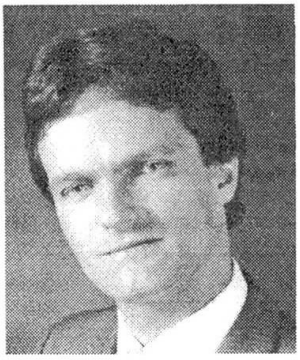
Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 83 (1999)

Artikel: Integrating automation into the life cycles of structures
Autor: Cobb, David
DOI: https://doi.org/10.5169/seals-62954

Integrating Automation into the Life Cycles of Structures

David COBB
Consultant Civil Engineer
Aldbury, Herts, UK



David Cobb, born 1957, chartered civil engineer, received his civil engineering degree from Surrey University and has since obtained Masters degrees in geotechnics and business administration. He is actively involved in EU research projects and helping organisations to win funding from Europe.

Summary

High-rise, long-spanning or simply repetitive-shaped structures lend themselves to automation and "robotisation". Automation concepts may be incorporated in many stages of their life cycle. This paper reports on a world-wide market research exercise which sought to establish respondents' views and knowledge in this area. Drivers for introducing such concepts include, in order of rank: productivity; quality; safety; working conditions; labour cost savings and standardisation. Quality of construction can be enhanced by removing/reducing human error, which frequently arises from on-site fatigue, itself a legacy of the construction environment. Savings of nearly 15% , achievable in only 5 years, for a typical building with the introduction of automation concepts are described. Cross-fertilisation and awareness programmes are needed to educate students and practising construction professionals alike.

Keywords: automation; robotics; life cycles; buildings; maintenance; sensors; manipulators; market research; standardisation; productivity

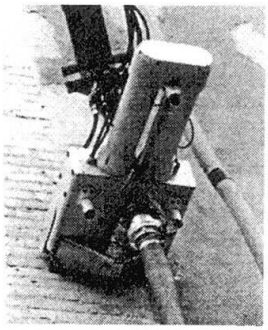
Abstract

The future competitiveness and success of the construction industry will be largely dependent upon the application of research findings, the introduction of innovative processes and products and their practical demonstration and marketing. The proposition to be tested in the underlying report to this paper (the ROBOBUILD report) was that the compound effect of introducing automation and robotics into a structure's life cycle could reduce costs without compromising on quality and safety. This proposition was tested using a detailed market research questionnaire (MRQ) with respondents coming from a world-wide geographic base.

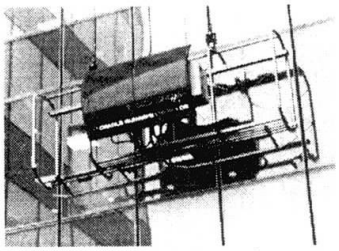
The fragmented nature of the construction industry offers both opportunities and barriers to the introduction of automation and robotics but its development should not be in isolation from other construction I.T. infrastructure developments. Robotic technology relies on series of 'toolboxes' which themselves comprise: mobility and navigation; manipulators; end-effectors; material feeding and sensing and control systems.

An MRQ question put to respondents asked them to score the level of importance when considering introducing AR into buildings and structures. The results indicated that productivity improvements ranked slightly ahead of improvements in quality and reliability. However there was strong support for improving: safety; working conditions; labour cost savings; standardisation of components; overall whole-life cost savings and simplification of operations.

There are estimated to be around 4,500 residential high-rise blocks in excess of 12 storeys height in the UK. The sums of money required are vast with, for example, London's Lewisham Authority who, in 1994/95 identified the need for an additional £40m to address problems that have a 'working at height' component alone. Thus anything that can be done to drive down the costs of assessment and remedial work by integrating automation techniques into the life cycle of structures will be welcomed by housing authorities across the UK. Systems, such as that shown right, can make light work of removal of loose or poor rendering by achieving up to 400m^2/hr productivity



System BIBER removing roughcast



OCS's ARCOW window cleaner in action

The robotisation of window cleaning is one area that has been receiving much attention in recent years and new systems, such as that shown left, may rely on mullion design being incorporated very early on in a new building concept.

Taking a look at one detailed response to an MRQ question respondents were asked to score achievable reductions in the construction of a typical office block with the application of automation and robotics. The results are tabulated below:

	Element	Typical average current costs (%)	Mean % reduction in 5 years with the application of AR	Potential average savings (%)
1.	Wall finishes	2.5	19.9	0.5
2.	Floor finishes	3.5	18.6	0.65
3.	External envelope	16.5	17.4	2.87
4.	Frame	5.5	17.1	0.94
5.	Services	34	16.3	5.54
6.	Ceiling finishes	2.5	15.7	0.39
7.	Upper floors	2.5	14.6	0.37
8.	Roof	5	12.7	0.64
9.	Prelims, fees, site costs etc.	7.5	12.0	0.90
10.	Substructure	7	12.0	0.84
11.	Internal divisions	9	11.8	1.06
	Total average saving possible in 5 years time for a complete structure with the introduction of automation and robotics into the construction process.			**14.70%**

The paper offers a number of conclusions and recommendations and to some extent these are already being implemented and will be reported upon at the conference. For example, a UK proposal to establish a network that bridges the technology-push market-pull gap has been submitted and a major EU-sponsored project has been launched that embraces these technological and economic issues. A good starting point for anyone wishing to deepen or develop their understanding of these issues is to visit the web site of the International Association for Automation and Robotics in Construction (IAARC) at *http://www.iaarc.org.*

New skills and ways of thinking need to be introduced into tertiary educational courses and by means of continuing professional development. Only then will professionals be able to consider how quality aspects can be enhanced by integrating automation concepts into the life cycles of structures.