Understanding the IT Productivity Paradox

Extended abstract by Peter Brödner, Institute for Work and Technology, Gelsenkirchen

1 The IT productivity paradox in figures

The IT productivity paradox points to the amazing fact that, despite massive and still growing investment in information technology (IT) over decades, no perceivable labour productivity increases can be observed. If we take the figures from the USA, for instance, real IT investment during the three decades from 1960 to 1990 developed only after a rather stagnant first phase (until 1975) from a low level of 20 billion USD per year up to 220 billion USD in 1990 (ie more than ten times as much). During the same period, productivity in the manufacturing industries has steadily but slowly increased without any change in the average growth rate while it stagnated since the early seventies in the non-manufacturing sectors (Brynjolfsson 1993). Since 1991 IT investments surpass those in manufacturing technology (Stewart 1997), without any further productivity effect, however. The most recent productivity study of the period from 1995 to 1999 by McKinsey Global Institute (2001) also comes to the conclusion that the markedly increased productivity growth in the US during the second half of the nineties can be traced back to the very specific restructuring effects on business process in six sectors only (eg wholesale, retailing, electronic and industrial machinery and equipment) that have almost no relationship to IT investment. No other industries contribute to this extraordinary productivity growth.

2 The shift from macro to micro analysis

In recent years, analysis of the productivity paradox in the US has shifted from a macro to a micro perspective. Since it is so difficult to find real productivity effects of IT investment on the macro level – as there are so many more effects on productivity that might be partly compensating for each other – micro level analysis appears to be more promising.

Accordingly, Brynjolfsson and Hitt (2001) have investigated IT investment in 400 big US companies on the basis of an econometric data analysis. They found that:

- IT systems can only increase a company's performance if the implementation goes hand in hand with decentralisation, object-oriented restructuring of the organisation, and high investment in personnel development;
- companies with decentralised organisation can achieve higher productivity gains from IT systems than those without;
- intangible assets such as collective action competence strongly influence the benefits from the use of IT systems.

Similarly, from our own investigations on the use of ERP systems, we have found that seven out of ten companies are not able to significantly improve their performance in terms of productivity, lead times, or in-process inventories, since they concentrate on technology implementation rather than organisational renewal and collective learning in connection with systems configuration and implementation. Only a small minority of firms, that primarily start with decentralising and restructuring the organisation according to business objects and developing appropriate collective action patterns concerning the configuration and use of the ERP systems in the renewed organisation, can effectively increase their business performance (Maucher 1998, 2001).

3 Theoretical perspective: Understanding the paradox

So far computers have been mainly understood as "number crunchers" (transforming mathematical objects) or as devices for automating mental work. In this perspective, their design, use and effects in the realm of mental work are regarded as comparable to those of classical machines transforming material or energy. This turns out to be a completely misleading approach, however.

Computers are *semiotic machines* and as such they form a particular class of machines that essentially differs from mechanical, electrical, chemical or biological machines or processes. All technical artefacts have, of course, in common that their functions are purposely designed, that the effects they produce are determined by the inputs and that, accordingly, users have to make sensible inputs in order to get intended results.

The fundamental differences between semiotic and other machines are rooted in their purpose, the way they work, and the domain of their actions. The domain of actions of classical machines is nature, as they all use natural (ie mechanical, electrical, chemical or biological) actions to transform material or energy, while the domain of actions of semiotic machines is social interaction, as they transform data (or signals) in sign processes of human interaction. Consequently, semiotic machines operate solely in the social domain of sign processes and they do not leave the realm of social relationships. While the functionality of classical machines is based on the knowledge and purposeful use of natural effects or forces, the functionality of semiotic machines, in contrast, is based on explicit prescriptions for acting by strictly formalising sign processes in order to organise and coordinate collective acting.

4 Conclusion

These fundamental differences distinguishing semiotic machines from others have far reaching consequences. Among other things, they help us to comprehend the IT productivity paradox and to devise appropriate procedures to overcome it.

In the case of classical machines, productivity effects are basically produced by the natural forces and actions that their designers have learned to make use of. In contrast, the functionality of semiotic machines depends solely on formalisation of the specific interactive play of the social actors involved, ie on the rules of the game they produced to make sense (signification), to exert influence (domination), and to assign value (legitimisation) in the way they act collectively (Giddens 1984). The formalisation and modelling of the actors' social relationships that are needed for design and use of semiotic machines as media for interaction are but expressions of the specific rules and resources of their action. Due to the reflexive nature of this endeavour, they simultaneously change these rules and resources by making them part of a new practice.

Accordingly, it is an inevitable consequence of the dynamics of social

systems and their sign processes rather than chance that the productivity effects of changing a social practice – and in particular of the implementation and use of IT systems – can be realised; if they are intended, and if appropriate collective acting schemes are deliberately and explicitly agreed and tested as a new form of common practice.