Full Virtualization – BISE's Contribution to a Vision

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Some innovations, whose long history of success faded into the background in the course of time, come back in a refreshed form decades later initiated by marketing activities of some companies. In the field of information and communication technology (ICT) we can currently see a renaissance of virtualization. Already at the end of the 1960 s there had been mainframe computers originating from IBM's family of /360 systems that used virtualization technology ready for series production. According to IBM, this was the most important product announcement in the company's history. On a single system multiple users were able to simultaneously use independent virtual machines and thus reduce the need for additional and expensive hardware. This technological progress was not only an important foundation for IBM's long lasting success story but also for many other companies. Just as in those days it is the economic factors that draw back the attention to virtualization today. True to the motto "Back to the Roots", current ICT initiates a trend reversal from many decentralized back to centralized and powerful large-scale systems in order to reduce procurement, operating, and maintenance cost. In his masterwork "Summa technologiae" published in 1964, Stanislav Lem shows that more than forty years ago people dealt with virtualization not only as regards infrastructure but that also visions of an application existed which would change people's lives. He outlined a "phantomatic machine" that allowed people who were connected to this machine to view and to experience fictitious situations, such as a balloon flight for instance. Today, these "machines" have become real and are called "cyberspace", "virtual world", or "virtual reality". They are used as simulation systems, e. g. in pilot training or massive multiplayer online games such as Second Life with thousands of users.

However, despite unmistakable parallels there have been some changes compared to the initial situation. Virtualization as it is being implemented today and is planned for tomorrow has left the infrastructural level long ago and has advanced to the economic and social structures of our society. Thereby, a range of topics with clear and exciting reference to business models, business processes, and their harmonized interaction with application systems and infrastructure emerges for business and information systems engineering (BISE) as a science. Moreover, virtualization also changes the relationship between man and machine and thus has an increasing impact on individuals and the social community. Where will this trend lead if we continuously advance and tap all its potential? It is these topics and issues that interest from a BISE perspective which we are trying to examine more closely with this special focus.

But what is virtualization?

According to the Oxford Dictionary, the term "virtual" has its etymological origins in the Latin word for "virtue", "power", and "capability" and means "what is possible due to aptitude or capability". "Virtual" corresponds to the property of a non-existent entity to be equivalent to a real entity as regards form and effect. Thus, in a first approximation, virtualization is the mapping of existing structures or creation of new structures, with form and effect usually being generated with the help of information and communication systems (ICS). For BISE this particularly means detecting the economically reasonable need for action and creating the necessary prerequisites for transformation. In accordance with the approach "think big, start small" solutions are developed step by step, establishing opportunities that have to be evaluated again.

The vision of full virtualization, which aims at universally mapping all the structures of our lives to ICS, could be a possible target of consequent advancement. What would the implications of this vision be for economy, society, and individuals if one thought it all the way through?

At first, probably all products and services, which are involved in the internal and external service process and have become useless due to full virtualization, would vanish from the market. Structures and institutions whose right to exist was based on these goods' physical presence would need to realign and to address other tasks. A succinct example is paper-based correspondence or interoffice mail which largely has been replaced by e-mail and is likely to further lose importance by means of legal electronic signatures. The same is true for many newspapers and other print media with all consequences, including problematic ones.

On the other hand, products would initially be developed as virtual products and tested for market potential before starting real production. This change within the interaction of virtual and physical goods and processes would influence the entire value creation. Suppliers and consumers would be integrated in a virtual development and production process and thus would be able to reduce costs and risk. Complex requirements are covered by new business and pricing models enabling a flexible and demand-oriented product and service supply by virtualization. This increasingly applies to traditionally "physical" industries. Thus, e. g. in the construction industry, procurement models such as "holes instead of drills" or "compressed air instead of compressors" show that instead of physical machines services can be offered and requested on-demand with guaranteed quality and availability. A similar change is to be expected for consulting and other services, which do not have to be carried out at a specific location but can be accessed by customers anywhere and anytime due to virtualization. Meetings and conferences held in virtual rooms not only provide a maximum of flexibility for organizers and participants but also avoid cost- and time-intensive as well as ecologically harmful travel distances. Some specific areas of social institutions such as universities or public authorities could be replaced by IT, which in turn can be aggregated at few central locations. In the other case, in which the real product is developed corresponding to its virtual counterpart, possible development and sales risks can be identified and verified in advance. Within the B2B sector, the complexity of this virtual production of goods and services also leads to new organizational network structures and an increasing dependency throughout the value chain. The resulting risks can hardly be estimated and may, as the example of the subprime credit crisis shows, cause an uncontrolled conflagration.

Full virtualization would not only change economic structures entirely but also society and individuals themselves. Especially the advantage of being flexible as regards time and place during production and consumption of virtual substitutes may lead to an increased social isolation of many people because major parts of working and leisure time might be spent at home. Direct social contact would primarily be limited to the people living in one's household. Everything else takes place within the online community. It may be doubted that virtual relationships, as they are possible and lived out today, offer an appropriate substitution to compensate for social deficits in the long run.

Is this in fact a desirable scenario despite the positive aspects? How is it possible to avoid negative effects of virtualization? It is BISE's task to act proactively and to address the relevant issues: Which progress as regards virtualization has been made on each ICS layer? What is the future need for action and research? To which degree should science and business practice continue to pursue the vision of full virtualization?

During the last years various successful business models have been established that primarily focus on virtualization. The basic idea of most of them is based on the fast and flexible bringing together of agents at a virtual place, process, or community. Value networks can be optimized by integrating many and advantageous locations, providers, or products with an almost infinite number of customers. In this context, e. g. e-commerce platforms are very successful. Other providers offer virtual meeting rooms where experts can get together to make planning decisions based on available 3-D-models or simulations. Especially in the case of larger projects this may help to identify and avoid cost-intensive incidents at an early stage. Military uses this technology to simulate tactical measures and possible counterattacks in various variants. For planned construction projects this is used, for instance, to generate optical impressions and to test functionalities as well as structures interactively. By means of computer-based visual real world extensions (mixed reality) it is also

possible to fulfill the requirements of complex procedures, such as real-time simulations in medicine.

However, virtualization does not only constitute a domain of the new economy, nor is it limited any longer to the fields of electronic market places, computer simulations, and services, as the examples taken from the construction industry show! By now, many traditional industrial enterprises have recognized that virtualization does not only sustain, but also sustainably augment competitiveness. The influence of markets, suppliers, customers, cooperation partners, and the competitors' behavior on the own risk/return position can be predicted more easily by means of respective simulations. Based on the resulting data, enterprises are able to intervene and control processes, and e. g. design their sourcing strategy in such a robust way that possible changes of the input parameters do not require other decisions. Processes designed to be more flexible and efficient due to virtualization lead to cost reduction and offer new opportunities within the value chain. Process elements that automatically adapt themselves to the environment are composed dynamically to make up entire processes without implying structural changes in the company. This means that the human being as production factor, whose importance constantly decreases due to this transformation of many operational or manufacturing activities, can shift his focus to creative, non-automatable, and complex tasks. On the other hand, people have also recognized that the company-wide optimization of interpersonal exchange of implicit knowledge significantly influences business processes. By means of ICT, virtual expert teams are built up. Existent and usually informal knowledge networks are analyzed as regards specific problems and then utilized according to their purposes.

Furthermore, virtualization is still an issue of the ICT-infrastructure itself. Here, IT virtualizes IT. The ICT-infrastructure provides computing power, data transport, and necessary storage capacity. Virtualization almost completely avoids capacity restrictions of individual subsystems because multiple computing and storage systems are aggregated into an efficient grid network. Companies with a powerful ICT-infrastructure offer their capacity to internal and external consumers as a so-called "cloud" (cloud computing) where applications are executed. Thus, consumers do not need to run or expand their own infrastructure. According to Steve Balmer, CEO at Microsoft, in the coming years the number of cloud computing providers will decrease to a few dominant providers, primarily including Amazon, Google, IBM, and Microsoft. These almost arbitrarily scalable computing capacities constitute the foundation for future business applications of virtualization, which will be even more complex and cannot be handled economically by the corporate system landscape. Companies that continue running their own ICT-infrastructures will be able to reduce the number of necessary hardware systems by server and desktop virtualization. In this way, they can create enormous cost reductions for procurement and operation. Gartner presumes in a current study that this trend of consolidation will have the greatest influence on data and computing centers until the year 2012.

It becomes obvious that we are approaching the vision of full virtualization in many domains. The major drivers are economic factors justifying the transformational effort and making companies invest. The limits usually set by technological possibilities shift due to the progressing development of computing power, networks, and available bandwidths. Global networks potentially connect many participants and thus enable openness and tolerance. However, an increasing technization and networking also leads to dependencies. Society and its individuals will adapt themselves to this situation and be subject to respective changes. The challenge will be to optimally balance this vision's chances and opportunities with the corresponding risks and threats.

This special focus comprises selected contributions addressing various sub-aspects. Three articles in the section BISE – Research Paper present new research results. Kai Fischbach, Peter A. Gloor, and Detlef Schoder introduce an approach to analyzing informal communication networks. Kai Riemer and Stefanie Filius address the issue of choosing the right media in virtualized working contexts. They also point out potential for improvements for media usage in distributed teams. Stephan Aier and Robert Winter propose a virtual architecture for decoupling IT and business that better meets the demand of changeability in both layers. In the BISE – State of the

Art section, Jens Vykoukal, Martin Wolf, and Roman Beck deal with grid services that can be integrated on-demand within a company's value creation process in order to not only reduce cost but also enable flexible reactions to changes. Besides these scientific contributions, this issue also contains a BISE – Catchword by Danny Pannicke and Rüdiger Zarnekow dealing with "Virtual worlds". A BISE – Profile of Dr. Martin Enderle, CEO of the Scout24 Holding GmbH, addresses "Possibilities and limitations of virtualization in online markets". Finally, in the BISE – Discussion section, scientists from BISE and neighboring disciplines discuss the question "What in fact is fundamental research in business and information systems engineering?"

We hope that this special focus offers interesting insights into the topic of "Full Virtualization – BISE's contribution to a vision". The topic has established itself across all ICS layers and provides a great potential for further development. While advancing this vision and pursuing economic goals, science and business practice should not neglect benefits for people.

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