SBS JOURNAL OF APPLIED BUSINESS

RESEARCH (SBS-JABR)

jabr.sbs.edu

ISSN: 2235-7750

VOLUME 1, SEPTEMBER 2012.

How IT can contribute to human affairs.

Author: Dr.Kurt Weiss

SBS Swiss Business School

We spend billions of dollars trying to understand the universe, while we still don't understand the conditions of a stable society, a working economy, or peace [1].

1. Introduction

Nothing gets old as fast as the future.

From its beginnings life on earth was driven by the adaption to changing environments and the survival of the best adapted [2] The result we see today is an overwhelming variety of species, not counting the ones vanished during the last century or hundreds of millions of years ago [3], not counting the ones discovered recently in extremely improbable niches such as deep water volcanic environments at temperatures of 800^0 C in total darkness under extreme pressures up to 60 MPa (600 atmospheres) [4], below Vostok in the Antarctica, the coldest spot on earth, in a lake covered by 3.7 km of ice disconnected from the rest of the world for the last 15 million years [5] in remote and all but inaccessible parts of rain forests [6], or in oxygen free, poisonous environments [7], not to speak of the untold species added continuously to the living world. A variety it is as incredibly diverse and rich to defy any conceivable master plan pretending to have (had) all this in "mind" [8]. Accidental variation, coincidences, and survival of the fittest is the name of the game.

Or is it? When Homo erectus entered the stage more than a million years ago [9] he had a very hard time to establish himself in a world full of possibilities on the one hand, but full of deadly threats on the other. On first sight nature equipped him badly for survival. He cannot fly nor swim. He cannot run very fast. He is not very strong or very tall. He is very sensitive to temperature changes. He has no claws, no fangs, and no stings. He is barely resistant to poison. His eyesight is comparatively poor, his hearing bandwidth is narrow, his sense of taste is unreliable, his tactile discrimination spectrum is very limited, and his smelling capacity is short ranged at best. His reproduction is complex and expensive, the production rate is low, and the natural loss rate is high. There is no warranty. Man is prone to all kind of accidents and diseases. He is difficult to repair. His life is short if he does not take countermeasures which have been at his disposal only in the very recent past. But man became a possibility. He survived, as yet, the merciless battle called evolution, because he engineered all kind of technical devices and clever tricks to fight the obstacles nature has been putting up against him in ever changing shapes. He began to compensate his natural weaknesses by tools and prostheses. He began to dominate his competition. He survived his gradual birth. In addition his relative successes made him think that his ability to adapt the environment to his needs instead of adapting himself to the environment gave him the tools to beat the Darwinian rules (inventing warm underwear instead of waiting for a fortuitous genetic variation luckily providing him with a thick fur). A lot of tools he invented indeed, but still all his achievements and innovations always will be overpowered by many orders of magnitude by the sheer force of nature. There is no conceivable technical trick to stop an earthquake, a tsunami, a volcano outbreak, a celestial body on a collision trajectory, or to slow down the continental drift. Nature's power will overrule any trick in the long run, and Humans better try to adapt to this fact, if they want to stay in the game.

How? Homo erectus lives predominantly in societies which need a certain amount of organization. Of course this is also true for ants, bees, and many other species that cannot survive without rules and structures. Rules in ant societies are relatively simple. As an example consider their strategy for finding food. Specialized ants (an adaptive success by itself) walk out to find places where food is available. If successful, they eat and walk back to their home anthill all the way depositing olfactory clues along their path. Other ants smell it, follow it, deposit clues again, and enhance the scent. The rules are very simple: (i) always mark your path and (ii) always follow the path with the strongest scent [10]. Another, somewhat more sophisticated, example is the well known dance of the bees directing other bees the way to blooming flowers where nectar is available [11]. These are

certainly clever rules, but simple they are in comparison with the rules needed for the survival of human societies. According to the available records they were already quite complex in historical times. And then look how involved, varied, and entangled they have become in our developed technological world where technology itself has become indispensible to maintain and improve the organization of human society. It is here that IT enters the stage. IT has become an indispensible tool to keep the machinery of human activities running. The implications of this fact are the topic of this essay. One should, however, keep in mind that many societies on our globe are still living on the basis of the older, simpler rules. One might even ask (and that is what concerned people do) which kind of societies in the long run will be better off. The ones adapting to nature or the ones trying to overcome its constraints?

The essay is structured as follows: The next three Sections discuss on a rather general level the interplay of IT with people, change, and the state. After an interlude about IT as a global commodity a more specified Section addresses the interaction of IT with business (the engine powering human affairs). Future work will cover the interaction of IT with society, and learning (the driver of everything). A summary and an outlook conclude the essay not without soliciting further work.

Concluding this introduction a disclaimer is in order. This is a positive, overoptimistic view. (Quoting David Ben Gurion: *One must try the impossible to reach the possible*.) Furthermore the eminent role of the arts and the humanities is not considered, neither are ethical, moral or religious considerations. Artists, poets, musicians, adventurers, philosophers, scientists, psychologists, medical doctors and many others clearly should be part of a more complete picture. Here we concentrate on *Homo Economicus* where we are aware of the fact that humans in general do not behave rationally [12]. The deep and wide gap in wealth, health, education, training, and so on across the world is another dramatically influential factor that is not considered in any detail. And then: If this essay will be of any use it might perhaps help to increase the stability of societies, contribute to a working economy, and increase the chances for peace (remember Ben Gurion). And if this happens, slowly and small step by small step, we will be able to spend more money for efforts beyond the horizon of *Homo Economicus* and to *send forth some of us as dedicated servants , to forward the search into the mysteries and marvelous simplicities of this strange and beautiful universe, our home* [13].

2. Homo Economicus and IT

Man survived by developing skills. He now needs help to survive his skills.

How can *Homo Economicus* thrive in the complex environment of our globe? What kind of organization does he need to survive the brutal, relentless, and never sleeping competition that surrounds him? How can he manage efficiently and effectively the technology and supply chain logistics driven processes from the resources to the ever growing number and diversity of products and services he needs or wants to keep him nourished, sheltered, healthy, sociable, reproductive, and prepared to adapt to the ever changing challenges he encounters at an ever increasing pace?

Big questions. Too big for an essay dealing with the much more restricted question about the how the potential of IT can contribute to the answers. Old questions they are, as old as humanity itself. IT, in contrast, is by all measures an absolute newcomer. It's first signs of life date back to the 1930^{ies} as a side branch of mathematics [14]. Its practical impact, barely noticed beyond a small circle of scientists and a few pioneering businesses, began in the 1970^{ies} [15] to get a decisive boost with the conception and invention of the internet in 1989 [16]. A mere 10 years later it became a worldwide commodity. Today (2011), about a third of all people on earth are estimated to

be involved in one sense or other with IT [17]. And counting. Never a technology has spread that fast.

Our questions therefore will be addressed keeping in mind the necessarily provisional and rapidly changing state of the present human affairs. *Homo Economicus* is in a state of revolution. And as it has happened so often in history, most people are not really aware of it. When they finally wake up to the facts, it may be too late for them to adapt. They will not be among the winners. The future happens, even without them.

Homo Economicus has many aspects. Let's try to summarize them somewhat frivolously with three terms: *Homo Sapiens*, *Homo Faber*, and *Homo Ludens. Homo Sapiens* thinks, learns, and teaches. His field is data, information, knowledge, and perhaps wisdom. *Homo Faber* acquires skills, applies them, and coaches others to use them. His territory is craftsmanship and engineering. *Homo Ludens* generates ideas, shapes them, and enables others to put them into practice. His playground is creativity and innovation. Of course, no individual is in one category only. Every one is a mixture of all three aspects with weights attached that make up an important part of his or her specific personality.

IT plays a different role for each category. A rough sketch might include the following traits. For *Homo Sapiens* IT is a tool to collect and organize data, process information, and perform all kind of manipulations of numbers and mathematical symbols and graphs to discuss ideas and results. *Homo Faber* uses IT to equip his tools with all kind of sophisticated devices, steer his machinery, and to make the products and services he fabricates run smoothly in the hand of their users. *Homo Ludens* employs IT to model and simulate his innovations, find out how they are affected by changes in design or parameterization, and to support others to put his ideas into practice. In all cases a central aspect of IT is communication. Here the impact of the IT induced revolution is probably felt most radically and, at the same time, is grossly underappreciated. Yes, all the technical equipment and sophisticated services (including entertainment) that heavily depend on IT supported communication (or rather: which would not work at all without such support) are very impressive indeed and acknowledged accordingly. Yes, the communicational tools (internet, emails, handheld devices of all sorts, and so on) that enable all of these achievements are manifestly around. On the other hand, however, the impact of all this machinery on *Homo Economicus* during working hours and beyond is as yet neither really appreciated nor understood. In fact it is a sort of nervous system holding everything together.

Each industry and each kind of business will need a different kind of mix of the three types of *Homo Economicus* and accordingly will have to make different choices for their IT tools. Some of them will be quite similar for all companies (every business needs bookkeeping) and therefore can be standardized to a high degree. Others will have to meet very specific needs (devising a precision watch or an airplane are quite different engineering tasks) so that the IT tools have to be adapted closely to the tasks at hand. (This does not mean that each piece of software has to be developed individually for each application, but it calls for a flexible standard that can customized to map the specific business processes of a given industry or company [18])

Homo Economicus and IT are glued together for good. Business without IT has no future except in a few tiny niches. This is not to everybody's liking. There are fears ranging from electro smog allegedly endangering health in many ways to data misuse reducing human beings to multidimensional data sets prone to be exploited by marketing strategists, or manipulated by political forces. Clearly these dangers exist as every technological innovation has taught us during all of human history. There were no car accidents before there were cars. Cars, however, persisted and so did the accidents. Change always brings about benefits as well as dangers. As long as the former outweigh the latter, change is here to stay [19]. We better take up the positive side and try to re-

duce the negative (with the help of air bags, speed limits, and the like when talking about cars). Complaining will not help. The future happens. Even without you.

3. Change and IT

When you change the way you look at things, the things you look at change.

IT has a qualitative and a quantitative impact on human affairs. As for quality, many tasks have become routine that were extremely difficult and time consuming, or outright impossible to accomplish without IT. Quantity simply means that almost all business processes have accelerated often by orders of magnitude [20]. Change, of course, is an immediate consequence of these (linked) developments. In what follows we discuss a few typical interlinked, representative examples on the IT equipped stage where modern business is performed. As always there are positive and negative aspects. The negative ones are by no means meant to stop or discredit the respective developments, but rather to help to avoid the inevitable traps inherent in all changes.

Communication is the first example and certainly one of the most influential one. It's hard to believe and difficult to appreciate how emails, SMS's, and so on have revolutionized communication as a whole. It's not only sheer speed which makes the difference, but also the contents which are exchanged much more informally, much more frequently, and between any numbers of correspondents. Language is affected too, orthography is, grammar is, and even manners, because politeness often is considered as too time consuming. Communication has become so overwhelmingly abounding that it threatens to end up next to impossible to handle. We might be heading towards an information catastrophe, where any piece of poignant news is irreversibly lost in a haystack of emails [21].

Knowledge is another issue experiencing a radical change through the workings of IT. Gone are the times of patiently (let alone scholarly) collecting data, connecting them to yield information, and eventually knowledge. Every item is available at a few clicks. Whatever the clicks produce is taken for granted because there is neither time nor the skills to establish the output's validity and because people (rightly?) think it cheaper to accept mistakes than to try to avoid them. One wonders how long it will take until knowledge is so far detached from reality that we will be confronted with uncontrollable disasters. (Economy and global finance are "good" candidates for this to happen.)
The next example is diagnosis. Not only in the traditional medical world but also when it comes to analyze all kinds of food ingredients, environmental influences, psychological considerations in educational issues or human relations, or when we try judging the good and the evil of scientific results or research methods. Diagnostic tools have become so abundant and are applied so superficially that they yield a grotesque, panoptical landscape of interpretations beyond any serious scientific scrutiny. Soon everybody is hopelessly lost in a cacophony of opinions. The diagnosis catastrophe is around the corner, perhaps best exemplified by the not so funny joke that only he is healthy who has not been medically examined thoroughly enough.

Another point in case is social and professional networks, IT driven developments which have changed the landscape of human interactions. The number of participants (February 2011) has passed 600 million people and counting [22]. On the social side (anonymous) exchanges around the clock wherever the internet is accessible, about anything of interest (or not) to anybody are established, maintained, or terminated at a click. Social contacts explode quantitatively and at the same time tend to get evermore superficial in inverse proportion to their number. Might the future be that everybody is connected to everybody with no contents other than being lonely together? On the business side networks are very efficient and effective global tools to connect offer and demand (e.g. via marketplaces), to start businesses, to organize projects, find people sharing ide-

as, and of course to recruit staff for your company [23]. And not to forget: networks may also have political implications to the better and to the worse.

As a last example consider what usually is called collective intelligence. We quoted in this context ants and bees in the introduction. Human beings rather tend to use their intelligence individually. It is difficult and an art in itself to train humans to think and act collectively (in team sports for instance). In addition collectiveness often comes along with negative associations [24]. But there are also visions of superior collective intelligences like Fred Hoyle's *Black Cloud* [25] being incomprehensible to the human mind, overloading it, and eventually even causing its destruction. Nevertheless, an IT based gradual build up of cooperative collective thinking may be a great opportunity for humanity. Perhaps the human brain itself, organized as an as yet poorly understood extremely sophisticated balance between localized and aggregate processes, is an excellent example of creative collectiveness.
Concluding this section we see that IT will bring about a tremendous load of change, open up uncountable options, and also developments people would rather not like see to happen. Whatever: if we want to end up among the ones fostering whatever negative aspects IT might bring about and the ones who push for its opportunities, we better address the challenge to be among the winners.

4. The State and IT

The state should serve the people. It's them who pick up the check.

How to govern a state? A question, of course, that is way beyond this essay. What we try here is to sketch a model based on three simple principles and to discuss a few ideas how IT can be used to make them work. In spirit with the disclaimer in the introduction many tasks the state should or could take care are left aside. We concentrate on the ones essential for economic success in a connected world.

The principles are [26]:

(i) Each and every institution and all decisions of the state have to be democratically legitimated. The last word always is with the people (the sovereign).
(ii) The power within the state dilutes from the bottom to the top. Federalism and subsidiary task distribution are the key concepts.
(iii) The state intervenes as weakly as possible with the private sector. Its tasks are reduced to a pragmatic minimum.

The result is a state that is a trusted service provider to the citizen who pays for it. Competition between the various federal sub-units enhances the efficiency and effectiveness of these processes. The local needs of the people will be locally addressed with priorities and financing decided locally. By the stakeholders for the stakeholders. The monopoly of power, law enforcement, and services that are more easily or effectively provided on a larger scale (transport, communicational networks, management of currencies, and a few others) are provided by coalitions of the basic federalist communities. These coalitions should be governed by bodies interfering as little as possible with the internal affairs of the smaller ones. In other words: Only tasks reaching beyond the local communities are organized by a coordinating institution whereby the latter should make sure to take recommendations received from below very seriously [27]. Certainly not an easy balance of power this requires, but one that has a fair chance to combine a maximum of individual freedom and general economic welfare with smoothly connected processes that empower the local federalist communities to fulfill their tasks in the larger framework of the state. Economy of scale is a welcome asset and, at the same time, a quantitative criterion to assign them most efficiently and effec-

tively. Entrepreneurship and competition will be the driving force for private businesses and the dwellings of state as well.

The story does not end here of course. Different value systems, cultural idiosyncrasies, different languages, and many other disagreements and opinions set the various states apart from each other. Why not extrapolate the present model to agglomerates of states with the proviso that the larger it is, the less power is given to its governing body? Not more than what's needed to increase the efficiency and effectiveness of the communal services to the benefit of the agglomerate's citizens without interfering with their local interests [28].

All this may appear as a picture of Utopia (the nowhere land). What we propose here, however, is to pursue the idea that the impact of the radical technological change caused by IT, with its tools applied responsibly wherever appropriate, might help to pave the way towards Eutopia (the land of beauty).

Change is the essence. Not linear change as we perceive it, when we look at what we have learned from archeology and other sciences used to reconstruct the history of Homo erectus' development. Linear means that it took about double the time to double the number of people, the territory occupied by them, or whatever else one cares to measure. The growth rate was constant. In the last centuries, however, it was definitely non linear. It was exponential. The growth rate itself was increasing. Computers not only got faster, they got *faster* faster as illustrated by Moore's law [29] (formulated in 1965 and still valid today after an astounding 47 years), that predicted the storage density of computer memories and their speed of calculation to double approximately every two years while the prize drops by a factor of two. Or look at Metcalf's law [30], formulated in 1980, telling us that the number of possible connections in a network does not grow linearly with the number of the network's nodes but proportional to the number of nodes squared. (Illustrated by networks such as the telephone system, fax, outlook, and Facebook.) The usefulness of networks does not grow at a constant rate in proportion to the increasing number of nodes, but at a much faster and accelerating rate.

Exponential growth (which in the beginning is deceivingly indistinguishable from linear growth) cannot go on forever [31]. Physical limits like the speed of light or the size of an atom will put an end to the validity of Moore's law in the framework of the presently available technology. But new technologies like quantum computing will eventually start the game all over again. And on we go. When everybody is connected by telephone or internet to everybody else new types of networks will be invented. Exponential growth, as long as it lasts, opens a plethora of mind boggling surprises. For instance Raymond Kurzweil [32] predicts, not undisputed of course, that in the year 2045 the computing power of Artificial Intelligence machines will surpass the brain power of all human brains combined (including creativity, and so on). He calls this moment in time *The Singularity* [33].

Here, we do not want to try to look that far in the future (nothing gets old as fast as predictions about the future). We are interested in the phase of exponential growth as caused and dictated by IT as we know it today. Difficult enough. Our minds are not used or trained to think in exponential terms. *It's not intuitive. Our built-in predictors are linear. When we're trying to avoid an animal, we pick the linear prediction of where it's going to be in 20 seconds and what to do about it. That is actually hardwired in our brains* [32]. Still worse, when talking about the state: it more often than not it is not even capable to cope with constant change rate [34]. (Population growth has come to stop in many countries in the last decennia but no one had reacted seriously to the easily predictable shortage of teachers, medical doctors, and so on.)

Here then is the challenge. The State stands in front of a bundle of pressing tasks: It should appreciate immediately all there is to know about IT, follow a crash course on how to handle linear change, study thoroughly all there is to know about exponential change, and the challenges con-

nected with growth coming to a stop or may be even changing sign. If successful the state will have a chance to end up in a position where it is able to govern to the benefits of its multifaceted community of taxpaying citizens [35]. The State certainly needs not be afraid to run out of tasks. It will be very busy on a 24/7 schedule to reach in reasonable shape *The Singularity* or whatever else will happen. Or even to get there at all.

5. IT as a global commodity

Distribution is more important than quantity.

Water in history, arguably, was the primary commodity holding societies together. At a river, a lake, the sea, or near a source is where people settled. As the settlements grew, the water had to be collected at a well or was distributed by irrigation systems of all kinds to supply otherwise dry places. Water by now is a commodity taken for granted, although there are some warnings [36]. In large parts of the world the same is true for electricity as a power source which became available only much later in the 19th century. Water of course is indispensable for life. Electricity is not, but the ease with which it can be distributed over hundreds of kilometers at low cost and high speed made it all but vital.

Equally fast and by all standards at even much lower cost information can be distributed over any distance from nanometers (in chips) to light years (in space). Not surprisingly therefore IT is forcefully on its way to become a global commodity. If it has today (2012) not yet reached everybody on earth, the reason is neither technical nor cost, but rather the fact that many people are not trained to use it for the obvious reason that they (still) are analphabets. They will hopefully learn soon and then be taught (among others by IT supported tools) to use IT ever more efficiently. It is not risky to bet that IT shortly will be the number one commodity on earth as long as water and electrical power are available. The world will look very differently from what it was in the year 2000.

A few general remarks might be of interest at this point. The two arguably most important concepts in physics are energy and entropy. Energy is a familiar concept, entropy less so although it certainly is equally consequential (in and beyond physics). Loosely speaking it is a quantity that measures the amount of order (or organizational structure) within a system. Consider as an example a closed box separated by an air tight wall into two compartments. One of them is filled with air, the other is evacuated. Pierce a hole in the wall and air will stream through the hole until the pressure on both sides is equal. In the beginning of the experiment the gas was more ordered (it was on one side of the wall and not on the other) than at its end (when it was equally distributed to both sides). If you had cared to install a tiny windmill in the hole, during the transition you would have had the possibility to exploit the wind power to do usable work. The transition from order (low entropy) to disorder (high entropy) yields useful power.

Other examples include temperature differences (representing order because heat is on one side and not on the other), water reservoirs in the mountains, or spatially separated electrical charges. Gradients like these allow producing useful power. Low entropy (a high degree of order meaning steep gradients) is the driver. If order is lost and entropy is high (all parameters are equal everywhere, no gradients) energy is needed to reestablish order. With other words: The availability of energy is necessary but by no means sufficient. In homogeneous systems its presence alone is of no help. Energy gradients (order and low entropy) make the difference.

Energy shortage is bad, but its availability alone will not help. The sun and – to a much smaller extent – the heat reservoir inside the earth provide us with orders or magnitude more energy per second than what we consume now or in the foreseeable future. There is no shortage of energy, no energy crisis. The problem is high entropy, not enough order, not enough structure, or organiza-

tion. Resources other than energy display the same pattern. Notably, when speaking about economy or money. Not quantity, but distribution is the issue.

What does all this mean for information technology? Information is closely related to entropy [37]. If a system is highly ordered (low entropy) it stands for a lot of information. If everything is homogenously distributed (maximum entropy) no information is available. The human society needs more than randomly distributed data to survive. It needs order, it needs information. IT is more than just a new useful and perhaps amusing technological gadget. IT is the essence of survival in complex systems like today's technology dependent human society. It is essential for life itself and of course business. Living beings need a nervous system and environment sensitive sensors to organize and coordinate the workings of its organisms. Muscles and bones will not suffice. Business with money as its only resource will not survive either. Today's business needs IT. IT will tell the winners from the losers. We better make sure to take it seriously and to use it thoughtfully.

6. Business and IT

It takes all the running you can do to keep in the same place [38].

6.1 Introduction

Information Technology is ever more important for successful businesses. Its efficiency and effectiveness are in most cases nothing less than mandatory. Most companies which have not reacted to these developments in the past have vanished. Those that will not react today will most likely experience severe difficulties to stay on the map. No board will want to see this happen.

Here we describe the most likely IT-influenced developments to be expected on the basis of what we know and experience today. From this we will try to draw a rough (admittedly speculative) picture of *The Future Company*.

6.2 Five Steps for a Change

Five trends are already quite visible. All of them will influence business strongly. Any company of a certain size will have serious difficulties to grow profitably or even to survive in the years to come, if they close their eyes to these developments. Or to put it in a more positive way: Only companies who face these changes open mindedly will be rewarded with success in the next decade and beyond. Let us now proceed with sketching these developments.

a. Dealing with Complexity

There is no doubt: the world is complex, business is complex, and software is complex. This complexity is not only here to stay, it steadily increases. And there is no hope to get rid of it, if society, technology, business, and software continue to evolve at a pace comparable to what we have seen in the past. If nothing is done to prevent it, we are heading full steam into a complexity crisis [39].

What can we do about it? If we cannot get rid of complexity we must find means to tame it. We must learn to deal with it. We must learn to deal with the contradictory requirements that things need to be complex to be really useful, while at the same time the more complex they are, the more difficult they are to handle. We must learn to navigate successfully between Scylla and Cha-

rybdis, to sail smoothly in troubled waters. For business this means to sort out a few key parameters from an incredibly vast number of variables. We must understand our businesses much more thoroughly and learn to measure, handle, and benchmark their complexity.

A few examples might be useful to elucidate what we mean. Consider for instance the origin of life which billions of years ago was born in the depth of the primordial soup by the simple mechanism Charles Darwin called [2] *Survival of the Fittest*. The emerging biological systems' complexity is boggling the mind. Look at the brain (our soft disc). It counts about 10 billions of neurons, at least 10 times as many connections, and contact points (synapses). All this complexity enables us to handle astonishingly well and to survive in our environment which is, if anything, even more complex. Or then: The physical world is extremely complex too, but scientists found a way to deal with it quite well so that engineers have been able to construct complicated machines such as the modern car whose more than 50'000 parts probably no single person understands in sufficient detail to be able to put it together from scratch. Astonishingly enough, however, (nearly) everybody is able to drive a car if he learns to manipulate some 10 handles. Or think of the conductor of a large orchestra who pulls together the "noises" from 100 professionally played instruments of many different kinds into one beautiful piece of music full of harmony, melody rhythm, and emotion.

It is with these examples (and many others) in mind that we look for a way to handle the complexity of our businesses in a world of ever increasing complexity. And it is here that we call on IT to help us out of misery. The scenario is as follows: On the one hand we have the complex companies, on the other one the equally complex world of business software. Business is about adding value (steel in → Rolex out). Value is added in business processes. If we map these business processes onto software processes we will have made a large step toward measuring, benchmarking, and, most importantly, handling the complexity of our business processes [40]. This is why: Software processes are based on strictly defined (mathematical) rules. They are measurable. We can ask a lot of quantitative questions such as: How many transactions are supported? How many branching points can be counted? How many elements are found in a given process? How efficient are the individual processes? The results, numbers, can now for instance be compared for companies of similar size in different industries, for similar companies (competitors) in the same industry, for similar companies in different countries, or for one single global company's subsidiaries in different countries. The results can be used as benchmarks offering companies a tool to improve systematically their respective performances. Gradually, and most importantly it will become possible to hide the enormous (inevitable) complexity of a company vis-à-vis their customers. The complexity of the company's internal business processes will be silent for them [41] and they can concentrate on their own business.

What we propose, therefore, is a new scientific discipline: Business Process Mapping [18]. Its goal is to make the complexity of companies manageable by mapping the company's specific business processes onto business software. Business software, of course, is also complex, but here complexity is in general much easier to measure, handle, and to control than it would be by looking directly into the company where you easily will get as many answers as the number of different managers you care to ask.

To conclude this section let's consider another example: Physics is a scientific discipline whose method is to map the complexity of nature (business in our case) by means of strictly controlled experiments (business processes) onto mathematics (business software) which is also complex but easier to handle with the help of formal rules (programming) and computers (computers).

b. Process Innovation vs. Product Innovation

In 1937 the Nobel Memorial Prize winning British economist Ronald Coase published a paper *The Nature of the Firm* [42] where he established what since has become known as Coase's law. It states that *a firm cannot grow any longer if the transactions needed to empower the growth are more expensive than the profit from the growth*. Plausible enough but like so many – when the dust has settled - simple truths it had to be discovered, supported by convincing arguments, and shown to be useful. Here we propose to paraphrase and restate this law [43] with respect to the role of innovations in business by saying that *if a firm wants to grow profitably it better makes sure that its product innovations do not get torpedoed by the cost of the processes needed to bring them to the market*. And as a consequence we claim *that nowadays process innovation is more often than not at least as important as product innovation.*

Clearly we are talking about production lines, distribution channels, customer relationship management, administration, and the like. Loosely speaking we are talking about "logistics". We are talking about doing things right rather than about doing the right things. Business, as we discussed in the previous section, is becoming ever more complex. Doing things right, therefore, is the longer the more the call of the day. Doing the right things is not enough.

Innovation is never easy. Ideas are one thing but development to market is another matter all together. One part of it is the development of the product itself, in essence mostly a technical challenge. The task here is to change the color of something, add or eliminate a button, make it faster or slower, bigger or smaller, heavier or lighter, use new materials, or what have you. Not easy but involving skills quite successfully acquired and practiced by generations of technical experts of all kinds. It is the other part where process innovation comes in. Here the real challenge is not technical. The challenge is people. People will be asked to change their habits, to enthuse themselves for new projects, to integrate in new teams, and so on. They need a skill not usually in the focus of in house training in companies (or taught at schools for that matter): They need change competence. Such is the challenge brought about by process innovation and it is change competence which makes process innovation in most cases considerably more difficult than product innovation. Martin Hilti, the founder of the HILTI Company summarized these ideas from an entrepreneurial view concisely as follows [44]: *Owning markets is much more important than owning factories*.

Let us look at a few examples of successful process innovations. Henry Ford realized that the conveyer belt (which was not his invention) made it possible for unskilled men to put together complicated machines. Gottlieb Duttweiler a Swiss entrepreneur in the first half of the 20th century, started a hugely successful retail company (Migros) based on the simple process idea to bring the products needed for daily life on (in the beginning) small trucks to villages with no shop (then quite common in Switzerland) so that people did not need to go to town. Michel Dell did not sell different computers than did his competitors, but he created a new method to produce and distribute them. He eventually became the market leader for quite some time. Amazon in its large storehouses does not sort the half million and more books according to some alphabetical order of authors or what, but equips each of them with an electronically readable tag so that they can be stored and fetched automatically. Containers revolutionized shipping. Alfred Hiestand, another Swiss entrepreneur in the second half of 20th century became rich by selling semi frozen croissants which, after heating them for 30 seconds, are fresh, crusty and tasty form 5 am till midnight. The same products, different processes! As a final and very spectacular example watch in Mumbai at noon each working day how over two million lunch boxes are extremely reliably distributed to the workers in town with the help of a code consisting of circles, crosses and triangles by carriers who do not know to read or write. Six sigma at its best [45].

What today's companies need, then, is a driving force which enables both: product innovation and process innovation. They need an innovation dynamo [46], a virtual device based on creativity,

communication skills, and change competence. On the one hand it will help to fill effectively the company's product pipeline, while on the other hand it will enable the company to bring these products efficiently to the customers. This dynamo will be an additional and important management tool for *The Future Company*.

c. ERP goes SOA

You are hungry. If you are to be helped, three steps are called for. Eating of course is one of them. But you also need to order your meal and to pay for it. In what order? It depends in the business model you choose. McDonalds will want you to order first, pay then, and to eat last. In a traditional restaurant you will order first, eat then, and pay at the end. If you take your lunch in the self service canteen of your employer you will pay and eat in that order. If a sit down buffet is available you again pay first, order then and eat at the end. Finally, if you are eating at home you just sit down and eat. Five business models for three steps [47]!

This is what Service Oriented Architecture (SOA) is all about. It allows you to structure your business processes with utmost flexibility. SOA is a method to encapsulate and orchestrate all available components (including IT) in such a way that internally and externally (relative to customers, suppliers, partners, and so on) business solutions are available as needed in each specific case. It should be clear that not the technical tasks (manipulating data, calculations, maintaining hardware, and the like) are addressed but rather the easy and effective coordination of IT services according to the business transactions at hand. SOA is a structure which integrates the business applications and at the same time hides their complexity behind a cleverly chosen architecture. Silent processes are the result.

Integration is the buzzword here. It has four main components. The first is integration of people. Every employee will have a unique "single sign on" access to all and every information handling equipment he needs in his specific role. Every information channel he is entitled to use is open at all times, and all other means of communication will be available to him in real time. The second integration concerns information. Data are uniformly and reliably administrated and distributed. They are summarized efficiently to furnish decision tools at the right moment and at the right place in a given process. The third is the integration of processes. Internal and external business processes are effectively correlated. They are as uniform as possible, scalable, flexible, and reach beyond artificial system boundaries. Furthermore business processes are to be easy to revise and improve. The forth (the heart of SOA) is integration of applications. An application platform supports all relevant technical standards and empowers a smooth interplay of web-services beyond company boundaries. It also allows for different ways to program additional software to yield optimally adapted (best practice) solutions to the encompassing business processes.

As a result the company will speak with one voice to the customer. The customer will know all he needs to know about the company's products and services. The processes are optimized with respect to the value chain and they are always easily adaptable to the changing demands of the market. Any dependence on a specific technology is substantially and sustainably reduced.

Another important aspect is, as always, cost. As new and more SOA applications are created their individual cost tends to zero, because most of the services are already available and only need to be orchestrated. As said before, the flexibility of the business solutions is greatly increased which, on the cost side, allows to dedicate a much larger share of the IT budget to adapt the company's IT solutions to the changing market conditions and new software developments, rather than to use nearly all of it to keep the system running.

On a grander scale SOA offers even more benefits to business. For instance consider the four most prominent driving forces behind SOA: deregulation (protected markets open up), globalization (end of low cost competition), technology (work is rapidly transferable), and commoditization (increased consumption at lower margins). Consequently, value chains characterized by concepts such as company centered, command and control, ownership driven, and self contained risk develop into business networks where the corresponding modified concepts are customer centric, connect and collaborate, relationship driven, and shared risk.

The relationship between IT and business started in the 1960^{ies} with a shy friendship between managers thinking technically and in functions and inert monolithic Enterprise Resource Planning (ERP) systems running on equally monolithic main frame computers. 30 years later it evolved towards a wavering romance with the same ERP systems but now running on a much more flexible client server architecture. Today all is set for a formal engagement between entrepreneurs thinking in processes with integrating SOA systems running on any appropriate technical platform. This platform is center stage in the next chapter.

d. Hard Discs go Internet

25 years ago, in 1984, computing became available to everybody. Replacing “write and enter” on a keyboard (involving programming) by “point and click” on a graphical user interface (GUI) transformed the interaction with computers hitherto only accessible to well trained specialists into a commodity for the public at large. Personal computers started their enormously successful invasion of the developed world and beyond, and conquered the desks and the laps of by now much more than one billion people. Desktops and laptops make up most of this technology platform, backed up by servers, data banks, glass fiber networks, and so on. Each of these personal computers contains a hard disc were the data and the programs are stored for each individual device. Hard discs are sophisticated technological machineries featuring small magnetic reading and writing heads hovering not much more than 10 billionth of a meter (10 nanometers) on top of some 10 rapidly swiveling patters covered by a complicated layer of tricky magnetic materials about 10-20 nanometers thick. Hard discs are heavy, consume a considerable amount of the power which keeps the PC running, and produce most of its waste heat which in turn asks for noisy cooling systems. They are quite shock sensitive and prone to all kinds of failures with drastic consequences of losing precious data not saved regularly (on other hard discs). And they are slow: Manipulating data on a hard disc is slower by at least a factor of 10^5 than performing a calculation.

No wonder ways out of this technological bottleneck are on top of the shopping list for the whole industry. There is by now little doubt that the solution is to be found in the idea of replacing hard discs by centralized internet services. Even better: this development is already in full flight. Music, films, videos and much more is already available in the net (iPads have no hard disc.). If today you buy a software package most likely you will not get an installation CD but an internet link, from where you can download what you have ordered and paid. Consequently notebooks – smaller and lighter as the former ones - without CD slots are already on the market. (It is not difficult to foresee that CD’s will become obsolete altogether and vanish as have the floppy discs five or six years ago.) Your personal computer will reduce to a screen with an integrated keyboard connected to the internet. It will shrink to what today is your cell phone which you will use less than 1 percent of the time for telephone calls. Economy of scale will have won the day.

We are entering the age of Cloud Computing. There are a confusing lot of definitions to explain what this is all about [48]. To quote one by Jeff Kaplan it is *a broad array of web-based services aimed at allowing users to obtain a wide range of functional capabilities on a “pay-as-you-go” basis that previously required tremendous hardware/software investments and professional skills to acquire. Cloud computing is the realization of the earlier ideals of utility computing without the tech-*

nical complexities or complicated deployment worries. Web-based services such as Software as a Service (SaaS), Platform as a Service (PaaS) or even Anything as a Service (AaaS) are the cornerstones of cloud computing. They provide computing services that are *highly reliable, scalable, and autonomic to support ubiquitous access, dynamic recovery, and composability. In particular consumers can determine the required service level through Quality of Service (QoS) parameters and Service Level Agreements (SLAs)* [49].

Cloud Computing of course also needs an appropriate hardware to make it work. Grid is its name. It *enables the sharing, selection, and aggregation of a wide variety of geographically distributed resources including supercomputers, storage systems, data sources, and specialized devices owned by different organizations for solving large-scale resource-intensive problems in science, engineering and commerce* [49] and references therein. (An often quoted analogy is the early 20th century transition from every factory having its own electrical power station to the centralized power stations of today.) Surely the choice for the sites (the nodes or hubs of the grid) where the hardware is to be installed and taken care of and the tremendous security issues raised by this concept will not be restricted to technical arguments but will touch heavily upon political issues as well. (It is a situation comparable to the ongoing controversies about the localization of the large particle accelerators like CERN or the deposition of waste material from nuclear reactors.) Incidentally, arguments about energy consumption, CO_2 production and the like may help to find a solution. Price Waterhouse Coopers in collaboration with Microsoft have recently interestingly enough evaluated the possibility to establish such a node in Iceland where clean energy and natural cooling are readily available [50]. As to security the problem may again not be technical in the first place but much more about how to deal with the human factor which will be our topic in the next Section.

e. People and Change

In the beginning of the industrial age the most precious resource was capital followed by the raw materials, the production means, and finally people who then were a commodity. Today clearly the situation is the other way round: Capital is the commodity and the lack of qualified well trained people with the right skills is more often than not the decisive factor hindering business success [51] [52].

This development started during the industrial revolution beginning in the 18th century when manual work was replaced by machines that for instance could transport and lift heavy materials much more efficiently and effectively than workers. As a consequence productivity increased tremendously and new jobs (manufacturing the machines for instance) emerged. In the middle of the 20th century conveyer belts with lots of people doing dull, repetitive work were replaced by industry robots and again productivity increased and new jobs were created. And now? We are in an age where routine mental work is replaced by machines. As an example, watch an accountant as he performs his tasks. He gets numbers from somewhere, transforms them into new numbers which he delivers to his boss, the board, the controllers, or whomever. His own work, transforming the numbers, is strictly determined by rules of accounting, by laws, by regulations such as the US Generally Accepted Accounting Principles (GAAP), and the like. If he deviates from these restrictions ever so slightly, if he displays the smallest trace of imagination, he goes to jail. A job like this one, which has to be done according to strict and formal prescriptions, is doomed to be replaced by machines (computers) that are much cheaper, faster, and more reliable than people who lose their jobs to the benefit of increasing productivity.

People once more have to look for work they can do better than the machines. It will not be calculations, simulations, or steering of equipment of all kinds. For these tasks computers are by orders of magnitudes superior to people. (For many years already computers have been superior playing chess, long thought a game where human intuition could not be beaten by a calculating machine.)

However, fields like creativity, communication, grasp of content and context, *Gestalterkennung*, shaping things, associative thinking and memories, translation of languages, semantic thinking, driving cars, and not to forget emotions, poetry, art, and sports, will be for many years to come the more or less exclusive playground for human beings until the next generation of ever more sophisticated machines comes up with new challenges.

Fields like these (and certainly many similar ones) define the skills needed for business in the next decade. Some of them are technical, be it in IT, or - a vastly larger field – in all kinds of engineering skills, craftsmanship, or trading skills, or of course research as a prerequisite for a large number of products and services. Non technical ones, strangely enough called soft skills, include methodological and social competences, communication skills, managing (or better enabling) capabilities, marketing competence, customer relationship management (CRM), and many more. The most important of all skills, however, is change competence.

Change is the hall mark of our times. Change is not new. In the past it has been rather slow. People could live through a professional career with one profession, even quite often with one employer. Today this is the longer the more out of the question. One might object that for instance a medical doctor will be a medical doctor during his whole career. May be, but before he retires he will have had to acquire so much additional knowledge on new diseases, new therapies, new diagnostic tools, technical skills, and the handling of apparatuses that, although he is still helping people to become and stay healthy, he will find himself in his daily work to do a lot of new and different things and do them quite differently from the time when his career started as a clinic intern.

Likewise, in business people today will (no surprise here) have the incentives to add value, to find a market, to create, distribute, and sell products and services to customers who are willing to pay for them, and so on. Working hard to achieve these goals during their careers they will find themselves performing many different tasks in many different functions, to be involved in many different projects, and working for more than one employer, if any. Continuous learning, bridging different disciplines (transdisciplinary not interdisciplinary!), thinking and acting in processes, always realizing that it is the customer and the customer only who pays my salary, practicing methodological and social skills on the same footing as technical skills will be the distinctive features of a successful career. Business people will see change not as threat but as a welcome opportunity to beat the machines once again, to increase productivity another time, to create new jobs, to increase welfare, and to make money.

6.3 The Future Company

The Future Company will be devoted to change. Markets will have become truly global having further expanded geographically (specifically into the Far East). Markets will also be reaching out for new products and services at an increasing rate. The Future Company in order to deal with all the various cultural and political diversities and to match the ever accelerating pace will have to rely on IT products and services even much more intensely than today.

Handling complexity will be the first challenge and the foremost prerequisite to enable change. The (scientific) discipline of Business Process Mapping will play a key role. Process innovation is the vehicle to open the roads towards change. A device such as the Innovation Dynamo will be helpful. The building blocks of change come under the name of Service Oriented Architecture, which will replace the monolithic ERP systems as a much more flexible tool. SOA enables companies to keep in step with the rapidly expanding markets which offer many new opportunities at a high pace. Competition will be tougher than ever and the winner will take next to all. Hardware, the bones of software, will change drastically as well. Cloud computing and Anything as a Service with

a few geographically concentrated, secure sites where everything is technically run are the new scenario. IT-departments will shrink or vanish altogether.

Finally, the quintessence which distinguishes your business from your competitors is the people staffing your company. To be successful they will find themselves in new professions or in new combinations of old ones, concentrating on skills which enable them to beat the computers. (Historically, quintessence the fifth element besides the four usual ones (earth, air, water and fire) which make up Plato's world, is the one that makes the difference in the medieval chemist's drugs market potential)

The Future Company happily married to an enormous variety of IT products and services will thrive on silent processes featuring the specific services which make up the company's Unique Selling Proposition (USP). They all will be linked to a node in the grid of the cloud driven by continuously learning people with appropriate technical, methodological, and social skills.

6.4 The Future Happens. Even without you

The future happens. Even without you. You better play the hand you are dealt. People are the heart of any company. So take good care of them. Give them every opportunity to learn and to dedicate themselves to what makes the gist of your company.

Finally, remember Alice meeting the Red Queen [38]. They together run faster and faster only to end up were the race began. Whereupon Alice remarks *Well, in our country…you'd generally get to somewhere else - if you ran very fast for a long time as we've been doing. A slow sort of country!* the Queen replied. *Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that.* That is of course what business is all about.

7. Summary

IT is here to stay. The future happens. Even without you.

Information technology is here to stay. Its impact on human affairs cannot be overestimated. Nor can the speed at which change happens.

Change in business is in full flight. Indeed, as already seen today, only those businesses survive that adapt carefully and fast to the possibilities and challenges IT presents. Interestingly enough, however, in Collins' important empirical analysis [50] of companies that made the transition from *Good to Great* based on *disciplined people, disciplined thought* and *disciplined action* there is no chapter on IT and IT does not even appear in the index, nor do computers. Now Collins, an eminent student of companies certainly did not overlook the role of IT. His analysis is to a large extent independent of the state of the art of the technical tools in the background. Or at least it was when *Good to Great* was published in 2001. However, what was background 10 years ago is now on its way to the frontispiece.

What has happened is that IT is no longer restricted to the role of an ever more efficient tool on the way from business decisions to the market. Effectiveness has become an important issue too. IT in business has made the transition from quantity to quality. The concepts relevant to the success and failure of companies depend in an essential way on IT developments and their application; a challenge to be addressed seriously if one does not want to be paralyzed by complexity, slowed

down way behind competition by broken processes, or ruined by redundant management of maladapted resources.

Business is at the heart of society. It is its engine. No wonder then that the changes in business are reflected in society. Jobs formally in the hands of people have been transferred to machines for centuries. During the last decades, in addition, a lot of jobs have been taken away from the brains of people to machines. Hitherto useful knowledge and skills become obsolete, new ones are needed. People lose their jobs and new jobs are in demand for people able to execute them. The time scales at which the new challenges present themselves and those at which people acquire the skills needed to meet them are out of phase. Social unrest results. Again, this is not a new phenomenon. But, besides being faster than ever, for the first time in history it is global [53].

Another issue is communication. Willy-nilly we get to know practically everything happening on earth (and beyond) almost in real time as soon as CNN and other media get their cameras in position. Via Facebook we can link to a two digit percentage (and counting) of all people on earth instantly and talk about anything we like. With Wikipedia and Google we have instant access to much more facts or not so facts than we will ever be able to digest. What will come out of all this turmoil?

IT will help and so will learning. Learning is survival. In comparison with animals humans depend for a very long time on adults caring for them. The reason is simple. The young have to spend a large amount of their energy on learning [54]. Learning is even more than survival. Learning is a shear necessity to be able to participate and to thrive in a world full of machinery and sophistication. Learning alone does not suffice. Unlearning is what is asked for in addition. A difficult task again, aptly summarized by Max Planck who said that *new ideas do not win over old ones by convincing the advocates of the old ones, but because eventually they die out* [55].

IT will heavily affect the state as well. First of all, the state almost everywhere has a long way to go to streamline its administrative tasks. It is a fair guess that thinking in IT supported unbroken processes will eliminate most of the seemingly inevitable bureaucratic obstructions so typical for political organizations [56] (and many companies too) and that cost could be reduced by a consequential two digit percentage figure. Mainly cost of human resources of course, with the advantage that personnel, not needed any longer in redundant, completely useless, or even counterproductive functions, could be incited to learn and prepare themselves to go (back) into the nongovernmental world and engage in IT driven productive work in demanding jobs. The gross national product will be pleased and so will the citizens as the state could put the additional moneys to good use by financing education and training, public transport, medical services, communication, social networks for those who need them, culture, and much more. All of course supported by IT.

The state will also be challenged to legislate and put into effect the rules and laws arising with the necessity to fight abuses of IT connected with privacy issues, copyrights, patent violations, security, and downright criminal activities. Last but not least IT can help to keep states not only lean but also clean. IT supported checks are very efficient tools to detect among other misdemeanors cheating, corruption, or personal fraud in the grindings of large and complicated organizations such as the state.

8. Outlook

Prediction is very difficult, especially if it's about the future.

Trade is what keeps the human species on the map. Its history is thoroughly documented [57] and shows that it underwent many changes through the millennia. Specifically, trade has accelerated at

an incredible pace. Taking agriculture and stock-farming as a benchmark the typical time scale is one year, for instance the time interval between sowing to harvesting or the time the next generation of cattle needs to get productive. Industry, averaged over its many different manifestations, by the long chalk is about twice as fast as measured, say, by the time it takes to launch a new product. Services, again based on some average, are about 10'000 times faster. It takes half an hour to get a haircut. IT is about an incredible factor of 10^{15} times faster than growing crop as one nanosecond (10^{-9} seconds) is the typical time scale for the physics of digital devices. Prefixes like Mega, Giga, have already reached everyday language while Tera (10^{12}) is on its way. Peta (10^{15}) is the next jump of orders of magnitude that will embellish our language. IT is Peta.

No wonder changes in almost every aspect of human affairs we have discussed are so imminent. No wonder IT's impact is so strong, and no wonder that the technical development of IT by far has out sped its practical applications [29]. And if ever the technical limitations will indeed turn out to be obstacles for further uses of IT in business, society, or learning new developments like optical computing, holographic memories, quantum computing, or even computing with the help of large molecules like DNA are already on the scientists workbenches. The challenge we face is to make better use of the possibilities today's IT has ready for us and to avoid its threats.

We spend billions of dollars to understand the universe and much more, certainly in the Tera range, in wars at a terrible prize of human suffering. Why not profit from IT's Peta potential to lessen the impact of conflicts, to learn more about the universe and all the other great scientific mysteries, to promote the arts and humanities, and at long last to acquire a better understanding of the conditions of a stable society, a working economy, and peace? .

9. Acknowledgements

It is a pleasure to thank my colleagues Matthias Kaster, Francis Kurz, Margarete Nuber, Estelle Schiltknecht, Andreas Spiess, Werner Wehrli, and Alexander Weiss for discussions, criticisms, and helpful comments.

10. References and Notes

[1] Adrian Cho, Science July 24, 2009 p 406-408
[2] Scientific American Vol. 300, January 2008 (Special Issue)
[3] http://en.wikipedia.org/wiki/List_of_extinct_animals
[4] Alexander S. *Bradley: Expanding the Limits of Life.* Scientific American Vol. 301 2009, December p 38-43; http://pubs.usgs.gov/gip/dynamic/exploring.htm
[5] Der Spiegel 6/2011 p 108
[6] Carina Hoorn: *The Birth of the Mighty Amazon*. Scientific American Vol. 294 2006, May p 40-47
[7] New Scientist December 8, 2010
[8] Walter Heitler: Der Mensch und die naturwissenschaftliche Erkenntnis, Viehweg & Sohn Braunschweig, 1961
[9] http://humanorigins.si.edu/evidence/human-fossils/species/homo-erectus
[10] Hölldobler, Bert/ Wilson, Edward O.: *The Ants*. Springer, Heidelberg 1990, ISBN 3-540-52092-9.
[11] von Frisch Karl: *Über die ‚Sprache' der Bienen. Eine tierpsychologische Untersuchung.* In: Zoologische Jahrbücher (Physiologie) 40, 1–186 (1923)
[12] Daniel Kahneman: Thinking Fast and Slow, Pinguin 2012.
[13] Misner Charles W., Thorne Kip S., Wheeler John Archibald: *Gravitation.* Freeman and Company San Francisco ISBN 0-7167-0334-3 p (v)
[14] e.g. Konrad Zuse, Friedrich L. Bauer und H. Zemanek: *Der Computer – Mein Lebenswerk: 100 Jahre Zuse*, Springer Berlin (2010) ISBN 978-2-642-1295-4
[15] *Real Time; A Tribute to Hasso Plattner* Wiley Publishing Inc. 2004 ISBN 0-7645-7108-7

[16] Tim Berners-Lee with Mark Fischetti; *Weaving the Web. The Original Design and Ultimate Destiny of the World Wide Web*, HarperCollins NY (2000), ISBN 0-06-251587-X
[17] Jonny Ryan; *A History of the Internet and the Digital Future,* Reaction Books (2010) ISBN 978-1-861-8977-0
[18] Standard Business Software from companies like Oracle, SAP, and others which can be customized.
[19] Charles Darwin: "It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change"
[20] Michael H. Hugos: *Essentials of Supply Chain Management,* John Wiley & Sons (2011) ISBN 978-1-118-10060-8
[21] It is very instructive to refer here to the strong connection between thermodynamics and information as pioneered by Claude Shannon. See e.g.
http://en.wikipedia.org/wiki/Entropy_in_thermodynamics_and_information_theory
[22] *Facebook*, Time Magazine February 11, 2011
[23] Examples are XING, Linkedin, or Doodle
[24] George Orwell: *Nineteen eighty-four,* Sacker and Warburg London 1949
[25] Fred Hoyle: *The Black Cloud,* Pinguin Books 1957, ISBN 0-4511-1432-9
[26] Hans-Adam II The Reigning Prince of Liechtenstein*: The State in the Third Millennium*, van Eck Publishers 2009, ISBN 978 3 905881-04-2
[27] Examples are Switzerland or Liechtenstein. Counterexamples, unfortunately, exist too. Some of the worst kind and most pervasive form of corruption and mismanagement is precisely perpetrated by local governments and authorities, pseudo democratically elected, rendering people totally powerless.
[28] Prospective examples are the European Union or the United Nations
[29] http://en.wikipedia.org/wiki/Moore's_law
[30] http://en.wikipedia.org/wiki/Metcalfe's_law
[31] Stuart Chase: *The Club of Rome and Its Computer*, Bulletin of the Atomic Scientists, March 1973
[32] Time February 21, 2011 p. 18-27
[33] http://www.singularitysummit.com/
[34] Nicholas Eberstadt and Hans Groth: *Demography and Public Dept: Time for a „Demographic Stress Test" for Western Economies. What does is mean for Switzerland?* The WDA-HSG letters No. 2010/1
[35] Susan Greenhalgh: *Just One Child – Science and Policy in Deng's China, Berkeley University California Press (2008)*
[36] http://biz.thestar.com.my/news/story.asp?file=/2008/6/18/business/21577668&sec=business
[37] Mark G. Raizen: *Demons, Entropy and the Quest for Absolute Zero, Scientific American* Vol. 304 March 2011, p 47-51
[38] John L. Mariotti: *The Complexity Crisis*, Platinum Press 2008 ISBN 10: 1-59869 -214-3
[39] This idea was developed in collaboration with my former colleague at SAP Dr. Andreas Spiess
[40] "Silent Processes" is a concept I learned from Dr. Hubert Oesterle, Professor at the University of St. Gallen Switzerland
[41] R.H. Coase: *The Problem of Social Cost*, Jour. Of Law and Economics, Vol. 3 (1960) pp 1- 44
[42] Kurt Weiss: *Ruling the Cost of Operative Expenses: A Key to Improving Business*. To be published
[43] *Martin Hilti, 80ter Geburtstag*, printed by Schwabe AG Switzerland 1995 ISBN 3-7965-9900-1, page 34
[44] George Eckes:, *Making Six Sigma Last*, John Wiley & Sons 2001, ISBN 0-471-41584-0
[45] Kurt Weiss, The Innovation Dynamo – A New Concept, to be published
[46] This example was provided to me by my colleague Hanspeter Groth at SAP
[47] http://cloudcomputing.sys-con.com/read/612375_p.htm
[48] http://arxiv.org/pdf/0808.3558
[49] http://www.invest.is/news/339/default.aspx (→ Iceland's clean energy and natural cooling)
[50] Jim Collins: *Good to Great*, Harper Business 2001, ISBN 0-06-662099-6 (hc)
[51] Jack Welsh and Suzy Welch: *Winning*, HarperCollins Publ. 2005, ISBN 0-06-075394-3
[52] Lewis Carroll: *The Annotated Alice* Ed. by Martin Gardner, Penguin Books 1976, p 210
[53] Thomas L. Friedman, *The World is Flat,* Ferrar, Straus, and Giroux, 2007 ISBN 3-374-29278-7
[54] Alison Gopnik: *How Babies Think* Scientific American Vol. 303 July 2010, p 56-71
[55] Max Planck: *Wissenschaftliche Selbstbiographie*, Leipzig 1948
[56] C. Northcote Parkinson: *Parkinson's Law or the Pursuit of Progress,* John Murray London for a pre IT classic always worth to be enjoyed again.
[57] http://en.wikipedia.org/wiki/Trade