

FORMALIZATION AS A WAY OF COORDINATION AND CONTROL IN A CONSTRUCTION FIRM

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ABSTRACT

The Construction Industry is characterized by intensive use of labour, low use of technology, many disciplines and participants involved; all these factors make the environment very uncertain. Uncertainty increases the amount of information to be processed and, in many occasions, overwhelms the firm's capacity to process information. A way to reduce the amount of information to be processed is Formalization that represents the rules in the organization to obtain standardized behaviour.

Our study on this paper is focused in the importance of formalization. This is a characteristic of the organizational structure of a firm, and can be used as a way of controlling and managing information. We stand that organizational design is a determining factor in the success of the implementation of new management philosophies. In particular, we study the case of a Large Peruvian Construction Firm, GyM, which is seen as a local benchmark of productivity and quality, being that in the last decade lean concepts have been implemented in its projects.

KEY WORDS

Organizational Structure, Formalization, Information flow management.

INTRODUCTION

The performance of a firm will be restricted by the characteristics of the environment and industry which it belongs. As known, construction is a "special" type of industry, it is characterized by low productivity, intensive use of labour, low use of technology and it involves many disciplines and many participants. All these facts make the environment very uncertain. Galbraith (1974) states that uncertainty, limits the ability of the firm to preplan, or make decisions about activities in advance their execution. Even more, he affirms that "*the greater the uncertainty of the task the greater the amount of information that has to be processed between decision makers during the execution of the task to get a given level of performance*".

Due to the great variability associated to a construction project, it is important to establish mechanisms of coordination and control for reducing the uncertainty that surround it. There are factors, in which the firm have little control, that increase uncertainty. For all the others the firm needs to identify its source in order to mitigate or eliminate their impact. Task uncertainty can arise from incomplete designs, suppliers, technology, environment and also from the same firm. For instance, when

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the organizational structure is not designed in accordance to the company needs or when it does not have rules and procedures clearly defined.

Formalization is a way to reach standardized behaviour; it can lead to low cost, product quality, and efficient operations. It represents the rules in the organization (Burton and Obel 1995).

Within this context this paper studies the importance of formalization, which is a characteristic of the organizational structure of a firm, as a way of controlling and managing information and in reducing uncertainty. We stand that organizational design is a determining factor in the success of the implementation of new management philosophies. In particular, we study the case of a Large Peruvian Construction Firm, GyM, which is seen as a local benchmark of productivity and quality, being that in the last decade lean concepts have been implemented in its projects.

METHODOLOGY

This paper is based on a literature review and a case study. The literary review is based on organizational structure and design from an information processing perspective. We study the case of a Large Construction Firm in Peru (GyM) that has been implementing lean concepts for a decade in all their Construction Projects. The idea was to study a firm which had implemented lean concepts in a formalized way and identify the factors that helped on the implementation.

The tools for studying the case study included casual interviews and observation of the firm. What also helped to understand how the firm worked was the fact that the research was done by an employee of the firm, who was familiar to its information flows. Burch et al. (1979) suggest that for studying and analyzing the information system in an organization, two types of information should be collected:

- General information: firm's size, organizational structure, and management philosophy. These characteristics are inherent to each organization and define their information requirements. This information was obtained through meetings with the CEO and the review of internal documents.
- Specific information related, exclusively, to the studied topic. In this case, we refer to the way the firm organizes its information and how formalization has helped in the implementation of new management philosophies. In this case, formalized documents and the fact that the researcher was a user of the system and had participated in more than one implementation of the Control Management Area helped to collect the information and understand how it worked.

LITERATURE REVIEW: ORGANIZATIONAL DESIGN: AN INFORMATION PROCESSING PERSPECTIVE

The idea of this item is to understand the importance of accurate flow of information for the decision-making process in a firm. Since the organizational structure determines this flow in the firm it is important to review some related concepts.

An organization is an information processing entity in which each member processes and transmits information in order to coordinate and control its activities. Its structure is the framework within its lines of authority and communications are arranged, and its rights and duties are allocated. It determines the manner and extent

to which roles, power, and responsibilities are delegated, controlled, and coordinated, and how information flows between levels of management. It depends entirely on the organization's objectives and the strategy chosen to achieve them².

The basis for organizational design is the goals and mission of the firm, the management and its style will select the strategy that will lead the firm to its goals. Stafford Beer proposes a design model based on a system approach: the Viable System Model (Espejo and Harnden 1989). He states that all organizations should be composed by subsystems, each having self-organizing and self-regulatory characteristics. According to Beer, each subsystem (or unit) must have five key systems in place to operate effectively in its environment: implementation, coordination, control, intelligence and policy. A viable system is one that can survive in a changing environment.

Galbraith (1974) affirms that "*the critical limiting factor of an organizational is the ability to handle the non-routine events that cannot be anticipated or planned for*". In the case of construction firms, the degree of uncertainty is high. Variations in organization design arise from different strategies to increase planning ability and to reduce the number of exceptional events that management must resolve. The organizational structure must be designed to support the information processing needs of the organization, so that the organization can remain efficient and viable (Burton and Obel 1995).

We present next the structural organization properties:

- Configuration: represents the form of the organizational structure. It specifies the principle for dividing work, breaking tasks into sub tasks and coordinating activities (Burton and Obel 1995). The most common configurations are: functional, divisional, products based, projects based, matrix, etc. A project configuration, for example, enhances coordination among specialties to achieve on-time completion and meet budget targets. Each configuration has advantages and disadvantages some promote a centralized decision-making while others the opposite, the idea is to try to choose the best fit for a particular firm.
- Formalization: represents the rules in the organization. It is a way to obtain a standardized behaviour. This property has two advantages:
 - It reduces the need of processing information: Galbraith (1974) states that "formalization of a decision making language simply means that more information is transmitted with the same number of symbols".
 - It increases the capacity to process information: it frees up higher hierarchies since lower hierarchies are able to make their own decisions supported by the rules in the organization.
- Complexity: it is related to the degree of:
 - Horizontal differentiation: it refers to the degree of specialization within the organization.
 - Vertical differentiation: it relates to the levels of hierarchy.

² <http://www.businessdictionary.com/definition/organizational-structure.html> (March, 2011)

- Spatial differentiation: it relates to the geographical dispersion of the activities in the organization.

The higher the degree of complexity of a firm, the higher the demand for information processing.

- Centralization: It relates to decision-making process. A firm has a higher degree of centralization while the decision-making process is concentrated in few people in the organization.

Besides these properties there are factors that condition the structural organization: environment, size, management, technology and strategy.

Galbraith (1974) defines four different strategies for improving information processing capabilities. These strategies are grouped into two categories: 1) Reduce the need for information processing and 2) Increase the capacity to process information.

Reduce the need for information processing

- Creation of Slack Resources. This includes extending delivery times, increasing budget or inventories. If any action is taken, this strategy will occur by default.
- Creation of Self-Contained Tasks. It means to create areas that can work autonomously without coordination with other teams or groups. This reduces the need for coordination and integration within different areas of the firm, and reduces the need for information processing but it has the disadvantage of incurring in high opportunity costs from non coordination.

Increase the capacity to process information.

- Investment in Vertical Integration Systems: Information Technology helps to integrate, store and process information and in that way support decision making; this strategy may also reduce the need for information processing.
- Creation of Lateral Relationships. Uncertainty can be reduced by moving the decision making where the information exists. Some strategies to achieve this are: direct contact between departments; teams; project managers; matrix configuration.

While higher level strategies have higher effects in reducing uncertainty, they also require "organizational investment" and higher administrative costs. Firms must choose the most optimal level for their immediate environment.

We present next the case study developed in a large construction firm in Peru.

CASE STUDY

GyM is a Peruvian large construction firm; it is one of the seven companies that form Graña y Montero Holding. This holding has provided engineering and infrastructure services for 78 years in the Peruvian construction market and it is the most prestigious local firm.

It works in the following business segments: Electromechanical, Services (contract mining, underground mining), Infrastructure (mining, tunnels, hydroelectric

centrals, roads, industrial concrete, earth movement, others), buildings (housing, commercial). It is important to highlight that GyM has played an important role in the development of mining in Peru and other countries; it has built the most important Concentrate Plants in Peru, Bolivia and Dominican Republic.

Its organizational structure has a matrix configuration: it incorporates a divisional (Figure 1) and a functional (Figure 2) configuration simultaneously. The company is divided in four divisions: Electro-mechanics, Services, Infrastructure, and Buildings. Each division is autonomous and have its own Board and Division Manager who reports to the CEO of the firm. The CEO reports to the Executive Vice President which reports to the Main Board.

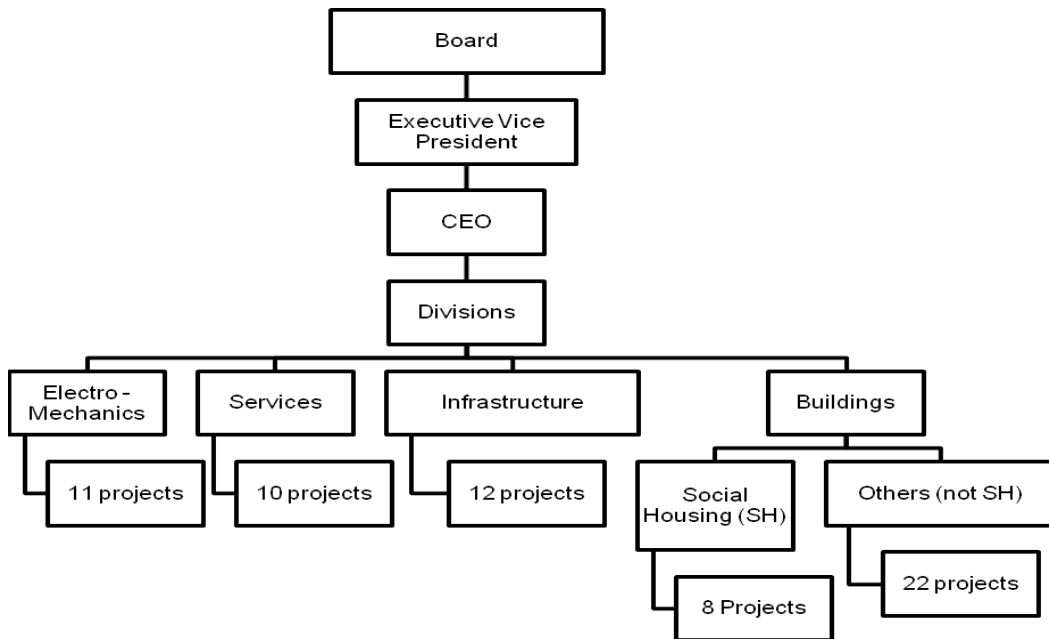


Figure 1: Firms Divisions (January 2011)

In addition to this, the firm has the following areas: Equipment Centre and Logistics, Legal Department, Finances and Management, Contracts & Proposal Area, Technical Area and Human Resources (Figure 2). Each of these areas responds to an Area Manager who responds to the CEO. These areas are common to the entire firm and support projects.

The Equipment Centre and Logistics, for example, is in charge to manage all the equipment of the company and to locate it in the construction sites which require it. It is also responsible of the maintenance of the equipment and the evaluation of the convenience of the purchase of some particular equipment for some projects. Logistics is responsible for the materials purchases; it works as a purchase centre. The information system that supports the logistics flows is named Oracle. This system integrates many areas of the firm and it is very useful for purchases, inventory control, accounting, finances, cost reports, payment, etc. All projects work on-line and register their orders through the system. All logistic flows are formalized; procedures and rules for purchasing and choosing suppliers exist.

The logistics area is also in charge to negotiate with suppliers the prices of resources that are frequently used in all sites; the idea is to take advantage of the economies of scale. GyM has identified the strategic importance of suppliers in their business thus one of the goals of this year is the development of local suppliers.

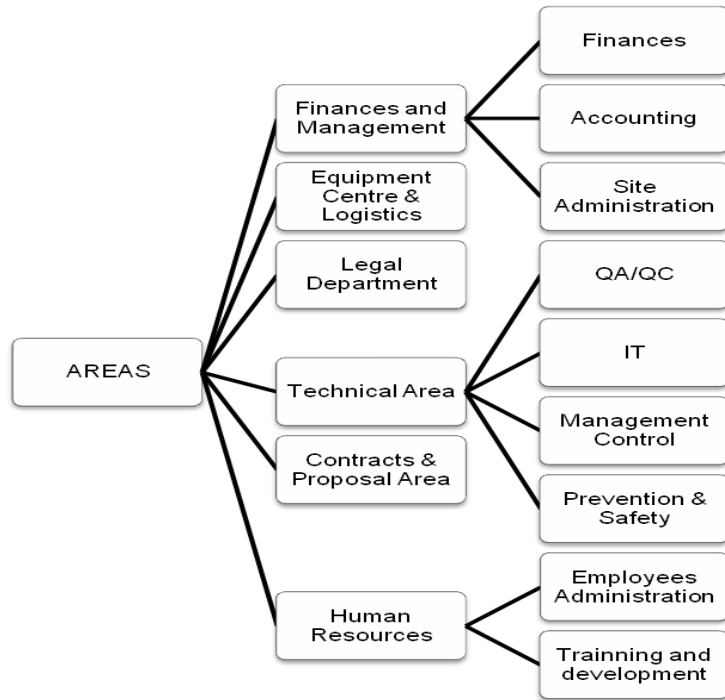


Figure 2: Functional Areas GyM

At the beginning of 2011, GyM managed a total of 63 projects (Figure 1) almost all of them located in Peru; however, there was one in Central America. In general, the site organization is formed by: a project leader (Construction Project Manager), production area, technical office, QC/QA area, administration, prevention and safety (Figure 3).

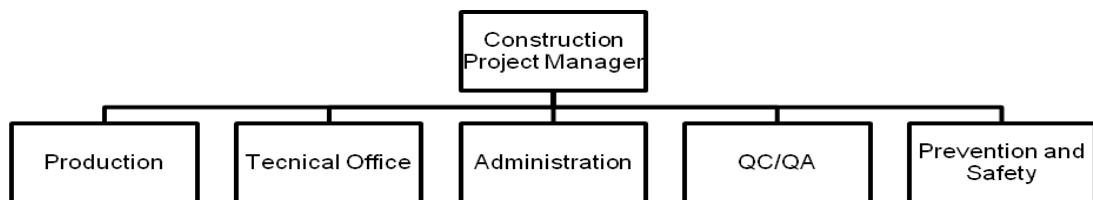


Figure 3: Site Organization

Each Construction Project Manager has autonomy over his project, he reports to the division manager where he belongs, but in general he makes the main decisions of his project. As a consequence, the company has a low degree of centralization; this is an appropriate characteristic of organizational structure given the size and diversification of the firm. The firm presents a high degree of complexity:

- Vertical Complexity: it has more than four levels of hierarchies.
- Horizontal Complexity: the firm has a high degree of diversification, it has many specialities. Therefore the need for information-processing is high.
- Spatial Complexity: given the nature of the business (construction), it has a high degree of spatial complexity, moreover since it has operations in more than one country.

It is clear to note that the higher the degree of complexity, the higher the need for information processing. The fact that GyM is a large construction company with a high degree of diversification makes a priority the need to establish formal mechanism to coordinate and control. To deal with the horizontal complexity the firm has been divided in divisions, the spatial complexity is mitigated with the project configuration, and the vertical complexity is neutralized with the low degree of centralization that makes that the information get fast to the decision-makers.

In the last six years the backlog, which is the total value of orders for a product that have not been filled and help a company estimate its future earnings, has increased in 210% (see Table 1). This is reflected in the size of the firm, while in August 2005 the company had 577 employees (only staff) in January 2011, it had 1746. It is important to note that while 77% of the employees worked in projects, the rest of them worked in the main office (functional areas).

Table 1: Backlog GyM

Backlog (Thousands US\$)	
August 2005	January 2011
344,051	1,068,054

We can note that the firm takes immediate actions when a change in the organizational structure is needed. As the company grows, the former managers are no longer able to process the amount of information that is required as a consequence of the increment in the number of projects; therefore the job tasks are divided again. In order to adapt to this growth some changes to its organizational structure have been made. In the last year, for example, the Building Division has been divided in two Sub Divisions: Social Housing Buildings and other Buildings (not social housing), each of them are in charge of a group of projects and report to the manager of the building division. The formerly technical area has been divided in two: a proposal area which is in charge of the estimating and technical area which groups other sub areas: QA/QC, IT, management control and safety.

In regard to its production management philosophy, almost a decade ago, the firm decided to put “efficiency” as one of its fundamental values. Since then, the firm has been involved in actions taken in order to increase productivity in all areas. It began with the implementation of Lean concepts in the projects.

In 2005 GyM identified the importance of having a formal system to guaranty that all people involved in projects, manage their projects using a standardized way. This was a priority since the firm had a perspective to grow and it need to guarantee that in spite of the size it would work in an integrated way. To attend this new requirement, a consultant firm was hired, and as a result some tools and indicators were identified.

In addition to this, the firm determined the importance not only of the formal tools and indicators but also of the establishment of a mechanism to get that all employees involved in projects use them in their daily work routines. As a consequence, the area of Management Control was born.

This area has the function to standardize the tools used on-site: planning, programming, cost controls and productivity. The idea was to ensure that these tools were well understood so that the reports generated from their use were: reliable, comparable among projects and mostly that the productivity tools, which were based in lean concepts, were well applied so that the firm could gain with its benefits.

This area has a strategic importance because it not only homogenizes the way people work but it also introduces new employees in lean concepts and teaches how to use them. Each time that a project begins; there is an on-site implementation for a period of time. After this; there are formal reports and indicators that have to be sent to this area to analyze this information. The area of Human Resources also supports training. New employees pass through a training programme where they are introduced with the firm history, values and its way of making things done.

It is important to highlight that GyM gives full support to knowledge sharing amongst the company and enhances the professional development of its employees. There is a Learning Corporate Centre which promotes corporate and individual growing through learning and knowledge sharing. The firm tries to capture information through papers written by employees about their experience in a specific technology, procedure, etc. There are also presentations about specific themes. The firm has identified some members as specialists in specific topics, so that they can be consulted. All this information is available through the Intranet.

ANALYSIS OF THE CASE STUDY

As explained GyM is a large construction firm in which organizational design is a key factor in the success of the company. Top executives of the firm are aware of this; they give special importance to planning the growth of the firm and adapting it to changes. A proof of this is the amount of years GyM is in the market despite changes not only in the company but also in the environment.

The firm distributes its work through divisions, projects configuration and functional areas; this gives the company flexibility for the decision-making process. It also has an information system that integrates the firm and an intranet where they share information and knowledge. It is possible to identify three of the strategies defined by Galbraith (1974) for improving information processing capabilities and reducing uncertainty:

- Creation of Self-Contained Tasks: each division of GyM work autonomously from the others, each work as a sub-system.
- Creation of Lateral Relationships: project configuration moves the decision making where the information exists.
- Investment in Vertical Integration Systems: the oracle system supports and formalizes the procuring process; it also integrates areas in the firm. The intranet also contributes to share information and to make rules and procedures available to employees.

This firm has a low degree of centralization; Construction Projects Managers have the authority to make decisions in their project in coordination with the division manager.

This gives agility to the decision-making process but it also can make the firm incur duplication costs (i.e. for each project a same type of employer is hired) and the firm may also neglect long-term technical development (Galbraith 1971). This is an issue that construction companies, in general, have to work on, they have to capture the knowledge in each project and incorporate it to the firm culture so that the firm can progress technically. This firm is trying to do so through its Learning Corporate Centre.

In relation to formalization we can say that GyM has a high degree of formalization, which, according to Burton and Obel (1995), is an appropriate choice given the size of the firm. GyM has formalized: areas, functions, roles of employees, procedures, management system, etc. All the rules and procedures are available to the entire firm through the intranet; there is also a printed version of them.

In spite of the high degree of formalization, the organization is still very flexible; rules are necessary to organize the tasks and play an important role in coordinating and controlling activities. However, rules must be designed based on the particular characteristics of the organization and be simple and clear.

The Management Control area is a clear example in how formalization can help a firm work in a coordinated way. As already explained, this area guarantees that the productivity, programming and cost controls are realized in a similar way and as established by the firm. This area is in charge of the implementation of lean concepts in the production system. An important consequence of formalization in the production area is that it is creating habits among employees. People learn applying tools in real situations. It is a fact, that at present, engineers are aware of the impact of planning and programming in the results of their projects.

However, the success of the implementation depends on a system approach, where parts and links have been carefully designed. Tools and indicators can be considered as the parts, while the structure that assures that these parts fit in the company are the links. This structure includes the implementation methodology and the mechanism of control. This system is continuously improved based on the feedback of the implementation on the projects.

It is relevant to take into consideration that this would not have been possible without the commitment of the top executives and the support of an organizational structure that facilitates the flow of information.

FINAL COMENTS

The organizational structure configuration is the macro scenario that will determine the routes were the information will flow in a company. Information flow has to be carefully designed. Information can be compared as a flow where data moves, is stored and processed, value is given in the moment that it is processed and converted in useful information for decision-making. So it is necessary to have an information system designed to guarantee accurate information when needed, reducing the impact of uncertainty in decision-making.

Formalization helps managing information, it is a way to coordinate and control among firm members. Rules are important in an organization because:

- At an operational level, they help people make their own decisions. With appropriate training and rules employees can do their work without depending of their immediately chief.

- They standardize, reduce variability, decrease uncertainty, and therefore reduce the amount of information to be processed.
- They guarantee reliable indicators, these can be used to control, evaluate a new technology or a new product or procedure, verify if the company achieving its goals, etc.

However, it is important to perceive that the benefits of formalization will be accomplished if the following conditions are present:

- Commitment of the top management: top executives must lead the implementation and must be convinced of its results; if this does not happen it would be very difficult to succeed and obtain long term results.
- Organizational design based on a system approach: that determines the flow of information of the firm, and divides the work in the firm in a viable way. A system approach is indispensable for the viability and to attain long term results. The design must consider: procedures, rules, formalized flows, implementation plan, controls and a feedback system.

As already commented, organizational design determines the success of the implementation of a new management philosophy in a firm. Future investigations could include the development of guidelines for construction companies to help to evaluate if its organizational structure is attending its information processing demands. It would also be very interesting to study the implementation of the Viable System Model (Espejo and Harnden 1989) proposed by Stafford Beer in a construction company, since it is adequate for communication and control in complex organizations.

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