

Comparative Analysis of Civil Construction Project Type Using the Concepts of ETO(Engineering to Order)

Gustavo Brandão Soares do Nascimento

Student of the Post Graduate Program in the Department of Industrial Engineering in the School of Engineering of the University of São Paulo at São Carlos – Ave Trabalhador Sancarlene, 400 – CEP: 13560-970 – São Carlos – SP - Brazil

Fábio Müller Guerrini, Ph.D.

Professor of the Department of Industrial Engineering in the School of Engineering of the University of São Paulo at São Carlos – Ave Trabalhador Sancarlene, 400 – CEP: 13560-970 – São Carlos – SP - Brazil

Abstract

Using classifications is a way of facilitating the communication between actors of a job field. In the construction sector, settle the information about material specifications, costs, customer needs, etc. The classification of production systems allows identifying administrations techniques that is adequate to the characteristics of the productive environment in each sector, helping organizations have quality rises, high levels of performance, low costs and this way being more efficient in process. The engineering to order (ETO) is the most common type of contract on construction industry being the design developed by previous definitions with the customer, but the construction only starts when the customer gives the order, between formal contracts. The product of civil construction becomes this way highly customized and the customer satisfaction depends on fundamentally the interaction organization – customer. This paper approaches the characteristics of civil construction product using the concept of ETO production.

Keywords

Civil construction, ETO, Classifications

1. Introduction

The classifications within a productive sector are necessary to facilitate the communication among the different actors involved, clarifying specifications, orders, processes, etc. to all participants. Civil construction has many classifications, but those normally define the specific type of use for the construction, without reference to its productive process. There are several classifications for the productive process in the industrial sector.

In the civil construction sector, the information is given in relation to specifications, cost management, client demands, etc. (EDHOLM, 1996). This way, a classification consistent with the environment of the Brazilian civil construction, considering its productive process and its objective, becomes presently necessary. One of the advantages of using classifications of the production systems for civil construction is that they allow the discrimination of groups of techniques for planning and production management appropriate to this particular tupe of system (PERALES, 2001).

2. Classifications for Productive Systems

Any operation produces goods or services, or both, and accomplishes this through a transformation process. By transformation we mean the use of resources to change the state or condition of something to produce outputs (SLACK, et al, 1999).

JOHNSON & MONTGOMERY (1974) present a classification using three categories:

- **Projects:** it has as main characteristic the administration of the resources specifically to manufacture a product of great size or complexity;
- **Intermittent processes:** their characteristic is the production of a large number of products in a flexible form. It can be by the order of different products or repetitive manufacture of the same product;
- **Continuous processes:** its characteristic is the production in wide scale of standardized products.

Although there are other classifications, one of the most relevant forms of productive systems classification is through its interaction with the customer. Within this classification, the productive systems can be classified in four types:

- **Make to Stock – MTS:** its main characteristic is that the production occurs before sale, leaving the products stocked. The products are generally standardized and manufactured on the basis of demand forecast, without any customization. The interaction of the customers with the project of the products is very small or almost null. “MTS systems have as their main advantage the swiftness in product delivery, but the costs with supplies tend to be great and the customer has no way of expressing his needs regarding the product” (EULALIA, 1995).
- **Assemble to Order – ATO:** it is characterized by the anticipated supply of subcomponents, raw materials, etc. so that when the customer order comes in the production process goes faster. This is a type of production that does not allow for the finished products be stored, but allows that, from the level of subassembly on down, in the structures of the product, any items can be stored (CORRÊA, 2001). Interaction with the customers is limited in terms of defining the specifications of the product. Deliveries of the products tend to be medium term and the planning of the demand occurs in the level of modules or subgroups, that is, in the level of intermediate products (EULALIA, 2001).
- **Make to Order – MTO:** it is characterized by the production only starting after the market order comes formally in, although the basic project may be developed from initial contacts with the customer. This system allows and even demands an interaction with the customer in extensive form, with the product being subject to some modifications even during the production phase (EULALIA, 2001). The level of customization of the product is usually high. In general, in a MTO system, it is necessary to wait for the client’s order not only because it brings information on the desired configuration of the final product, but also because it brings specifications of manufacture of the components themselves, which many times are made on the basis of drawings supplied by the customer. And so, the scheduling must necessarily come after the demand, which means that the production must be extremely reactive, for its level and its mix of outputs will follow the level and the mix demanded by the market (CORRÊA, 2001).

Examples of industries that deal with the MTO system are the naval, aviation and heavy machinery industries, as well as some civil construction companies. The assembly of the product, in this case, also demands different services, sometimes even pre-manufacture of parts of the product, and different volumes of work, besides distinctive specifications.

- **Engineering to Order – ETO:** it is basically an extension of the MTO, with the product project being done almost entirely in accordance to the customer’s specifications. “In ETO production, the project as well as the components manufacture and final assembly are made only when the customer order is really in (CORRÊA, 2001). The products are highly customized (one-of-a-kind)

and the level of interaction with the customer is very high, making the product specifications almost unpredictable. For this reason, the only supplies on hand are the most common raw materials. It is normally geared toward very complex products and with very long lead times (PIRES, 1995).

From the concept of competitive cycle (MARUCHECK & McCLELLAND apud PIRES, 1995), which refers to the time between receiving the order and shipping out the final product, the difference among the four systems is represented in the table below:

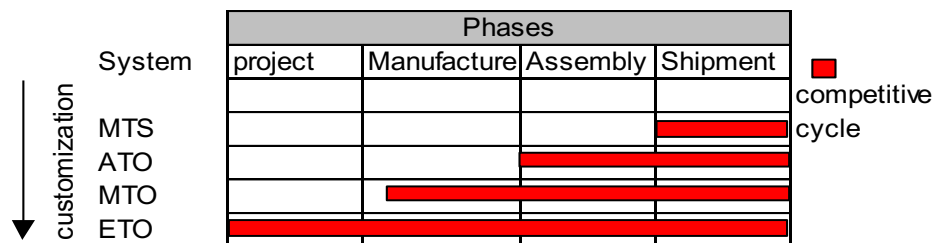


Figure 1: The competitive cycles for the four production systems (Pires, 1995).

3. Civil Construction Characterization in Brazil

Civil construction is responsible for nearly everything related to housing, transportation, sanitation and the settlement of human beings, while still presently having a great movement of capital and high accumulation of investments in its various sources. Many surveys and researches are being done on this sector to seek improvements, in the areas of technology, management, materials, environmental impact, etc. However, several similar characteristics can be noted in the various segments of this sector, making it possible its characterization.

FARAH (1998) writes that the sector in Brazil is characterized by the large number of firms, by subcontractation, by the informal market and the low articulation among the sector agents. The author divides the main characteristics in two types: intrinsic and extrinsic. The intrinsic are listed below:

- *Product nature*: one-of-a-kind, high added value, large dimensions, high mass concentration and disaggregated process;
- *Determinants of the demand*: Demand depends on income and job levels, the products are investment goods;
- *Structure*: The construction industry is broken up into a large number of intervenients
- *Processes characteristics*: the venture is characterized by a long maturation period, a long life time for the product and separation between the project and its execution;
- *Craftsmanship x industry*: Utilization of craftsmanship in parallel with high technology;
- *High incidence of man power in the value of the product*: The value of man power is still high on the final price of the output if compared with other industries.

Among the extrinsic characteristics – in Brazil – we can quote (FARAH, 1998): very important informal sector (more than 50% of the workers are not registered according to labor laws), a great number of small and very small companies, predominance of domestic private capital; utilization of conventional technologies; behavior dependent on the economic situation of the country.

HARVEY & ASHWORTH (1997) characterize the construction industry this way: the physical nature of the product: one of a kind, of high added value; the product is normally manufactured with basis on the client's premisses; project is separated from its execution; the organization of the construction process: subsequent, dependent and fragmented processes.

ROCHA LIMA JR (1994) characterizes civil construction by the risks of the companies acting in the various subsectors, linking the market with the product being produced.

- **Contracted services and works:** Offer of services for the construction of works built through contracting (that is, contract by fixed price, with payments that can be made in installments, with price adjustments, according to forecasts pre-established in the contract or by unit prices). Its range comprises building works, heavy construction and industrial facilities.
- **Outputs:** real estate enterprises or real estate based enterprises, operating in production for sale in the open market (real estate and/or offices) – real estate enterprises – which result effectively in a real estate deal through the transfer of right of property of the real estate, or operates the commercial exploration of the real estate (shopping center, flat, hotel) – real estate based enterprises – where business is based on the use of the real estate and not necessarily on its sale. It is the situation of building works.
- **Delegation:** Exploration of highways, hydroelectric plants. It consists in building, maintaining and exploring well these facilities. It is the case of public utilities.

From the characteristics of each subsector identified by ROCHA LIMA JR. (1994) and the concept of ETO, a table that summarizes these aspects was drawn.

The services of contracted works are characterized by a contract, established between the client and the firm, defining the prices and product specifications. According to SCHWEDER (1993), the objectives for contracting the managing company are to spare the organization activities or management functions that are not related to its specific objectives, preventing the company from operating in two different directions.

SCHWEDER(1993) suggests that real state enterprises’s starting point is the expectation of building to commercialize. The contract relation among the organizations in civil construction is defined by the execution process. The choice of such procedure is associated to: lack of information (level of definition of projects at the time of the bidding) to be offered to the participants for the purpose of requesting bids for the execution of said services, with the common interest of dividing the operation risks among the participants and, in compliance with the law, when the contracting agent is a public company.

Table 1 relates the characteristics of ETO with the range of subsectors described in table 3. The characteristics analyzed were: basic project, formal order, client, time of completion, customization and productive flexibility.

Table 1: Comparison between contracted services and ETO

ETO	Contracted services and works		
	Buildings	Heavy construction	Industrial assembly
Project	Done by the firm, with specifications defined with the customer	Done previously by a qualified firm, usually different from the one that will do the work	Done by the firm, with specifications defined with the customer
Order	By contract	By bidding	By contract
Customer	Investors, companies and private party interested in building	Government and large companies	Investors, companies and private party interested in building
Lead time	High	High	High to average
Customization	High	High to average	High to average
Flexibility	variable as per amount of services by the firm	variable as per amount of services by the firm	variable as per amount of services by the firm
Type	ETO	MTO	ETO

The systemization of contracted services and works suggested by the characteristics of ETO presents similarities in the works of heavy construction and industrial assembly as far as lead time is concerned, in general a long term proposition; in the case of buildings, a medium lead time is also considered. Customization varies from high to average, with the possibility of problems in complying with project specifications in the case of heavy construction and in industrial assembly; in the case of buildings, the product is specified according to the client.. The productive flexibility depends, in all cases, on the number of works under way associated to the company's capacity.

The main differences among buildings, heavy construction and industrial assembly are present in the definition of the basic project. In buildings and industrial assembly projects the contracted company defines the project according to the customer's needs. However, in the case of industrial assembly, the utilization of structural elements and pre-fab insulation is more frequent, considering the function of the industrial assembly work. In heavy construction, the project is usually made by a qualified firm, different from the firm responsible for the construction.

The kind of order that differentiates the "competitive cycle" throughout the time comprised between the receipt of the order and the delivery of the final product characterizes the works of buildings and industrial assembly MTO, and the works of heavy constructions as ETO.

Observing the definitions given for the productive systems, especially the one relative to interaction with the customer, it becomes clear that civil construction can be classified as an ETO system. However, this is not the only classification possible. Many companies establish previously the definition for the customer, characterizing themselves more as MTS. Other companies, using industrial assembly, have their productive process resembling more an ACT, and others yet, having the project, the MTO system.

4. Conclusion

The form of interaction with the customer and the production system in the civil construction fits within the ETO concept. This classification clarifies the characteristics of contract and services in the civil construction sector for it shows the project conditions, stated period of delivery, product specifications and relationship with the customer.

Moreover, within the totality of the system where the product is inserted, this classification allows the identification of the techniques for production administration better adjusted to the characteristics of the productive environment of companies in the sector of civil construction.

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