# Automation with or without 'humanization'?
# Dilemma in a developing construction environment

**Dr.ir. Wilco Tijhuis**

*Ass.-professor at University of Twente, School of Business, Public Administration and Technology, Department of Construction Process Management; P.O.Box 217, NL 7500 AE, Enschede; The Netherlands; www.utwente.nl; w.tijhuis@utwente.nl*

*Managing partner at WT/Beheer BV - a holding of international development activities; P.O.Box 110, NL 7460 AC Rijssen; The Netherlands; www.wtbeheer.com; tijhuis@wtbeheer.com*

**ABSTRACT:** In the present modern construction industry there is a growing acceptance for automation. Not only while the human need for it is growing or whatsoever, but also while the living environment in general is increasingly involved with automation-processes and equipment. See e.g. ICT-developments like mobile phones, internet, computers, household-appliances, etc. These daily 'tools' have been strongly integrated in day to day life and business. At least in the so called 'modern society'. However, especially in developing areas the use of such equipment and technologies is still quite underscaled. That means that the way of behaviour of the people involved in daily life and business often is a pure 'struggle for life'.

This paper focusses on the aspect of how to approach the 'automation' of daily life, especially in construction business as a means for improving construction productivity. More specific, focussing on an (underdeveloped but) developing environment. The dilemma of *'automation'* or *'labour-intensifying'* is discussed. In general it shows that the human component, i.e. culture and other human factors (here altogether called 'humanization') plays a more than just a role in it. It is a means which can help to overcome (practical) barriers on the path to better organized construction processes. Therefore, the question on how to get introduced a real 'Future Site' depends more on the level of human acceptance (barriers) than on the level of technological developments. Although the approach presented in this paper is written mainly within the scope of construction in developing regions, it may also be used to *rethink* the situation of construction industry in modern developed regions.

**KEYWORDS:** Automation, Construction business, Environment, Humanization, Technology.

## 1. INTRODUCTION

During the last twenty-five years a strong increase of automation has been intensified. Lots of developments in construction were starting within this period. Think e.g. on new materials like high-strength concretes, special steel-qualities for high-rise buildings, but also e.g. corrugated-board products like boxes for homeless and beggars, etc. [Bats, 1994; Smurfit Lona, 1994]. However, these developments where gradually growing from 'materials' towards 'processes' (e.g. lean construction, etc.[Koskela,1993] and 'tools', e.g. robotics and IT, etc. [Cobb, 2001]). Especially these last mentioned aspects, the robotics and IT (tools) are of growing importance, as they act as (and influence…) the human-machine interfaces. And that means that there are at least three key-issues:

- *Environment (e.g. region, etc.);*
- *Humans (e.g. employee, etc.);*
- *Technology (e.g. equipment, etc.).*

When looking to automation-issues a the means for improving construction productivity, it often seems the case that there is still 'a gap' between these two key-issues. This will be analyzed more into detail.

## 2. THE GAP: A FOCUS

Discussing about 'a gap' can lead to several ways of understanding. In general it means something *uncompleted*, or *missing*, or *not finished* or whatsoever, reflected on a sort of 'bridge-structure'. Against the background of automation in construction, focussed on the two key-issues of 'humans' and 'machines', this may seem a rather strange way of analyzing, as within 'automation'-issues one may think first about machines, IT, etc. And that is not just the way how this paper is

looking at these issues: *Automation starts in our approach with human beings*. Such an approach <u>does not</u> mainly lead in our opinion to aspects of:

*...how to make automation succesful/effective/efficient in helping people.*

But <u>does</u> more mainly lead to several aspects of:

*...how to make humans succesful/effective/efficient by using automation.*

So, before 'bridging gap(s)' one should be aware of which gap(s) there are. Looking more into detail, in figure 1. this 'gap' is represented schematically, based on several fields of attention and leading thus to several 'gaps' like e.g.:

- *Financial gap;*
- *Technical gap;*
- *Organizational gap;*
- *Cultural gap;*
- *Environmental gap;*
- *Etc.*

Several of these gaps are abvious between each of the three mentioned key-issues, although there may be differences in level or intensity. However, especially the gaps related to *'environment'* can differ quite a lot while this is in a global perspective a very diversified area, acting as the 'playing ground' for humans and technology in construction. See figure 1.
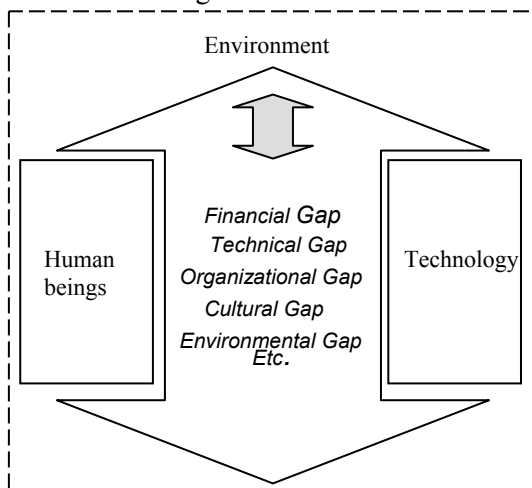


Figure 1. Several 'gaps' between 'environment', 'human beings' and 'technology' in automation processes in construction.

For reasons of embedding this topic within the activities of CIB-Task Group TG 23 'Culture in Construction' (of which the author of this paper is a joint coordinator) combined with the attempt to make a more sharp focus, this paper draws special attention to the question *how to bridge the*

- *Cultural gap,*

Or more in general:

- *Automation with or without 'humanization'?*

This, more specific in the field of human behaviour and related factors (here called altogether 'humanization'), while the human factor in construction obviously plays an important role in problems, occurring during daily construction practice. Not only on a national level but also on an international scale; and not only in a 'modern' construction environment but also in a 'developing' construction environment [Tijhuis, 2002].

## 3. ENVIRONMENT: SOME DEVELOPMENTS

As in present industry the use of e.g. new technologies offers a lot of opportunities for improving construction processes and therefore should be stimulated if possible, it should in still be introduced quite carefully. This not only from e.g. a financial point of view (as e.g. Van der Schaaf mentions that such new technologies could be leading to cost-overruns in the first phases of introduction [Schaaf Van der, 1987]), but also and more especially from a cultural and/or sociological point of view, as e.g. the International Labour Organization (ILO) mentions that especially in case of developing areas, the use of labour-based technology is a serious means for local poverty-reduction [ILO, 2003].

> **Remarks:**
> *Comparing the financial and sociological aspects of automation (see above e.g. the remarks of Van der Schaaf and ILO), one can see that these items often can lead towards a dilemma: Automation or not? And if yes, towards which level?, etc. Nevertheless, it still gives interesting 'food for thought'.*

Related to this issue, it is being recognized on one hand that especially in developing areas the need for modern equipment is obvious while there is a strong need for fast improvement of e.g. local infrastructure etc. (being often in a bad situation), acting as an important means of stimulating local/regional economic growth. However, on the other hand this generally means that there are quite less possibilities for using local labour, e.g. due to the use of those automatized equipment, etc. *A real dilemma!?*

This means at least that automation without paying attention to the 'human factors' will not be 'the' solution for improving construction productivity. At least not in areas which are not fully adjusted to 'modern construction'.

## 4. HUMAN BEINGS: SOME DEVELOPMENTS

Being part of the human society, this society is a very dynamic one. Not only on local or regional levels but also on national and surely on international levels. Due to e.g. communication technology within the last decennia, the 'influence' of this globalization is getting more prominent: As a result, the role of information is becoming a key-issue for action and reaction in the present environment, Against these backgrounds everyone can see and experience that these global developments are influencing the local situation, leading towards a way of 'glocalization'.

However, looking to these (technological) developments, the role of human communication still stays the most important thing in really doing business [Tijhuis, 2001]; at least to settle and restore good (business) contacts within peronal (business) networks, apart from using tools like electronic communication and related issues. Within this point of view the human role with e.g. its personal *behaviour, training, skills* and *experiences* still stays in the centre of the 'automatized' (building) environment with developments in the field of e.g. *IT, electronics, mechanical tools* and *equipment*, as e.g. represented in figure 2.

Analyzing more close these automatized construction environments and the human role within it, one can distinguish more or less two main phases in construction automation:
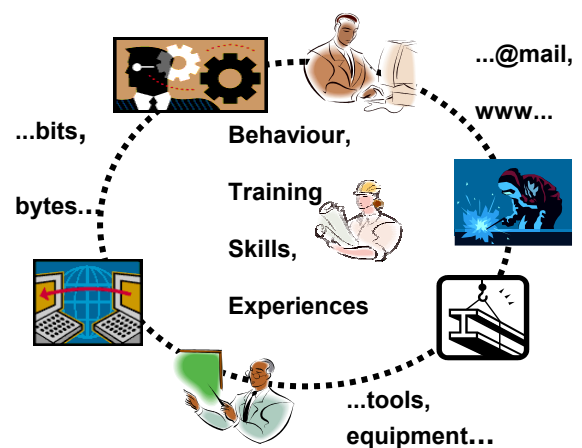
- *Developing*

- *Implementing.*



*Figure 2. Central human role in an 'automatized construction environment'.*

In the recent past, about ten to fifteen years ago, it seems that especially on branch and governmental levels there has been a strong emphasis on developing and just implementis without taking seriously care of the human factors (so 'just automation'), at least in the Dutch situation. As e.g. described in proceedings of a Dutch construction automation conference in 1986, related to the governmental 'Innovative Research Programme' (IOP) for the construction industry, one can see that the topics mainly were related to 'how to create an electronic building model or environment', whereas there were also then some concerns that the 'human factor' is an important issue in *implementing* automation [Calibre et al, 1986]. So in the *development*-phase of automation there were no concerns…?!

Just since about five to ten years ago there became more interest in human factors, due e.g. to the experiences that there were 'missing links' in automation processes in construction: Although implemented systems should be complete and functioning, people still had handling problems with it, leading to lot of failures (and costs!).

These issues, together with e.g. an increasing need for transparency in construction processes, were recently some of the 'drivers' for the Dutch government to establish a new national research programme on 'Process and System Innovation in Building' (PSIB) [ARTB, 2002], being more or less a Dutch 'counterpart' to the British programme in 'Rethinking Construction' [Egan, 1998]. Human factors play an important role in it, as e.g. 'Culture and Behaviour' has become an own specific field of attention in this programme.

## 5. TECHNOLOGY: SOME DEVELOPMENTS

In modern construction industry several developments are actual. There one can see that on the 'machine-side' construction industry uses a lot of new technologies from other industries like IT (e.g. ERP or workflow-software), electronics (e.g. mobile phones), mechanical-engineering (e.g. TBM's), space-technology (e.g. carbon/glass-fibers), etc. [e.g. EEIG, 1999]. On the 'human-side' it uses new approaches like 'IFD' [e.g. Hendriks & Van Gassel, 2001] but also ones which are not quite new anymore, but still under development and improving, like e.g. early 'industrialization-drivers' in e.g. early Post-World-War II period [e.g. Bromberg, 1947] and 'open building' since the 1960's and 1970's, etc. [e.g. Habraken, 1961]. And a lot of other developments can still be mentioned, like e.g. robotics in construction by using the fastes microprocessors and sensors, superlift-loads in offshore projects by using innovative jacking-systems, etc. Think e.g. about the recovery of the 'Kursk'-submarine, etc.

## 6. THE CULTURAL GAP: PRESENT SITUATION

As global environment changes continuously, one should expect the continuous change of cultural aspects (i.e. human behaviour) within it, too. As this is still the case, a common state-of-the-art description of 'the' present situation on this 'culture-topic' is still very difficult, and maybe even impossible: As every human being acts according his or her character, mood, environment or whatsoever, and researchers still try to get a more 'generalized' view on it (for using the data e.g. in 'predictive behaviour-models'), this really is a difficult task… But also very interesting, as construction still stays a 'people's business!

> **Remarks:**
> *People involved in construction still stay the main factor of production, although productivity itself can differ (depending e.g. on the degree of automation, training and skills, etc.). Therefore, as construction industry still is the ultimate 'people's business', the culture-issue within this paper focusses especially on the human behaviour of people, involved in construction projects; not trying to find*

*an 'utopia' nor an 'arcadia' [Medawar & Medawar, 1972] but especially trying to get more understanding of reality.*

Being able to understand culture (in this case human behaviour) can bring a lot more understanding for human uncertain factors within the construction process. Especially in an international scope, where the differences between human behaviour can cause really a lot of failure-costs (see e.g. the cross-cultural research on construction projects, related to difficulties into contracts, etc. [Tijhuis & Maas, 1996]).

As one of the representatives of this field of research and practice in construction, the already mentioned CIB Task Group 23 'Culture in Construction' is assembling an international comparison on human behaviour in construction processes, both on theoretical and practical level. Firmly rooted into well-known research-results like e.g. Hofstede, etc. on the one hand [e.g. Hofstede, 1980; 1988], combined with (formats for) described practical experiences on the other hand, it seriously increases the availability and understanding of information on this specific topic [e.g. Fellows & Seymour, 2002].

However, within the scope of this paper, the author wishes to give at least a summary of the present situation in this field as follows: *'Culture seems to become increasingly a part of the deal'.*

## 7. BRIDGING THE GAP: AUTOMATION AND HUMANIZATION

The mentioned statement *'automation with or without humanization'* in the title of this paper focusses on the dilemma which this may incorporate, especially in the described developing regions. However, putting it forward as a question indicates that it is often being looked at as a 'duty' to decide whether or not to pay attention to the human factors. And this often is the case: Fundamental research on robotics e.g. tries at one hand to imitate the way natural environments and humans act and react (e.g. with the development of fuzzy logics, human and artificial intelligence, etc.), and on the other hand is also fully aware that maybe other ways of robotic behaviour and/or mechanisms can be suitable for its designed taks, too. E.g. in this last situation, a robot may be even not being designed as a 'typical robot' (i.e. not a 'look-a-like' of a human being).

> **Remarks:**

*See e.g. the differences between the 'image' of a robot, like e.g. in the 1950's represented in science fiction comics, etc.: They were typical 'mechanical human beings', whereas in present days a robot can also be e.g. an extended computer, or a complex automatic control-system in traffic, or an automatized concreting or excavating machine, etc.*

Main 'path of decision' in wether or not to use automation in construction stays the question of two main topics:

> *(1) whether or not using automation?*;

and if so, then:

> *(2) how to give the people involved optimized use of it*?

Both of these topics are in fact based on the 'interfaces' between the three distinguished key-issues, as described in the start of this paper:

- *Environment;*
              Interface
- *Human-beings;*
              Interface
- *Technology.*

Both interfaces are represented schematically between the key-issues involved in figure 3, linked to the two main questions as described above. See figure 3.

So, briding the gap between automation and humanization is still possible, but it should at least be committed to a positive answer to the both questions:

> *(1) Yes, there is an interface (e.g. fulfilled by -combinations of- need, relationship, matched way of behaviour, contract, , etc.) between the human being an the environment (construction process, project, market-needs, etc.) involved;*
>
> *(2) Yes, there is an interface (e.g. fulfilled by -combinations of- matched way of behaviour, fit-for-purpose, etc.) between the human being and the technology (automation).*
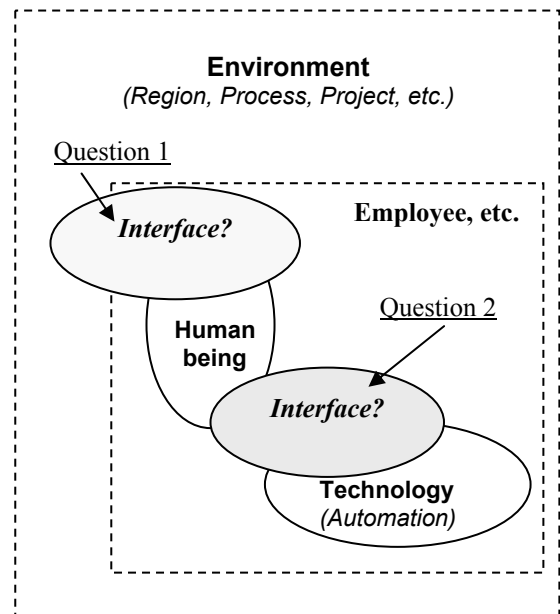


*Figure 3. Main path of decision in wether or not to use automation in construction, using two main interfaces between the three distinguished key-issues.*

Automation attempt therefore should start at least by means of the first step (1), with the search for how to fit the match between the needs of the environment itself and the human needs. The answer to this should result into a second step (2), with fitting the match between the human needs and the technology available. Therefore, the question on how to get introduced a real 'Future Site' depends more on the level of human acceptance (barriers) than on the technological developments.

## 8. CONCLUSIONS & RECOMMENDATIONS

As a result of this paper, the main conclusions and recommendations are represented as follows:

1. Before putting forward the question on *how* to implement automation in construction (i.e. focussing on the <u>interface</u> between *humans & machines*), one should be putting forward *why* to strive for automation construction (i.e. focussing on the <u>interface</u> between *environment & humans*).

2. If one has decided to introduce automation in construction, the level to which it should be integrated is an important detail. Especially while automation can be an alternative to labour-intensifying strategies, this means that

automation can be a stimulus as well as a threat to the people involved.

3. One should not 'automatically' assume that developing environments should only be improved by using the most modern and automation technology. It continuously should be the match between *environment, human beings* and *technology*.

4. The question on how to get introduced a real 'Future Site' depends more on the level of human acceptance (barriers) than on the level of technological developments.

Although the approach presented in this paper is written mainly within the scope of construction in developing regions, it may also be used to *rethink* the present situation in construction industry within modern developed regions.

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