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Industrialization processes in Swiss SMEs

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KEYWORDS

Industrialization, SME, standardization, systematization, process orientation.

1 Introduction

Since the 1990s, the construction industry has been undergoing fundamental structural change, which is perceived externally through bankruptcies and poor share prices of many companies [Hofmann 1999]. After many years of stagnating or declining demand, the symptoms of a perfect market with a large number of homorphous demands and virtually randomly interchangeable suppliers are impacting the Swiss structural engineering market, in spite of the fact that demand is meanwhile picking up again. Price competition is extremely fierce and involves bidding rounds that generate inadequate margins or insufficient profits to allow many companies to ensure their survival over the long term [Girmscheid 2005a].

The offering price is nowadays one of the principal criteria for awarding construction contracts. The less specialist expertise that is needed for the execution of the works, the more important the price becomes. In residential construction, where this holds particularly true, the price of a service is frequently the only criterion for selecting a supplier, given the lack of any other alternatives. In fact, the pricing structure generally bears very little resemblance to the actual cost structure. It is the market, and not internal cost calculations, that determines the price [Girmscheid 2006]. In order to win a construction contract, competitors underbid each other in the bidding process or bidding rounds although the financial scope within the industry is unbelievably narrow, with margins averaging between 2 % and 3 % [Girmscheid 2005a].

As illustrated by Boenert and Bloemeke [2003] and, in similar form, by Winch and Carr [2001], more than one third of all costs incurred across the entire construction process do not add value and are, for the most part, avoidable (Fig. 1). By introducing and optimizing planning, logistics and control processes, such calculation examples could soon become a thing of the past, if existing savings potential were to be rigorously exploited.

Corporate goals, such as customer satisfaction, low manufacturing costs, short construction times and high levels of quality, are irrespective of the size of a company. Success depends purely on selecting the right method of implementation, which must be tailored to each individual company. It is not just production requirements that need to be improved – it is important to establish a systematic

interaction among planning and construction production that incorporates marketing considerations and marketing strategies [Girmscheid 2006].

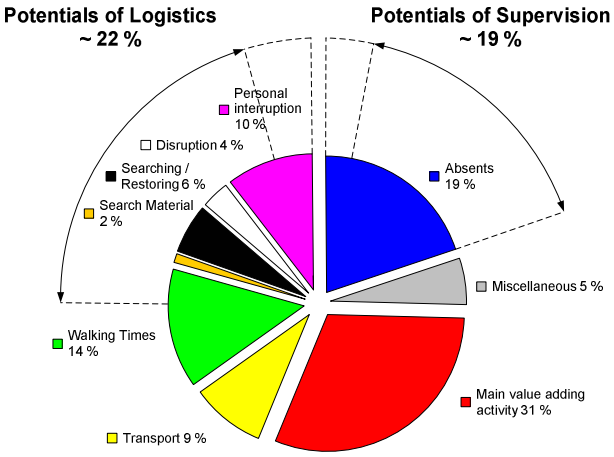

Figure 1. Potential means of reducing costs.

2 Research methodology

The hermeneutic spiral for this research project, which was developed within the framework of the theoretic-analytical constructivist research approach [Girmscheid 2004], is comprised of the following sources of findings:

- business management analysis of the individual processes
- qualitative data collation from problem-focused, semi-structured interviews
- evaluation of the interviews and findings from literature
- logical-deductive structuring of alternative actions arising from the evaluations
- organization of workshops to verify and structure operative solution clusters from the alternative actions

The interpretavistic constructivist research paradigm developed by von Glasersfeld [1987] is applied to constructing socio-technical systems for processes and alternative actions based on input-output relationships. The solution clusters and alternative actions or measures will be validated theory-driven logically [Girmscheid 2004] and empirically [Stier 1999] using sources of literature and interactive workshops with the companies involved, and tested for suitability. The concluding quality test will be performed by triangulating the results according to Yin [2003], on the basis of literature, qualitative surveys and practical realizability tests.

In order to achieve the resource oriented SME goals, conceptual operative industrialization concepts were analyzed, heuristically developed and validated for realizability in a research project conducted by SFIT Zurich in cooperation with the Swiss Association of Construction Entrepreneurs (SBV) [Bärthel 2002]. The project focused specifically on SME production, where the material generic characteristics are rationalization through standardization, systematization, flexibilization and mechanization / automation, according to Girmscheid [2005b].

3 Possible solutions for SMEs

To ensure their future, SMEs must focus on a resource oriented improvement of their profit situation, in addition to their strategic, market oriented positioning and target oriented marketing. Since a general increase in the price level is equally as unlikely as any release of the tension in the

construction market, this improvement can and must be achieved by exploiting the following success potentials:

- by reducing costs against the background of price levels that are stagnating overall or even continuing to decline
- by expanding their product range towards system provision by including activities that extend beyond actual construction
- by improving the price structure with the aid of customer oriented services that are not exposed to direct price competition but which make the bid more attractive by increasing the customer benefit

Ultimately, it is the property developers as the construction industry's clients who decide whether a range of offered services is successful or not, which is why any attempts by a company to improve its position must focus on the market or customer interests. Irrespective of the optimal strategic positioning, it is above all the SMEs, which offer virtually interchangeable market services in construction production, which must strive to achieve maximum cost efficiency.

Girmscheid [2006] defines construction industrialization generally as the "rationalization of work processes to achieve cost efficiency, and improved productivity and quality". Transposed to SMEs in the construction industry, this means:

- Market orientation
  - Focus on specific market segments
  - Supra-regional specialization in specific work areas
- Resource orientation
  - Interaction among planning, work preparation and construction delivery
  - Optimized processes and an optimized organizational structure
  - The use of prefabricated components and variable construction modules
  - Standardization of construction processes and the building materials used
  - Mechanization and automatization of processes

Fig. 2 shows the structure of construction industrialization in different industrialization paradigms, together with the relevant marketing strategies and possible areas of application. Realization is dependent on cooperation among planners and specialist companies, which necessitates new project delivery and business models [Girmscheid 2006].

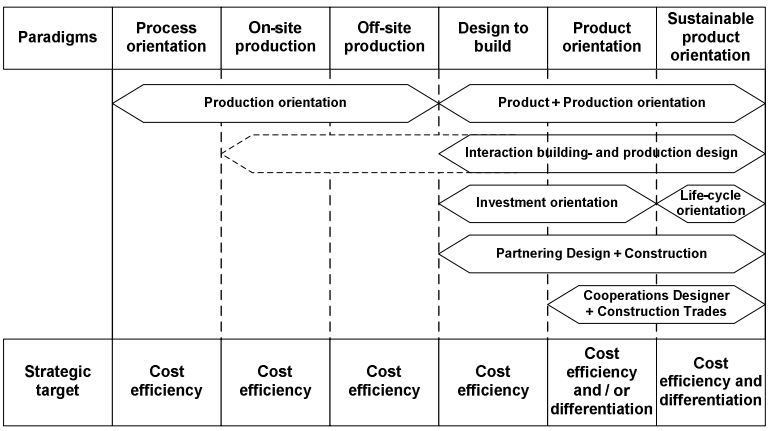

Figure 2. Industrialization paradigms and their relevant strategies.

3.1 Operative solutions

Since the combination of strategic and operative approaches is the only way to sustainably increase competitive ability over the long term, the following operative solution clusters were logically derived, in addition to the strategic solutions (Fig. 3):

- Standardization of materials, components and construction methods
- Systematization and rationalization of the integrative interactive delivery and production planning processes
- Rationalization of the deployment of equipment by using "all-round equipment" to increase the level of utilization
- Rationalization by using standardized information technologies for internal and external data exchange
- Rationalization and standardization through prefabricating components

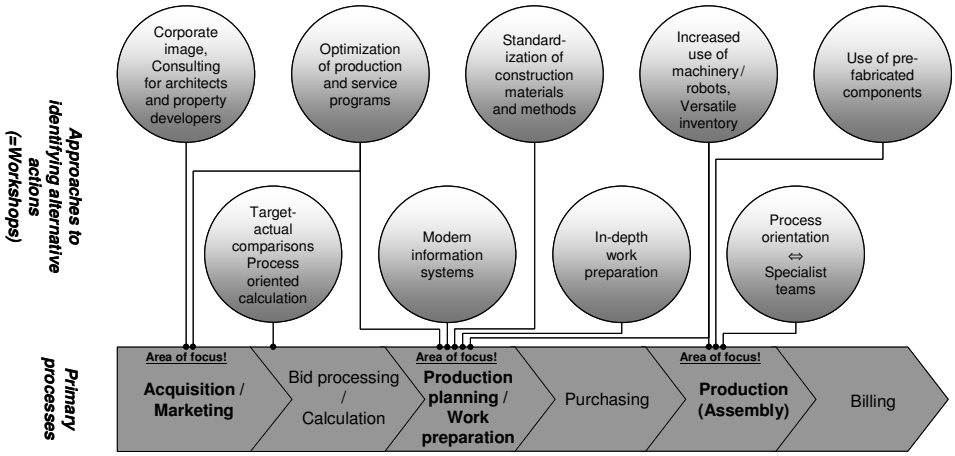

Figure 3. Possible alternative actions and their allocation to the primary processes in the value creation chain.

Various alternative actions were derived from workshops with industrial partners to develop a qualitative structure and implementation of the individual solution clusters. The logical approaches to possible solution clusters and alternative actions emerged, on the one hand, from analyses of small series and single order production in the field of mechanical and plant engineering that focus on the issues of diversity and the associated complexity costs. Further approached were based on an observation of the manufacturing and logistics processes (including the flow of information) in the construction industry [Schweizerischer Baumeisterverband (Hrsg.) 2002]. The approaches that were determined, together with their allocation to the primary processes of the value creation chain, are shown in Fig. 3.

3.2 Alternative actions for industrializing SMEs

Based on the potential solution clusters for industrializing SMEs (Fig. 3), which were derived empirically and logically, related alternative actions and measures based thereon were theoretic-analytically developed and qualitatively tested for realizability by industrial partners. The integrated approaches can be read in Bärthel [2002], this publication focuses on presenting the following solution clusters and alternative actions as examples:

- Rationalization through systematization and standardization of construction materials and prefabricated components
- Rationalization through flexibilization of inventory deployment using "all-round" equipment and construction aids

Building materials and prefabricated components:

Individually designed structures that are planned and built for the same purpose (e.g. homes) are often made from the same building materials and using similar construction processes. This offers a possibility of standardizing within the company those building materials that do not have an architectural impact. In the case of the shell, in particular, generally only technical functions need to be ensured, which gives SMEs certain freedom to decide which building materials to use, thus offering potential for standardization. The following practical examples highlight the approach to rationalization:

- Use of steel fibre reinforced concrete in floor slabs (Fig. 4) as an example of rationalization through the standardization and systematization of building materials. Possibilities of rationalization arise from the elimination of reinforcement works on the building site and a thinner slab, compared with conventional mesh reinforcement.

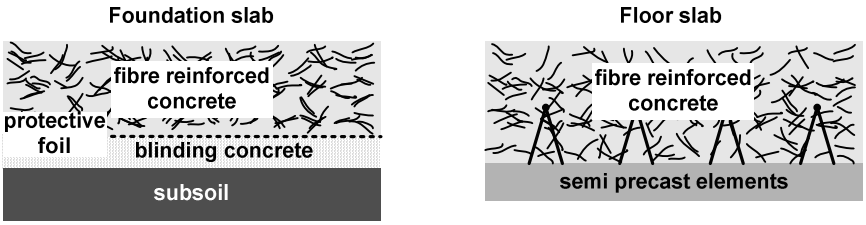

Figure 4. Rationalization through the use of standardized building materials (e.g. use of steel fibre reinforced concrete in foundation and floor slabs) and prefabricated components (e.g. semi precast floor slab elements)

- Use of hollow reinforced concrete walls in cellars as an example of rationalization through the use of prefabricated components (Fig. 5). Potential rationalization arises from the elimination of placing reinforcement on site and formworks.
- Use of semi precast construction systems with steel fibre reinforced top layers as an example for rationalization through combining standardized building materials with semi precast floor slab elements (Fig. 4 and Fig. 5), where the placing of reinforcement on site and formworks on the building site can also be eliminated.

Figure 5. Rationalization through the use of prefabricated components (e.g. hollow reinforced concrete walls and semi precast elements)

Equipment and construction aids:

Construction works can be performed using various construction methods and, in consequence, also using various construction aids and equipment. Generally speaking, the degree of specialization of the material and equipment relates analogously to the value adding potential, but is inversely proportionate to the degree of utilization. In order to ensure a high degree of utilization and, in consequence, a streamlined construction delivery across several projects, the existing construction

aids and equipment must therefore be as flexible as possible. There are two basic ways of achieving this flexibility:

- Use of "all-round inventory", which generally does not offer optimal project-specific value added, given its high degree of flexibility, but which does guarantee a high degree of utilization and, as such, a rationalization of inventory deployment as a result of its extensive possibilities of application. One example would be the use of telescopic loaders that can be used both for loading and unloading, and for earthworks or transportation.
- Outsourcing construction aids and equipment and renting them on a project-specific basis. In this case, the system offering optimal value added is chosen and used for each project, whilst at the same time not tying up the SME's capital over the long term. One example for project-specific rental would be the use of rented formwork, which could be chosen for a specific project, adapted where necessary, and rented for the duration of construction.

Generally speaking, rationalization must be prepared using target oriented, systematic and standardized planning and work preparation.

The entirety of the individually developed measures was subsequently summarized in decision-making diagrams and check lists [Schweizerischer Baumeisterverband (Hrsg.) 2002], where the various statements relating to the measures and their implementation could be evaluated on a company-specific basis. An evaluation of the decision-making diagrams and check lists also enables statements to be made relating to cost saving potential arising for the individual business areas of a company from industrial construction.

4 Conclusion

Industrial construction offers optimal prerequisites for improving efficiency and strengthening earnings power, both in large and small companies. The main problems are primarily issues of planning, logistics and standardized processes, and less of a technical nature. Success depends, above all, on the attitude of the company's management, since customer orientation also means product orientation, and necessitates a willingness to change on the part of all players.

Any strategy aimed at industrializing construction must include approaches to overcoming the fragmentation of construction and planning works. The starting point for industrialization lies in a three-fold change

- of the sequential independent processes of preparing work drawings and production planning to form an interactive integrative planning approach aimed at "design to build"
- of construction production planning and logistics, which are scarcely or not at all systematized, to form a generally standardized systematic process to increase productivity (value adding)
- of improving planned construction production and logistics by introducing a continuous improvement process with a simple controlling mechanism to ensure systematic target management

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