Sonderdruck

An Anatomy of the Swiss Construction Cluster

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Center for Science and Technology Studies
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Centre d'études de la science et de la technologie
Centro di studi sulla scienza e la tecnologia

CEST 2001/7

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also published in:

OECD (2001) Innovative Clusters.
Drivers of National Innovation Systems.

Juni 2001 CEST 2001/7

Impressum

Edition	CEST Inselgasse 1; CH-3003 Bern Fon +41-31-322 96 66 Fax +41-31-322 80 70 www.cest.ch
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Graphik	Michael Kurmann
ISBN	

Vorwort

Die Wettbewerbsfähigkeit eines Standortes hängt mehr und mehr von der Funktionsfähigkeit seines Innovationssystems ab, insbesondere von der Generierung, Diffusion und Nutzung von Wissen. Ein Grossteil dieses Wissensaustausches - über den Markt oder informell abgewickelt - findet in Clustern statt, welche als Innovationssysteme der Mesoebene verstanden werden können und Netzwerke und Wertketten von Lieferanten, Kunden und/oder Wissensorganisationen beinhalten.

Seit mehreren Jahren werden in verschiedenen OECD-Ländern Studien zu Clustern und deren Innovationsdynamik durchgeführt (vgl. z.B. OECD 1999 Boosting Innovation - The Cluster Approach). Die vorliegende Analyse zum schweizerischen Baucluster ist ein Kapital aus dem jüngsten Sammelband der OECD, welcher Beiträge zu Clusteranalysen und -politik verschiedener Länder beinhaltet. (OECD (2001) Innovative Clusters. Drivers of National Innovation Systems. Paris. p. 229-247).

Chapter 11

AN ANATOMY OF THE SWISS CONSTRUCTION CLUSTER

by

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Introduction

The construction cluster is primarily a national – in this case a Swiss – phenomenon, with only the suppliers and supporting industries having international components. Although it is currently experiencing a recovery, it still has to deal with the effects of the severe recession of the 1990s, and the general base for a take-off and further restructuring and innovation is small. The construction cluster is perceived as mature and established, although there is considerable room for applying new technologies and products as well as for introducing organisational innovations. Due to the ongoing structural changes in the cluster itself as well as in its environment, firms are forced to orient themselves more towards the needs of their clients, to adapt to growing competition and to consider the integration of activities such as the bundling of previously separate activities (hence the increasing importance of the "one-stop shop" for planning, building and managing). To overcome the severe fragmentation of the value chain in the construction cluster (especially between planning and production), innovations in project handling and knowledge management for the development of more integrated solutions are needed.

The aim of this paper is three-fold: the first two sections are dedicated to the identification and description of the Swiss construction cluster, based on a combination of a (quantitative) input-output analysis and a more qualitative investigation. The main segments – building construction and civil engineering; installation and completion; suppliers; related services – are characterised by their economic profile, including employment, firm structure and market orientation. The chapter then goes on to discuss dynamics, innovation and co-operation. The core of the cluster can be characterised as being moderately innovative, with suppliers being an important source of innovations. A central issue concerns the fragmentation of the activities in the life cycle of a building, mirrored in the very many organisations involved, the distributed responsibilities and the traditional project handling, which all lead to sub-optimal – and usually not very innovative – solutions. Finally, cluster-related policies are discussed, emphasising the crucial role played by state agencies as procurers and brokers.

* The author gratefully acknowledges useful comments by the editors and by A. Berwert.

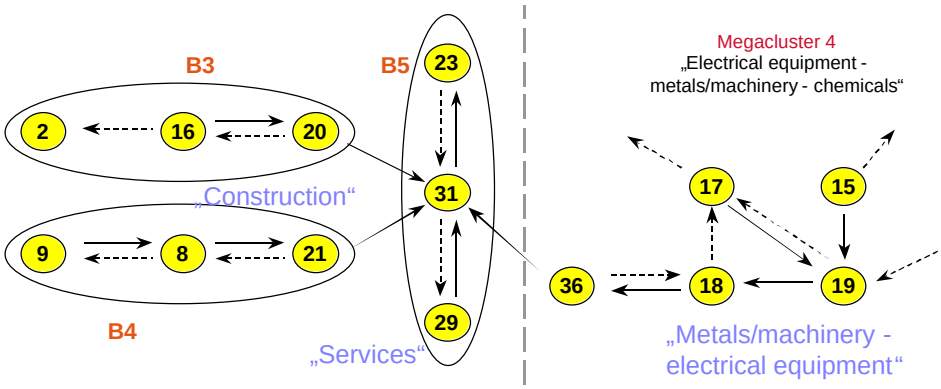
Identification of the Swiss construction cluster

In this chapter, construction and its related businesses are analysed using the cluster or value-chain approach,[1] with a view to identifying knowledge flows and innovation. This approach combines a more quantitative analysis of user-supplier linkages exploiting input-output data (transaction matrix) with a qualitative investigation of the value chains leading to the demand for buildings.

The analysis of the Swiss input-output data carried out by means of an algorithm[2] used in other OECD countries (Peeters *et al.*, Chapter 12 of this volume) shows that the cluster has two main strands: "building construction and civil engineering activities" (20) and "installation and completion activities" (21), with their corresponding preceding activities (see Figure 1). Both strands (20 and 21) are forward-linked to the "real estate business" (31). Upstream activities are, on the one hand, the "non-ferrous metals" (16) and "electricity, gas and water" (2) sectors and, on the other, the "woods and furniture" (8) and "wood industry" (9) sectors. Due to the level of aggregation of the input-output data (37 sectors), the analysis does not yield more detailed results.

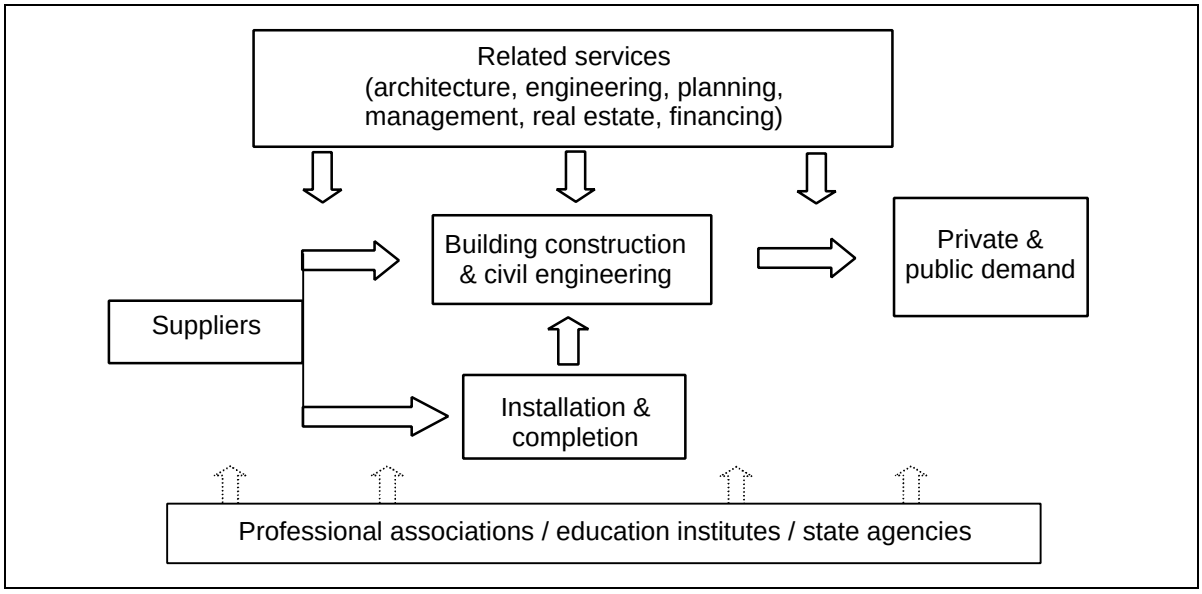
Nevertheless, the synthesis of various elements (input-output analysis, value-chain approach, statistics, expert opinions, knowledge flows) confirms this basic cluster structure (depicted in Figure 2). Private and public customers demand a wide variety of buildings for living or industrial purposes. These core products of the cluster constitute the base for construction and all other complementary activities; namely, inputs from suppliers as well as supplementary installations and completion work. Various services accompany the different value chains. This economic tissue of the cluster is influenced by other organisations; namely, professional associations, educational institutions and state agencies. In reality, the construction cluster – even when perceived as a mature cluster – is not as clear-cut as the sketchy graph suggests. Some activities are closely tied to the core activities while others have much looser links.

Figure 1. **The Swiss construction cluster as the result of input-output analysis**



Key: [2] Electricity, gas and water; [8] Wood and furniture; [9] Wood industry; [15] Rubber and plastics; [15] Non-ferrous metals; [17] Metals; [18] Machine building; [19] Electrical equipment; [20] Construction (main activities); [21] Building (finishing and completion); [23] Retail trade; [29] Banking; [31] Real estate; [36] Government.
Source: Peeters *et al.*, Chapter 12 of this volume.

Figure 2. **The Swiss construction cluster**



Profile of the Swiss construction cluster

The construction cluster constitutes a considerable part of the Swiss economy, contributing 6%-10% to Swiss GDP (depending on the indicator) and employing around 400 000 people (some 10% of the Swiss workforce). Table 1 summarises the economic tissue of the construction cluster based on employment data, firm structure and market orientation.

Table 1. **Synopsis of the economic tissue of the construction cluster**

	Employment 1998	Structure	Market orientation
Building construction and civil engineering	156 000	SMEs. 3 big firms (loose holdings), followed by 10 smaller firms.	Domestic.
Installation and completion	81 000 + 52 000	SMEs.	Sanitary install.: European. Rest: Domestic.
Suppliers	50 000 (estimate)	Some big (international) firms. Rest: SMEs.	Cement, construction chemicals, polymeric materials: International (specialised) players. Rest: Domestic.
Related services	32 000 + 17 000 + 18 000	SMEs.	Domestic. Some firms of international repute.

Note: Some figures are estimates.

The cluster is based on heterogeneous demand: the demand for houses as a final good; and the demand for buildings for industry as an intermediate demand, implying different owners, requirements, etc. The fragmentation of the construction market is based on technologies, know-how, education or machinery and is not much determined by demand criteria such as functions, quality, standards, etc. Private construction spending is twice as high as public spending, with house building being the major private construction activity. Unfortunately, the majority of clients, especially

unprofessional house builders as well as conservative public procurers, do not usually play the role of demanding customers. Furthermore, the severe ten-year recession which started in 1990 limited already scarce resources (due to very low profit margins) for longer-term development and did not nurture a climate of long-term change and innovation. Business-cycle-corrected employment data (1985-98) show – against the background of a general shift away from the secondary to the tertiary sector – a reduction in the core construction business as well as in the segment of potential suppliers. A clear upward trend for "other business activities" (NACE 74) is not fully mirrored in the sub-segment of construction-related services (for data, see Annex Table 1). Currently, there are signs of a smooth recovery in the construction cluster as a whole.

The core segment of "building construction and civil engineering" (NACE 45.2) was exposed to the severe recession, competition and restructuring. It is dominated by SMEs, although there are three big building contractors (with a turnover of more than CHF 500 million), followed by ten smaller ones. The big firms (Zschokke, Batigroup, Marti) all result from the mergers of the 1990s and incorporate dozens of firms with several thousand employees. Their activities usually comprise construction as the core [all segments (building and civil engineering) with varying specialisations], but also include services such as planning and general contractor activities and, above all, engage in real estate. The segment is oriented towards the domestic market. Previous engagement in neighbouring countries has now practically ceased.

Where are the available opportunities for Swiss construction firms? Due to the project-oriented work and hence the fragmentation of the construction process, a better integration in terms of activities, knowledge and other resources is needed. SMEs will continue to operate in the national market, but a better profiling based on quality and performance will need to gradually replace pure price competition. Large construction firms have the opportunity to bundle their competencies to allow them to operate on the world market, especially in regions with booming demand. Strengths lie in tunnelling activities, but also in segments such as hydro-electric power plants, subway construction, and highway and railway systems in mountainous regions (Girmscheid, 1997).

Construction business is supported by building installation (NACE 45.3) and building completion (NACE 45.4)[3]. This segment which is fairly substantial in terms of employment is dominated by domestically oriented SMEs, although some companies have grown to international scale (see example in Box 1).

Box 1. **Geberit: sanitary technology for the European market**

The Geberit group with a turnover of CHF 1.1 billion employs 4 300 persons and is active in more than 70 countries, although its core markets are situated in Europe. The company invests nearly 3% of sales in innovative products and, as a result, more than 30% of sales are generated by new or improved products which have been brought to market within the last three years. Electronic components are becoming increasingly important in sanitary engineering. R&D in the group – which has its headquarters in Switzerland – is performed by cross-functional teams applying information technology.

Construction and supporting businesses rely on a variety of inputs from the following sectors: Quarrying (NACE 14.1, NACE 14.2); Renting of construction/demolition equipment with operator (NACE 45.5); Manufacture of non-metallic mineral products (NACE 26), especially glass, ceramic tiles and flags, bricks, cement, articles made of concrete, plaster and cement; Manufacture of metal products (excl. machinery) (NACE 28); Wood-working and processing (NACE 20); Chemicals; Other products and services (wholesale trade, transport, energy). Since these branches are defined by products and not by the use of their products, it is difficult to determine the employment share of the construction cluster, but estimates attribute around 50 000 employees. This segment is dominated by SMEs (sometimes of regional importance) which are oriented towards the domestic market. However,

there are some – in their fields – big, international players (Box 2). Undoubtedly, these internationally competitive and successful companies contribute to the dynamism and innovation of the construction cluster.

Box 2. **Suppliers: some international players of Swiss origin**

Holderbank: Holderbank is one of the world's leading suppliers of cement, aggregates and concrete. With a turnover of around CHF 11 billion, it employs over 40 000 persons in more than 70 countries. Founded in 1912, investments outside Switzerland (and increasingly to growing markets) began in the 1920s, establishing a strategy which assumes that demographic expansion is the driving force behind cement consumption. For its cement business, two companies, Management and Consulting Ltd in Switzerland and Engineering Canada Ltd, constitute a turntable for group-wide transfer of know-how, experience and best practices. These firms support the group's activities with services, advice and management tools in the fields of environmental performance, development of human resources, IT, process technology, engineering, geology, research and logistics.

Sika: Founded in 1910 in Switzerland, Sika is a globally active company in the field of construction chemicals and industrial materials, which employs around 7 000 persons and yields a turnover of CHF 1.6 billion. As a producer of speciality chemicals, both for construction and other industries, the company builds on strong and independent R&D organised in multidisciplinary teams.

Sarna: The company is specialised in the processing and application of polymeric materials, employs 2 500 persons and realises a turnover of CHF 666 million. The competence in polymers is applied in different fields, with only one of the three firms belonging to Sarna being relevant for the construction cluster; namely, Sarnafil, which delivers polymer membrane waterproofing systems for use in high-rise construction and civil engineering. The other two firms deliver products such as IT peripherals, electronics, medical technology and components for the automotive industry.

ZZ Holding: The recent development of this industrial conglomerate illustrates the importance of the international scale in the supplier business. Starting in 1912 with the merger of local brick plants, it has developed into an industrial group which in 1998 employed 2 900 persons and realised a turnover of around CHF 1 billion in the fields of machinery and plant construction, building materials and building systems, consumer and industrial products and others. In 1999 it sold its brick, roof tile and insulation materials activities to the Belgian/Austrian Koramic/Wienerberger Group, an international/European ceramics and brick producer. In view of the increasing concentration in Europe, with fewer but larger suppliers operating throughout the region, the construction business of ZZ Holding had become too small to be competitive on its own.

The related services segment plays an integrating role in the cluster and shows considerable innovation potential. Activities are quite heterogeneous, either preceding, following or paralleling the core activities of building construction. In these fields, process innovations are important and constitute a major potential for increasing the efficiency of the construction cluster. Although the delineation is not very strict, parts of the following activities are deemed to belong to the construction cluster: Architecture and engineering firms (NACE 74.2); Real estate (NACE 70); Financing. Architecture and engineering firms are mostly small enterprises, some of international repute. The business climate is shaped by competitions and tenders. Architectural competitions have a long-standing tradition, with the first rules implemented in 1877 by the Swiss Society of Engineers and Architects. In addition to firms which concentrate their activities in a specific part of the value chain, others – through their services – span the whole cluster. Steiner, for example, styles itself as a total services contractor, offering conception, design and planning, realisation, and property management.

Box 3. **OLMeRO: linking via the Internet**

This is a newly launched business-to-business (B2B) Internet-platform which aims to become the most important virtual marketplace for the Swiss construction business. OLMeRO is a start-up which grew out of the business plan competition, "Venture2000", organised jointly by the Federal Institute of Technology Zurich (ETHZ) and McKinsey. Placing of orders and trade in all kinds of material via the Internet have the potential to increase market transparency and the efficiency of transactions.

Dynamics, innovation and co-operation

Changes and challenges

Over the coming decades, the construction cluster could benefit from positive growth rates in the economy and population as well as from speculative price trends in real estate markets. Since the 1990s, the situation has changed fundamentally, and the construction cluster is experiencing not only cyclical problems but also structural changes. One indication is the detachment of construction investment from GDP development, leading to fierce price competition which is pushing down the average number of employees per firm while leaving the number of firms constant.

The demand for residential construction is strongly influenced by changes in age structure, income distribution, family structure and modes of living together. Next to costly renovations, there is increased demand for cheaper, standardised houses. According to different cost studies, around one-quarter of total construction costs could be influenced by introducing "industrialised construction" (Girmscheid and Hofmann, 2000). The construction of industrial buildings shows a trend towards shorter planning and production times, lower costs, reduced space requirements for workplaces as well as increased variability of use. These tendencies could lead to a fragmentation between purpose-built constructions with high requirements and cheaper multi-purpose buildings with modular structures. Construction activities related to infrastructure are shifting from new construction to renovation, from building construction to civil engineering, from road to railroad construction.

These general trends towards more advanced and demanding construction activities are impeded by several factors: the traditional and regional orientation of markets hinders further specialisation and the establishment of bigger units; reduction of excess capacity is difficult since entry barriers for newcomers are low; above-average performance is not adequately rewarded since price competition and personal networks determine which companies win the bids for construction projects; lack of transparency regarding performance, quality and costs; ignorance of long-term costs; tender strategies of firms, which tend to be oriented towards short-term full employment of resources; collusive behaviour (in 2000, the national competition commission had to sanction some distribution, tender and price agreements).

Innovation and performance

The construction cluster is perceived as not being very innovative. However, a closer look shows that some segments – especially those with suppliers and services but even some businesses in the more core activities – are more dynamic and innovative. Looking at R&D, construction-related activities are small, with some private applied R&D performed by suppliers and companies carrying out completion work, and some basic and applied R&D performed by the Federal Institutes of Technology (ETH), the specialised colleges (*Fachhochschulen*) and the professional associations.

Data from the two relevant innovation surveys for 1996 (including industry and construction and services) confirm this picture. The share of innovative firms (for example, 42% for construction) shown in Table 2 does not seem to be particularly low, but when these figures are compared with the industry average, construction and real estate activities score well below average and suppliers show only mediate innovativeness. Nevertheless, some specialty fields such as construction chemicals are very innovative; this is in line with the overall innovativeness of the chemicals sector, where more than 90% of firms conduct some innovative activities.

Table 2. **Percentage of innovative firms, 1996**

Core business	
Construction (45)	42%
Potential suppliers	
Manufacture of wood and wood products (20)	52%
Manufacture of other non-metallic mineral products (26)	54%
Manufacture of fabricated metal products (28)	67%
Potential related services	
Other business activities (74)	63%
Real estate activities (70)	40%
Industry	78%
Construction / services	58.7%

Source: Arvanitis *et al.* (1998); NACE codes in brackets.

Patents are often used as an indicator of the success of innovative activities. An analysis of Swiss patenting at the European Patent Office (Schmoch *et al.*, 2000) shows that the construction sector accounts for a considerable 6% of all Swiss patents. Since the mid-1980s, the number of patents has increased in accordance with the international trend. Key patenting fields relate to building construction and completion. The specialisation index[4] rose from 26 in 1984-86 to 42 in 1989-91 and up to 45 in 1994-96, indicating a very solid and even increasing strength in Swiss construction patenting. This patenting is broadly based on a wide number of firms, especially medium-sized firms.

Another indicator of the importance of innovations is the percentage of turnover attributable to new or improved products. Table 3 shows a lower importance for the core construction sector in comparison with suppliers or total industry.

Table 3. **Percentage of turnover attributed to new or substantially improved products, 1996**

Core business	
Construction (45)	9%
Potential suppliers	
Manufacture of wood and wood products (20)	13.5%
Manufacture of other non-metallic mineral products (26)	14.9%
Manufacture of fabricated metal products (28)	13%
Potential related services	
Other business activities (74)	9%
Real estate activities (70)	1%
Industry	22.7%
Construction / services	9.7%

Source: Arvanitis *et al.* (1998); NACE codes in brackets.

This is in line with the perception of actors (Table 4). Only 29% of construction firms consider their product innovations as important for their economic success, which is less than the average of potential suppliers and of total industry. It is interesting to see that, despite the equal importance of product and process innovations in the total economy, construction firms attribute a higher economic significance to process than to product innovation. This, and the fact that innovations which are new to the sector and not only to the firm, are quite rare, are clear signs of a mature sector.

Table 4. **Percentage of firms which rank their product/process innovations as "economically important", 1996**

	Product innovation	Process innovation
Core business		
Construction (45)	29%	35.8%
Potential suppliers		
Manufacture of wood and wood products (20)	35.8%	46.1%
Manufacture of other non-metallic mineral products (26)	49.2%	59.2%
Manufacture of fabricated metal products (28)	76.5%	47.4%
Potential related services		
Other business activities (74)	38.6%	46.2%
Real estate activities (70)	0%	25.1%
Industry	59.4%	57.8%
Construction / services	44.4%	44.3%

Source: Arvanitis *et al.* (1998); NACE codes in brackets.

How is innovation linked to performance? Unfortunately, there are no econometric studies available for the construction cluster. Nevertheless, data suggest stagnating performance with over-capacity. In spite, or perhaps because, of the recession of the 1990s, the construction volume per employee in the construction business rose by 6% between 1991 and 1998, going hand in hand with increased capital intensity. However, labour productivity is low and barely improving (Table 5). Of course, there is a considerable variance between the different sub-sectors of the cluster and between individual firms. Sectors peripheral to the construction business, as well as firms with a pronounced innovation strategy, seem to perform better than others.

Table 5. **Gross value added per FTE**

In CHF thousands

	1997	1998	Percentage change
Core business			
Construction (45)	64	63	-1.4%
Potential suppliers			
Manufacture of wood and wood products (20)	78	74	-5.3%
Manufacture of other non-metallic mineral products (26)	108	114	+5.8%
Manufacture of fabricated metal products (28)	80	79	-0.7%
Potential related services			
Other business activities (74+71)	77	77	+0.2%
Real estate activities (70)	193	195	+0.8%
Other sectors (for comparison):			
- Hotels and restaurants (55)	44	44	+0.8
- Financial intermediation (banks) (65)	246	258	+4.9

Note: FTE = full-time equivalent; 1998: provisional data.
Source: Statistics Switzerland (BfS).

Innovation and co-operation

The requirements of modern innovation processes push firms to co-operate with each other (OECD, 1999). Data show that, in performing R&D or innovation activities, firms in the construction cluster collaborate slightly less than the industry average, with the exception of wood manufacturing and real estate, where collaboration intensity is well below average (Table 6).

More revealing is the pattern of co-operation partners (Table 7). In general, co-operative activities related to innovation or R&D are average or below-average, with supplier-producer relationships being the most important.

Table 6. **Percentage of firms with co-operations in R&D or innovation, 1996**

Core business	
Construction (45)	41.3 %
Potential suppliers	
Manufacture of wood and wood products (20)	28.3 %
Manufacture of other non-metallic mineral products (26)	40.2 %
Manufacture of fabricated metal products (28)	48.7 %
Potential related services	
Other business activities (74)	41.7 %
Real estate activities (70)	28.6 %
Industry	50.8 %
Construction / services	44.4 %

Source: Arvanitis *et al.* (1998); NACE codes in brackets.

Table 7. **Partners in R&D or innovation co-operation, 1996**

	Clients	Suppliers	Competitors	Other firms	Universities
Core business					
Construction (45)	35%	67.5%	50%	22.5%	7.5%
Potential suppliers					
Manufacture of wood and wood products (20)	53.2%	37.6%	46.8%	31.2%	46.8%
Manufacture of other non-metallic mineral products (26)	53.8%	23.6%	26.4%	0%	36.6%
Manufacture of fabricated metal products (28)	92.6%	22.2%	7.4%	22.2%	66.2%
Potential related services					
Other business activities (74)	47.7%	36.4%	47.7%	27.3%	27.3%
Real estate activities (70)	(50%)	(50%)	(100%)	(0%)	(0%)
Industry	51.7%	59%	28.5%	27.8%	52.6%
Construction / services	38.5%	50.9%	50.4%	19%	13.7%

Source: Arvanitis *et al.* (1998); NACE codes in brackets.

Firms in the core business show an above-average co-operation intensity with suppliers, and a below-average co-operation intensity with clients. This indicates that the innovation potential incorporated in forward and backward linkages is better used on the supplier than on the customer side. This, and the fact that the peripheral sectors of the cluster are more customer-oriented in their

innovation co-operation activities, supports the view that construction firms draw on innovations stemming from suppliers. On the other hand, project-based organisation of work, fierce price competition on the end-product market and the usually not very demanding customers, can explain the low engagement with customers.

Another interesting observation is the very low co-operation rate with universities. Is this a sign of weakness and a potential area for improvement? What do universities have to offer the construction cluster? Is there a real need for co-operation? These questions bring up the question of the link between construction activities (or economic activities in general) and science at universities. Trying to provide an answer with data calls for patent analysis which provides an indicator for the linkage to science (Schmoch *et al.*, 2000). References to scientific journals in patent documents show that, on average, 0.85 scientific articles are cited per patent. For construction patents, only 0.2 scientific articles are cited, meaning that there is only a weak linkage of construction to science. Of course, this goes well with the low co-operation rate. Nevertheless, experts refer to important co-operative efforts with construction firms and the Federal Institute of Technology, especially in the field of construction engineering and management. It is likely that such co-operation activities are not well reflected in scientific journals and hence not in patent documents.

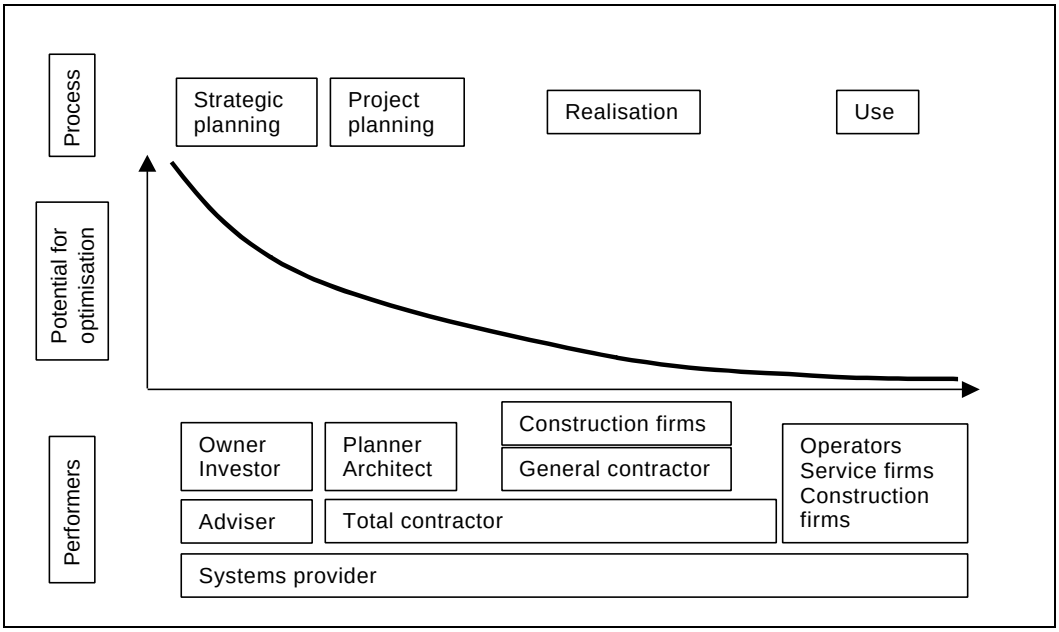
The peripheral sectors of the cluster are more customer-oriented in their innovation co-operations. The more innovative and dynamic the supplier firms, the better they link to the university sector (hence the higher percentage in construction chemicals or concrete technology). In addition, firms have strong ties to EMPA, a federal institute for research and testing which is affiliated to the Federal Institutes of Technology (ETH).

The need for co-operation and organisational innovation

So far we have looked at innovation and patenting and the situation for the cluster does not seem to be as bad as one would have expected. So, is there a problem? Yes, and it relates to the organisation of the construction process, its fragmentation and project orientation. A major inefficiency stems from the division of labour and poor co-ordination in the sequence of the activities during the life cycle of a construction project; namely, strategic planning, project planning, realisation (construction), use (including real estate management and renewal) and destruction (Girmscheid, 2000; Wettstein, 2000; Girmscheid, 1997).

As illustrated in Figure 3, the responsibilities for the different processes are most often organisationally separated since there are virtually no systems providers and only few total or general contractors. Furthermore, as in the case of the construction phase, responsibility is frequently split between several performers. This (over)fragmentation and poor co-ordination leads to a key deficiency: optimisation takes place only on activities under the same responsibility and is usually detached from the whole value chain. This also reflects the (somewhat inherent) project-oriented business approach (bringing together owner, planer, manager and construction firms) and the traditional way it is handled (mental attitudes; detailed specifications; almost no project-spreading knowledge use). The most severe divide exists between the planning process and the construction process. Often the useful experience and know-how of those involved in construction is not used sufficiently in the planning process. And even when producers are involved, it is often too late to implement any innovative, efficient and beneficial solutions. Nevertheless, there are promising attempts to improve this crucial interface, especially the joint initiative (SMART) of the associations for engineers, architects and construction firms for a concept of inter-sectoral collaborations which aim at the delivery of a single, integrated product in the place of several separate products.

Figure 3. **The construction process: organisational fragmentation and optimisation**



Source: UBS (2000).

Cluster-related policies

Policies and actions at different state levels (local, regional, national, international) influence the construction cluster. Generally, state agencies act as regulators, clients and promoters or brokers. The following paragraphs concentrate on contemporary, Swiss-specific and innovation-relevant issues.

The following two cases provide examples of how *regulatory changes* are intended to bring more market elements into construction-relevant regulations and thus increase the potential for innovation. First, following a liberal tradition, state actions and regulations are called into question on a regular basis. Recently, a compulsory regulatory impact analysis for federal regulations and projects of significant economic impact was introduced. In addition, for certain issues, a compatibility test for SMEs has to be conducted. This general simplification of new and existing rules has beneficial effects on regulations and projects specifically relevant to the construction cluster. Second, a Swiss specificity – which has consequences for regulation – is the fact that around 70% of the population lives in rented apartments or houses. For political reasons, rents are coupled with mortgage rates, which implies that rents reflect costs rather than market conditions. Ongoing discussions favour the replacement of this mechanism with an inflation-coupled index which would allow more market-driven adaptations of prices and a further segmentation of the market that would feed back to firms and their products.

Spatial planning and traffic policies set rules for various players but also show a demand effect through the building of infrastructure, especially large-scale projects such as, for example, railways (Bahn2000, NEAT). In general, the quality and innovativeness of state demand is determined by *procurement* rules (Gauch and Stöckli, 1999). In terms of volume, the cantons and communities outperform the federal state in public procurement. Due to decentralised legislation, many differing procurement rules apply, although the (Swiss) common market law as well as an agreement between cantons do have an integrating effect. Nevertheless, there are some drawbacks for transparency and costs since, for example, a thorough search of procurement projects has to be done by looking through

two dozen different procurement publications. Recently, federal procurement relevant for the construction cluster is co-ordinated by a joint committee of the federal building and real estate organs. Concerning the selection process, the federal procurement law sets out certain selection criteria, obviously price, quality, etc., but also including sustainability. However, innovation is not explicitly mentioned. Federal procurers are said to select traditional, market-proven solutions rather than innovative, experimental ones.

In terms of procurement methods, again a traditional picture appears. It is commonly believed that a good procurer has to determine very many details, thus functional procurement is not common. Nevertheless, there are some signs that procurement methods are changing, especially at the cantonal level but also at the federal level where the introduction of electronic procurement for standard goods is now being discussed. Furthermore, there have been some private and public attempts (labels, technological innovations, computer tools, conferences, etc.) to incorporate ecological requirements in construction activities ("sustainable construction") since it is obvious that the construction cluster has a vast potential for ecological improvements (50% of construction investment is spent for new buildings; 60% of total Swiss energy consumption is for construction and operation of buildings). Although a number of initiatives exist, the possibilities for combining ecological requirements and public procurement to bring about innovation have yet to be fully exploited.

With some initiatives, the federal state takes on the role as a *broker*. From an innovation perspective, the CTI funding mechanism and the Effi-Bau initiative are relevant for the construction cluster. The CTI (Commission on Technology and Innovation) has been the funding mechanism for applied R&D for more than 50 years, sponsoring the costs of non-profit partners in joint industry-science R&D projects up to a maximum of 50% of total costs. In 1986-2000, CHF 24 million were spent on projects directly related to construction, inducing private R&D expenditure of an additional CHF 36 million. In terms of public funding, the ETHs, with around CHF 14.7 million of public funds benefited most, followed by the technical colleges (*Fachhochschulen*), with CHF 3.5 million. Looking at the thematic priorities, CHF 12 million were spent for construction technology, CHF 4.2 million for material science and CHF 3.3 million for information technology (software).

An example of a fully-fledged cluster policy is the recent federal initiative Effi-Bau (the acronym stands for efficiency potential of the Swiss construction business).[5] The severe recession of the 1990s was the catalyst for the action. Starting from an initial general impression that the construction cluster with its over-segmentation was being challenged by the increasing complexity and additional requirements of construction processes, a reorientation as well as the application of new production and management concepts such as integrated construction planning and production were seen as possible solutions which would enable SMEs to survive the recession. The idea of the initiative was to obtain a comprehensive judgement on the state of the construction cluster and to communicate the result, to locate efficiency potentials within the cluster and to concretise them within certain projects, and to apply and diffuse the knowledge gained.

The initiative encompassed four phases, starting in 1995 with an interdisciplinary steering committee defining the overall goals of the initiative and launching three parallel analyses to ensure a comprehensive review of the state and problems of the construction cluster and to locate efficiency potentials.

In the second phase (1995-96), these analyses were realised. Paying attention to feedback loops, different hearings with representatives of the construction cluster were carried out. Not surprisingly, the different analyses highlighted more or less the same weaknesses but with different weightings. Most weaknesses and even recommendations for improvements were widely recognised but had not yet been implemented. The overall message for improving the construction cluster can be summarised

as follows: increase the competence of the cluster actors while providing them with an optimal playing field. Three main objectives were deduced from this vision:

- *Increase the competence of the clients (owners or users)*. Emphasis was put on unprofessional owners (those not backed by an advisor) who are responsible for a substantial part of construction spending.

- *Increase the competence of the suppliers*. The aim was to better adjust the activities of planning and construction firms to market needs, especially by supplying integrated services and products as well as better project management.

- *Improve framework conditions*, focusing on further education, procedures for the obtention of permits, and procurement.

In the third phase (1997-78), various development and pilot projects were launched and carried out (for a total volume of less than CHF 3 million). Out of 200 proposals (within the three main objectives), 16 were selected and realised. Projects had to deliver concrete products which could be used in practice and were tested in real cases. Examples of the achievements include: a computer program to determine the value of a building; a manual to calculate the expected costs for strategic planning; the application of the concept of a virtual enterprise, some recommendations and model contracts; the analysis of the new public procurement law and some recommendations.

The fourth phase (1998) was dedicated to diffusing the end results using different methods (publications, seminars, etc.). This process was mainly carried out by the organisations which supported the initiative.

Effi-Bau is considered a success since it revitalised the cluster and brought together different actors. Most important was the initiation of dialogue, networking and broader co-operation. Concerning the weaknesses of the construction cluster and its innovation potential, few novelties were identified. However, some aspects were developed further and, with its reference to practice, it helped to point to certain perspectives and action fields for industry. Also important was the fact that weaknesses were explicitly mentioned and discussed.

Summary and conclusions

This chapter has described the construction business and its related activities using a value-chain (cluster) approach focused on dynamics and innovation. The construction cluster is made up of established businesses under heavy strain from recession and price competition. Firm behaviour and market segmentation is traditional, leaving insufficient room for demand criteria. Today's strengths were built up over the years and are often based on existing economic structures or other Swiss specificities (*e.g.* tunnelling, construction chemicals, polymeric materials).

Despite the maturity of the cluster, innovative segments do exist, especially in the peripheral sectors where some European and international players are present. From the perspective of technological innovations, the construction business scores fairly well thanks to an adequate innovation rate and fairly strong patenting activity. The strong interface between the core construction businesses and suppliers paves the way for the diffusion of supplier-generated innovations in the construction business. On the other side, customers are not sufficiently demanding or innovative to have a dynamic impetus on the cluster. Furthermore, cluster actors face an (inherent) organisational problem due to the traditional project-oriented business with sub-optimal co-ordination, knowledge

management and learning. Even though the value chain in the Swiss construction business is heavily fragmented (mostly between planning and production), some private and public initiatives (SMART, Effi-Bau) highlighted the usefulness and appropriateness of a cluster perspective integrating the different value chains. Thus, innovation and growth in the cluster is dependent on the ability to organise the necessary horizontal and vertical co-ordination.

Policies related to the construction cluster represent many societal issues, such as the importance of the cluster for employment, the importance of rents in the living costs of the majority of citizens, the importance of construction for spatial development, etc. It is clear that the role of the state is comprehensive, particularly when public procurement makes up an important part of demand. The orientation of these policies towards a cluster perspective is difficult but beneficial, especially when the aim is to target innovation while respecting other goals. In general, government and other actors should strive to enable change, promote dialogue, support cultural and behavioural shifts, etc. A cluster policy needs to identify the strengths and weaknesses of the relevant cluster in order to bolster the former and remedy the latter. In the case of the Swiss construction cluster, this will entail: *i)* improving innovation conditions for suppliers as well as supporting the interface between suppliers and construction firms, since supplier-driven innovations constitute a dynamic element in the cluster; and *ii)* fostering competence building on the demand side in order to create additional dynamism.

Annex

DEVELOPMENT OF EMPLOYMENT IN THE CONSTRUCTION CLUSTER

Annex Table 1. **Persons employed in different (potential) segments of the construction cluster**

NACE	Description	1985	1991	1995	1998
	Tertiary sector	2 038 073	2 475 922	2 436 011	2 447 225
	Secondary sector	1 239 385	1 284 981	1 112 804	1 024 203
45	Construction	348 831	382 732	339 454	293 893
	Core business				
45.2	Building of complete constructions or parts thereof; civil engineering			190 585	156 701
45.21	General construction of buildings and civil engineering works			127 610	95 385
45.22	Erection of roof covering and frames			27 652	27 851
45.23	Construction of highways, roads, airfields and sport facilities			16 930	15 433
45.24	Construction of water projects			358	118
45.25	Other construction work involving special trades			18 035	17 914
	Supporting industries				
45.1	Site preparation			3 250	3 644
45.3	Building installation			89 252	81 262
45.31	Installation of electrical wiring and fittings			40 672	36 524
45.32	Insulation work activities			3 730	3 154
45.33	Plumbing			41 445	36 824
45.34	Other building installation			3 405	4 760
45.4	Building completion			56 144	52 079
45.41	Plastering			8 314	6 218
45.42	Joinery installation			4 587	4 311
45.43	Floor and wall covering			11 232	11 617
45.44	Painting and glazing			30 368	28 421
45.45	Other building completion			1 643	1 512
	Potential suppliers (selection)				
14	Other mining and quarrying	6 168	7 178	5 968	5 187
14.1	Quarrying of stone			1 217	1 013
14.2	Quarrying of sand and clay			4 406	3 445
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	54 520	52 573	43 731	38 328
26	Manufacture of other non-metallic mineral products	26 235	26 397	21 734	19 902
26.1	Manufacture of glass and glass products			4 241	4 267
26.3	Manufacture of ceramic tiles and flags			430	20
26.4	Manufacture of bricks, tiles and construction products, in baked clay			1 444	1 071
26.5	Manufacture of cement, lime and plaster			1 298	1 059
26.6	Manufacture of articles of concrete, plaster and cement			6 809	6 849
28	Manufacture of fabricated metal products, except machinery and equipment	81 792	90 446	90 692	83 108
45.5	Renting of construction or demolition equipment with operator			223	207

Annex Table 1. **Persons employed in different (potential) segments of the construction cluster** *(cont'd.)*

NACE	Description	1985	1991	1995	1998
	Potential related services (selection)				
74	Other business activities	180 911	256 902	258 359	266 449
74.2	Architectural and engineering activities and related technical consultancy			83 225	73 864
74.20A	Architects			34 930	31 625
74.20B	Interior designers			1 128	1 111
74.20C	Construction engineers			19 240	17 541
74.20D	Other engineering firms			16 183	11 485
74.20E	Surveyors			2 978	3 116
74.20F	Town and country planning firms			845	793
74.20G	Landscape gardeners			1 374	636
74.20H	Other technical consultancy & planning firms			6 547	7 557
70	Real estate activities	15 215	18 778	17 292	18 492
70.1	Real estate activities with own property			1 576	811
70.2	Letting of own property			1 790	1 637
70.3	Real estate activities on a fee or contract basis			13 926	16 044
70.31	Real estate agencies			3 024	3 880
70.32	Management of real estate on a fee or contract basis			10 902	12 164

Source: STATWEB 2001 (http://www.statweb.admin.ch/).

NOTES

1. A cluster is a set of organisations either characterised by their interdependence (buyer-supplier, input-output or value chain relationships) or their commonalties (geographical location, the generation or use of a common technology, the use of common distribution channels, or a common labour pool). See, for example, Bergman and Feser (1999); DeBresson (1996).

2. The so-called “method of maxima” yields the most important user-supplier relationships.

3. Site preparation (NACE 45.1) can also be included here.

4. The specialisation index RPA_{ij} is defined as: 100 tanh ln $((PAT_{ij}/\Sigma_i PAT_{ij})/(\Sigma j PAT_{ij}/\Sigma_{ij} PAT_{ij}))$, where PAT_{ij} is the number of patents of country i in technology field j.

5. The basis for this federal initiative can be found in the message to the Parliament (Schweizerischer Bundesrat, 1994), as well as in the relevant legal documents. Further information on the initiative can be found at http://www.effi-bau.ch.

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