

Business development opportunities for robotics in Dutch construction industry

Koos Johannes

*Dutch Foundation for Building Research,
P.O. Box 1819, 3000 BV Rotterdam, The Netherlands.
k.johannes@sbr.nl*

ABSTRACT: This paper describes a research project of the Dutch foundation for building research, aimed at identifying and describing the key technologies for robotics and automated production systems in the building & construction industry. The project focusses on the Dutch building & construction industry (housing & utility buildings excluding civil engineering constructions). The main goals of the project are to:

- Describe the available technologies, relevant for automated production systems, currently referred to as:
 - Construction robots and/or computercontrolled machines
 - Automated buildingfactories
 - Computer aided manufacturing
- Identify the opportunity area's for successful implementation of automated production systems
- Describe the consequences of applying automated production systems for the organization of small and medium sized enterprises (SME's)
- Develop a detailed plan for knowledge transfer.

KEYWORDS: Off-site construction, product/market/technology mapping, business development, SME's.

1. INTRODUCTION

Traditionally in the construction industry the production activities are concentrated on the building site. The last decades however, a shift towards prefabrication and off-site production can be recognized. By relocation of production activities towards a factory environment the building production process can become more efficient and better controlled. When in such a factory environment buildings and/or building components are produced according to industrialized manufacturing principles and concepts, we speak in this paper of an industrialized construction process.

Automated production systems can play a major role in industrialized construction processes because the advantages of prefabrication can be further enhanced:

- Technical quality of the end product can be controlled better, leading to constant quality which better meets the expectations of clients
- Working conditions for construction workers are better (weather independent and replacement of routine activities by computers/machines)

- Productivity in the construction industry can be improved
- Because of the replacement of human labour by machines/computers, human resources are better manageable in times of economic fluctuations and changing workvolumes.

2. TAKING NEW TECHNOLOGIES TO THE MARKET

Despite the potential advantages of automated production systems, these systems and their associated technologies have not penetrated the building & construction industry on a large scale, because of several reasons.

2.1 Marketconsiderations

The market for construction projects is heterogenous. Differences in clients needs, building function and characteristics and physical site-circumstances for example lead to different building & construction approaches. Some approaches allow application of industrialized manufacturing concepts more than others. Although industrialization of the building & construction industry cannot be stopped, the

expectation is that they will always to some degree be projects which require building & construction approaches based on traditional technologies.

Automated production systems should therefore be targeted to those market segments in which they add the most value. Systems which are successfully implemented in one country will not automatically be suitable in another country because of differences in market volumes, industry structure etc.

2.2 Business strategy & operations

Implementation of automated production systems requires investments of individual companies in technology (hardware, software) and people (training & development). In many cases the introduction of automated production systems will have consequences for the internal organisation. The relations between the calculation department, the engineering department and the workforce will change. Business operations will have to be redesigned.

Except for the internal organisation, implementation of automated production systems can also have an impact on the external relations. Many contractors and subcontractors/suppliers of building components work in business-to-business markets and interact with other stakeholders in the building & construction supply chain. So therefore investments in automated production systems should be part of a company strategy and a sound integrated view on business definition (in which business are we in?), products & services, markets.

2.3 Knowledge infrastructure

The acquisition, installation and operation of automated production systems requires specific know how and expertise. To make a sound investment decision, knowledge about the possibilities and limitations of the systems and associated technologies is needed. Also the implementation and use of these systems may require knowledge and skills which are not available in the company and will have to be acquired.

Taking everything into account, we can conclude that for many construction companies and subcontractors, which are small & medium sized

enterprises (SME's) the decision to adopt and implement automated production systems is difficult because of a lack of knowledge and insight in the business development opportunities.

3. RESEARCH QUESTIONS & APPROACH

The project addresses the following questions:

- Which technologies, associated with automated production systems are relevant and available for the building & construction industry.
- To what degree and in which form are these technologies currently being applied by the industry.
- Which product/market/technology combinations offer opportunities for applying automated production systems.
- What kind of knowledge-transfer will be necessary to accelerate the adoption of the technologies in the opportunity-rich market segments.

The overall structure of the research-project is shown in Figure 1. The project is currently in the start-up phase. The project is planned to take off in the final quarter of 2003.

4. TARGET GROUP FOR THIS STUDY

In the construction industry, the supply chain can be complex and fragmented. From the suppliers of raw materials unto the handover of the building to the end user, a lot of stakeholders and businesses are involved. Because the supply chain in the total construction industry is too comprehensive to study as a whole, a decision has to be made on which part of the supply chain to include in this project. As is shown in figure 1, which shows a hierarchy of building products (based on [Eekhout]), this project is limited to automated production systems for buildings, building parts, building components and subcomponents. This for example means that automated production systems for producing cement and bricks will not be covered in this project but that automated production systems for producing prefabricated façades will be.

Table 1. Hierarchy of building products

| Name | Examples |
|----------------------|---|
| raw material | sand, gravel |
| material | Cement |
| compositematerial | concrete; glasfiber reinforced polyester |
| semifinished product | aluminium profiles, metal plates |
| element | Bricks |
| subcomponent | window, frame |
| component | claddingpanels roofpanels prefab concrete floorsheets |
| buildingpart | foundation, façade, roof |
| building | school, office, house |

Based on: [Eekhout]

So the research activities will concentrate on the use of automated production systems by the following targetgroups:

- Building contractors with inhouse workshopfacilities and factories for prefabrication
- Subcontractors/producers of prefabricated buildings (timberframed, steelframed, systems builders)
- Producers of subcomponents and components (prefab concrete sheets, façade systems, frames etc.).

The role of the other stakeholders, for example the architect and the client will however not be neglected.

5. FINAL CONSIDERATIONS & REMARKS

The potential value of this project related to an earlier study of SBR [SBR] and to for example the IFD-programme [SEV] is that in this project technology is linked to marketing. The purpose of this project is to identify marketsegments in which structural application of automated production systems is feasible. In this way the project aims at stimulating project indepent innovation.

It is expected that after finishing this project the targetcompanies are informed about automated production systems and the associated technologies in a way that they should be able to:

- Recognize the possibilities for automated production systems in their own corporate context.
- Make a balanced decision about the possible introduction of these systems in the own organisation.

- Find support for setting up implementation- and introductionprojects in their company (financial support through subsidies, consultancy, training etc.).

6. REFERENCES

[Eekhout] Eekhout, Mick, 2003, *Faalkostenreductie en industrialisatieconcepten*, Paper BouwBeter Congres, Stichting Bouwresearch.

[SBR] SBR, 1996, De toepassing van robots en computergestuurde werktuigen in de bouw, Stichting Bouwresearch.

[SEV] SEV, Leaflet IFD and www.sev.nl.

Figure 1. Overall structure of the research project

