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Changes in German Production and Demography - the Supporting Role of ICT

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Purpose

The automobile industry is one of the most important industries in Germany and one of the key areas for R&D. To hold this position the industry has to face two challenges: 1st, changing parameters in and for industrial production like minimizing the time to market or shortened product life cycles; and 2nd, demographic change. The purpose of the study was to identify need for action and to present sub-sectors in which ICT could take a supportive role for industrial production.

Changes in the production sector

The demographic development in Germany and other European countries is dominated by two trends: The rising average age and the decreasing population. In consequence, the number of elderly employees is going to increase constantly. Thus, the recent staffing policy of releasing employees 50 years and older into early retirement respectively unemployment is inadequate. Particularly innovative industries like the automobile industry have to meet recent and future requirements of integrating elderly employees.

Germany's industrial workforce is growing old

In the automobile industry the challenge of planning industrial production systems, today and in the future, consists of

- preserving the physical and mental performance of employees,
- integrating the increasing number of older employees,
- adapting the production systems and processes to the changing requirements and
- supporting these changes by new information and communication technologies.

Researchers of the project "Development of new Information Technologies to adapt to changes in production and demography" analyzed the upcoming demographic change. Furthermore, the changes of production within the automobile industry were identified. The respective consequences on the work system can thus be elaborated and further needs for action can be derived. The focus of this project was the supportive role of information and communication technologies (ICT) in order to maintain efficiency and effectiveness of the production system.

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Auto industry takes part in the foresight process

The study consisted of three phases:

Phase 1: Analysis of requirement
Phase 2: Development of a design matrix for ICT
Phase 3: Evaluation of the design matrix

The "analysis of requirement" phase consisted of two work packages - one concerning *changes in production* and one concerning *demographic changes*. Both work packages started out with developing scenarios in each field.

In the work package "changes in production" the second step consisted of specifying requirements and areas with need for action. In the third step implementation possibilities were identified and the results were evaluated.

In the work package "demographic change" the second step consisted of categorizing employee groups according to typologies of the social sciences and by using "Time worked in lifetime". In the third step these results were also evaluated.

The scenario development for "changes in production" was done in the framework of a one-day future workshop with a focus on mid- and long-term timeframes. The experts of the workshop were representatives of the automobile industry, mainly from OEMs and suppliers and from production areas as well as from human resources departments. The results of this future workshop were three scenarios, a worst-case, a best-case and a trend-scenario. The scenarios included technological, personnel and organisational factors. The scenarios in the work package "demographic change" were based on trends and findings as found in literature. The three types of scenarios were built based on those findings.

Interviewing experts from industry and sciences helped to evaluate the results of both work packages. In addition to this, the results of the work package "changes in production" have been compared to activities started and planned at one OEM and one supplier.

In the second phase, a design matrix for new information and communication technologies was developed. Recommendations for the design and functions of new tools in the category of ICT were worked out based on the results of the first phase. The following aspects were considered:

- Changing demands due to change in production technology and demography
- Short-, mid- and long-term intervention time frames
- Work force typologies.

The team presented the results in a so-called design matrix.

In phase three, experts evaluated the results presented in the design matrix during workshops and interviews. The content of the matrix was reassessed according to the feedback.

The validated design matrix

Scenarios for two different areas were developed and resulted in the design matrix for ICT. Some trends and aspects of the scenarios are presented in this brief.

	Worst Case Scenario	Best Case Scenario	Trend Scenario
T	Variant-rich products, individualization, and small-series production Declining degree of mechanization in processing and assembling	High degree of interplant cooperation	Use of ICT in planning and coordination activities
O	Outsourcing in foreign countries and high degree of cross linking Restriction of German core business to development and distribution	Team and project work pattern in indirect work areas and across plants Elderly employees as key personnel in development and construction Parts of production is shifted from OEM to suppliers	Tayloristic work organization especially in production
P	Polarised profile in the labour skill structure Brain drain abroad Early retirement of older workforce	High degree of temporary labour, low degree of permanent work force Variation in labour utilization Labour specification includes willingness and capability to learn, flexibility, mobility and multilingualism Bundling of competency types	Shortage of highly qualified labour Modular system of advanced training with shortened basic training Diversity as strategic resource

Characteristics of the production scenarios: The main scenario results, validated through an expert workshop and interviews, are shown in the above table. The results are organized by the three fields: technology (T), organisation (O) and personnel (P) for worst case, best case and trend scenario.

Trends in the automobile industry: The number of Original Equipment Manufacturer (OEM) will be reduced because of relocating production to suppliers. The remaining production will be characterized by high technology. The permanent staff will be highly trained and will be complemented to a large extend by temporary workers which will respond to the dynamic manpower requirements

Demographic scenarios: The main results/characteristics of the demographic scenarios are given below.

Influencing factor / descriptor		Worst Case Scenario	Best Case Scenario	Trend Scenario
Structure of population	Birth rate	>2,1	<1,4	1,4
	Life expectancy (years)	♂<83	♂ >83	♂~83
		♀<88	♀>88	♀~88
	Migration	> 200.000	balanced	+ 200.000
Labour market and economy	Employment ratio (%)	♂>79,3	♂<79,3	♂@79,3
		♀>65,2	♀<65,2	♀@65,2
	Work age-limit	70 years	65 years	67 years
	Education level	Balanced on high level	Shortage of highly skilled labour force	Slight shortage of highly skilled labour force
	Investment	High investments in Germany, technological progress	Low investments, brain drain	Stagnating investments und limited technological progress

Demographic change happens below the level of perception, it occurs too slowly to become apparently visible in a short-term context. Currently a shortage of highly qualified labour - due to demographic changes - is not obvious in companies. Though it has been a topic in the media, company representatives have only been confronted with the consequences of it by discussing the scenarios. A major problem in handling demographic change is that there is no short-term solution. New competencies and company-internal learning processes allowing continuous adaptation to the changing conditions are needed.

Recommendation for action to handle demographic change by staffing policy: "Excess of age" is not seen as an independent problem for operational business nor is it categorized as currently important. "Aging" is not independently significant, if addressed at all, it is handled in close connections to other aspects in regard to operational benefit considerations.

In order to minimize risk, companies need to offer alternative career options to improve intra-company flexibility and mobility for young qualified personnel and at the same time to improve the company's recruitment chances.

In summary, for staffing policies of the future the following demands are seen:

- Permanent exchange between the generations and age diversity as an integrated goal
- Safety and health, recruiting, personnel development need an aligned, networked goal setting
- Change from only short-term to short-, mid- and long-term personnel planning is needed (up to 20 years)
- Inter-generation contracts to balance age specific demands to improve employer attractiveness

What has ICT to offer?

Looking at future development in production processes, not all are related to an aging population. Nevertheless, those developments have to be handled by an aging working population. The main purpose of the study was to identify options where ICT is able to support the adaptation process to these developments. In the table below the specification for ICT as support instrument are shown, again for the three different scenarios in the areas of technology (T), organisation (O) and personnel (P).

ICT as support instrument:

	Worst Case Scenario	Best Case Scenario	Trend Scenario
T	IT-support for planning and controlling, and material flow ICT to minimize physically exhausting activities	IT-support for close cooperative bonds Modular design of new technologies to ensure usability and compatibility	Standardisation of external interfaces
O	Real-time information flow	IT-support to handle flexible working time models	ICT as continuous instrument for qualification
P	ICT as integrated element of teaching and learning	Ensuring the transfer of gained experience (know how) IT-support for spatial mobility	Independent of target group, self explaining communication support

Augmented reality, artificial intelligence and simulation to support new production schemes

Qualifying employees to meet future lack of highly qualified labour is only one way to address the problem; designing technology, which can be utilised by non-specialists, is another way. The challenge will be to enable ICT tools to adapt themselves according to the abilities of the single employee.

Augmented reality, artificial intelligence and simulation should be able to meet most demands looking at the ICT demands identified in the above table. An example: The capability to cope with the raising demand for flexibility and multivariants products can be improved through better IT-support for planning and controlling, and material flow - point 1 in the table - by simulation of the whole integrated production process. This capability can even be further improved by applying artificial intelligence according to the needs of the employee involved.

Almost all listed demands can be met by ICT through the fields of augmented reality, artificial intelligence or simulation or through a combination of two of these. Two demands, though, will not be met by the covered ICT technologies: the information flow in real-time - point 6 - and standardization of external interfaces - point 3.

The information flow has to be real-time in order to meet the communication demand of strong cooperative networks. It is restricted to technical information even if augmented reality allows for a continuous information flow in real-time. Network communication requires relevant and exhaustive information. A reduction of complexity is therefore needed, but the ability to do so is not in the scope of augmented reality.

Standardization of external interfaces is a major prerequisite for the needed information flow in-between networks. For this task, the covered technologies are not expected to have the potential to cover this. Nevertheless, both points must not be disregarded.

What could/should be done and what is unlikely?

Augmented reality (AR): Urgent need for research regarding AR is seen in further development of identified deficits like avoiding symptoms of fatigue, to raise the usability and demands induced by demography changes - aging and/or less qualified work force. True-to-life illustration in real-time with a situative and cooperative overlay of information has to be made possible. This is particularly needed to fully use the potential of AR as an integrative element in teaching and learning, as an instrument for qualification and for ensuring spatial mobility.

Simulation: The physical model of humans needs to be further developed. The modelling and simulation of mental structures, especially in the context of thinking and behaviour patterns in production areas is a main research topic. A starting point could be the area of human deviances and its influencing factors, impacts on the working process and correction possibilities.

Artificial intelligence: The different application areas of artificial intelligence, e.g. robotic, intelligent knowledge management, user interfaces and clothing have in common that their stage of maturity does not yet allow industrial application. Though the potential is high, the costs to bring it to industrial application are high as well. Especially in the Germans automotive industry, with its SME structure, the capability for financial investments from SME-side is limited. The exploitation of the possibilities is therefore unlikely.

The situation can be compared to the development of computing during the last 30 years. As today in ICT, 30 years ago it was not imaginable how and to which degree the computer technology would find its way into daily life. Today, computing is a must in our lives.

Sources and References

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