

SOCIAL REQUIREMENTS FOR THE USE OF ROBOTS ON BUILDING SITES

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SUMMARY

Despite the wide variety of rationalization processes, building work is not based on any concept of labour distribution in Taylor's sense of the term. In the Federal Republic of Germany it is more organized on the gang system. This functions in accordance with the principle of flexible work-force deployment. In principle, each member of the gang is required to be able to perform every kind of work that might arise. This guarantees that all members of the working gang are interchangeable. Independent action, communication and cooperation, which do not need to rely on orders from a superior, are taken for granted. The development of industrial robots must assume these essential features in the building process. What is required is a labour-distribution concept that preferably allocates to the robot those physically difficult and routinely monotonous activities that are part of the gang's activities. The worker, on the other hand, needs to be freed gradually from this activity, so that he can devote himself to more significant activities calling for qualified skills. The entire process into which the robot is to be integrated must be coordinated by people. The robot must be man's helper and not the other way round!

1. THE LACK OF SKILLED WORKERS AND YOUNG TALENT

The building trade is running short of workers. Is it not time for robots to help? Taking rationalization measures to close the gap in the market for skilled workers - surely this is bound to satisfy even critical union-members? The question can be answered positively only as long as we restrict ourselves to this phenomenon, and ignore employment policy as a whole, which need not be scrutinized more closely here. But if we address ourselves to the working conditions that dominate the building trade, the urgency of a labour-oriented organizational concept can no longer be overlooked. Neither wage incentives nor the reduction of physical strain by means of high-tech on the building site can overcome the crisis in building work.

The lack of young talent and skilled workers in the building industry is by no means peculiar to Germany. Apart from the Scandinavian countries and the Netherlands, we come across this phenomenon in all Western European countries, as well as Japan.

For the Federal Republic of Germany at least, the lack of skilled building workers is not a unique event, but has repeated itself at intervals since 1949. Time and again, irregular and flexible employment has meant that skilled workers have migrated to other professions. In our view, the prospect of a more stable form of employment with a secure annual income and

regular and/or calculable working conditions has been the decisive factor in this migration.

Since the 50's attempts have been made to counter this migratory process by means of wage policies: first of all, through wage adjustments between Christmas and new Year, and then through the bad-weather allowance for the months of November to March. In the 60's and 70's, attempts were made by the collective bargainers to absorb the lack of skilled workers by increased training efforts. A collective agreement was reached on an umbrella training programme whereby building workers could receive an above-average qualification in comparison to their European colleagues.

All this, however, did not prevent the migration trend from being accelerated owing to the structural crisis in the building trade during the 80's. This once again made public the character of seasonal work, owing to mass lay-offs of building workers in the winter months.

Even if the current boom in building has been able to stop the migratory trend for the most part, even so, half of the training places offered are still open. Furthermore, the industry has a large proportion of older workers, which will lead to further gaps in the supply of skilled workers and executive officers: By the year 2000, some 300,000 building workers will have left the industry for reasons of age.

2. RESTRICTIVE WORKING CONDITIONS AND CHANGES IN VALUES

The elimination of the skilled-worker crisis can only be achieved if working conditions in the building industry are effectively improved, for our findings have shown that it is here where the real causes are to be found. Every approach to a solution that does not deliberately select the social reasons for the lack of skilled workers as its point of departure runs the danger - more unconsciously than consciously - of exacerbating existing problems and/or of compounding them by adding new ones.

Currently the building profession does not enjoy very much esteem, as an investigation in 12 building companies has shown. One third of those asked (31 per cent) said that they would change to a factory job even for less income, if a suitable opportunity presented itself. 80 per cent of those asked would advise their sons not to take up a building profession.(1) In a survey that we conducted, 82.7 per cent of those asked said that they frequently or continually had to work under the pressure of unreasonable deadlines.(2) The younger people in particular are no longer accepting the prevailing working conditions. Most frequently rejected are the disproportionately long working hours in the summer months together with hard physical work, which manifests itself in the heavy drop in the willingness to work overtime among young employees. Some 130 hours of overtime per month (the industrial average: 67 hours of overtime), distributed mainly over the months of May to September puts the building workers very much at the top of the overtime ladder. In many firms overtime is expressly refused by young building workers. Young building workers say that the higher income that overtime provides is not as

important as their leisure time.

A further reason resides in the irregular income. The main employment phase is concentrated on the summer months, whereas, in winter, they have to make do with short-time wages, bad-weather allowances or unemployment benefits. The long periods of work, and travel to and from work, do not give the building worker any leisure time in the summer. Many trainees change their profession once their training is complete, giving the irregular working hours as their express reason. They even accept work that is below their level of qualification in return for regular working hours.

All these are clear indications of a change in values. It corresponds to the self-confidence which has grown out of the building process and which is based on the gradual development of their own qualifications and independent action. To this extent the social character of building work is no different from that of other groups of skilled workers. The following thought is particularly applicable for the young, qualified building worker: "Anyone who does not attach primarily external reproductive aspects, but rather personal sense criteria, to his work, ... will not be long in scrutinizing and revising his investment and behaviour in his work, if his demands are not fulfilled." (3)

The lack of skilled workers and young talent are therefore only a peripheral image problem of the building industry. First and foremost they result from the contradictions in the way building work is organized. For a long time restrictive working conditions have prevailed over objective and subjective opportunities for the worker to obtain qualifications. This must have lodged in the workers' awareness as a negative attribute of the industry, all the more seriously because working conditions in other sectors are seen as being subject to change or reorganization. It is precisely this fatal fact that humanization and a genuine shortening of the weekly working hours have, for the most part passed the building industry by.

Whereas new production concepts are being discussed everywhere in other sectors of industry in order to enrich the content of labour through exacting jobs, surprisingly enough, the building industry has not seen fit to undertake this type of activity, despite the crisis in the supply of skilled workers. At the moment it seems more inclined to put its hopes in intensifying the division of labour between companies. In the subcontracting system associated with this it thinks it sees the chance of circumventing the lack of skilled workers. In the short term, this strategy may lead to success, particularly as unemployment in the East is releasing new work-force potential. What is to be feared, however, is that the building industry is undermining its own foundations, composed as they are of quality, qualification and the greatest efficiency, the very things that have ensured its lead in productivity over the competition.

3. THE TECHNOCENTRIC METHOD - THE WRONG TRACK

Even setting one's hopes on technological solutions by using robots falls short of a real solution. The specific pro-

duction conditions such as changes in the place of production, single item or small batch production and changing environmental conditions (weather, working underground etc.) place disproportionately high demands on the use of robots on the building site. It is true, of course, that in certain sectors of the building industry, e.g. road or tunnel construction, the use of machines and equipment is already rated very highly today. However, in the most important sector, building construction, this use has been limited to the intermediate processes, namely transport. The assembly processes (the connecting or bonding of separate parts) are still carried out mainly by hand (e.g. timbering, masonry, assembly of prefabricated parts).

The use of robots in this area calls into question the team principle and may break up the social framework that has grown out of it. This is particularly the case, because in the technocentric imagination of the developers the building process is seen merely as the sum of a sequence of separate actions and cooperation and communication between building workers can be ignored as central qualifying elements. Although the use of robots may reduce the amount of effort involved in carrying, lifting and replacing heavy loads in individual areas of activity, the price that has to be paid is a reduction in qualifications. The developers of building-site robotics counter these problems by pointing to the fact that more qualifications are needed for operating the robots. But it is precisely this point that makes it clear how little the building-work process itself is the point of departure for the robotic concepts that are to be created. Rather, the point of departure for considerations of this type is an already strongly Taylorian working process of the type often to be found in stationary industries. Here, skilled work has indeed been extended, thanks to EDP-supported systems, through the addition of elements of cooperation and communication that have always been inherent in the building process from its beginnings to this very day. So they do not need to be added to it artificially!

In actual fact, of course, it is not the building industry that is forcing the development of robotics, but it is the developers themselves who are urgently seeking new fields of application. If one looks at Japanese developments, it becomes especially clear that the real building process is being neglected. It is not the culturally determined model of cooperation, but the dissolution of the cooperative working process into individual patterns of action that forms the point of departure for studies of robotics at the Waseda University in Tokyo. Here a technocentric approach prevails (4) that assumes a fully automated operation - at least intermittently. The building-site staff are only allocated peripheral and residual activities.

At the same time, attempts are being made to identify the elements of building construction that need to be adapted to the use of industrial robots. This is the very opposite of the team concept practised on Japanese building sites, whereby the workers agree on their daily performance every day, and thus also determine the number of working hours, and begin and end each day with a team discussion. Every team is committed to quality work, to the observation of work safety and to the

keeping of deadlines. Each individual worker feels he is responsible for the entire enterprise and solves any problems that occur on his own initiative.

Even if prefabricated building components scarcely play a part in the Japanese building industry, in essence, the building processes in Japan and Germany are comparable. In Japan, too, despite high wages, the lack of skilled workers is a decisive factor in the development of industrial robots. Unlike the Federal Republic of Germany, however, this development is being accelerated by the six largest Japanese building companies themselves. (5) Here, too, the lack of skilled workers is the driving force behind this - despite above-average wages.

The fact that both in Japan and the Federal Republic of Germany the real building process has so little regard for the development of robots may be found in the current limitations of this technology. It is precisely for this reason that the way it is used needs to be accepted even less. If the potential to obtain qualifications is to be guaranteed and possibly even extended, and if strains and stresses on the workers are to be reduced, a robotics concept must be made to fit in with the true building process.

In our view, the direction that this development must take is determined by the following formulation: the robot must be the building worker's helper, and not the other way round!

4. THE CONCEPT OF THE DISTRIBUTION OF LABOUR AND THE USE OF ROBOTS

The required subordination of the robot to the man working on the building site assumes that the robot will be integrated into the existing organization of the gang and that it will be turned into a tool for the use of members of the gang. This requirement stems from the production process specific to building work. Despite the extensive use of machinery, which unquestionably has significantly promoted work productivity and work intensity, the prevailing distribution of building-site labour into its basic elements has never been questioned, unlike, for example, in Great Britain. (6) There is no doubt that the mechanization of transport, from the crane to the concrete pump, as well as operations scheduling, has led to both the elimination of pauses created by production processes and to a precisely timed coordination of men and machinery. Even so, this has never meant giving up an organization of work based on the gang system.

In the Federal Republic of Germany the building-gang system is based on the principle of flexibility in the use of the work-force. It requires that, in principle, every member of the gang is in a position to carry out every type of work that occurs, thus guaranteeing the interchangeability of gang members. At the same time it requires a high measure of individual executive autonomy, i.e. independent action without reliance on orders from a superior. (7) Preparation for work is limited to the coordination and control of the overall process and leaves the building workers the responsibility for the sub-processes.

The necessary procedural knowledge is imparted by means of extra-company training that is continually supplemented and

extended through cooperation within the gang. In the practical working process, the building worker acquires the special qualifications of flexibility, interchangeability and executive autonomy. Whilst working around the building site, the man grows into and with his task. It is precisely this flexible working concept that promotes communication and trains the skills needed to combine different techniques. In particular, the distinct cooperative and communicative structures, as well as the scheduling possibilities, lead to a distribution of labour within the group and to both an individual and a joint feeling of responsibility for the constructional product. The amount of planning needed is thus kept to a minimum. Planning weaknesses are compensated for and the product quality as a whole is safeguarded.

The autonomous activity required within the team serves not only to create more efficiency, but also helps everyone develop his own qualifications and extends individual competence. To this extent, the building process is a permanent learning process that guarantees the continuous development of qualified skills. The robot, on the other hand, learns nothing, and despite this, presumes to be competent.

The ultimate consequence of applying the technocentric concept of robotics can only lead to the building worker being deprived of his qualifications. This means that the learning process acquired though working in the gang is severely curtailed. The inevitable result is a reduction in the number of qualified skills.

Taking the building process itself as the starting point, we need to foster an anthropocentric approach that includes the various levels of technological and organizational developments and concedes the building-site employees their autonomy in dealing with machines (see diagram)

ANTHROPOCENTRIC APPROACH

Division of Labour	qualifying activities neither too little nor too much physical or psychological effort
Cooperation	avoidance of accident risks noise and vibration risks from hazardous materials perceptual strain
Coordination	knowledge of the robot's functional range designing and programming operational schedules for robots supervision and control
Organization	transfer of responsibility the group as a learning process participatory organizational structures

5. SOCIAL REQUIREMENTS FOR THE DEVELOPMENT OF INDUSTRIAL ROBOTS AND THEIR USE

First of all, a division of labour concept needs to be developed that relates to the current organization of building-site work and matches the social demands of the employee for the abolition of restrictive working conditions. The division of labour concept demanded must ensure that the allocation of functions with respect to the activity to be carried out within the framework of the building gang is organized in such a way that the robot preferably receives physically demanding work and routinely monotonous activities. On the other hand, the worker needs to be gradually freed from these activities in order to be able to concentrate on those tasks that are a challenge to the skills for which he is qualified (building corners, arches, fireplaces etc. is challenging work, whereas, for example, laying lines of bricks is more of a routine job).

The division of labour concept needs to be supplemented by a cooperative concept. The workers' social demands make it necessary for the required cooperative concept to be based on the principle of undisturbed collaboration within the framework of automated building-site work. Both technical and organizational regulations must ensure especially that no risks of accident result from cooperation between man and robot, nor any disturbance due to noise or vibration, nor any unreasonable perceptual strains or risks from hazardous materials.

The working process organized in terms of the division of labour and cooperation between man and robot must be coordinated by people. There must be a guarantee that the robot is subordinate to human instructions. In this case, the particular point of departure should be the currently prevalent concept of working gang organization, coordination and supervision. This ensures that the gang can preserve a high level of autonomy. The members of the gang discuss the work to be done with one another and allocate it amongst themselves. A coordination concept is required that covers both the robot's technological facilities and the workers' qualified skills. It needs to contain and deliberately promote the following knowledge and abilities of the workers:

- Knowledge of the robot's range of functions including its specific parameters;
- Abilities to design operational schedules for the robot as a component part of the gang's plan of work;
- Abilities to translate the robot's operational schedule into the robot's language;
- Abilities to continuously supervise and control the sequence of its activities;
- Safeguarding of a smooth-running operational process through inspection and if necessary amendment of the working and material conditions.

These demands receive additional importance if one bases them on the experience of manufacturing companies in other branches of industry in establishing CIM (Computer Integrated Manufacturing) schemes. If the introduction of the CIM system

is seen primarily as a technological problem, very often the companies in question come to grief, i.e. the solution is neither compatible with economic or social principles and the aims set are not achieved. So if those involved in highly advanced division-of-labour processes are gradually coming to realize the need to return to integrated processes, how much more does this apply to the building industry?

Seeing that the deployment of schemes similar to CIM is to be expected in building firms, cooperation between man, organization and technology needs to be thought out anew.(8)

In conclusion we wish to state the following: unionist technological policy is geared to a social and ecological arrangement of work and technology. Briefly it aims at

- creating humane and qualified labour structures
- a systematic qualifications policy
- a staffing policy based on solidarity
- the realization of the right to informational self-determination, as well as
- an increase in the opportunities for co-determination and cooperation amongst employees and those who represent their interests. (9)

On this understanding, we invite all developers to take part in a dialogue with the aim of determining, together with Bau-Steine-Erden, the development and use of industrial robots.

FOOTNOTES

- * Technical officers on the Central Federal Board of the Bau-Steine-Erden Union, Frankfurt am Main
- 1 cf Kuen, Kurt: Wie denken Bauarbeiter über ihren Beruf? Bauwirtschaft 1989, Issues 2 and II
- 2 cf IG BSE, Arbeit und Gesundheit 1, Frankfurt am Main
- 3 Baethge, Martin: Arbeit, Vergesellschaftung, Identität - Zur zunehmenden Subjektivierung der Arbeit, in SOFI Reports, December 1990, p. 3
- 4 cf Brödner, Peter: Fabrik 2000, Berlin 1985
- 5 cf Bennett, Martin et al.: Capital & Counties Report, Japanese Construction Industry, University of Reading, UK, 1987, p. 53 ff
- 6 The building-site process is very strongly based on the division of labour and is performed by means of labour-only-contracting and through pseudo-independent building workers.
- 7 The scheduling and cooperative opportunities were initially elaborated in: Janssen, Jörn/Richter, Wolfgang: Arbeitsbedingungen der Bauarbeiter, Frankfurt/Main, 1983
- 8 Bullinger, H.-J.: CIM bedeutet Integration von Mensch, Organisation und Technik in: Fachtagung CIM - Erst Organisation, dann Technik, Stuttgart, 1990
- 9 DGB: Arbeitsprogramm Gewerkschaftliche Politik zur Gestaltung von Arbeit und Technik, DGB-Bundesvorstand, Düsseldorf, 1991