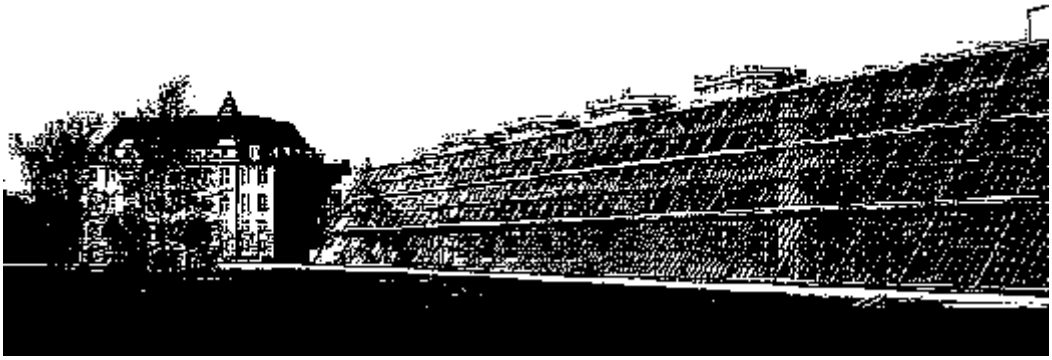

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Women in German manufacturing industry - the impact of work organisation and technology development

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Introduction

Aggressive market conditions force manufacturing companies to change their production systems and to implement new forms of work organisation and management. Decentralisation, object-oriented product organisation, integrated development of products, intensive forms of communication and cooperation within the company and among companies, suitable technical support and multidisciplinary skills are characteristics of modern manufacturing systems (Brödner, 1992; Kuark, 1994). At the same time information and communication technologies enable new forms of work organisation, as well as they have got the potential for the development of new products and services, e.g. new work-places. The information and communication technologies are just at the beginning of their „product life". A lot of uses are to be developed in the future.[1]

It seems likely that new forms of work organisation, in linkage with new technologies, have got major impacts on the employment prospects of women in production, both positives and negatives. On the one hand, the development and use of new technologies was often a "male" task.[2] Male workers in production of many industrial sectors hold machine setter or system operator positions, while most women do unskilled work as machine attendants. Nowadays, the segregation could aggravate if women were not to take part from the beginning in deciding, implementing and using technical support for modern manufacturing systems, e.g. such based on teleworking and Multimedia.[3] On the other hand cooperative forms of work organisation can improve the working condition in production and have got qualifying effects. The use of new technologies may open up employment fields for women, which formerly were closed.

The professional qualifications of women in the manufacturing industry determine decisively whether women may use the chances of the developments or whether the employment risks prevail. Therefore, the qualification needs of female workers should be examined in more detail, and training programmes should be developed which are accessible and stimulating for women. The paper is organised as follows: The first chapter presents cooperative forms of work in and between manufacturing companies as well as modern information and communication technologies which both support these forms of work and contribute to create new ones, like tele-work and work within virtual companies. The second chapter describes shortly women's employment structures in the German manufacturing industry. Chapter three discusses qualification needs for new forms of work organisation and information/communication technologies. The following chapters outline the characteristics of adequate vocational qualification programmes for women und discuss to what extent multimedia forms of learning could improve these programmes.

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[1] Bosch 1997
[2] Hürten, 1996, p. 86 - 95
[3] Bahl-Benker, 1994, p. 260 - 281

Cooperative forms of work and new information/communication technologies in German manufacturing industry

Cooperative forms of work

Since the 1980s new organisational approaches have been discussed through the industrialised countries. Terms like ´lean production´, ´flexible organisation´, ´Total Quality Management´(TQM) and concepts of cooperative work like ´group work´ have become part of everyday language in management literature and in industrial relations. The basic idea of these words is: Employees should be involved in matters of their companies, particularly in their daily work and their immediate work environment more intensively than any time before. They are asked and expected to identify with their companies and their jobs, to engage themselves in their daily work to constantly improve work process and products. The present section briefly present cooperative forms of work, like the working within multidisciplinary project teams or group work

Cooperative forms of work are regarded as an efficient form of work organisation in the 21st century which increases productivity of companies as well as makes work more attractive, socially and intellectually rewarding. Referring to project work, there are obvious advantages in having teams being composed of experienced specialists: products are designed in shorter periods of time with minimum costs of development, with an easy transition to production, and are assembled and tested with a minimum of cost and time. Cooperative work is a non-traditional approach to the design and manufacturing process.

Converting the design and manufacturing process from a sequential form with clearly differentiated functions to one that requires the cooperative work of different units involves many difficulties. Their overcoming requires money, time and expertise for a collective learning process, to understand the insufficiencies of existing practices and to establish new ones. Many small and middle-sized firms (SMEs) have not enough internal resources to implement such cultural changes of perspectives, attitudes, conventions and action schemes. Although a firm's organisational culture and the institutionally embedded social cognition are highly resistant to change, they are indispensible conditions for meaningful and effective acting of the people within the firm's social system and in the new structural context.

Main aims of group work include: task integration, decentralisation of decision-making, greater flexibility of work processes, the provision of higher quality goods and services, a better use of human skills, enriched workplaces and an improvement of working life. There is a fundamental difference between the original European group work and other world practices, e.g. the Japanese ones. Two extremes could be distinguished: the groups select their own members; qualifications of group members are mixed to enable members to learn from, and help, one another. The groups regulate their own internal proceedings and have large autonomy in regard to task design and task execution. They also elect their own leader (Scandinavian models). Other groups (for example the ones associated with ´lean production´ models) display very different features. Group membership is mandatory, and members are carefully selected. Group members are expected to recommend further possibilities to streamline the execution of their tasks. In task execution they have to adhere to solutions that are put forward and agreed upon by the members. The organisation of work is prescribed by superi-

ors who are nominated by management. From a quality of working life point of view, the ´lean production groups´ run against German and other European notions of ´good work´. While group members have discretion in task design, they are completely rule-bound in task execution. This form of work is accepted in Japan because it guarantees life-long employment and a remuneration system which binds employees to their employer. The Scandinavian form of group work had considerable success, in particular by increasing work motivation, reducing absenteeism and sickness leave. But its potential for increasing productivity levels are far from clear.[4] Nowadays a cooperative form of work `Japanese Inspired Production Systems´(JIPS) is experimenting in European and US companies which try to combine the advantages and disadvantages of both systems. There is no unitary concept till now: Various types exist in the same country and even in the same company.

The public statistic in Germany does not cover the spread of cooperative work-organisations. From different surveys we know that group work is practised to a lesser extent than it is suggested by the scientific and political discussion. ISF stated that less than 20% of enterprises in mechanical engineering are „structural innovative“, which means that they show certain aspects of group work.[5] The NIFA panel in the mechanical engineering branch found that 2,5% of all enterprises practised group work[6]. IAT found in a representative household-survey 1993, that 6,9% of employees worked in group work. Group work is more common in big enterprises with more than 1.000 employees. Investment goods producing companies use it considerably more often than the consumer good and food industry. 20% of the group workers stated that this work organisation has been implemented during the last three years (1990 - 1993). On the one hand this indicates that in fact the work organisation in the manufacturing industry is changing. On the other hand, cooperative work organisations did already exist before the debate about them began in 1991.[7]

New forms of cooperation between decentralized units

New forms of work and the management of information make possible to carry out succesfully network-like, field-oriented cooperation forms in and between companies, e.g network-oriented information structures, strategic or regional networks. The name „strategic networks“ comes from the fact that they are managed strategically by one or more focal organisations. These organisations determine e.g. the market on which the network operates.[8] Almost all branches of the industry develop network-like cooperation structures, as a consequence of an intensified cooperation with other companies, or of an "outsourcing" of company´s functions as well as network-oriented information structures based on new technologies, but there are branch specific differencies. Besides the organisation of these network-like structures in the industrial sector a very important problem for their success is the understanding of the changed data content; this can be realised by using international standards of product data description.

[4] Pekruhl, 1996, p. 7ff
[5] Hirsch-Kreinsen, 1994, p. 41 - 44
[6] Saurwein, 1992
[7] Kleinschmidt, Pekruhl 1994
[8] There are some differences between regional and strategic networks: strategic networks have a formal organization; regional networks are self-organized.

The most cases of network-like structures can be found in the German car industry in connection with the drastic reduction of manufacturing depth, the building up of a "Just in Time" production and the development of intercompanies information systems. Examples of network-oriented information structures can be within the car´s suppliers domain referring to the cooperation with sub-suppliers and based on new communication technologies like tele-cooperation (see 2.3).

In the German electronic and electrical engineering industry there are many network-like cooperation structures on the basis of hard and soft products, on the basis of market structure and last but not least on the basis of research government support within this domain. Examples are the cooperation of SIEMENS (Germany) with IBM about Mega-Chip production, with MATSUSHITA (Japan) in connection with the production of semiconductors or with MIPS COMPUTER SYSTEMS (USA) about the using of MIPS-Technology[9]) to produce processors with reduced instruction set (RISC). Relationships with the suppliers have been developed in the electronic and electrical engineering industry in the same direction as in the car industry. Network-like relationships exist also between the system producers and the clients.

In the publishing and printing industry there are traditional cooperations with the authors within the production of books and magazines. These are not isolated events, but they are nestling among a continuous process of the development and fulfillment of reciprocal obligations. During the last years has started the "outsourcing" of some tasks like artistic and grafic lay out, the text formatting and parts of editorial report work. These tasks are not carried out by the own staff but they are assigned to (external) subcontractors. The selling of books and magazines follows a network of corresponding dealers. During the last two years, network-oriented information structures have been developed within the printing industry, for example to link decentralized locations at the producing of printed materials. Strategical and regional networks are one of the future strategies which can help companies to remain competitive. They bring advantages for SMEs, because the SMEs can act as big companies on the market, as well as for big manufacturing companies which mix their objectives within such networks but remain very influential. Powerful network-oriented information structures offer chances for the shortening of the "time to market" of products, fast reactions to clients' wishes through the development of a flexible and integrated manufacturing network under the consideration of manufacturing steps, permanent product services which are independent of the location.

During the last years a new form of networks of companies has been developed. Small, flexible companies with own entrepreneurial responsibility are organized within a network under the management of a powerful core company. This last one has the product-know-how and the financial power to conduct the network. Although decentralized units, the power and with it also the disposal of work places and of working conditions is centrally exercised. The companies do not exist in their old form, the existing regulations governing industrial relations and agreed norms in the decentralised units will be inefficient.

New technologies, tele-work and tele-cooperation

[9] Million instructions per second

With interdisciplinary cooperation and flat hierarchies, new organisations of production require new technical support. High-performance computer nets like ISDN and Multimedia communication technology allow new forms of computer support for cooperating partners who are separated in time or space. They fulfil a common task by using telecommunication technologies like video conference, tele-conference, data transmission or shared user systems. This form of tele-cooperation has been implemented in a growing number of organisations.

Tele-cooperation technologies allow contact with national and international customers and suppliers, co-ordination and information exchange between all those involved in the development of a product, and advice. Companies can also use these Multimedia channels for sales promotions or distribution supports. Service through computer (tele-service) can help to diminish the distance between seller and buyer which is growing because of the globalisation of markets. For companies whose branch offices are located in different countries, utilisation of Multimedia - especially that of tele-conference systems - means increased flexibility and a reduction of official journeys, reducing the entailing absences of employees from the head offices.

To remain competitive both nationally and internationally, German companies have to offer more and more new services around their products. The German association of mechanical engineering and machinery (VDMA) sees the increasing use of ISDN as the technical prerequisite for remote diagnosis and remote maintenance. They considerably reduce companies' expenses for repair services as technicians are able to identify around 80 percent of faults through remote diagnosis, thus being able to bring along the right replacement parts on their first tour. These examples demonstrate how the information highway could change spheres of activities and structures in production companies.

From the perspective of women with children, an important use of new information and communication technologies is tele-work. In this, employees work at a spatial distance from their employer or customer, supported by information and communication technologies. For example, the employee can work at home (tele-home labour) and deliver her results via the existing communications net. That way, tele-home labour offers women an enhanced opportunity to combine job and family responsibilities. A different form of tele-work is work at decentralised branches of one company (satellite offices) or at common operational facilities of several companies (neighbourhood offices). Tele-work brings more own responsibility and indepen-dence for the employees, but it could also lead to isolation. So alternative forms of tele-work (at home and in the offices) should be preferable. A last but not lest advantage of the tele-work is the possibility it gives to the employees to adapt the working time to their necessities and personal rhythm.

According to the Ministry of Education, Science and Technology, there are just 30.000 tele-workplaces in Germany at present. But it is possible to create new ones in industries like wholesale and foreign trade, electrical engineering, paper and printing as well as in public administration. In the shape of tele-work, marketing, customer services, accounting, technical drawing, software development, clerical work, reservations, remote maintenance, copy typing and data input could also increasingly be done by women. However, there must be safeguards against the danger of tele-work leading to a lack in quality or to a downgrading of intrinsic values of women's work and a preservation of the traditional division of labour within the family. Through changing a number of job descriptions, new information and communication

technologies could help to overcome the division of the traditional more male and more female dominated occupations.

Nowadays a new form of cooperation is developing in connection with networking, tele-cooperation and tele-work: the virtual company. Within this form of cooperation some (independent) companies and some individuals work together within a determined project or for a determined employer. In this case the cooperation is limited in time, it is distributed locally (often globally) and the cooperation partners use data networks as their central communication tool. Virtual companies could be often found in connection with tele-work computer industry (both of hardware and of software), in customer services and support and in media industry. In this context, a new trend of companies management is to distribute risks and charges among subcontractors by ”outsourcing”. This is efficient when the subcontractor is really independent and could be inconvenient in the case of a dependent employee.

Subcontractors often enjoy the work within virtual companies because of the cooperation with different partners and employers. Often virtual companies offer good possibilities for unexperienced employees or for those which would like to change their job or to begin working after a long break, because they can get new qualifications within this form of work and so improve their chances to find a permanent job later. A general and important problem to promote tele-work and virtual companies is that the companies management understand the role and the new possibilities which new technologies and these forms of work play for the improvement of employees´s life and to create legal conditions and rules of their use inside their companies. Productive cooperative work of decentralised units is an important innovation potential in the industrial and services fields.

Women´s work in German manufacturing industry

In West Germany, the employment of women rose steadily since the beginning of the seventies. Nevertheless, compared with the UK, France or the Nordic countries the female employment ratio is rather low: 1995, it reached 59,9%. In East Germany it was considerably higher (73,9%) because there women with children are used to continue with paid work.

Women are more likely to work on low and middle positions inside the enterprises. 1995, a quarter of the women in East Germany and more than a third of women in West Germany were employed on an unskilled position. The share of skilled women in the total female work-force was higher in East Germany: 1995 it was 39,7% compared to 29,8% in the West. Nevertheless, in the whole of Germany in the higher positions of management and directors, the number of men outweights the number of women to a considerable extent (table 1).

Partly as a consequence of the employment structures, women earn less money than men. Comparisons between the average monthly wages of women and men reveal income differences between 35% and 28%.[10] There is also a work-time-related explanation for the lower female incomes: women are often employed in part-time work and they work less overtime

[10] Ministerium für Gleichstellung von Frau und Mann des Landes Nordrhein-Westfalen, 1996, p. 119f

than men. Furthermore, typical female vocations and professions tend to be less paid than men´s professions.[11]

Table 1 Employment of women and men by their position, Mikrozensus 1995

	East-Germany		West-Germany	
Position	**women**	**men**	**women**	**men**
director	0,8%	1,9%	0,7%	2,6%
higher management	1,3%	2,0%	1,2%	3,7%
middle management	2,0%	2,5%	1,3%	3,3%
technician, master	13,1%	12,9%	10,7%	16,1%
foremen, qualified white-collar	17,2%	8,5%	19,7%	14,3%
sales personnel, qualified blue-collar	39,7%	50,2%	29,8%	33,1%
unskilled white-collar/ blue-collar	25,8%	19,6%	36,6%	24,9%

Source: Tischer 1997

[11] Arbeitsmarktreport, p. 50

Most of the women are employed in the service sector of the economy and hold white-collar positions. In 1995, only 20,2% of women in West Germany worked in the manufacturing industry. There is an interesting relation between the skill-level of working women and the type of job they hold, blue-collar or white-collar. The overwhelming majority of skilled women work in white-collar positions. In contrast to that, in the blue-collar positions which include most of the production work-places in the manufacturing industry, skilled women are in the minority (figure 1). The reason is that only very few women start a qualification in the technical vocations of the manufacturing industry.[12]

In 1996, about two million women were employed in the manufacturing industry, 930.000 of them in blue-collar positions. By the number of jobs in blue-collar positions, the most important employers for women are the electrical engineering industry and the food industry. These two industries together employ 300.000 female workers. In the "second row", with about 50.000 to 70.000 female workers each, there are five industrial branches: plastics processing, garment industry, iron and steel products, precision mechanics and vehicle engineering. In 1996, these five branches together employed further 300.000 women in blue-collar positions. The remaining 300.000 female workers can be found in the other 21 branches of manufacturing industry (table 2).

Women work in all branches of the manufacturing industry, they are not restricted to „typical women´s branches“. Only the garment industry is a „female industry“, with a women´s employment share of nearly 80% (table 2). Seven industries are „mixed“: female workers have an employment share of between 40% and 60%. They produce consumer goods and textiles. The remaining 20 industries are in tendency or completely "men's branches", with female employment shares of less than 40%, e.g. less than 20%.

Gender segregation of work functions rather inside the industries, e.g. the allocation of genders to work-places, than between the industries, e.g. the allocation of genders to industries. Several studies of industrial sociology have shown that in the production women fulfill rather standardised, simple and repetitive tasks in the assembly and dispatch departments.[13]

During the last six years, the employment in the German manufacturing industry declined at a fast pace. The job losses started as early as 1991 and were reinforced by a serious recession since 1992/1993. In absolute figures, more men than women lost their work-place in industry: men's employment sunk about 900.000, women´s employment about 400.000. The job-cuts affected mainly blue-collar positions in production or near to production while the number of clerical jobs remained stable (figure 2).

Nevertheless, in the blue-collar position this process reduced women´s work-places to a higher extent. As a consequence, the female employment share in the blue-collar positions declined in almost all industries[14]). In average, the employment share of women in blue-collar positions sunk with 2,8 percentage points (table 3).

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[12] Berufsbildungsbericht 1996, p. 58: 1996, the ten most frequently chosen apprenticeships by girls were service vocations (medicine, administration, trade, hairdresser, bank, restaurants). 56% of the female apprentice-starters were in these jobs. Among the ten most frequently chosen apprenticeships by boys eight were technical vocations and two service vocations (car-mechanics, electrician, construction, carpentry, plumber, painter, trade, mechanic, bank). 41% of the male apprentice-starters were in these jobs.

[13] Böhne, 1995

[14] With the exception of food industry and precision mechanics

Table 2: Blue-collar workers in manufacturing industry, West Germany 1996
in thousand

	total blue-collar worker	of them: female	share of female workers
ship engineering	14	0,2	1,4
stones and earth	130	4	2,9
steel/light-metal construction	250	7	2,9
iron and steel making	116	5	4,2
aircraft engineering	26	1,5	5,8
mechanical engineering	532	39	7,3
vehicle engineering	636	51	7,9
founding	65	5	8,0
pulp and paper manufacturing	41	3	8,0
steel forming	208	22	10,5
sawmills, wood processing	314	36	11,4
glass	46	8	17,4
chemical industry	253	47	18,5
iron and steel products	258	63	24,3
plastics processing	261	66	25,5
printing, reproduction	132	37	28,4
food industry	400	126	31,4
paper processing, book binding	69	22	31,8
computer/office machinery	12	4	33,0
electrical engineering	497	169	34,0
fine ceramics	36	15	41,6
precision mechanics/optics	120	53	44,1
music instruments, toys	16	8	47,3
textile processing	100	48	47,8
clocks	4	2	52,5
leather, shoes	31	17	52,9
jewellery	11	7	58,6
garment industry	83	65	78,6
total	**4.661**	**930**	**19,9**

Source: ANBA 3/1997

In some branches the relation between the female job losses and the female employment share is extremely unbalanced, as for example in aircraft engineering, plastics processing, electrical engineering, paper processing, book binding or printing (table 3). They indicate a structural displacement of female work. As the electrical engineering is one of the biggest employers for female industrial work, these figures are alarming.[15]

[15] Correlations have been made between the variables of table 3: a)Total job losses and female job losses (Corr.coefficient 0,98), b) Total job losses and difference in the female employment share (Corr. coefficient 0,12), c) Female job losses and difference in the female employment share (Corr. coefficient 0,23); d) Share of female job losses in total job losses and difference in the female employment share (Corr. coefficient 0,74); e) Female employment share 1991 and difference in the female employment share (Corr. coefficient 0,57). The female job losses are strongly correlated to the total job-losses of workers. Nevertheless, no statistical explanation for the declining female employment share is available. It did not decline more in those industries where the total job losses were higher. It did not decline more in those industries where the job losses of female workers

Table 3: Employment shifts of blue-collar workers in manufacturing industry, West Germany 1991 - 1996

	Job losses 91 - 96 in thousand	of them: women´s jobs in thousand	Share of women´s job losses in total job losses	female employment share in 1991	Difference in female employment shares 91 - 96
chemical industry	-74	-17	22,6	19,4	-0,9
plastics processing	-64	-28	43,9	29,1	-3,6
stones and earth	-6	-0,3	5,3	3,	-0,1
fine ceramics	-15	-7	50,0	44,0	-2,4
glass	-11	-2,5	23,7	18,6	-1,2
iron and steel making	-54	-2,7	5,0	4,5	-0,2
founding	-26	-2,5	9,8	8,5	-0,5
steel forming	-37	-8,3	22,4	12,3	-1,8
steel/light-metal construction	-16	-2,3	13,9	3,6	-0,7
mechanical engineering	-166	-15,8	9,5	7,8	-0,5
vehicle engineering	-149	-22,2	14,9	9,3	-1,3
ship engineering	-13	-0,2	1,9	1,6	-0,2
aircraft engineering	-1	-0,9	66,8	8,8	-3,0
computer/office machinery	-11	-4,4	39,2	36,0	-3,0
electrical engineering	-192	-93	48,6	38,1	-4,1
precision mechanics/optics	-16	-6	37,3	43,3	0,8
clocks	-5	-2,6	53,8	53,2	-0,7
iron and steel products	-66	-24,4	37,1	26,9	-2,6
music instruments, toys	-5	-2,8	57,47	49,6	-2,3
jewellery	-6	-3,9	65,1	60,9	-2,3
sawmills, wood processing	-26	-8	30,8	12,9	-1,5
pulp and paper manufacturing	-10	-2,1	21,5	10,6	-2,6
paper processing, book binding	-17	-8,9	51,7	35,8	-4,0
printing, reproduction	-30	-13,5	44,8	31,5	-3,1
leather, shoes	-19	-12,6	67,7	58,4	-5,5
textile processing	-73	-40	54,9	50,8	-3,0
garment industry	-74	-67,4	90,6	84,3	-5,7
food industry	-52	-16,2	30,9	31,4	0,1
manufacturing industry	**-1.235**	**-416**	**33,7**	**22,8**	**-2,88**

were higher. It declined more in those branches where women had a higher employment share in 1991, though the correlation is rather loose.

Source: ANBA 3/92; ANBA 3/1997, own calculations

The crisis forced the enterprises of the manufacturing industry to lower the costs per unit in production. This constraint gave rise to numerous attempts to re-organise the production process. Work-places are not simply substituted by robots, the story is more complex. With the help of information- and communication-technology, tasks in the production process are re-designed, work tasks become more integrated and complex. On the one side simple work-places are reduced, on the other side emerge higher-class, demanding work-places.

The electrical engineering industry is an example for these processes. It produces the equipment of information and communication technologies: the market situation is rather favourable. Furthermore it is expected that new functions and applications will be developed, thereby securing a stable growth of the industry. Nevertheless, the added value of electrical engineering shifts from production to the development and to the service. The industry offers good employment prospects - but only for (high)skilled workers. Only few women possess the suitable vocational qualification to take over the newly created work-fields. In Germany, the number of female students in electronic engineering can be neglected.[16]

On the other hand, information and communication technologies may enhance women's employment. It reduces hard physical work which has got an ascription as „men's tasks". It enables a higher integration of production with service tasks which have got an ascription as „women's work". It allows a more flexible organisation of work time or, as in tele-work, the fulfilment of job duties remote from the work-place. Empirical evidence of these developments exist in the publishing industry. Many work tasks in the preparation of the printing process have been rationalised by information and communication technologies during the last 20 years. Particularly hard physical work was reduced in this production stage. Women entered successfully these work-fields, also enabled by the fact that men „went out" because of insecure employment prospects. Nowadays publishing is in the midst of a further restructuring process brought about directly by the implementation of numerous technological advances. The printing and publishing companies increasingly offer different services, also in the field of Multimedia. Here, women can take up an employment chance, provided that they have the technical qualification for it.[17]

Qualification demand of new work organisations and information/communication technologies

The existing projections of the future demand for qualifications in Germany are almost unanimous in that the demand for qualified and highly qualified manpower will continue to grow in the next two decades. In the manufacturing industry, new technologies as well as different production and work organisations require manpower able to work with sophisticated machines and to fulfil a wide and changing variety of work tasks. An ever growing part of simple and repetitive tasks is done by machines; human work will gain importance in production planning, in repair and maintenance which require profound professional knowledge. As a consequence, jobs for unskilled labour are being cut back further: until 2010 their share

[16] Herausforderung Informationsgesellschaft, p. 147 ff.
[17] Herausforderung Informationsgesellschaft, p. 138

will drop from about 20% in the middle of the nineties to 13%. For about 70% of jobs, labour with middle-level qualifications, and for 15 - 18% of the workplaces university graduates will be required.[18]

The future qualification demands of the manufacturing industry will vary according to the products, production regimes and markets of the different branches. Nevertheless, three general characteristics for qualification demand can be distinguished: knowledge of the production process, knowledge of information/communication technology and a set of social competences.

Knowledge of the production process is necessary because modern information technology makes production abstract. Operations which have been performed by manual workers are substituted by machines, which allow at the same time a growing integration of the successive stages of production. Computer-integrated manufacturing in most cases does not change the physical processes of production, but control them more precisely and process them more effectively. The workers experience the stages of production indirectly, mediated by the numerical control. To process the machines they use a computer-monitor instead of a switchboard. To remove disturbances they programme the machines instead of repairing them with a screw-driver. Disturbances in the production process are not immediately visible in computer-integrated manufacturing. Therefore, beyond the know-how in handling and processing the new machines, workers need an abstract knowledge about the production process to identify the problems. Furthermore, this knowledge must cover several stages of the production. This type of production knowledge is closely connected with the qualification profile of professional workers, e.g. which had received a complete vocational education in the German system of dual vocational education. It can reach far beyond the horizon of semi-skilled workers in Tayloristic production systems which have learned during their short practical training only some specified parts of the production process.

Information and communication technology links the production narrow to the „neighbouring departments“, planning on the one side, dispatchment on the other side. Information and reports towards these departments become more intensive and more precise. For example, production workers enter data about stillstands and disturbances in production in a computer at their work-place which are evaluated by the production planning. Or, they use data-bases for information about available spare parts. At the „edges“ of the production, in design, planning and distribution, information and communication technology is even more important, and most firms have installed the necessary hardware as well as software. Nevertheless, they cannot make use of the technologies potential if the workers knowledge is restricted to some standard applications. This is today the most common case in the enterprises. To arrange adapted solutions with information and communication technology it is necessary to know, how and why it functions, e.g. basic technical knowledge. Competence for the use of information and communication technologies embraces even more abilities: „Navigation competence“ describes the ability to orientate and to move in different information networks. „Recherche competence“ means the ability to organise an effective search for and the choice of information in data-services or in CD-ROM based information systems. An important func-

[18] Buttler, Tessaring 1993, p.2: they refer to the demand projections calculated by IAB/Prognos 1989 and to Weisshuhn/Wahse 1993, unpublished

tion has got logical thinking, as well as the readiness to experiment and to "play" with the potential of the systems.[19]

Information and communication technologies facilitate cooperative forms of work organisation. Therefore, social skills seem to be decisive in future: the ability to work in a team, to communicate and to solve conflicts. In the context of production, these skills cannot be divided from professional knowledge about the production process. In group work, for example, the participating workers have to know the processes and problems in their „environment“, at the different production stages in order to organise the work on their own initiative. Participatory elements, e.g. where group-speakers are elected and represent the group interests towards the management, require from the workers abilities to communicate and to negotiate.[20] More independent and self-organised forms of work, for example tele-work or virtual companies, last but not least require from the employees the ability to co-ordinate and to overview one´s own work, the ability to take decisions, individual self-confidence.

In the context of restructuring processes within companies and the implementation of new technologies, the question of qualification is a crucial one. For all actors within companies, it is necessary both to extend qualification profiles on a technical basis and to qualify with regard to cooperative and communicative skills, i.e. the knowledge of structures within companies and sequences of operations. As a response to these far-reaching demands on qualification, men seem to be preferred for training in companies. This still deepens the inequality gap between men and women on the labour market. Notable results[21] show that women's interest in new technologies is increasing and that they use computers as much and as readily as men in daily life. But there is a set of barriers which prevent women to participate to a larger extent at vocational training. At first, in the production most of them work in unskilled positions which are more or less excluded from training.[22] Secondly, women with child are hindered to participate more in training because of their family obligations. Thirdly, corporate and collective agreements on the promotion of women do not aim at specific qualifications and occupational development perspectives for women.

A qualification module for women in manufacturing companies

The integration of women into new forms of work organisation and new technologies should be supported by qualification modules which are available and attractive for them. One aspect of ”availability” refers to the organisational issues, taking into consideration the circumstances of women´s life. The work within the family requires a flexible time-table of career orientated further education. Within labour market qualification programmes for female returners some concepts have already been worked out: the qualification programmes should include continuous advisory´s possibilities and child-care facilities. It is to think over how to transpose such models to vocational training within manufacturing companies.

The second aspect of the ”availability” refers to the content and to the techniques used for the development of the qualification modules. Women are often not aware of their technical ex-

[19] Herausforderung, p. 84
[20] Böhne, Hamburg 1995
[21] Frerichs/Morschhäuser, 1989; Bahl-Benker, 1994
[22] Beer, 1997

perience and they have an ”utilitarian” relationship to the technology. Not the ”technology” itself, but its use and its support for solving a problem or a task, are in the focus of females’ interest. This specific aspects should be taken into consideration within curriculum. Furthermore, qualification programmes for women in technical professions, which were carried out in the eighties, showed that sex-homogenous learning groups have positive effects on the success of the learning process.

Communicative and cooperative elements could contribute to develop qualification modules attractive, enjoying and conversant with female work-style. Such elements contribute to the gaining of social competence needed for the integration into cooperative forms of work and new technologies too. ”Attractivity” means in the context of German labour market also that the acquired knowledge and skills are attested with a certificate.

It is supposed that learning methods which are based on Multimedia satisfy requirements like wide applicability, flexibility, availability and attractivity. They facilitate e.g. self-organised learning processes, which are not limited to the mediation of theoretical technical subjects, but simulation of work situations, the working out of problems by plan-games, the testing of solutions. On-line helps could be used if difficulties appear during the work. Tele-teaching and tele-learning allow world wide contacts with teachers and pupils as well as being and learning together in virtual class rooms. This could improve women's prospects of qualification to a high degree and offers better integration opportunities to women rejoining the workforce. Therefore, it seems worthwhile to examine the potential of multimedia learning methods for women´s qualification programmes in more detail.

Potential of multimedia learning for the vocational qualification

Computers have been used for personnel training since about 1987 - such a training is known as Computer-based training (CBT). In the beginning the CBT-programmes were restricted to the use of text; they reproduced written learning materials for the use at the PC-monitor. The learning person was able to read through the text and give simple responses to well-defined questions. The rapid progress in information technology allowed differentiated presentation of facts in Multimedia form: pictures, graphics, video sequences and sound. Nowadays the technical preconditions for an increasingly differentiated interaction between the programme and the learning person exist, as it is the case in technical and systemical simulations.

Generally, information and communication technology is spreading everywhere in work-life. Learning how to handle this technology is one of the most important qualification needs for the workforce. As along with the technology the programmes and functions change constantly too and an end of the qualification needs connected to them is not in view. To use the information technology which has to be worked with in every-day-practice at the same time for learning in CBT-programmes is strategically advantageous. People who never before had worked with a computer can gain confidence in the technology of absolving a learning-programme in advance. And people who are used to work with a computer can update their knowledge quickly and in direct linkage to the programmes they work with. Seen in a visionary way, the use of information technology for learning purpose allows a better integration of learning processes and work practice.[23]

[23] Bullinger, p.19

Nevertheless, it is a long way from the actual state-of-the-art to the vision. CBT, using Multimedia, is a rapidly growing area. A lot of new programmes are developed and offered which do not meet the expectations and needs of the customers. Frequently it is complained that the learning software is not compatible to the standard user software, the curricula of the programmes lack quality. Some typical characteristics for an emerging market exist: a lack of transparency about the offer, the prices and the quality of learning software; overoptimistic advertisement from the side of the suppliers, insecurity and caution from the side of the customers. There is a need to screen the advantages and potentials of computer-based training carefully and to spell out conditions where the use makes sense.

In comparison with traditional training-methods in seminars, CBT is expected to be cheaper, to allow a more flexible organisation and to be more effective. CBT enables a reduction of training-hours in seminars and therefore economises costs for trainers, travels, subsistence and the loss of work-time. On the other hand the development of a CBT programme is expensive: the curricula and content has to be pre-structured very carefully, because later amendments in the programmes are difficult. The production of CBT programmes is cost-intensive, although contemporary authors software will reduce these costs. Thirdly equipment and infrastructure has to be added to the calculation, although the prices for computer-equipment are decreasing. Cost-comparisons between CBT and traditional learning methods come to the conclusion that CBT is cheaper when at minimum hundred persons participate in the programme.[24]
CBT allows a more flexible organisation of learning processes with respect to the time and the location. The time of teachers and learners does not have to be co-ordinated punctually. The learners may use the programmes during their working-time in breaks or at home. The same content is available in the same quality at times not determined for a big number of employees. That enables to involve more employees into training programmes and a more equal access to training in comparison to the wide-spread „snowball-system“. According to this traditional practice, enterprises send only a few employees to seminars who are responsible to transfer their knowledge afterwards to their colleagues. This system is often very inefficient. Using CBT programmes and Multimedia, companies could cover some of their qualification needs which have not met before because of high costs, of organisational problems or because of trainer’s lack for new topics.

Some conditions have to be fulfilled in order that CBT unfolds its potential of flexibility. At the work place and at home enough time has to reserved for learning processes. Also learning with a CBT-programme requires a calm environment which is rather absent both at the normal work-place and at home, at least for women with family. If CBT programmes should be get through at home an adequate equipment is necessary. The fulfilment of these conditions, on the other hand, reduces the cost-advantage of CBT programmes. For the training at home additional equipment has to be bought by the firm, although 12% of German households already possess an own PC.

CBT is said to be pedagogical more efficient than traditional learning methods. Because contents and facts are transported by several channels - text, graphic, picture, voice - participants learn them faster and more reliable. Unfortunately, there is no general empirical evidence for that assessment. Vice versa, the use of several perception channels may dull the learners in-

[24] Ross, p. 5ff

stead of stimulating them. Not the undifferentiated use of media, according to a „more is better“ philosophy, but an adequate use of the possible perception channels in a carefully prepared learning concept lead to the learn success.[25]

One important aspect of CBT learning is that it enables individual learning. According to their skill-level learners may repeat units without disturbing the learning process of others. They may choose the units they need, leaving out contents of less relevance for them. Nevertheless, this requires from the participants already a competence to individual learning, e.i. formulating individual goals, choosing the right contents and self-discipline in the learning-process.

The potential of multimedia-based learning and the qualification needs of enterprises are in some contradiction to each other. The goal of learning is social: it should enable individuals to enlarge their competence in social contexts. Qualification for cooperative work-organisations for example consists in large parts of learning how to come to terms with other people. But, also in the more narrow sense of learning technical knowledge it should be applied finally in the context of the firm or the partners. Learning is a genuine social arrangement. Learned contents are controlled, reinforced and widened in a communicative exchange with other learners or with a tutor. This leads to the conclusion that multimedia CBT programmes are not the qualification itself, but the arrangements in which they are embedded. A communicative context is necessary, the exchange on the experiences made with the CBT programme and the immediate adaptation of the learned contents into the work-process.[26]

Conclusion

Manufacturing industry changes rapidly: the (production) work is organised in a more cooperative way, and it is organised in a more decentralised way. Information and communication technologies enable and reinforce these developments. Work-places with simple and standardised tasks are declining further. In many industries, these are women’s workplaces. Accordingly, the female employment share among the blue-collar worker declined.

To improve the employment chances of women in manufacturing industry qualification is a crucial aspect. Qualification demand consists of three necessary elements: (technical) knowledge of the production processes, (technical) knowledge about information and communication technology and social skills. Further qualification for women towards these directions has to respect the specific living conditions of women as well as a specific female approach towards technical topics.

Qualification programmes for women (at work) have to be flexible in time and location, attractive and orientated towards the practical use and applications. Furthermore, they should be of use in the labour market. Learning techniques based on multimedia may fulfill some of these conditions: to what extent and in which context has to be clarified in the WOQUATEWO project.

[25] Weidenmann, p. 6
[26] König, p. 6f/ Ross, p. 21 ff./ Zimmer, p. 7-9