

# **The Future of Work in a Knowledge-Based Economy**

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## **1 Introduction: „The future is not ours to see...“**

Looking into the future always is a doubtful and risky endeavour. „The future is not ours to see, what ever will be, will be!“ was an early warning we have all been hearing when lying in the cradle. The failures are uncounted, and in the relatively rare cases, in which a forecast was blessed with success and clarity, the audience would, unfortunately, just not believe it – from Cassandra onwards.

This holds true in particular in times of poor lucidity we seem to experience right now. Numerous contradicting prophecies are competing with each other in the public discourse ranging from „late capitalism“ to „service economy“, from the „working society“ to the „leisure society“ or from the „information society“ to the „fun society“ – to quote just a few examples. While some authors foresee that the society is running out of work at all, others claim that it can only be rescued by more work. Some deplore that we „amuse us to death“, and others drive us to school for „life long learning“. It is a real hell of a mess – and I better had refused to give a talk on the future of work.

There is a touch of hope, however. Sure, the future is being made by all of us being involved as actors in the process of societal development. We are both authors and actors of our own drama. The future then is the emerging result of this complex interaction process. This perspective provides us with the opportunity for reflection and for concept formation on what is going on in this process. Building such a conceptual model allows us to understand the nature of change, to explain how the present situation has developed as it is from previous situations and, hence, what we can expect to be the core, or the essence, of further development. In other words: It provides us with orientation and coherent perception in the complex web of events, from which we may identify and assess courses of development leading into the future.

This already prescribes the line of argumentation followed in this paper. We start in chapter 2 with the unfolding of the concept of division of knowledge as the fundamental working principle in the social interaction process of the knowledge-based economy (as compared to the division of labour in the industrial economy).

This provides us with a basic understanding of the nature of change we presently undergo and allows us (in chapter 3) to identify and analyse a number of prevailing entrepreneurial innovation strategies in the light of their dynamics and capacities to cope with change. Each of them is associated with a specific structure and quality of work. An assessment of these innovation strategies with respect to their compatibility with the dynamics of division of knowledge and, hence, their sustainability in chapter 4 will then shed some light on paramount characteristics of future work that can reasonably be expected.

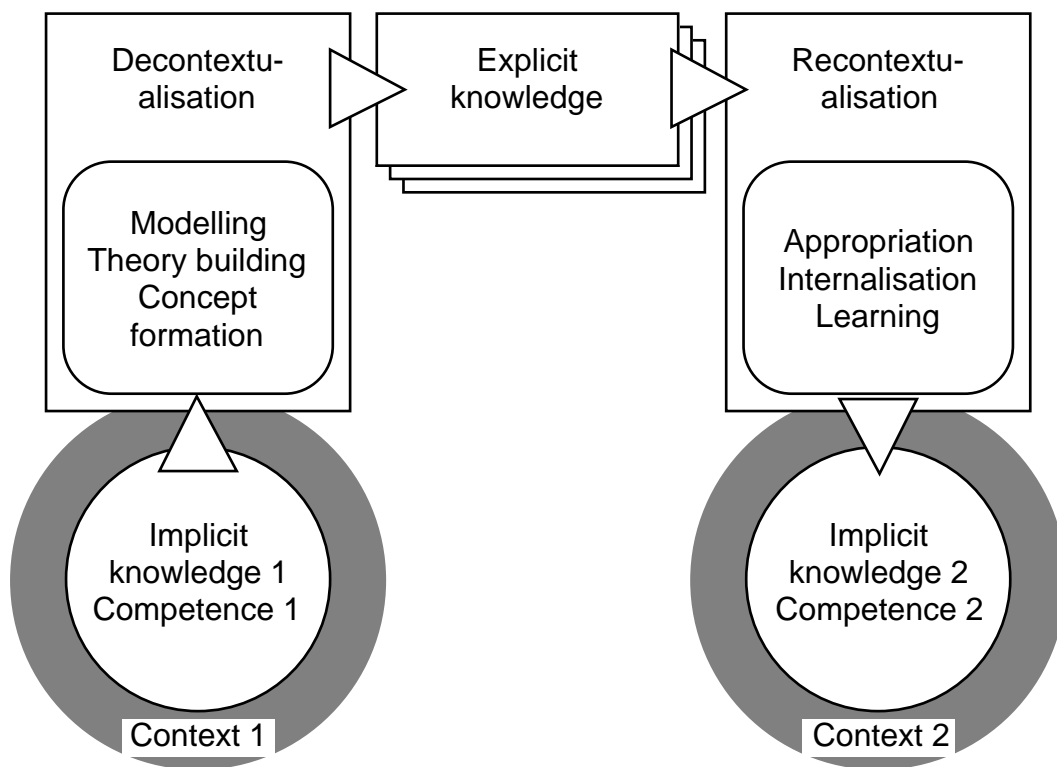
The focus of the paper is on the changes in the quality of work in the first place, but it also takes into account the quantitative proportions of different forms of work. Changes in the institutional framework of the economy are not (or only marginally) considered, though. Thanks to a number of recent surveys both from Germany and from the EU, the empirical data base is quite impressive. Combined with the detailed knowledge we have collected from a great number of comparative case studies, this forms a widely approved constellation of empirical evidence for what is being developed on the next pages.

## **2 Division of Knowledge: Working Principle of the Knowledge-Based Economy**

A number of authors has emphasised far reaching transformations highly developed societies are presently undergoing (Bell 1973, Drucker 1993 and 1994, Stehr 1994). The transition from the industrial to the knowledge society, although it appears as a long lasting process, in fact turns out to be a radical change with far reaching qualitative and quantitative effects. In the course of this transition wealth and employment of an economy are becoming more and more dependent on its knowledge and capacity to innovate, while the performance of the industrial society was predominantly built on the use of capital and the productivity in manufacturing goods. Dealing with knowledge follows, of course, different rules as the production and exchange of goods and related services. It is, therefore, necessary to understand the nature of change in order to get an appropriate assessment of the future of work.

The processes of product creation and innovation normally require the social interaction of a great number of actors. In these processes, knowledge is increasingly serving as a basic and indispensable ingredient. A concept is needed to catch the underlying working principles and to understand these interaction processes. The term *division of knowledge* denotes this complex societal process of interaction through which knowledge is being effectively generated and used in social contexts. Division of knowledge means both the specialisation and differentiation of knowledge – hence its division and fragmentation over different knowledge domains, disciplines and communities of practice – while the knowledge is being generated and the sharing and integration of knowledge domains as well while it is being used for problem solving (Brödner et al. 1999).

The strong relationship between knowing and acting requires another important distinction, the distinction between explicit theoretical or propositional and implicit or practical knowledge. From an action and interaction perspective, the dynamic interplay and the mutual transformation processes between the two forms of knowledge are most important. In an action context, the implicit knowledge, the natural human action competence always comes first (no matter how far it may be developed). It is through specific efforts of reflection and concept formation only that some aspects of a social practice can be explicated and abstracted from the situational context (i.e. transformed into explicit, decontextualised knowledge). In a given situation, explicit knowledge therefore is always limited and partial as compared to the practical knowledge it stems from. The situated use of explicit knowledge, in turn, again requires the specific efforts of appropriation and recontextualisation, a process by which it is transformed into enriched implicit knowledge or action competence. In this sense, explicit propositional knowledge is, as abstract as it is, of no use, it requires practical action competence to be applied and recontextualised in a specific situation (Brödner 1997, Nonaka & Takeuchi 1995, Polanyi 1966, Ryle 1969; see fig. 1).



*Fig. 1: The process of knowledge transformation*

Knowledge is a capacity to act, it enables reflected acting, and its appropriation increases the competence to act which, in turn, can again be partially explicated into new knowledge through reflection. Knowledge, thus, is being enriched

through use in contrast to goods that are being consumed. And the more differentiated explicit knowledge exists, the more important implicit knowledge and advanced competences become in order to put it to use in a given context. Moreover, implicit knowledge is embodied either individually, as personal expertise, or collectively in communities of practice (Brown & Duguid 1991); it cannot be expropriated (except in cases of explication), but can only be made effective through co-operation and socialisation. These are the dynamics and basic working principles of individual and collective learning. The organisation and the quality of the related interaction and knowledge transformation processes, therefore, essentially determine the performance of collective learning and the capacity to innovate.

The concept of division of knowledge referring to the basic working principles of a knowledge-based economy can now be used to explain the main differences as compared with the industrial economy based on the related and complementary concept of *division of labour*. Both concepts refer to specific processes of social interaction comprising both separating and synthesising effects each.

Aspect	Division of labour	Division of knowledge
Object of interaction	Goods & services	Implicit & explicit knowledge
Form of interaction	Exchange (transaction)	Sharing
Purpose of interaction	Redistribution of goods & services	Increase of knowledge
Effect of process	Specialisation	Specialisation & diffusion
Result	Productivity	Capacity to innovate
Next step in process	Separated operation	Internalisation, recontextualisation
Mode of interaction	Predominantly competition	Predominantly co-operation
Tradability	Given	Limited
Compensation	Specific	General

*Fig. 2: Division of labour versus division of knowledge in institutional perspective*

In the case of an industrial economy, the development of productivity, value creation and wealth are rooted in the division of labour bringing about specialised work. In the case of a knowledge-based economy, the development of the capacity to innovate, of value creation and wealth are based on the division of knowledge.

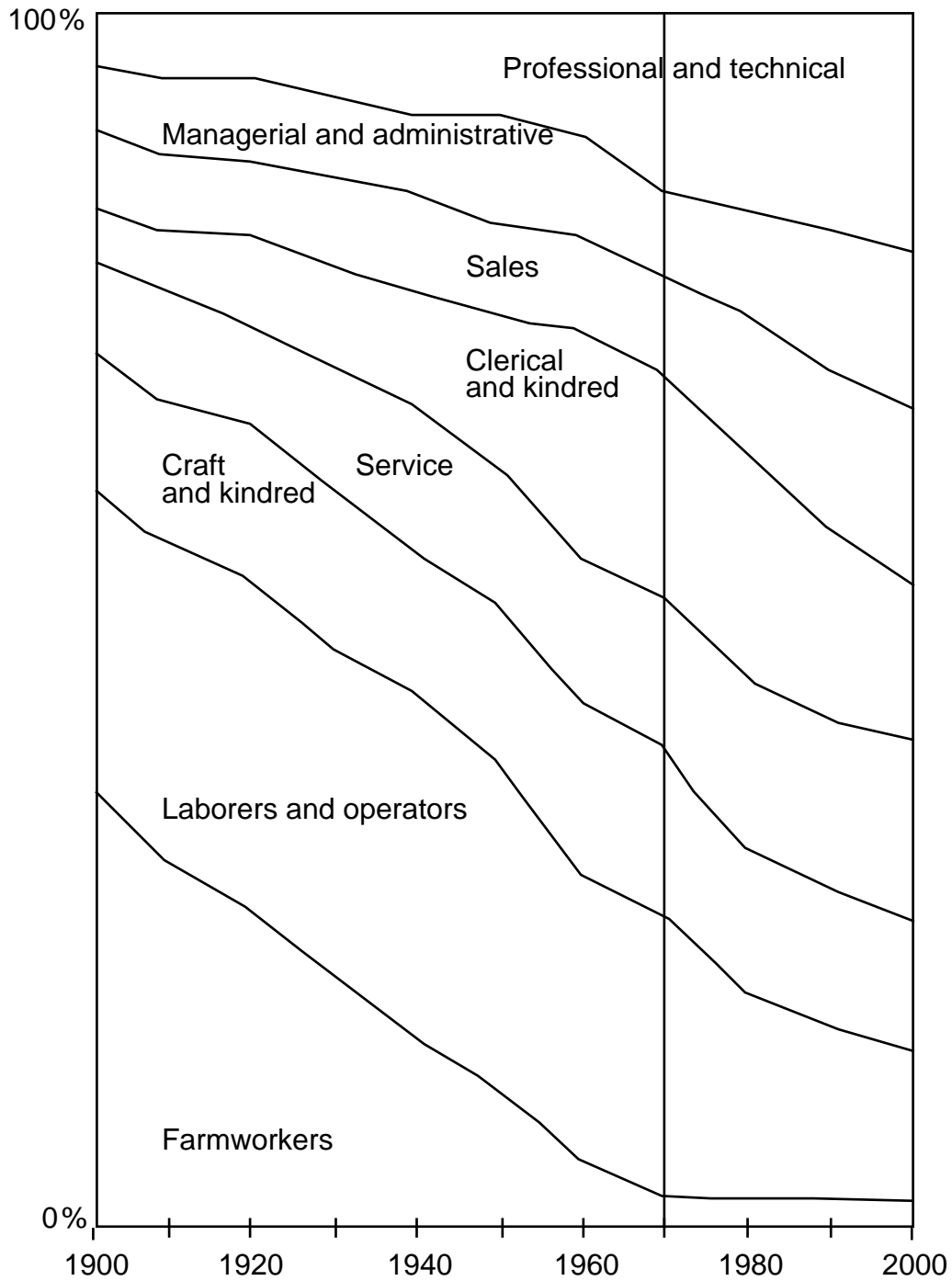
In the industrial economy the synthesis of the outcome of specialised work is accomplished on the societal level through exchange of goods produced on the market place and on the level of the enterprise through co-operation as co-ordinated action of many specialised workers. In the knowledge-based economy, in contrast, the synthesis of fragmented knowledge needed for value creation is predominantly being achieved through inter- and intra-firm co-operation and sharing of knowledge between experts and in communities of practice. This is why collaboration in networks is increasingly becoming important and necessary for economic success (see fig. 2).

In the knowledge-based economy customer orientation and the creation of use value for the customer are in the centre of economic activity. In this context, the traditional distinction between goods and services does not make sense any longer. The customer wants to have satisfied his needs and to get solved his problems. This determines the use value of economic activities that is typically created by an effort where services, knowledge and material resources are being combined and, hence, depend on each other. This can ultimately lead to a situation where the supplier does not sell a product any more, but offers a service that meets the demand of the customer. Clearly, this service is based on a (software) product, but the product remains in the ownership of the supplier. The general perspective is creating value for the customer rather than producing goods or services.

This clearly indicates that the industrial and the knowledge-based economy are working to different rules. „Sell me a cake and I have it; sell me the recipe and we both have it“ – provided that the recipe is appropriately interpreted. This indicates that knowledge, in contrast to goods and services, diffuses through interaction. Moreover, competence and knowledge grow in the process of using them, whereas goods and services are being consumed. The knowledge-based economy, therefore, needs a different and new institutional framework in order to fully develop to its potential. Many of the problems European economies are facing in these days are rooted in the difficulties, misconceptions and resistances of the transition process to the knowledge-based economy rather than the ever lasting process of globalisation.

The dynamics of division of knowledge and knowledge transformation enhances the capacity of enterprises or industrial clusters to build sustaining comparative advantages in international competition. This process of self-creating comparative advantages for knowledge-intensive products and services is based on the mechanism that, as soon as just a minimum advantage has emerged by chance or by technology politics, the underlying competences developed so far are difficult to imitate. The further development works self-amplifying due to positive feedback in the social interaction processes of knowledge formation and use („technological externalities“). The more specialised competences and knowledge are developed, the more far reaching become the potentials for problem solving and linking to competent partners, and the more difficult is it for competitors to appropriate knowledge at the same level. Specialisation, thus, creates advantages for competition and economic development.

These sketchy considerations may be sufficient in my context to explicate the nature of change and the new quality of a knowledge-based economy. There also



*Fig. 3: Development of Shares of the Total Workforce in the USA, 1900 - 2000 (Source: Stewart 1997)*

exists a number of quantitative indicators that reveal the extent to which the transition towards the knowledge-based economy has already come into existence in highly developed countries (no matter how many obstacles still might be to remove).

There obviously is a growing demand for knowledge workers („symbol analysts“, Reich 1991). Their role is to identify and analyse problems and needs with customers, to develop problem solving approaches, and to link and mediate necessary competences and pieces of knowledge. Accordingly, their specific competences are abstraction, system thinking, experimentation and exploration as well as communication and co-operation. Their total number has been estimated already to account for one fifth of the US work force in 1990. A more detailed picture of the development of the shares different types of workers had in the US work force over the past hundred years is shown in fig. 3 (Stewart 1997).

Another strong indicator for the transition to a knowledge-based economy is the diffusion of information and communication technologies used as basic tools and media for the knowledge workers. In the period from 1965 to 1991 the investment in information technology in the USA has grown by a factor of six, while the investment in manufacturing technology has hardly doubled and has recently been surpassed by the former (see fig. 4).

Year	Investment in billions of US-\$ in		Information technology as percentage of manufacturing technology
	manufacturing technology	information technology	
1965	60.3	18.8	31
1970	63.4	28.6	45
1975	68.6	27.4	40
1980	96.7	52.0	54
1983	77.2	61.5	80
1991	107.0	112.0	105

*Fig. 4: Investments in manufacturing and in information technologies in the USA, 1965 - 1991 (Stewart 1997)*

This outline of basic features of a knowledge-based economy serves as background against which possible futures of work can now be analysed and assessed. To this end, it appears appropriate to focus on enterprise strategies for innovation, since innovation can be regarded as expression of entrepreneurship (Drucker 1985). These enterprise strategies form the locus where market perspectives and customer requirements are linked to available resources and given frame conditions and where these external circumstances are transposed into specific processes of knowledge formation and use.

## **3 Innovation Strategies**

### **3.1 Lacking Dynamics: Business as usual**

In the nineties, a great number of new management and organisation conceptions have shown up that seem to indicate a process of transformation. The spectrum of conceptions and labels stretches from „Lean Production“ and „Business Process Reengineering“ over „Total Quality Management“ and „Agile Manufacturing“ to the „Fractal Factory“ and the „Learning Organisation“ (after all not less than three dozens of such conceptions are being discussed). In this confusing world of „Sloganeering“, most managers have already lost the overview and orientation. The conceptions and strategies labelled in this diversity often lack substantial theoretical foundation or merely wrap well known organisational principles with new labels. There are almost no serious attempts and efforts to systematically analyse and compare the diverse conceptions and strategies in order to find out about similarities and differences, to relate them to previous innovation strategies and, thus, to regain clarity and orientation.

Despite of this even growing flood of change in innovation rhetorics, the real dynamics of change in most enterprises is very low. Two representative employee surveys on the diffusion of group work and other forms of co-operative work in Germany carried out by the Institute for Work and Technology in 1993 and 1998, for instance, have revealed that still surprisingly few employees are working in one of the different forms of group work. The total amount was 6.9 % in 1993 and 11.8 % in 1998. Looking at the specific form of semi-autonomous group work which is, as we know from case studies, one of the strategic elements for successful innovation strategies and high competitiveness only 2.2 % of the employees in 1993 and 3.2 % in 1998 worked in semi-autonomous groups. The highest increases can be observed in the service sectors (especially in health services) while group work in manufacturing (especially in investment goods production) increased only little, despite of high awareness of its potentials. Similar results of low diffusion of group work are also reported in the Europe-wide EPOC survey in 1997: In Germany, only 8 % of the firms are practising one of the forms of group work as compared to 18 % in Sweden, 12 % in the Netherlands or 2 % in Spain (with a European average of 8 %; EPOC Research Team 1998, Kleinschmidt & Pekruhl 1994, Nordhause-Janz & Pekruhl 2000).

Looking at concurrent engineering schemes as another strategic element for improving competitiveness, the winds of change again are relatively low. These schemes have been introduced by innovative firms to link and integrate different activities of product and process development in early stages of product definition in order to avoid frictions and cognitive dissonancies and to reduce time-to-market (see chapter 3.3). The potentials of implementation, in particular in the investment goods industries, presently are by far not exhausted yet. And international comparative case studies reveal that implementation efforts for concurrent engineering schemes are falling back as compared to those efforts in the USA (Dreher et al. 1995, Jürgens & Lippert 1997).



Consequently, for a vast majority of firms almost no strategically intended and systematically implemented change of traditional manufacturing structures and procedures can be observed. They still follow the old tracks of horizontal and vertical division of labour they are used to, although they might undertake one or the other experiment that mostly fail, however, due to insufficient commitment and management support. Moreover, most of their change efforts are focused on technical process innovations such as the implementation of enterprise resources planning (ERP) systems or engineering data management (EDM) systems rather than organisational improvements. They do, of course, stepwise successfully innovate their products according to the state of the art, but the way they are doing their business is still conventional.

Apart from these conventional firms sticking to traditional organisational patterns and doing business as usual, two distinct innovation strategies can be observed. The differences between these two can best be described with respect to the productivity formula that defines productivity as the relation of value-added and expenditure of economic activity. One of the two classes of enterprises – we call their strategy the „low road of innovation“ – is focusing all their innovative attempts on diminishing the denominator – the expenditure –, while the other one – we call their strategy the „high road of innovation“ – is concentrating on expanding the value-added – the numerator – without neglecting, of course, the opportunities for reducing the effort. The basic strategic orientation, thus, is cost competition on the low road and qualitative competition on the high road (Brödner et al. 1998).

### **3.2 The Low Road: „Cost accounting is hazardous to your wealth!“**

Enterprises following the low road of innovation are predominantly concentrating their innovative activities on reducing the expenditure in resources as the denominator of economic efficiency. They rather aim at doing the same with less. In order to improve competitiveness and to achieve more flexibility, their focus is to cut costs, in particular, to reduce the work force („downsizing“), to shrink to core business („outsourcing“), and to restructure work processes („reengineering“). By all kinds of process innovation, they attempt to exhaust existing rationalisation potentials and to reduce organisational slacks both internally and in co-operation with their suppliers. Thus, they are searching for a logistic optimum throughout the whole value adding chain („systemic rationalisation“, Sauer & Döhl 1994). Opportunities for expanding business by creating new products and services and by exploring new markets, on the other hand, are mostly not regarded.

Accordingly, enterprises of this type often stick to their traditional products and markets. They, therefore, are confronted with rather stagnating market volumes and with price competition that compels them to further cost reductions – a true vicious circle. For some time, this mere cost reduction strategy may, of course, improve the balance sheet, while the overall market position tends to be weakened, however.

There is quite some empirical evidence for the hazards of this innovation strategy. Enterprises with a low manufacturing scope, for instance, typically achieve only 4.6% profit on sales in the average as compared to 6.4% of those with high manufacturing scope (Kinkel & Lay 1998). Investigations from the USA in the early nineties reveal that companies with a high amount of downsizing normally experienced smaller profits and reduced productivity of the work force. Less than half of those companies were able to achieve their cost reduction objectives, less than one third of them could increase profits and less than a quarter of them could improve productivity (Applebaum & Batt 1994).

Together with this strategy, a conventional understanding of markets and relations with customers is prevailing. This understanding conceptualises customer demand primarily as a specific set of functional requirements for products that can be obtained from market analyses and customer questionnaires. Customer-specific services rather play a subordinate role. The relationships to the suppliers that are so important for this strategy due to the low manufacturing scope are subject to strict cost control and change with competition on the supply side markets. It, therefore, is almost impossible to build long term, trust-based relations for jointly developed innovations or co-ordinated investments. In the following, the main characteristics of this cost competition strategy are illustrated in more detail.

**Work organisation and personnel development:** Enterprises following the low road of innovation often implement under the labels of „Total Quality Management“ or „Lean Production“ similar new organisational schemes as they can be also found in enterprises on the high road. This appears confusing at first glance, the differences become clearly visible, however, if not only the abstract conceptions but rather the real working procedures are being investigated. The process-oriented organisation of work as well as group work integrating value adding activities that used to be separated before are, as it is well known, suited to increase productivity and to reduce throughput time and in-process inventory. By this, they contribute considerably to reduce costs, and that is exactly why they find the interest of low road management in search of cost cutting measures.

The functionally divided activities of the traditional hierarchical organisation are also in this strategy increasingly being restructured and reintegrated in business processes oriented towards adding value for the customer. This reorganisation of work mostly remains relatively limited to job rotation and job enlargement rather than job enrichment or co-operation, however. Improvements under participation of the employees are concentrated on process optimisation to avoid frictions and slacks. Beside of this, separate planning units and rationalisation teams still play a major role in designing and implementing process changes. The workers, thus, have little influence and experience high time pressure and work intensity. Attempts to implement concurrent engineering schemes are undertaken rarely or half-heartedly only. Opportunities to unfold and comprehensively use human competence to act are remaining unexhausted.

This points to the fact that management does not really take care of broad and comprehensive development of human resources. Personnel development is rather

limited to the appropriation of process-specific qualifications or selected bottleneck skills. As a consequence, there is a strong tendency to separate the work force into permanent, highly educated and skilled employees forming a core work force and temporary, less skilled employees as a periphery that allow for adapting to capacity changes. By concentrating on cost reduction, opportunities for increasing productivity through the creation and use of knowledge are, thus, being neglected. Since all process-oriented changes are predominantly aiming at reducing the work force, there are only little incentives for the employees to develop self-initiative and to commit themselves in process innovations. This probably is the most significant difference to the strategy of the high road of innovation that deliberately attempts to re-invest human capital gained by reorganisation and personnel development into product development and expansion of capacities.

**Co-operative relationships** in the cost cutting strategy are primarily directed towards optimising the processes of the value chain. This orientation of "systemic rationalisation" has often also been denominated as "supply chain management". Even if all producing units are working at their best there still can improvements and cost reductions be achieved by smoothing the material flow, i.e. by better coordination of volumes and due dates between the units. In particular, intermediate inventories with their associated costs can be reduced to a considerable extent by the so-called just-in-time delivery.

It is no surprise that the strategy of the low road puts so much emphasis on this systemic rationalisation of the supply chain. If all activities are being outsourced that are not considered as belonging to the core business, and if this is regarded as the main measure for cost reduction, then the co-operative relationships between the producing units actually deserve high recognition by management. Substantial economic benefits then have to be realised by improving the interplay of all units along the value chain. This requires, of course, a sophisticated inter-firm co-operation and co-ordination of the logistic processes.

These co-operative relationships are often dominated to a high extent by a single powerful organisation being in the position to strongly select its suppliers under strict cost competition. Accordingly, the dominant organisation is also in the position to design and implement the logistic processes to its own conditions and to determine or even take over the functions of planning and controlling of the logistic processes along the supply chain. The main focus then is on supply chain management rather than the formation of effective co-operative relationships among equal partners. This management perspective that still is highly determined by the Taylor model of „scientific management“ typically underestimates the considerable transaction costs it causes, however. In particular, the costs for communication, for mutual understanding of problems and solutions and for co-operation are systematically underestimated. Quality problems and frictions between the units, therefore, are wide-spread and frequent.

**IT infrastructure:** The effective co-ordination of the logistic processes is based on a strong coupling of diverse IT systems being used within the firms. This coupling strategy often leads, in order to avoid adaptation and compatibility prob-

lems, to the result that the dominant partner prescribes the IT platform and standard software modules to be used by all other partners. It is even more important, that typically also the logic and the procedures of the order management for the whole supply chain is designed according to the traditional centralised model of production planning and control. Central planning prescriptions are, thus, pushed through to the suppliers on the basis of these „supply chain management“ systems. This central planning requires total transparency of production states and in-process inventories in all units of the chain. This transparency cannot (due to the central order management) be used by all partners, however, for process improvements, e.g. by a new design of the inter-firm division of labour.

Moreover, it is often neglected to develop a mutual understanding of concepts and procedures as a necessary prerequisite for shared comprehension of data types and functions in the supply chain. This is a task of equal importance for sensible interpretation and efficient co-operation, however. Due to unequal co-operation, supply chain management, thus, seems to repeat all the mistakes of centralised production planning and control that have been identified as causes for failure in single firm order management (Brödner 1997, Davenport 1994 and 1998).

### **3.3 The High Road: Entrepreneurial Basis of the Knowledge-Based Economy**

One of the main characteristics of the high road of innovation is, in contrast to the low road, its strategic orientation to direct all productive forces and innovative capacities in the enterprise towards customer-oriented development of products and services. This means in particular to explore new areas of business in order to expand the value-added („expanding the bang rather than cutting the buck“, Hamel & Prahalad 1994). At the same time, the comprehensive development and use of human resources to this end – on the basis of new organisational schemes – is also used to foster other factors of success such as increase in productivity or lead time reduction. In this way, the strategy of the high road combines product and process innovations in a balanced way, where expanding the value-added through customer-specific products and services is the leading perspective.

Enterprises following the high road put high emphasis on the customer orientation of all their activities. They take high efforts to explore markets, to understand the needs and problems of their lead customers and to derive new products and services from that customer knowledge. They maintain close contacts with their lead customers and they jointly work out solutions for their problems. They systematically analyse lost orders, customer complaints and failure reports. They also allocate high efforts to systematic simplification, structuration and modularisation of their products and services in order to offer customer-specific solutions on the cost-effective basis of standardised modules.

In these customer-oriented innovation processes, the willingness and the capacity for co-operation have far developed that enable them to cope with challenging tasks becoming more and more complex and requiring more and more diverse knowledge. Thus, project-based co-operation both within the company and across

its borders has become a fundamental working principle. It comprises actors from lead customers, research institutions or important suppliers and it is based on long-term trust relations rather than short-term cost competition. This basically co-operative attitude attempts to make effective use of the specific knowledge and action competence and, at the same time, to share the results as well as the risks. Based on a number of case studies, the following details may illustrate the main characteristic of this strategy (Brödner et al. 1998, Work & Technology Consortium 1997).

**Concurrent Engineering or Integrated Product Development** are organisational and management endeavours to reintegrate engineering design tasks concerning products and processes that have been separated before and to bring together the different knowledge domains needed for this. The integration of different perspectives, competencies and knowledge domains, the development of a shared comprehension of the design tasks among the experts form the real core of concurrent engineering efforts. The objectives behind these efforts are to reduce time to market, to do things right the first time, and to use comprehensively the available knowledge sources for products and processes better suited to the requirements identified (Ehrlenspiel 1995).

Since knowledge and competencies needed for design are diverse and widely spread over the company's departments (and, maybe, even across its borders), the integration of design activities makes it necessary to form design teams where all those co-operate who possess specific knowledge or expertise for achieving a good design. This forms a new type of work wherein the members are expected to understand and accept other perspectives, to relate their own ideas in a productive way to those of others, and to develop a shared understanding of the underlying problems and possible solutions. This mental reorientation is difficult to achieve; it can be supported by a socially skilled team leader with the ability to solve design conflicts, to overcome mismatches in perspectives, and to take care that their work is striving for integrated solutions in the light of customer and production requirements (Brödner 1996).

As cases from various industries demonstrate, major achievements can be reached in reducing time to market (typically by a factor of two), in finding better solutions for customers with fewer costs, or in developing more innovative solutions as a combination of products and services.

**Customer Orientation** has become an important business focus due to increased knowledge intensity and competition. A greater supply of more or less standardised products incorporating some use value for customers is no longer a sufficient basis for sound business. Rather an in-depth analysis of customers needs is becoming more and more important, since customers have reached a position of having more competitive choices. For the supplier, this does not only mean that he has to offer more customised products; he also has to put much more effort into demand analysis (e.g. in the form of lost order analysis or by co-operation with important customers) and problem solving activities for the customer.

Thus, the new way of doing business goes far beyond designing and manufacturing products of high quality, customised functionality, and in due time; it may also include services such as engineering maintenance, training of staff or even financing. As comparative analysis strongly indicates, this way of expanding business through customer focus is one of the major success factors in competition.

**Networks of Innovation** can help to overcome limits of know-how and manpower capacity in single companies. The capability for innovation is determined not only by organisational structures within the company and by internal social processes, but also by co-operational structures and processes between companies and by mutually agreed development programmes of companies, unions, state agencies and particular institutions. In view of the high speed, high risk and high complexity of innovation, many firms can assure their innovative capabilities only in co-operation with other companies or with research agencies. This holds true not only for small and medium sized enterprises but also for big multinationals. Networks of innovation require, however, high communicative and social skills, apart from the professional knowledge.

Research evidence shows that co-operation for innovation is self evident in most of those knowledge-intensive, high-tech companies that are highly competitive and innovative. Co-operation for innovation is particularly essential if innovation strategies are highly complex, especially in cases of integrated innovation for custom-made products and in cases of complete innovative product- and service-systems.

**Knowledge Management** has become a management task of growing strategic importance. More complex products, services and processes with a widening range of materials and procedures in a dynamic market environment require more differentiated knowledge to market and produce them. This growing body of knowledge available world-wide is rapidly fragmenting into separate, specialised domains, developed and maintained by many different institutions. Knowledge, therefore, is highly fragmented and dispersed. Against this background, knowledge management basically has three important tasks (Leonard-Barton 1995, Nonaka & Takeuchi 1995, Probst et al. 1997, Willke 1996 and 1998): (1) to explicate and codify socially embodied knowledge in a structured way, (2) to connect people to these explicit knowledge bases for their effective use, and (3) to integrate the different perspectives needed for problem solving.

Knowledge normally is created in the context of work processes, it is of the experiential type suited to practical needs, and it is embodied in communities of practice (Brown & Duguid 1991). Therefore, much effort is needed to transform and codify it into reproducible, structured, explicit and generalised knowledge (in the form of data bases, process descriptions, technologies etc.) that can be shared with others and is easily accessible by them for use in different contexts.

Accordingly, explicit knowledge always is, due to its very nature, abstract and decontextualised and not easily applicable. The use of explicit knowledge, therefore, always requires competent human experts to interpret and recontextualise knowledge for solving a specific problem in a specific situation. Without an idea

how the knowledge can make sense in the specific situation the knowledge will be useless. Moreover, analysing and adequately solving problems typically requires a number of different knowledge domains. Consequently, the different experts that are able to handle this knowledge for problem solving, have to be brought together so that the different knowledge domains and perspectives can be productively linked and integrated.

Taking all these aspects together, knowledge management is a complex and demanding task of gaining access to fragmented knowledge domains and of organising co-operative processes, where the different sources of knowledge are being integrated. A good example of this is Concurrent Engineering where experts from different domains, i.e. marketing, production, purchasing and design, work together in the early phases of product definition and process design in order to get the product right both for the customers and for production.

**Skill Development and Knowledge Formation** („intellectual capital“, Stewart 1997) have turned out to be decisive success factors in high performance organisations. Management, therefore, regards human resource development as a strategic investment to be comprehensively used rather than as a domain of costs to be reduced (with an effort of ca. 5 to 8% of total compensation per year). Human resources are systematically developed in connection with reorganising work and creating holistic tasks for comprehensive development and use of competence and knowledge. Whereas on the low road the Tayloristic perspective builds on the assumption that production processes can, with sufficient research effort, be completely comprehended and controlled (even in the case of high flexibility for coping with dynamic markets), and, hence, production processes can be completely designed and managed by explicit propositional knowledge, the human-centred perspective on the high road recognises the fact that explicit knowledge is always limited in principle.

The unique human ability to perceive and act in complex situations without referring to explicit rules, therefore, is indispensably needed in order to make sense of this limited abstract knowledge and in order to make it usable for practical innovations. This basic fact of skill development and knowledge formation makes systematic personnel development and life-long learning a permanent management task in knowledge-intensive processes of value creation. This task is not sufficiently achieved by external training programmes far from real work. Rather and above all, challenging work tasks in changing situations as well as interdisciplinary co-operation in multi-functional teams are the appropriate places to learn. This leads to a new conception of work itself as a unity of value creation, reflection, design, and learning that, in the process of working itself, gives opportunity to develop individual and collective action competence to be used for product and process innovation. In this way, work itself becomes the most important place for competence formation and innovation. Skills and knowledge, thus, develop in and through work rather than training.

**Supportive IT Systems:** IT systems in this context have to be designed and implemented as a supportive infrastructure rather than a means of automation. In

order to be used as tools to assist workers in solving their individual tasks and as media to support co-operation, usefulness with regard to the task and usability with regard to the workers' needs must be at the centre of the design. In contrast to the traditional perspectives of imitating and replacing human skills by IT systems, the tool and media perspective aims at a symbiosis of human skill and technological performance that makes work more productive and leaves room for further skill development and technical improvements through learning (Brödner 1997).

In contrast to the traditional IT perspective (to imitate and replace human capabilities), this new perspective aims at using the IT infrastructure as tools for accomplishing specific tasks and as media for co-operation. Situated human action competence is, thus, being combined with the performance of the data processing machine. Interaction is much more powerful than algorithms for automatic process control, in particular under uncertainty. According to this perspective, human work can not only be made more productive, but also be designed such that it leaves room for improving work processes through reflection and learning as well as for further development of action competence.

If IT systems are being designed and implemented according to this tool and media perspective, they may also serve as externalised memory of the organisation. It then is part of knowledge management to elaborate, with the necessary participation of users, appropriate procedures for structuration and codification of existing explicit knowledge that, thus, can be captured, stored, retrieved and used in working processes. If well designed and used in this way, the externalised knowledge base of the organisation can interactively grow with the work being done.

**Company Culture:** The construction of the high road to innovation, the implementation of fundamental changes in the company are hindered and quite often even completely blocked by the inertial capacity of an existing company culture. In general terms, the company culture or, more precisely, the organisational culture within a company, might be defined as „the way things are done around here“. This way of doing things is shaped by custom and practice, values and attitudes that are taken for granted. They lay down a frame of reference that guides the thoughts and actions of the workforce. This frame of reference has been tried and tested over many years and therefore provides a secure basis for everyday actions. This culture is a complex of unquestioned basic assumptions that shape the perceptions, the thinking and the feelings of members of the organisation when they find themselves faced with certain recurring situations. The historical embeddedness of organisational culture and the fact that this culture provides members of the organisation with a secure basis for their actions makes it extremely resistant to any short-term change. The culture in a Taylorian-bureaucratic firm is of course adapted to that form of organisation.

If implemented rigorously, the high road to innovation marks an almost complete break with the traditional basic principles of bureaucratic organisation. The one-way flow of decisions from top to bottom is replaced by a system in which decisions taken at all levels of the hierarchy mutually influence each other. Typical el-



ements of bureaucratic organisation such as standardisation and formalisation based on abstract principles are replaced by the continuous improvement of both products and processes through those doing the work. The division of the organisation into functional units gives way to a task-based mode of work organisation and direct communication and interaction between the various organisational units. The hitherto familiar principles of command and execution, of a hierarchical command structure, central planning and information flows converging at a central level are abandoned, at least in part. A system based on spheres of competence and central control is replaced by a system of individual and collective responsibilities, orders give way to agreed objectives, and the need to obtain authorisation for many measures is abandoned. The traditional bureaucratic organisation is literally taken to pieces and reassembled in a completely different way. From the cultural point of view this means that virtually everything that used to be self-evident suddenly no longer applies.

In order to overcome the old principles and patterns of behaviour and to enter the high road the company has to develop a new company culture which is characterised by new ways of feeling, thinking and acting as are self-evident in high-road-companies. Thus, the enterprise has to become *a learning organisation with a culture of innovation* in which all members deliberately and collectively move away from old paths and develop new and more appropriate ways of innovation. Learning processes, however, are needed not only to adapt the organisation's culture to new needs, but also as a fundamental of all radical innovative processes.

## **4 Approaches towards the Future of Work**

So far, we have identified different entrepreneurial strategies in highly developed countries as they can be presently observed. This puts us in the position to assess these strategies against the background of the underlying transitional dynamics in the process of forming a knowledge-based economy. Comparing the functional logic and working principles of the strategies identified with respect to the requirement of the transition process may provide us with clear hints which innovation strategy is more likely to correspond to the fundamental change, to drive it forward, and hence to sustain in the transition process. According to this line of argumentation, we can at present already observe major important features that shape the future of work in a knowledge-based economy.

First of all it has to be stated that there is no uniform type and structure of work at present. The overall picture is differentiated, and main differences are most likely to persist. The quantitative proportions and the relative weight may change, but the basic qualitative differences will probably remain for quite a while. At present, a marked horizontal and vertical division of labour and a hierarchical structure of command, co-ordination and control according to the Taylor model of organisation are still dominant in many sectors (manufacturing and non-manufacturing). This is due to the fact that the enterprises following the business-as-usual and the low road strategies are still a vast majority. And there will,

of course, remain a number of sectors and businesses with products and services of low complexity and little dynamics where this type of organisation appears appropriate.

The recent Institute for Work and Technology employee survey in Germany (Nordhaus-Janzen & Pekruhl 2000) may underline this statement. By means of eleven diverse indicators the employees were asked about the degree of autonomy in doing their job, about the degree of direct participation in shaping their organisational and technical work structures and procedures, and about the level of co-operation with colleagues in the work process. On the basis of these data, different types of single and group work can be identified (that for this paper have been reduced to three). In type I, the *Tayloristic form of work*, the levels of autonomy and participation are low, and co-operation has no influence. In type II, the *participatory form of work*, autonomy is low, while participation and co-operation reach high levels. Finally, type III, the *post-Tayloristic form of work*, is characterised by high values of participation and autonomy, and, additionally, when working in teams, there also exists a high degree of co-operation.

The results are, regarding the prevailing rhetorics on new production concepts, rather surprising. The share of employees in Tayloristic forms of work organisation as well as the share of employees in non-Tayloristic forms of work organisation have both increased over the last five years, while the weight of participatory work organisation has diminished. Above all, the share of employees whose work is heteronomous is much larger than the share of those working autonomously (see fig. 5). This can be clearly interpreted as an effect of the recent advances of the management-driven top-down innovation strategies on the low road.

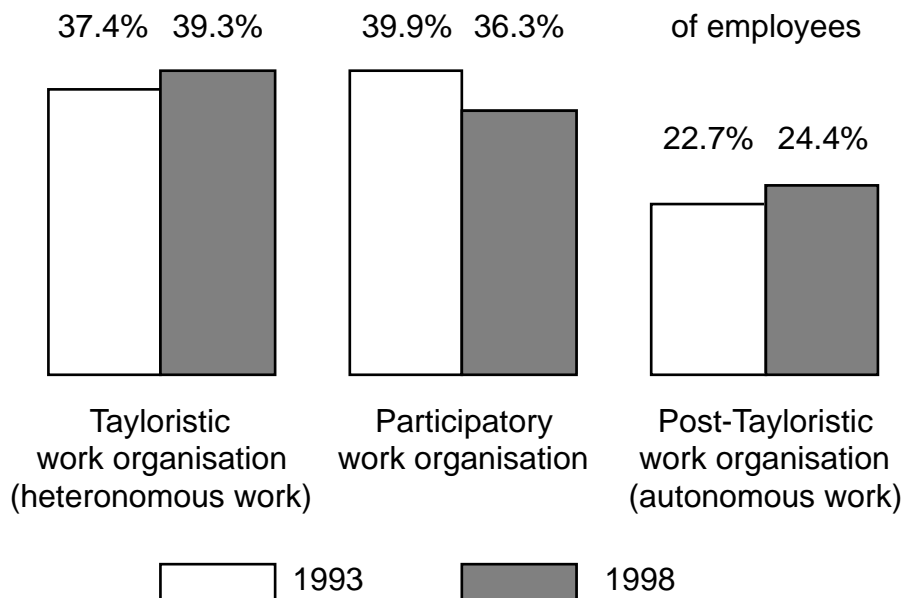
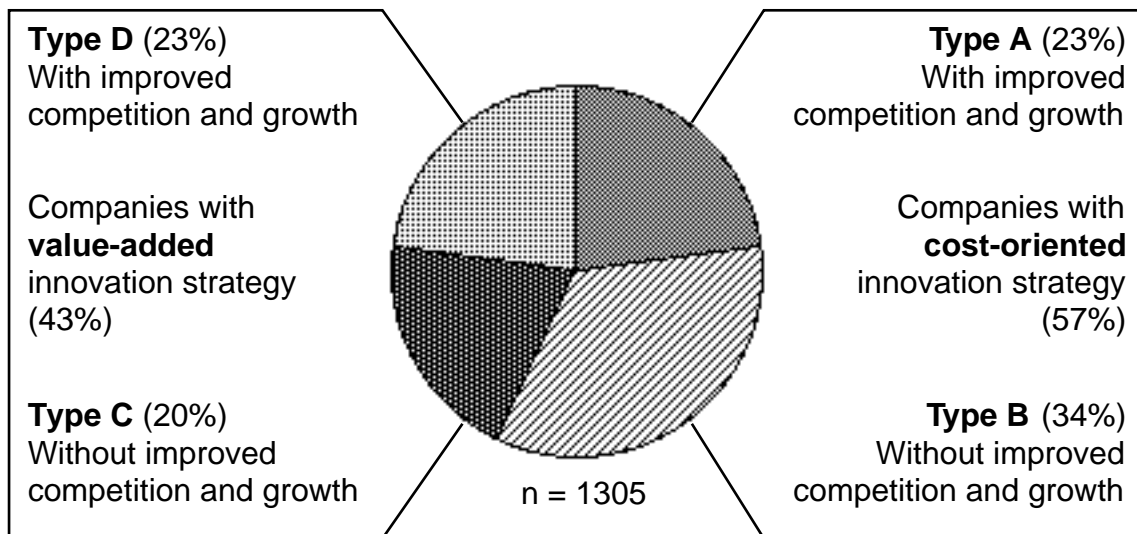


Fig. 5: Distribution of forms of work organisation in Germany (Source: Adapted from Nordhaus-Janzen & Pekruhl 2000)

It is most likely, however, that both the business-as-usual and the low road strategies, although they may remain successful in specific sectors of simple products and services with little change and low knowledge intensity, are losing weight in the overall proportions of the developing knowledge-based economy. In this economy, as we have characterised it at the beginning, the capacity of organisations to create and share knowledge in co-operative relations (both internally and externally), the ability of organisations and networks or clusters to collectively learn faster than their competitors, and the willingness to explore new businesses are of crucial importance for economic success. And, with its characteristics in mind, it is quite obvious that the high road strategy of innovation is in accordance with these necessary conditions for development.

It is this correspondence between the rules and working principles of a knowledge-based economy and the basic characteristics of the high road strategy from which we may conclude that this latter strategy will gain momentum in the future to a considerable degree. This strategy will clearly take the lead and it will shape the leading work structure. This correspondence provides us with the opportunity that we can observe already at present basic characteristics of the forms of work that are most relevant for the future of work. Thus, we may see the quality of future work in leading areas, while the quantitative proportions of the different types of work are open to numerous factors hardly to predict.

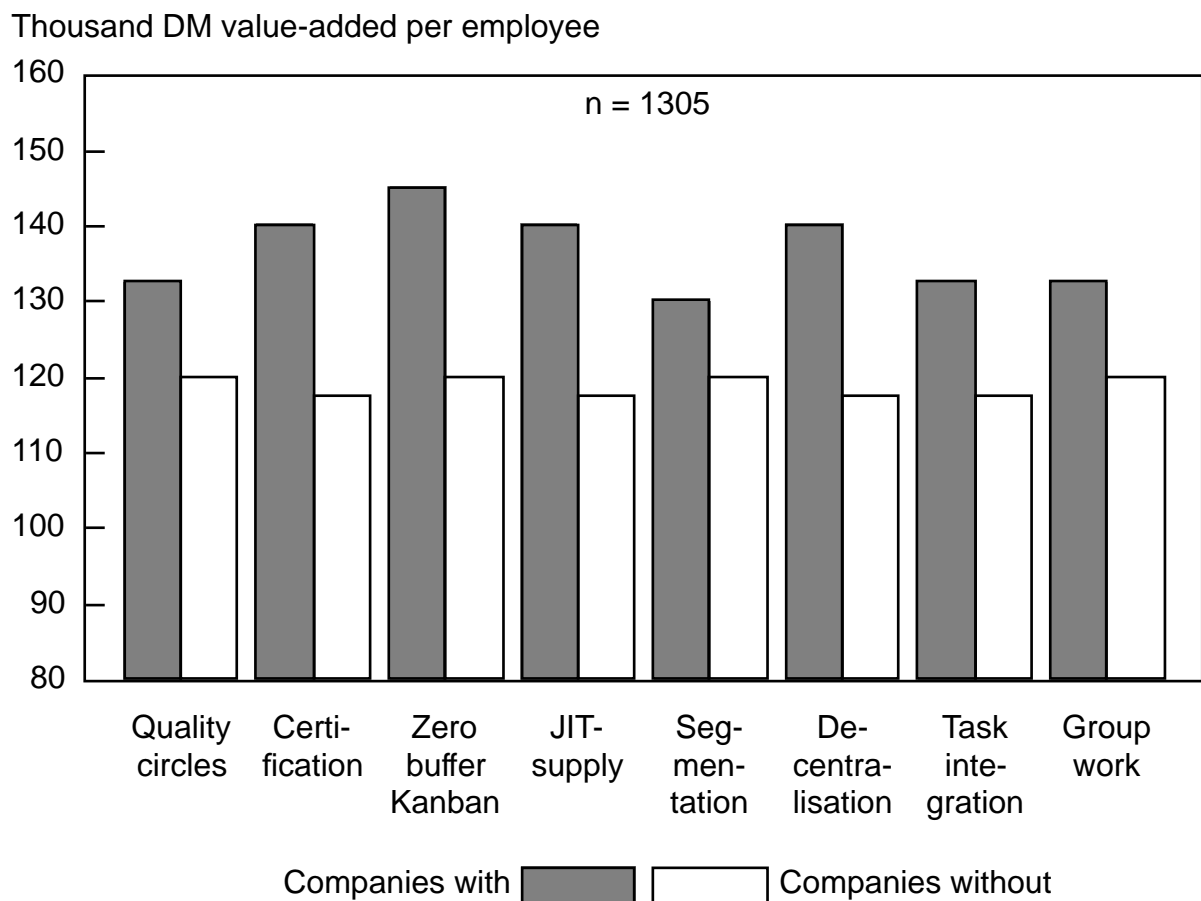


*Fig. 6: Effects of different innovation strategies (Source: Lay 1997)*

This perspective can be supported by some empirical evidence. First, the strategic orientations we have characterised above can also be identified in large statistical samples. Although our basic distinctions are emphasising ideal types and hybrid forms can be found in reality (with a dominant component though), the low road as well as the high road strategy can be detected in the survey data of more than 1300 companies in the German investment goods industry. Second, these different

innovation strategies have quite distinct effects not only on the quality of work as indicated but also on the economic performance and the creation of employment. While the cost-oriented strategy of the low road typically leads to reduction of employment, the expansive, value-adding strategy of the high road is much more likely to create new employment by exploring new businesses with innovative products and services – even if productivity considerably increases (see fig. 6).

Third, the extraordinary economic benefit that can be achieved by the radical implementation of new organisational conceptions cannot only be demonstrated by case studies, but also show up in different survey data. The Europe-wide EPOC survey („employee participation in organisational change“) in more than 6000 EU firms has revealed that 68% of the firms having implemented semi-autonomous groups could realise cost reductions. Throughput times could be reduced in 87% of these firms, 98% improved their products and services, and 85% increased sales (EPOC Research Group 1998). Comparable positive correlations between new organisation conceptions and economic performance can equally be found in the German investment goods investigation (Lay et al. 1996; see fig. 7).



*Fig. 7: Productivity effects of different new organisational conceptions (Source: Lay et al. 1996)*

The likely expansion of the high road of innovation is also supported by the supply side of the labour market. The German Institute for Labour Market and Occupational Research estimates that the share of employees without formal occupational training will decrease from 16.7% in 1995 to 11.4% in 2010, while at the upper end of the qualification spectrum the share of employees with university degree will increase from 14.1% in 1995 to 17.0% in 2010. The medium range share of employees with formal occupational training will accordingly expand from 69.1% in 1995 to 71.6% in 2010 (IAB 1999). In order to integrate young people in their work processes without loss of motivation and to make full use of the capacity, organisations are compelled to offer attractive tasks and working conditions.

In sum, the new forms of work organisation designed to create customer value (often called „object-oriented organisation“), the holistic work tasks and co-operative work processes they provide, the systematic personnel development perspective, and participatory management together culminate in facilitating comprehensive development and use of human resources. This is seen as the basic factor for economic success. It offers challenging tasks and requires self-initiative, self-responsibility, co-operative and other social skills in fastly changing contexts as well as the willingness for life-long learning on the side of the employees. It, thus, also promises to expand employment and to create wealth. Consequently, both the necessities as well as the opportunities of the ongoing transition to the knowledge-based economy are conducive for the expansion of the high road of innovation and the diffusion of this type of work in the future.

There are a number of risks in this development, however, as positive as it may look. Newspaper headlines tell us almost daily about high stress and even burn-out in highly attractive and qualified positions. In particular ambitious, but low structured jobs with unspecified expectations, high degree of innovativeness and strict deadlines provide high challenge, but can also be intensive and consuming human resources – a honey trap. The intensity of work becomes a hazard to the quality of work as to the worker himself. For the time being, a vast majority of knowledge workers seems to experience such intensive work processes associated with severe risks such as high intensity, permanent stress and often self-induced overload. This causes high internal and external costs for long-term health regeneration or early retirement, let aside the waste of competence and knowledge.

It therefore appears necessary to develop organisational schemes and institutional regulations for this type of intensive work that can transform it into sustainable work systems, which, over the short and long term, can contribute to organisational renewal and provide lasting favourable conditions for innovation. Instead of depleting the resources needed in the work processes (and thereby externalising regeneration costs to the workers and the society), sustainable work systems develop and reproduce material and human resources in the process of deploying them. Health risks are reduced to a minimum by a set of organisational, temporal and institutional principles and rules for work design that aim at reproducing the resources deployed – such as skills, knowledge, co-operation, trust, motivation, employability, learning schemes, constructive industrial relations etc. – in the work processes using them. This appears as a paramount development task for the future of work in a knowledge-based economy.

## 5 Concluding Remarks

The future of work in a knowledge-based economy can – as we may sum up the considerations in this paper – to a certain extent be seen already at present in the enterprises following the high road of innovation. Customer focus, comprehensive problem solving for customers, is the guideline for their value creating processes which they try to expand by exploring new ideas for solutions and turning them into new business activities. To this end they systematically invest into growth of knowledge and competence, and they consequently, conceive human resources as an asset to be developed rather than a cost to be reduced. They clearly realise that most of the skills and competences needed are embodied and cannot be expropriated, but must be maintained and developed in and through the work processes in which they are used. All managerial activities – work organisation, IT infrastructure, reward systems, staff development and leadership – therefore, are directed to achieve this. Success in competition primarily depends on the capacity to innovate and, hence, on fast collective learning.

At present, this entrepreneurial strategy is clearly taken by just a minority of enterprises, of course. The reason why it still can be regarded as leading the future of work is that it is the most appropriate strategy to cope with the challenges of the division of knowledge and the dynamics of knowledge transformation in the coming knowledge-based economy. The transition from the industrial to the knowledge-based economy will predominantly depend on the appropriateness and quality by which these complex interaction processes can be organised. It will be realised through the work of enterprises on the high road of innovation, and it will, in turn, contribute to expand the business opportunities to them.

It is obvious that these transition processes require appropriate changes in the institutional framework of the society (which have only marginally been regarded in this paper). Education and training systems need to undergo – to mention just a few important aspects – considerable adaptations. On one hand they have to put much more emphasis on the formation and appropriation of basic knowledge and on the development of social skills for co-operation, whereas they have, on the other hand, to develop a wide spectrum of further training opportunities for life-long learning. The present boom in creating company-driven „virtual universities“ seems to indicate the great demand for this. In fact, the whole attitude towards learning must change in favour of learning as being a normal life-long activity and integral part of work.

This also has, of course, great impact on social security systems. They must allow for more flexibility in adapting to a much greater diversity of individual occupational careers. The dynamics of knowledge formation and use requires that the knowledge workers can freely move between different employers and chose between different types of work contracts without suffering from social security disadvantages. In order to be willing to take risks and uncertainty in the change and innovation processes, they need security and stability in other respects.

These and other institutional conditions must be developed adequately such that sustainable work systems and wealth in the knowledge-based economy can grow.

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