their organization.
- Individuality; living systems have from observer independent identity, which is constantly preserved through the processes of production of their organization that they keep invariant.
- Unity; the living systems are unities because of their specific organization. They specify their own boundaries, which separate them from other unities and the medium in which they exist through the inherent processes of self-production. They also maintain their inherent identity, which is independent from the observer.

– No inputs and outputs; the living systems do not have inputs and outputs. All the internal structural changes that occur while interacting with the environment are subordinated to the maintenance of their organization. The interaction with the environment may however be viewed as inputs/outputs but this is only to our perception - observers' perception . Allopoietic machines can have inputs and outputs in form of processes, which are subordinated to something else than their own organization. They for instance produce something else, like a machine in a factory which output is a product that is not a part of its organization.

CONSTRUCTION FIRMS – AUTOPOIETIC SOCIAL SYSTEMS

The ideas presented in this paper are constructed upon the social inferences defined by Maturana (1972)[1]. If a coupling of employees (components) in a firm (a system) represents their participation in firm's realization, then it is appropriate to define the extent to which it entails the realization of employees' autopoiesis. It is suggested that a firm is a higher order autopoietic system. First, employees are human beings and as such autopoietic living systems, which maintain ther own organization, participate in the autopoiesis of their families and in the realization of a particular firm.Thus, the participation of employees in the realization of a particular firm should not diminish their and their families' autopoiesis. However, a firm needs employees for its realization and they need a firm for a maintenance of their own organization (their lives). That illustrates circular organization mentioned above. According to that, if a firm as a higher order autopoietic system is restricting employees by prescribing certain allowed relations, like it is happening in hierarchically departmentalized firms, then it is consequently diminishing their autopoietic participation in it. Such a firm is then much less adaptive to external changes because employees could not participate in the firm's autopoiesis.

In other words, these certain allowed relations limit employees' ability to participate in the process of adaptation to external perturbations which are then not subordinated to the maintenance of firm's organization. Social systems of that kind are peculiar social systems (Maturana and Varela 1972). Employees are partially realizing their autopoiesis through a firm in which they work. In this context Maturana (1972) has proposed that a collection of autopoietic systems that, through the realization of their autopoiesis, interact with each other constituting and integrating a system that operates as a medium in which they realize their autopoiesis, is indistinguishable from a natural social system. Hence, a firm, by realizing its employees' autopoiesis can be treated as a natural social system constituted and integrated by its employees. The interactions between employees, which determine their relations, constitute firm's organization. Therefore, a particular firm exists because it realizes each employee's autopoiesis, which is constitutive to the realization of a firm. Employees are members of a particular firm because through that they maintain their and their families' lives. This is in essence the main reason that firms exist at all. People work in firms because they earn salaries that they need in order to survive, so firms actually support their lives and that is why human beings have created them. However, as observes people may integrate several systems (composite unities) that are or are not natural social systems. The ones in which people are integrated through relations that do not involve their autopoiesis, are not natural social systems (Maturana 1972).

[1] The authors did not share the opinion on this matter, hence only Maturana's contribution is presented.

A firm's structure is defined through the properties of its employees and by the actual relations between them. The identity of a firm is hence a consequence of its employees' nature. Their individual properties determine the structure of a firm, which further determine firm's properties and these operate as a selective mechanism that determines their properties through the realization of their personal development in a firm. Therefore, employees in different firms exhibit various behavioural patterns that characterize each firm. An employee participates in the constitution of a particular firm only to the extent that realizes the relations proper to his work. This notion reveals an interesting implication. It means that an employee, if specialized for a certain work, will participate in the constitution of a firm only within a domain of that specialization. Further on, managers' efforts of gaining more "enthusiasm" and "loyalty" from their employees is meaningless, unless they involve employees in firm's overall life and abandon specialization (Torrington *et al.* 1998).

Employees are autopoietic living system and all their activities are directed towards satisfying their autopoiesis in a society (firm, family, etc.) by accepting and rejecting the external perturbations and by doing so they realize their individual worlds. Therefore, by operating in a social domain (by constituting a certain society), the actions of acceptance and rejection necessary affect the lives of other human beings. The basic ethical problem for an employee is, to what extent should she/he and her/his co-employees be "loyal" to a firm? In this manner an employee actually, to a certain extent, demands a surrender of autonomy and individuality from herself/himself and other co-employees. This is an interesting subject, which opens another question. Should managers surrender their autonomy and individuality for the sake of a firm in which they work before demanding that from their employees? It was stated before that human beings are autopoietic systems, which by accepting and rejecting external perturbations, while they integrate a society, necessary affect lives of other human beings. Therefore, managers as firm's driving force (Torrington *et al.* 1998) should be first who show "loyalty" to a firm in order to expect their employees to follow their paths and not vice versa. Which means that the whole autopoietic process should be started by its managers and conducted in a way that would allow employees to enhance their own autopoiesis. That is why more and more especially hi-tech firms involve their employees in sharing profits and spreading responsibilities. Such employees then further enhance firms' organization because they know that by doing so they can improve their own lives(Shingo 1988, Love *et al.* 2000).

The cultural condition of a firm is determined by the properties of their components (employees). If the properties of the components change, then the firm could follow two paths:

- Change of system's properties without changing its organization (a system follows changed properties of their components through internal structural changes)
- A system disintegrates and becomes something else (changed components re-integrate a system in a different manner or uncouple from it)

It follows that a firm as a social system can change its structure and hence the properties only if the properties of employees change, which can be started only by external perturbations. Hence, a firm can change its behaviour and reorganize itself only if employees change their attitude, which can happen only through the external influence.

Members of a particular social system should satisfy certain relations regardless their wish so or not. Employees, by being members of a particular firm are there to work

whether they wish so, at a certain moment, or not. Consequently, employees sometimes hide certain properties in order to avoid stressful situations. If they want to change firm's overall performance, they should not act because of stress they are facing due to possibly poor results, but because they simply want cultural changes in a firm. Such changes, which maintain firm's organization invariant, also maintain its adaptability. By realizing its own organization firm's tendency is stability of internal relations, thus avoiding stressful situations. The consequence of the stabilizing process is a creation of an unfair climate, which can in addition be supported by employees themselves because they usually do not want to lose their positions or jobs. Therefore, they operate in a way that slows down any process of interactions between a firm and the environment that may generate changes in their work (Torrington *et al.* 1998).

A firm is defined by the relations, which define it as a firm of a particular kind. These relations in it are in agreement with the interactions between employees. If an individual, which integrates a firm, behaves in a manner, which is different from the relations in it, then this employee in the eyes of an observer does not interact as a component of a firm. They can interact in this manner only if these interactions are operationally outside a firm. If the stabilizing processes are allowed, then there is no room for such employees because their new ideas are not contained within its domain of relations. Creativity of some individuals always comes operationally from outside a social system and necessary leads either, to the generation of behavioural changes in the system's defining relations, or disintegration of a creative individual from it (Maturana 1972).

Generally, any human being can be a participant of many different social systems and can behave, as an observer, operationally outside these systems. By doing that human being creates its individual perspective and may view its participation in them as contradictory. Therefore, observers are always operationally outside the observed social system and hence can always be potentially antisocial. Nevertheless, employees should always behave as observers of the present state in order to constantly adapt to external changes and maintain their firm's and hence own autopoiesis. If managers (and employees) are not aware of this then a firm is dealing with lagging, which may lead to a disintegration of a firm.

Employees become members of a particular firm when becoming structurally coupled to it, which happens through the behavioural acceptance of a firm. After, for instance, joining a firm, an employee has to accept the actual relations that hold within it. Firms are thus as explained earlier stabilizing the properties of their employees in order to match their actual relations. That necessary restricts the creativity of individuals through the restrictions of their possible interactions outside the prescribed ones. That however is very dangerous because it is a natural process of stabilization of every social system, which can cause a complete halt of new and fresh ideas outside of those prescribed by a social system. Hence, firms should favour creativity and abandon stabilization so that their employees would freely generate and incorporate fresh ideas. Another pitfall of stabilizing processes is that they have to do only with the stability of firms in the medium and not with their employees' living standard. They, however, might operate as observers and view the stability as contradictory to their actual living. But, as said before, the operational stability in the medium of existence is a natural process and any other path like changed strategies or structural changes are not spontaneous. These changes are not natural processes but a product of human and managers should be at most aware of this.

It was mentioned before that human beings have a capability to create their own perspectives from which they can validate the societies in which they operate and hence become observers. All societies are not equally desirable and therefore all firms have not equally satisfied employees. If employees define their perspective, from which the validation of their societies is maintained, then it might happen that some unsatisfied employees start to observe another possibly more desirable firms. They can lose many good and especially creative people, if they persist in incomprehensibility of their employees' antisocial behaviour. Every time, when employees become antisocial, there is a sign that something in a firm is not operating properly and should attain great interest of the management. Many large and rigid firms restrict the possibility for employees of becoming observers in two ways (Torrington *et al.* 1998):

- By specifying the tasks that the employees can be involved in ("*This is not of your concern!"* type of specifications).
- By uncoupling antisocial employees so that they either lose their positions or jobs, thus representing an example to other employees.

Finally, autopoietic firms are necessary non-hierarchical. All the employees are observers, who constantly validate firms and contribute to their overall development. Therefore, all the employees are operationally equivalent so the hierarchy does not apply. Every single human being is an observer, thus a potential creator of ideas, if firms do not restrict it of becoming so. Firms of that kind:

- Do not have word "antisocial" in their vocabularies (they view antisocial behaviour as a driving force, which maintains their organization intact).
- Are very dynamic (they are actually searching for people who bring changes from different environments).
- Are very desirable by employees (they make it possible for employees to fully integrate their capabilities in firm's operational living and are fully involved in the realization of employees' autopoiesis).
- Are highly adaptive (they are capable to transform external changes and turn them into their own benefit).
- Are positively accepted by the medium in which they exist (they are capable of fast reactions to external environmental perturbations, they can very rapidly respond to the demands).

Taken as a whole the discussed defining parameters of autopoietic social systems are the basis for subsequent analysis of the present organizational behaviour in the construction industry. The notions here can serve as benchmarking parallels revealing the shortcomings of the present organizational behaviour in the construction firms that cause poor productivity, low profitability and other problems in comparison to autopoietic social systems.

All activities of a construction firm lead towards a successful completion of projects because that keeps it alive. Thus, it is an autopoietic social system that is trying to keep its organization invariant while structurally coupling with the environment in which it exists. It is an adaptive system, more precisely defined as a higher order autopoietic system because it contains employees that are also living systems. Through a recursive point of view, the author distinguishes two sub-domains in a

domain of perturbations, which a construction firm as a social system can sustain without disintegration and experience in an every day life:

1. market driven perturbations
2. project driven perturbations

The two sub-domains are differentiated exclusively on the relation-driven basis. A market as the environment in which a construction firm exists consists of demands, which represent market's perturbative relations. While a firm is involved in a particular project, it is facing another type of perturbations, which arise from specific firm – client, type of relations. Firm's activities are therefore focussed in structurally adapting to those differing and sometimes contradictory perturbations without disintegration. The adaptability to external perturbations entirely depends on internal organizational structure of a firm, which is in present performed in many different modifications.

Market driven perturbations

Markets create all perturbations that are generated through relations between them and a particular construction firm. Economic fluctuations are very influential as industry's performance generally is concerned (Aghion *et al.*, 1998). Construction industry seems to be particularly sensible to market fluctuations. Market level perturbations may arise in varying forms as price changes, new governmental policies, decreases in demand, etc. The natural process of stabilization, which is limiting firm's adaptability towards changes causes lack of creativity that is so necessary for its adaptability. Further, Newcombe (1990) shows that construction firms' strategic changes are followed by internal structural adaptations. They are changing their structures in order to interact successively within certain mediums (markets: local, regional, international). If firm follows an expansion strategy (e.g. from a local to a regional), they would need to adjust their structures accordingly. This is revealing firms' ontogeny and adaptation to changes of the medium but not to changes in the medium in which they interact. Market driven perturbations are usually not so rapid and they are certainly not so volatile as the project driven perturbations. Nevertheless, they are much more dangerous, because of their persistency and possible catastrophic events.

Project driven perturbations

These perturbations actually develop when a particular firm is already involved in a project. Their generators are relations between a construction firm, client(s) and other involved parties, which constitute another social system (subcontrators, suppliers, etc.). The conflicting domain, which is spontaneously created in this level is the observers domain. All the components of different social systems involved are operating as observers of another social system, which necessary leads to the choice of acceptance or rejection of what is happening in involved social systems. This is a complex system of relations that generate interactions between the components of the same and other social systems and sometimes operating against the relations prescribed within the interacting social systems. While the components of a particular social system interact with the components of another social system they necessary open system's boundaries defined by internally prescribed relations. The outcome is sometimes a complete halt of interactions between the involved components from different or even the same social system, which is usually called a lack of communication (Oglesby *et al.*, 1989). Hence, creativity should actually be spontaneously generated by the interactions of different people from different firms.

The reality shows that construction firms usually restrict creativity and as a consequence the all mighty problems are still very much surrounding us.

Ususal argument is that often construction firms do not undergo a learning process (Oglesby *et al.*, 1989). By limiting creativity in the process of stabilization the firms define the domain of operations in which their components can interact between themselves and among other constituents of projects' realization. New ideas, no matter the potential value they may or may not have are hence not accepted. Just imagine a young engineer in a big construction firm that would like to implement few of his bright ideas. Nevertheless, a learning process can be treated as a process of accepting and creating new ideas, hence in contradictory to firm's prescribed relations. This vicious circle keeps construction industry well behind the manufacturing, software and other high-tech industries as idea-generating process is concerned. The driving force in all of them is creativity, a powerful outcome of releasing the restrictions prescribed by a firm. The creative ideas can operationally come only from outside the relations prescribed by a firm. It should, if trying to become an "idea-generating machine", abandon all the restrictions by constantly modifying its relations to the external perturbations, hence become highly adaptive complex social system.

CONCLUSIONS

There is no doubt, our main objective is to enhance the construction industry's performance. However, despite the enormous attempts in the literature the construction industry is still far behind the other industries as productivity, profitability and general performace is concerned. The main objective of this work is thus to express the long forgotten issue of organization that is by the author's opinion the main reason for the present situation in the construction industry. The two seemingly simple questions stated at the beginning and the answers given in the text show that it is at most important to unerstand the way our organizations operate. It was illustrated that a particular firm exists because it realizes its employees' autopoiesis. They are members of a particular firm because through that they maintain their and their families' lives. That is in essence the main reason for firms'existence in general and it should be clearly understood. Another interesting inference depicted from the text is that firm's structure and hence properties are defined exclusively by its employees' properties, which means that if managers want to achieve internal cultural and structural changes they first have to change their own attitude and all the rest will follow automatically. However, this may happen only by eliminating prescribed relations that may restrict their creativity, which brings desired cultural changes and by being aware of the natural process of stabilization. Creativity should be welcomed and not restricted because it falls outside prescribed relations.

Further on, it was demonstrated that construction firms deal with the two most significant domains of external perturbations,namely market level and project level perturbations. Their significance is exposed because they may be viewed as the potential source of creativity. First, markets determine firms' strategic and cultural changes, and second projects necessarily demand relations between employees of different firms, open their boundaries, and through that give opportunity to accept creative ideas.

It was far beyond the scope of this work to study the effects of the external market and project level perturbations, therefore they should be more closely and generally

examined in terms of relations of interactions in the future. Finally, it would be very interesting to study a course of internal cultural changes within different industries and compare them with the present situation in the construction industry.

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