INNOVATION AND “CONSTRUCTION INDUSTRY MESO-SYSTEM” ANALYSIS

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ABSTRACT

The “construction industry meso-system” analysis which is proposed underlines the complexity and the heterogeneity of the construction industry. It focuses on the use of the structures. It includes not only the construction firms and the professionals but also the materials industry and the property management firms. It highlights the part held by the existing stock. This “construction industry meso-system” analysis emphasizes the importance of innovation in non-technical fields, focuses on the use of the facilities and deals with profitability.

KEYWORDS:
Meso-economics, economic meso-system, construction industry, innovation.

INTRODUCTION

The economic “meso-system” analysis of the construction industry consists in using a unifying concept, the "economic meso-system", to study the construction industry, and in applying a meso-economic method of analysis based on the concepts of structuring characteristics, segments, groups of activities, operational configurations of players and institutional regulations (Carassus, 1998, 1999, 2000)1. Below are some views, stemming from this “meso-system” approach, to analyse innovation in the construction industry.

I - THE CONSTRUCTION INDUSTRY: A COMPLEX “ECONOMIC MESO-SYSTEM”

DEFINITION OF THE “MESO-SYSTEM” AND ITS STRUCTURING CHARACTERISTICS

The construction industry economic meso-system can be defined as the organised complex of commercial and non-commercial relations between productive and institutional actors taking part in the production and management of services provided by the facilities used, throughout their life cycle, as the living and working environment of a population. The diagram attached (see annex) gives a simplified presentation of the construction industry meso-system.

Two main characteristics in particular are structuring this meso-system: products are localised and static on a site, and the localised orders for these products present an extraordinary diversity and heterogeneity. Other elements characterising construction (prototypes adapted to each site and environment, construction firms not controlling design, manufactured elements assembled on

1 This is the subject of work in progress within a CIB (International Council for Research and Innovation in Building and Construction) group. The “Construction Industry Comparative Analysis” Project group, which we are co-ordinating, is a joint group of CIB Working Commissions n°55 “Building Economics” and n°65 “Organisation and Management of Construction”. It aims to compare in particular the Australian, British, French, Portuguese and Swedish construction industries on the basis of this kind of method (Andersson, 2000, de Valence, 2000, Lopes and Bezelga, 2000).
itinerant sites, adaptability to the evolving demand of existing structures, essential role of institutional rules, etc.) tend to be determined by these two structuring particularities.

In the more developed countries, sheltered from war for over 50 years, the optimisation and renovation of the existing stock, has become a central issue to the construction activity. A significant indication of this evolution is the major role played by the improvement and maintenance work in the construction activity of a large number of more developed countries.

THE AIM OF THE CONSTRUCTION INDUSTRY IS TO PRODUCE AND MANAGE THE SERVICES PROVIDED BY STRUCTURES

What productive issue must the construction meso-system solve? The most common answer to this question is: building. In addition the object of economic research is often what is generally known as the "act of building". This answer is, however, too limited. It is a question of producing and managing the living and working environment of a whole population, for housing, working, transportation, education, sport, leisure, etc. The entire built environment, regarded as distinct from the natural environment, falls into the field of activity of construction. And building environments is not the only activity in this field. We need to add management, maintenance, improvement, demolition, and reconstruction activities.

The population does not need the physical structures themselves for their living and working environment, but the services provided by those physical structures and the quality of their location. The aim of the construction meso-system is not to build the physical structures necessary to people's living and working environment, but to produce and manage the services rendered to end users and the community by these structures throughout their physical life-cycle (production, use, improvement, demolition). When building a new structure, designers and construction firms produce the potential services provided by the structure to the future end users and the community. As for property and facilities managers, the situation is much clearer: their core business is to manage the day-to-day and long-term services to end users and the community (Tempelmans Plat, 1996).

THREE MAIN GROUPS OF ACTIVITIES

The construction economic meso-system is made of segments, which are professions or sectors. These segments are part of the groups of activity. In construction, there are three main groups of activity.

Most of the times, the construction industry is defined as being made up of construction firms and professionals. According to our analysis, it is one of the three main groups of construction activities. It deals with the short-lived design and complex production assembly on itinerant sites. This group of activities covers on the one hand service activities involving project management (order, design, co-ordination and control of structure construction and renovation operations) and, on the other hand, implementation and assembly activities on itinerant sites of industry-produced elements. It is a very cyclical activity with an erratic profitability, which is often low. Profits depend on the moment of business cycle. For construction firms as well for real estate developers, profit may be important during the prosperity phase but losses can be huge during the recession phase.

The second group of activities is the upstream industrial part of the meso-system, which focuses on the industrial production, and distribution of materials and machinery implemented, assembled, and installed by construction firms on work sites. They are cyclical activities, which depend on construction business cycles, but profitability is not as erratic as in project-based activities and profit may be high in some situations.

The third group of activities is often ommited though its role is increasing in the construction meso-system. It concerns the continuous management of the existing stock of structures and property transactions. Continuous management is a three-dimensional service activity: asset management
(strategic stock management by decisions to purchase, sell, renovate, demolish, build), property management (major repairs and administration), facilities management (managing services provided to the final user, care-taking, operation, everyday maintenance). Unlike project-based and materials activities, property and facilities management is a non-cyclical activity. Profit is recurrent and may be high, especially in BOT (Build-Transfer-Operation) activities. For ease of purpose, we associate this activity with another form of service activity: real estate activity, purchasing and selling new or existing buildings.

Due to the fact that the structures are immobile on site (with all the implications this has for users and the neighbourhood), the meso-system is mediated by a large number of institutional regulations. These regulations may concern building permits, construction codes, product and service certification, labour management, prices, procurement methods, funding and tax. They are defined and applied by a complex system of public institutions (international, national, regional, local) and private institutions (industrial, unions, consumer organisations).

A characteristic of the construction meso-system is its fragmentation into a large number of segments, themselves composed by numerous small and medium-sized companies. But our analysis shows that this fragmentation depends on the meso-system segment. The spectrum is going from very concentrated oligopoles to atomised activities with many intermediary situations.

This meso-system analysis is close to the “construction industry cluster” approach used by Gerard de Valence for the Australian industry (de Valence, 2000) and to the analysis developed by Graham Ive and Stephen Gruneberg for the UK industry (Ive and Gruneberg, 2000 A and 2000 B).

**THE CONSTRUCTION INDUSTRY IS SPECIFIC…AS EACH INDUSTRY IS**

Up to now, we thought that the construction activity was apart in the national economy (Carassus, 1998). We changed our mind when we briefly analysed the main industrial processes. Since Joan Woodward who defined the first typology of the industrial production systems (Woodward, 1965), many economists have proposed classifications allowing to better know similarities and differences among industrial processes.

In this paper, we use the typology proposed by Armand Hatchuel and Jean-Claude Sardas for the manufactured industry (Hatchuel and Sardas, 1992). They identify eight main production systems. They define an industrial production system through its entities (raw materials, semifinished products, finished products), its resources (plant, equipment), its tasks (specified by the crossing between entities and resources) and its control process. Table 1 summarises the characteristics of the eight main production systems.

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2 In the new French VINCI group, which defines itself as “the worldwide first construction and associated services group” (turnover 16.4 billion Euros, 115 000 employees), BOT activity (car parks, highways, airports, bridges, etc.) represents only 8% of the turnover but 40% of the operating profit (Les Echos, 2000 October 5th, p.17).
First, the striking point is the extraordinary heterogeneity of the manufacturing industry. What do the boiler manufacturing industry, the cosmetic industry, the aircraft industry and the glass industry have in common? This heterogeneity would have been much more important if we had also taken into account the extractive industries and the food industry. Second, when the two researchers analysed type no 5 (complex production with networks of firms like the space industry), they noticed that this kind of industry was very recent and that its production system was close to the construction industry one in a high technology context.

There is no reason for considering the construction industry as being more specific than the other industries. Like each industry, the construction industry has a productive issue to solve, it puts into practice its specific know-how, and it has its specific characteristics. Though this opinion is very unusual among researchers specialised in the construction industry, it is common among experts from the manufacturing industry. As Pierre Veltz says, “there are as many differences between the steel industry and the car industry as between the car industry and the construction industry” (Veltz, 1996, p. 149). When it is said that the construction industry is specific, Christophe Midler answers: “All sectors are specific. Nothing is more specific than the car industry, nothing is more specific than the pharmaceutical industry etc” (Midler, 1998, p. 203).

### Table 1. Typology of the main production systems in the manufactured industry

<table>
<thead>
<tr>
<th>Transformation</th>
<th>Multi-unit rate (several dozen products per year)</th>
<th>Average rate (several dozen products per day)</th>
<th>High rate (several hundred products per day)</th>
<th>Uninterrupted production rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>1- Workshops within networks</td>
<td>2- Flexible workshops or flow workshops (group technology)</td>
<td>3- Flexible lines (or delayed differentiation)</td>
<td>4- Physio-chemical process or steady-state biotechnological process</td>
</tr>
<tr>
<td></td>
<td>Ironworks, industrial boilers, steel and special metal transformation</td>
<td>Parts for planes, electronic circuits</td>
<td>Parts for cars, plastic parts</td>
<td></td>
</tr>
<tr>
<td>Assembly</td>
<td>5- Complex production : network of plants and firms</td>
<td>6- Multi-workshop plant</td>
<td>7- Assembly line, either traditional or including synchronous call</td>
<td>8- Composition by mixing products</td>
</tr>
<tr>
<td>Examples</td>
<td>Large-scale projects, system electronics, space programmes, aircraft programmes</td>
<td>Professional electronics, mechanical equipment, instrumentation</td>
<td>Cars, electrical household appliances, hi-fi equipments</td>
<td></td>
</tr>
</tbody>
</table>

FIVE TYPES OF CONSTRUCTION INDUSTRY SUB-SYSTEMS?

The extraordinary heterogeneity and fragmentation of the construction industry meso-system enables us to envisage the existence of sub-systems which, without being totally independent, may be clearly differentiated. By taking into account four criteria - the type of structure, the degree of complexity, the type of market (international, national, local) and the size of the construction companies - , it seems possible to distinguish five sub-systems.

The international sub-system covering the production and management made by big companies of large, complex civil engineering and building works, forms the minority part of construction subject to global competition. The national sub-systems cover the production and management of roadworks. It includes roadwork companies, which are often quite large in size and are present on both the new construction market and the improvement-maintenance market. National and local sub-systems centred on the production and management of non-road civil engineering works and networks (new constructions and improvement-maintenance) form the third type of sub-system. Finally, the national and local sub-systems of production and management of non-residential buildings and multi-family blocks of flats (new constructions and improvement-maintenance) are led by large and medium-sized companies. It can be distinguished from local sub-systems involving the production of individual houses (new constructions and improvement-maintenance) which are mainly governed by smaller companies.

DIVERSIFIED OPERATIONAL CONFIGURATIONS OF PLAYERS

The high level of fragmentation of the construction industry meso-system may be reflected in the operational configurations of players producing and managing structures using relatively divergent processes. We can also consider that the clear leadership of one of the participants may contain this fragmentation.

Regarding production, the operational configurations of players may range from the very fragmented to the very integrated ones. Separating design and building stages and the absence of a real leader may fragment configurations. But they may also be clearly placed under the responsibility of one of the participants (client, project manager, main contractor). Design and building may be grouped together, as may be design, building and maintenance. The most integrated operational configuration is build-operate-transfer (BOT) where funding, design, construction and property management are carried out under the responsibility of a single participant.

Regarding property management, the operational configurations of players may be relatively dispersed with a large number of companies participating on behalf of the manager. This configuration may be integrated into the technical domain with a "multi-technical" contract granted by the manager to a single facilities management company. It may be integrated with a "multi-services" contract granted to a single company responsible not only for technical management and repairs, but also for care taking, security and logistics (reception, photocopying, car fleet, travel, etc.).

II – SOME VIEWS ABOUT INNOVATION STEMMING FROM THE “CONSTRUCTION INDUSTRY MESO-SYSTEM” ANALYSIS

EXCHANGING EXPERIENCE WITH COMPARABLE INDUSTRIES

If the construction industry is not more specific than other industrial sectors, it is possible to exchange experience with industries or part of industrial activities, which present some similarities with the construction industry. For the project-based activity of professionals and construction firms, the comparison with the car industry is useless because this industry is very different from construction. It may be useful if “the parallel is not with building cars on the production line (but) is with designing...

In the property and facilities management activity, “much repair and maintenance work uses a repeat process” (Egan, 1998, § 31). This process is close to several industrial or service activities, mixing “front office” activities, in contact with the end user, and “back office” activities, based on operation and maintenance of more or less complex machinery.

Exchanges and comparisons can be made without any complex from the construction industry. Pierre Veltz analyses the evolution of the industrial organisation model. In the 20th century, big pyramidal firms led the model with Taylor-type productivity based on the work intensity of each worker. The 21st century model is based on a network of cellular firms with a productivity based on the efficiency of co-operation between the teams involved (Veltz, 2000, p. 173-190). This new model seems to be very close to the construction firms model, made by networks of SMEs or teams. This model never succeeded in implementing the Taylor model because productivity depends more on co-operation between the teams than on the work intensity of each worker.

TECHNICAL AND NON-TECHNICAL INNOVATION FOCUSED ON THE USE OF STRUCTURES

According to meso-system analysis, the real aim of the construction industry is to produce and manage the services rendered by structures. Correlatively, one important aim of innovation is to increase the quality of the services provided to the end user and the community. This can be achieved not only through technical innovation but also through non-technical innovation.

We must admit that the definition of technical innovation may be broad and may include the notion of service. According to the OECD definition, “a technological product innovation is the implementation or commercialisation of a product with improved performance characteristics such as to deliver objectively new or improved services to the consumer. A technological process innovation is the implementation/adoption of new or significantly improved production or delivery methods” (OECD, 1997).

The definition of innovation by Joseph Schumpeter is broader. According to him, innovation may concern new products or a new quality of products, new production and commercialisation methods, new markets, new sources of raw materials or semi-finished products, new business organisation (Schumpeter, 1926, p. 94, 1939, p. 84, 1947, p. 116). A wide definition of innovation including not only technical but also organisational, marketing, financial aspects is more suitable when the aim of the industry is to provide services to the end user.

The meso-system approach allows us to put into perspective the often-quoted low level of technical R&D expenditure in construction firms. This low level is not surprising for those firms. Their activity of which is not to manufacture products but to assemble manufactured products on the site. As the R&D director of a major French construction firm told us 3, organisational innovation and new communication technologies are more important than technical innovation for building sites. Keith Hampton, who includes material and plant industries in the construction sector, notices that “clearly the materials and products segment is the key R&D driver within the sector” (Hampton, 1999, p.6). Analysing technical R&D for construction without taking into account material and machinery industries is meaningless, the essential part of technical R&D being produced in that segment.

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3 Informal discussion with Vincent Cousin, R&D director of GTM group, November 1999.
SPECIFYING WHICH CONSTRUCTION INDUSTRY SUB-SYSTEM IS CONCERNED

At least five construction industries sub-systems can be distinguished, the innovation process being different in each one. It is quite clear that the road construction industry and the civil engineering construction industry are different from the building industry and that most of the times they take advantage of specific innovation programmes. But within the building industry, the analysis is often presented for a more or less homogeneous activity. We should ask ourselves whether we are dealing with the big building projects subject to global competition? With national and local sub-systems producing non-residential buildings and multi-family blocks of flats? With local sub-systems for the production of individual houses? Are we dealing with new construction, refurbishment, repair and maintenance? Is the Egan Report dealing with the whole construction industry or with important new projects ordered by major clients to large construction firms? Specifying the field of innovation is very important for an industry of an extraordinary complexity emphasised by the meso system analysis.

DEVELOPING INNOVATION IN PROPERTY AND FACILITIES MANAGEMENT FIRMS

As we noticed, stock (asset, property, and facilities) management is a central issue for the construction industry in some more developed countries. In France, United Kingdom, Italy, Nordic countries, 40% to 60% of building works and 30% to 40% of civil engineering works concern improvement and maintenance of the existing stock (Carassus, 1999). Innovation in property and facilities management firms is rarely taken into account (Koivu and Mäntylä, 1999).

Innovation should be more backed in this group of activity for several reasons. Their core business deals with the services to end-users. We emphasised the importance of innovation focused on the use of structures. Some of those firms are managing very important portfolios, rationalised and repetitive processes can be quite easily implemented. The innovation potential can be developed in relationship with the merging potential of this SMEs-governed activity. Their activity is diversified, dealing not only with refurbishment and maintenance but also with new construction implemented to extend their portfolios.

USING FRAGMENTATION AS STRENGTH?

Fragmentation of the construction meso-system is an often-quoted obstacle to innovation. Two types of fragmentation can be distinguished: the meso-system fragmentation and the process fragmentation. The meso-system analysis highlights the fact that the meso-system fragmentation is very differentiated depending on the segments or sub-segments (Carassus, 2000, Annexes 1 to 6). In France, property management, real estate agencies, developers and designers are fragmented activities, even if there are some big companies in each segment. Among the construction firms’ segment broken down into 32 types of companies, four categories can be distinguished: relatively concentrated activities with civil engineering companies and general contractors, specialised medium civil engineering enterprises, technical finishings activities (electricity, heating, etc.) with the coexistence of big firms and SMEs, non technical craftsmen-governed finishings activities. Among the materials firms, three categories can be identified: concentrated oligopoles (like the cement industry), relatively concentrated activities (like ceramic tile producers), and scattered activities (like concrete element producers).

Behind the usual assertion of fragmentation, the construction meso-system is in fact very heterogeneous, even the construction firms segment, with the coexistence of big firms, SMEs and craftsmen. This fragmentation is differentiated according to the scattering degree of the orders, the level of technical complexity and the capital intensity of the activity. Paradoxically, it may be
strength: the situation of a cyclical activity “seems to militate in favour of the fragmentation of the industry, which boasts of its ability to adapt to changing economic and social environments”\(^4\).

According to many experts, the *construction process* is too fragmented. The meso-economic approach emphasises the complexity of the industry and the extraordinary diversity and heterogeneity of the demand. The construction industry meso-system offers a wide spectrum of operational configurations of players, from the most fragmented to the most integrated ones. M.D. Konchar and V.E. Sanvido compared the efficiency of construction management at risk process, design & build and design-bid-build in the UK and USA. After having analysed the success factors of each process, they wrote: “it is evident that by focusing on these few critical success factors, a project can achieve success regardless of the project delivery system employed” (Konchar and Sanvido, 1999, p. 296). As a matter of fact, there is no construction process, which is always better than the others are. Innovation has to improve the different construction processes, each of them being adapted to the structure to be built, the players to be involved, and the local context.

Is fragmentation really a weakness? At the meso level, fragmentation increases the flexibility and adaptability of the construction industry to changing environments. At the micro level, fragmentation can be managed with clear leadership and an efficient network.

**IMPROVING PROFITABILITY THROUGH INNOVATION**

Very often, innovation is promoted without underlining its link with the firm’s profitability. It is a problem especially in the construction industry where insufficient profit is a structural weakness. The meso-system analysis highlights the differences of profitability between the groups of activities: cyclical and often low profitability of construction firms, cyclical and often correct profitability of material producers, recurrent and sometimes high profitability of property and facilities management firms. Innovation has to reduce the weakness of low and cyclical profitability to promote recurrent and predictable profitability. It emphasises the importance of innovation in the maintenance and services areas.

**CONCLUSION**

The meso-system analysis can be useful to analyse and to promote innovation in the construction industry. The topic has to be studied more thoroughly. The first main view concerns the importance of exchanging experiences with comparable industrial processes. One needs to consider technical and non-technical innovation, innovation linked with the use of the built environment, innovation in the property and facilities management firms, innovation backing a better profitability.

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Annex. The construction industry “meso-system”
(Simplified diagram)

<table>
<thead>
<tr>
<th>Life-cycle of the built environment</th>
<th>New construction (potential service to users)</th>
<th>Management of the service provided by structures to users</th>
<th>Demolition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Procurement</td>
<td>Design, control</td>
<td>Implementation</td>
</tr>
<tr>
<td>Continuous property management and transaction activities</td>
<td>Real estate agents</td>
<td>Property and facilities managers</td>
<td></td>
</tr>
<tr>
<td>Short-lived project management and on-site production activities</td>
<td>Clients</td>
<td>Developers</td>
<td>Project managers, Architects, Quantity surveyors, Consultants</td>
</tr>
<tr>
<td>Manufacturing and distribution activities</td>
<td></td>
<td></td>
<td>General contractors, trades, craftsmen</td>
</tr>
<tr>
<td>Institutional actors</td>
<td>International institutions</td>
<td>State</td>
<td>Regional and local authorities</td>
</tr>
<tr>
<td></td>
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REFERENCES


