TRAUNER VERLAG
UNIVERSITÄT

Schriftenreihe
Informatik

12

Hofer Christian, Chroust Gerhard
(editors)

IDIMT-2004

12th Interdisciplinary
Information Management Talks
Proceedings

Impressum

Schriftenreihe Informatik

Hofer Christian, Chroust Gerhard (editors)
IDIMT-2004
12th Interdisciplinary Information Management Talks
Proceedings

Gedruckt mit Förderung des Bundesministeriums
für Bildung, Wissenschaft und Kultur

Die Konferenz IDIMT-2004
fand vom 15.-17. September 2004 in Budweis,
Tschechische Republik statt

Programmkomitee
Prof. Dr. Chroust Gerhard
Dr. Doucek Petr
Prof. Dr. Gross Tom
Dr. Hofer Christian
Hoyer Christoph
Klas Jan
Klöckner Konrad
Dr. Knez-Riedl Jozica
Prof. Dr. Lavrin Anton
Dr. Loesch Christian
Prof. Dr. Mulej Matjaž
Prof. Dr. Raffai Maria
Rebjonok Alexander
Dr. Sonntag Michael

Herstellung:
Kern: Johannes-Kepler-Universität
Linz, A 4045 Linz-Auhof
Umschlag: Trauner Druck, A 4021
Linz, Köglstraße 14

ISBN 3-85487-665-3
www.trauner.at

Welcome to IDIMT!

Welcome to Europe!

I have the pleasure of welcoming you to this year's Interdisciplinary Information Management Talks. 2004 is a very special year for Europe, and also for IDIMT:

Our IDIMT conferences have become an inner-European event and I would like to welcome all of you as our European partners.

The European Union has become a Federation of some 450 million inhabitants, covering some 4 million square km. And we are proud to have been a small cogwheel in this process:

IDIMT started back in 1993 when several of our partners had barely overcome the hardships of communist regime and from that time on the integration of our small central-European event has grown, in diversity and in depth.

Huge imperia have existed in the past: China, Rome, Persia, Soviet Union. They only lasted as long as the ruling person or oligarchy was able to maintain power and control: a strong army, a strict bureaucracy. The individual subjects of these imperia were often unaware of their fellow countrymen far away, and often not even aware of the central power.

Europe is now to be based on different foundations: the free will of its people and on democracy, as expressed by a common parliament and free elections. It is the intention that Europe become a closely knit society gaining the profits of synergy – let the whole be more than its parts – the founding premise of systems thinking.

A key issue to this European vision is *Information and its Management:* the central theme of IDIMT. Only technology – together with a sound theoretical foundation is able to provide Europe-wide access and interchange of information.

This year's program reflects these European needs:

- The European society has to be based on electronic information interchange:
  „E-Society - Perspectives and Risks for European Integration"
- Beyond information we need collaboration:
  „Cooperative Information Environments"
- Coming generation will have to use modern means and technologies more effectively:
  „Educational Aspects of Computer and Information Science"
- Small enterprises, the backbone of the European economy will be based more and more on knowledge:
  "Information and Knowledge Services for SMEs"
- Authenticity, Truth and Trust are one of the foundations of an efficient economy and the keys to personal and economic cooperation:
  „Creditworthiness as a Requisitely Holistic/Systemic Information?"
- All these issues must be discussed in view of the dramatic changes in technology:
  „Information Technology - from Trends to Horizons"„

Thus IDIMT 2004 covers many of the most relevant issues in ACT and as a consequence of importance to an integrated Europe; or as Profs. Ehleman and Vodacek formulated in back in 1993: *"… managerial thinking and management systems have been rapidly undergoing substantial, sometimes even painful changes. The political transition … [and] the transformation to the market type economy have created quite new tasks and problems we were not used to.*"

With respect to the organisation of IDIMT 2004 I have the pleasant task of thanking our supporters and sponsors:

- Our sincere thanks go to the Austrian Government for supporting the publication of our proceedings.
- Our thanks include the Austrian and the Czech tax payers. I feel the obligation to provide some return on investment by enlarging their knowledge and understanding and by documenting our conference. Hopefully this will improve their social and economic environment in the long run.
- I want to express our thanks to the two universities: The University of Economics Prague and the J. Kepler University Linz for providing the infrastructure for the preparation of IDIMT 2004.

We must not forget all those persons who have contributed to its realization:

- The organising chairman Petr Doucek and his team,
- Christian Hofer for handling all aspects of the scientific programme,
- the keynoters and session organiser forming the programme committee,
- Christian Hofer additionally for co-editing the proceedings,
- all submitters of interesting and challenging papers,
- all participants for their contribution to this interdisciplinary exchange of know-how and ideas.

May IDIMT 2004 again provide you with new ideas, new concepts and
new friendships in a truly European Spirit.
I conclude with my sincerest wishes for
successful
Interdisciplinary Information Management Talks 2004.

Gerhard Chroust
Linz, July 2004

PREFACE

Welcome to the 12th IDIMT-conference. For the second time the conference takes place in Budweis and we are happy that we found such an excellent place for exchanging our thoughts and ideas. But this little old town offers much more than just an environment for the conference: There are a lot of beautiful sights, many friendly people and great eating places offering delicious food and drinks. And last but not least: There is one of the most famous beer breweries of the world within walking distance …

Started in 1995 as a small conference between Czech and Austrian scientists in the little village of Kobuva Hut in the Bohemian Forest the conference improved constantly during the years. The originally small kernel of scientists is extending year by year with new faces and bringing in fresh ideas and new spirit. This scientifically and geographically diverse composition of the community is one of the most important success factors for this event and makes it so valuable for all of us. The quality of contributions improved from conference to conference as well as the number of participants increased constantly. This year we have participants from 10 different countries and for the first time we have participants from France and Pakistan. Finally we accepted 24 papers and again the reviewer had a lot of work to do in reviewing and selecting the papers from the submitted ones.

Over the years many things changed, but the fundamental idea of the conference remained alike: Providing a solid base for an interdisciplinary and informal exchange of thoughts and interests about economical, technological, and sociological topics. The holistic interchange of concepts and ideas is one of the strengths of the IDIMT and thus makes it so valuable for all participants.

This year we kept the well-proved structure of the previous conferences with no major changes:

1. Again the conference takes place at the same time period like last year. As proven many times mid of September seems to be an ideal date for our conference. One the one hand vacation time is over for most of the participants on the other hand winter term has not been started yet and allows university members to attend the conference before lectures start.

2. The conference runs for two full days - Thursday and Friday - again, because the last years showed that two “full time” days are ideal for all participants. The conference starts with dinner on Wednesday evening, the official opening starts on Thursday morning with an invited lecture. Early Friday afternoon the conference closes and allows participants to travel home comfortable.

3. This year we continue with the well-proved structure of the sessions. Every session will be opened by the presentation of one keynote paper and followed by short presentation of several position papers. Again we ensure that there is plenty of time for an intensive follow-on discussion allowing an active participation for all participants.

The main focus of this year’s conference will be in the challenges, advantages and problems brought by the ability to electronically interconnect the society, by using cooperative information environments. Special attention will be given to questions of technology trends, information and knowledge services, as well as educational aspects. This year’s themes are:

- Information Technology - from Trends to Horizons
  Invited Speaker: Dr. Christian Loesch

- E-Society - Perspectives and Risks for European Integration
  Keynote Speaker: Dr. Petr Doucek, Session Organizer: Dr. Michael Sonntag

- Cooperative Information Environments
  Keynote Speaker: Prof. Tom Gross, Session Organizer: Konrad Klöckner

- Creditworthiness as a Requisitely Holistic/Systemic Information
  Keynote Speakers: Prof. Matjaz Mulej and Prof. Jozica Knez-Riedl, Session Organizer: Alexander Rebjonok

- Educational Aspects of Computer and Information Science
  Keynote Speaker: Prof. Maria Raffai, Session Organizer: Christoph Hoyer

- Information and Knowledge Services for SMEs
  Keynote Speaker: Prof. Anton Lavrin, Session Organizer: Jan Klas

The preparation and realization of IDIMT-2004 would not be possible without the support of many organizations and persons. Therefore we would like to thank:

- the Austrian Ministry of Education, Science and Culture for financially supporting the preparation of the proceedings,
- the “Action Austria Czech Republic” for financial support,
- Computer Associates Austria for sponsoring,
- the Prague University of Economics and the Johannes Kepler University Linz, which as partner universities provide much of the organizational infrastructure,
- Trauner Verlag for including the proceedings in their book series,
- Petr Doucek for chairing the Organizing Committee and preparing accommodation in Budweis,
- all session organizers for establishing contacts and soliciting contributors,
- all keynote speakers, speakers and editors of position papers,
- the secretaries of the involved institutes, and
- all other unnamed persons contributing to the success of this conference.

Christian Hofer
Gerhard Chroust

July 2004

SPONSORS

of IDIMT-2004

Austrian Ministry of Education, Science and Culture

Action Austria Czech Republic

Computer Associates Austria

Johannes Kepler University Linz

Prague University of Economy

Contents

Invited Lecture

INFORMATION TECHNOLOGY: FROM TRENDS TO HORIZONS

Christian Loesch

Silicon based computer technology has taken us through a period of exponential growth of technological capabilities but also to unprecedented side effects through cross fertilizing and enabling many other areas of science and technology. But as all phenomena of exponential growth, sooner or later this technology trip must come to an end as the technology is increasingly stretched to the limit.

The race is now already on to discover silicon's successor, since to the winner will not only come glory but also inconceivable profits. The search for the post silicon future has led to the exploration of extraordinary possibilities of nanotechnology and molecular computing as well as far-out options as quantum or DNA computing.

We cannot reliably predict many implications of such developments – but since they may shape our future, it could be worthwhile to review, discuss and assess some these developments and their potential impact on a plethora of fields ranging from science to society and economy.

1 Introduction

The impact of the technology revolution is reaching far beyond merely generating products and services, it changes how people interact and live. Increased miniaturization and sensorization of items as clothing, appliances, cars or housing will likely change the way these devices interact with our lifestyle and these effects are not to proceed without issue.

The realization of these possibilities will depend on several factors ranging from infrastructure investments to technology breakthroughs, the advancement of science and technology and its social acceptance and will additionally vary around the globe, making forecasting additionally difficult.

Let us first peruse where we stand and where the scientific, technological and economic thrust is going to lead us in the next years. Based on this assessment we will than look at the follow-on potential on the horizon of research endeavours.

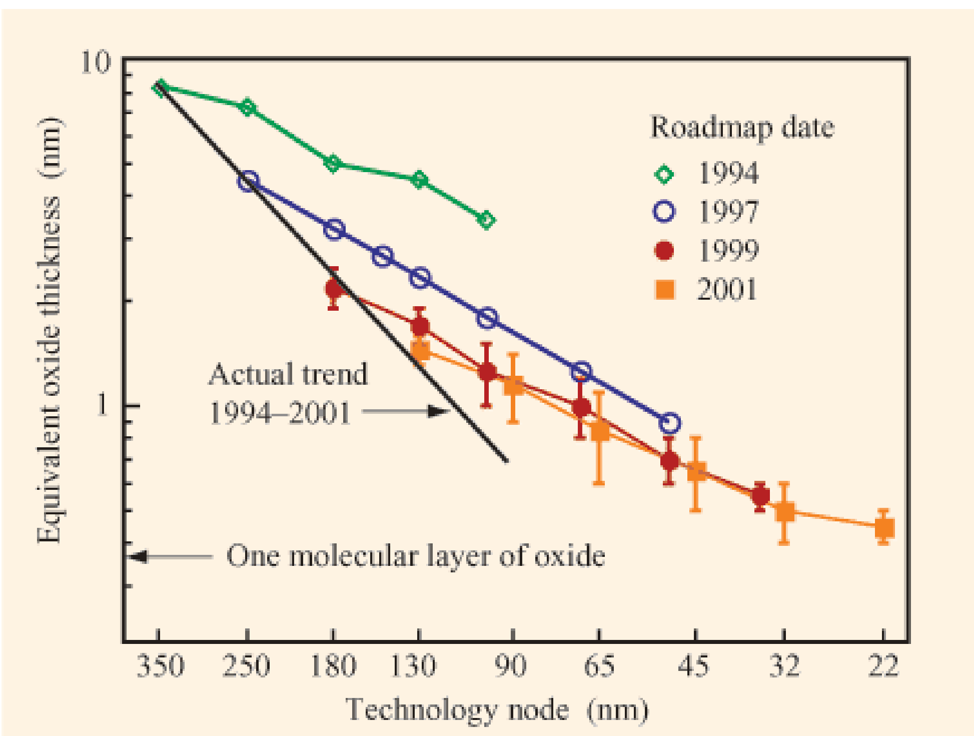
2 Silicon Technology

The exponential improvement of integrated circuits has fuelled the growth of economy, science and of course the information technology for nearly half a century and it is obvious that this advance forever. But predictions of limits have been proven wrong in the majority of cases, since the predicted boundaries have been shifting nearly at the same speed as the improvements.

Not the increases in speed or density but that the increase of components and functions is greater than the increase in costs per chip is the key factor for these developments. The information revolution will therefore continue as long as cost per function is declining.

Therefore preference will be given to protect the investments in know-how and equipment and extend the current silicon technology to its limits. This is no constraint since such a development will result in continued exponential improvements and within the next ten years in equipment as PC's 10000 times as powerful as today's advanced models, using no keyboards being a conversation active machine with low power high density features.

The NTRS roadmap for Semiconductors provides a consensus scenario of leading experts of science and industry how parameters will scale today's devices. Additionally it shows impressively how all ambitious forecasts have been surpassed by the actual developments.



Picture 1: NTRS roadmaps for semiconductors and its adjustments

Decisive for these developments have been and will be:

- Lithography
- Design and Interconnections
- Architecture
- Cost

2.1 Lithography

Photolithography a key process of integrated circuit manufacturing is a combination of optical, chemical and micro mechanical processes to transfer geometric shapes onto the surface of silicon wafer. The steps involved in the photolithographic process are wafer cleaning, barrier layer formation, photoresist application, soft baking, mask alignment, exposure and development and hard baking. This technology is successfully used for more than a billion transistors per second, but it approaches two principal limits.

First for optical lithography – the current workhorse of semiconductor industry – the minimum feature size is closely related to the wavelength of light. Since we are already approaching the short wave edge of conventional optics but even shorter wavelengths will be necessary; but sub-100 nm patterns can only be made by x-rays and electron beam or E(xtreme)UV.

The second limit is cost. Just the tools to produce chips with features under 100 nm will cost up to hundred millions of dollars each. [9]

This explains the efforts to extend the familiar technologies to advanced UV lithography to its limits and explore in parallel improvements possibilities like improved energy management, low temperature operation, the use of superconductivity or materials as GaAs or diamond on silicon.

2.2 Design and Interconnections

System performance of the integrated functionality superseded the pure raw transistor performance as yardstick. Clock rate improvement is not entirely due to transistor performance but also to improved logic design. An optimistic case of continuing improvements would lead to 20+ GHz processors in 2010 and raising the number transistors on a chip from the 170 million (IBM POWER) chip marketed since 2001 to a billion transistor chip envisaged for 2010, or 4,3 billion functions for mass production in 2015. [16]

But there are fundamental limits, as e.g. the tunnelling of electrons since the insulators are 2-3 nm thick today and cannot become less than about 1,5 nm thick while pure extrapolation of the historical trend in dielectric thickness extends below a molecular layer of SiO_2 already in 2006.

2.3 Architecture

Designers of have used the increasing numbers of transistors to improve the performance of a uniprocessor core or by adding caches. Adding transistors to uniprocessor shows diminishing returns, SMP´s (shared multi processor) increase the probability that the contents of a requested memory location is in the cache of another processor and thus causes additional traffic between the processors and memory. As a result many applications actually degrade in performance with large numbers of processors. Already years ago H. Grosh pointed out that the performance of paging systems actually decreases with increasing storage.

This has led to alternative architectural attempts as to exploit parallelism at multiple levels at various granularities and migrating from the von Neumann style architecture to cellular architectures and connection machines. Such architecture was proposed for a computer named connection machine, with thousands of processing elements with build-in connections between them or IBM's Blue gene a research computer presently under development, a system, with 32000 chips which may provide one petaflops of computing power.

This approach carries also some other potential advantages as each node becomes an off-the-shelf commodity, tools incl. programming development, testing and debugging programs and program libraries written for the SMP can run unchanged. Combinations of connectionist and von Neumann style of computing architecture would be possible and provide greater overall systems performance than processor performance alone.

In addition we are witnessing a development called lateral integration leading to future electronic elements featuring a mix of technologies on the same chip as high performance logic, low power logic, static RAM, RF, analogue, DRAM (Dynamic Random Access Memory), flash memories, MEMS (microelectronic electro mechanical systems), and a variety of sensors etc. on the same die. [22]

2.4 Cost

The exponential increase in transistor densities and processing speed is being sustained by a similar increase in the financial outlays for tools and facilities that produce these chips. Some expect equilibrium around 2015 - 2020 when a fabrication facility might cost up to 200 billion $. However since the 90´s the increase of financial outlays to build the facilities has slowed from 20% p.a. to less than 15% p.a. due to better equipment productivity and a slower increase in the number of process steps.

2.4.1 Storage Technology

The pace of storage technology has accelerated to a 60% compound growth rate. Trends for the next few years show no decrease in the pace of technology improvement. Past attempts to predict the ultimate limits have been dismal failures. Today’s best disk drives operate at 100 times of the predicted limit of maximum densities. However limits seem also here to be fundamental, like thermodynamics of the energy stored in a magnetic bit, the head to disk spacing only an order of magnitude larger than an atomic diameter or the intrinsic switching speed of magnetic materials or the superparamagnetic limit.

Parallel to the above-mentioned development of magnetic storage devices several other research venues are being pursued as holographic storage or Millipede memories.

2.5 Optical computing

Attractive features of optical technologies are the integration of communication and computing as the absence of cooling problems and cross talk have instigated research into this field.

The ultimate goal is to develop a technology for on-chip integration of ultra-small circuits that can manipulate light signals; similar to the way electrical signals are manipulated in chips. [7]

3 Nanotechnology

Today there is a nanophysics gold rush and scores of researchers and institutions are scrambling for a piece of action. Nanotechnology tries to create materials and system at a length scale of >100nm as shown below and in parallel exploit additional phenomena intrinsic to it.

Some sizing to put things into proportion:

1 Nanometer	10-9 (billionth) meter
Human hair (diameter)	10 000 nm
Feature of computer chip	180 nm
Protein, DNA	~ 1 -20 nm
Hydrogen atom	0,04 nm

We are only at the beginning to acquire the detailed knowledge of this future technology, where the properties and behaviour of matter are governed by a complex and rich combination of classical and quantum mechanics.

The ITRS Roadmap forecasts that by 2014 the minimum feature size will decrease to 20 nm meaning that each switching event will involve only about 8 electrons, so that accounting for single electron charges will become crucial.

The future potential of the current CMOS-technology (Complementary Metal Oxide Semiconductor) should not be underestimated since it is pointing to high performance processors with 20 billion functions and to mass production elements with 4,3 billions functions. However following 2015 limits will be encountered as interconnections between transistors might limit the effective computing speed, thermal dissipation in chips posing another increasing challenge (less a fundamental as an economic challenge).

Another challenge will be surfaces. When we shrink to nanodimensions much of the foundations of solid-state physics, standing on the premise that the surface to volume ratio of objects is very small i.e. physical properties are dominated by the physics of the bulk, are changing significance. Nanoscale changes effect even classical properties as the melting point and forces as van der Waal forces become important with decreasing scale as illustrated by the surface to volume ratio of a Fe-particle of

- 30 nm particle has 5% of atoms on the surface while a
- 3 nm particle has 50% of atoms on the surface. [19]

3.1 Microelectronics and Nanoelectronics

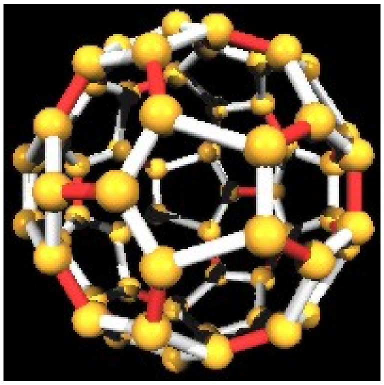
Microelectronics and nanoelectronics are different. Thousands of molecules, clustered together can carry electrons from one metal electrode to another. These clustered molecules can be used as on/off switches and might be thus usable also as computer memory; it is a well-understood reaction in which electrons shuffle around within the molecule. In the “on“- position conductivity is 1000 times better than in the “off”-position and research is looking for molecules with better properties. The electronics might look more than a chemistry set with new ways of organizing and assembling might be required.

Researchers have created nanoscale electronic components as transistors, relays, logic gates, from organic molecules as well as carbon nanotubes and semiconductor nanowires. The challenge is to connect these components. Unlike the conventional circuit will the design not proceed from blueprint to pattern to chip but from a haphazard jumble of up to 10^{24} components and wires not all of them even working into a useful device.

The age of nanoscience has dawned but the age of nanotechnology – finding practical uses for nanostructures has not fully dawned yet.

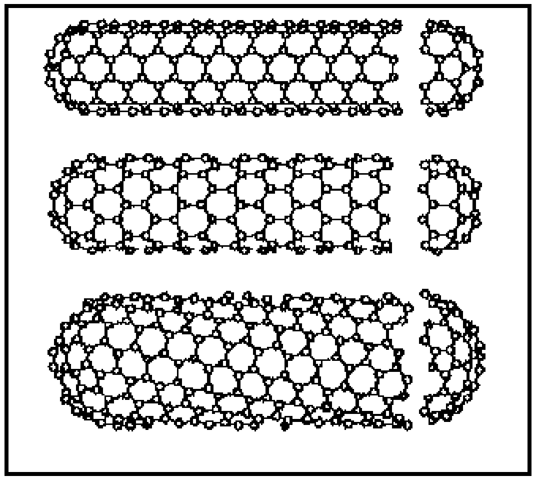
3.1.1 Nanomaterials

One of the basic breakthroughs was the buckyball and its derivatives.



Picture 2: Buckyball or Fullerene (after Richard Buckminister Fuller), diameter 1 nm

A Buckyball or fullerene is a carbon molecule composed of at least 60 atoms of carbon arranged in a ball-like structure. Nanotubes are long drawn fullerenes. The carbon nanotube is the best-known example of inorganic wires, functioning both as interconnections and as components.



Picture 3 Different structures of nanotubes, Veld, TU Eindhoven.

Carbon nanotubes have been around since 1991, when S. Iijima discovered them. Scientists were excited about their unique qualities. Their astonishing physical properties as 100 times the strength of steel but only of 1/60 weight, as well as electrical properties, their as potential use as RAM's with 1 trillion bit / cm^2, which could be read 100 times faster than silicon and conduct electricity well made them attractive for intensive R & D.

There are critical voices asking if nanotubes are over-hyped since hundreds of millions of dollars have been awarded to research and developments at more than 1000 universities. Many see in this development not a development of its own merits but as a process that might contribute to prolong the silicon age by another decennium. Probably we are going to see a hybridisation between silicon and nanotube technologies. A major problem with nanotubes is to make them uniformly, reliable and in quantity, since slight differences can make a conductor to a semiconductor.

To overcome the unreliability of individual nanodevices the current work on defect tolerance architecture and self-assembly is critical to future nanoelectronics.

Building an arsenal of molecular and nanoscale devices is a first step, but interconnecting these devices seems to be the even greater challenge.

Nanofabricated devices also reach beyond the scope of computing devices as e.g. quantum dots/wires show. Crystals called quantum dots contain only a few hundred atoms and emit different wavelength of light depending on their size and will be of use in various applications e.g. as ultra fine biological markers. [7, 28]

4 Molecular computing

Scientists of Bell Labs suggested the use of molecules for electronics more than a quarter century ago. Molecules are only few nanometers in size, and it appears feasible to make elements containing billions or even trillions of switches and components. This would enable small devices with supercomputer capabilities on your wrist or within your shirt. Molecular memories could have a million times the storage density of today's most advanced chips, leaving Moore´s Law a distant memory. If molecular computing on its own becomes feasible, it would mark a leap beyond silicon. Engineers could pack more circuitry onto a microchip than silicon ever dreamed of, and do it much more cheaply. A new and exciting science has emerged in the intersection of Computer Science, Physics, Chemistry, Biology, Material Science and Engineering.

4.1 Molecular Devices

The first widely used molecular electronic devices will probably not compete with silicon devices; they are more likely to be sensors rather than logic devices. Also memory devices based on organic materials are under development all round the world. But molecular devices must not only compete with a rapidly advancing silicon technology but as well with host of bi-stable materials systems also under development. They are only likely to be successful if their manufacturing costs are significantly lower. The solution might be the possibilities to prepare many copies of the same molecule in parallel or self-assembly concepts in which the shape of molecules dictates that they will form themselves in regular assemblages may be the solution. [33]

Molecular electronics also encompasses other potential devices as colloid storage or transparent magnet storage devices (where transparency would allow 3D structures) or devices using the molecular cascades like the "linked chevron cascade". [8]

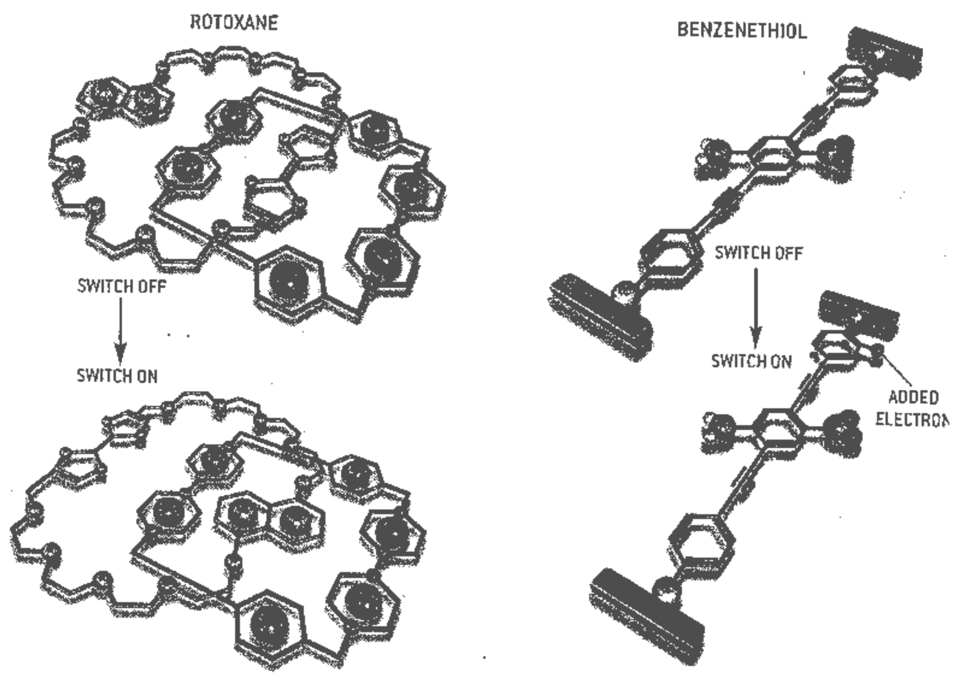
But there are many problems still to be resolved as interconnection between devices, long time memories or defect correction, but the highly attractive price/performance of such devices will continue to instigate further research.

High carrier mobility organic thin-film transistors are comparable in performance to amorphous silicon. Potential applications are in large area electronics (e.g. electronic paper, print circuitry, displays, bulletin boards and smart cards etc.). They can be fabricated on flexible substrates at low cost, as 100 millions transistors in postage stamp size, or as large flexible plastic displays driven by plastic transistors or applications like a wall or car that change colour upon request. Organic electronics may also lead to circuits stamped on rolls suitable for small data volume and short time memory applications (supermarket, product labelling or maintenance tags) produced with ink jet technologies. Before its commercial use problems like adequate drive technology or its slowness of have to be solved.

These outlooks would include equally futuristic manufacturing outlooks like inkjet printer or “stamping” technologies replacing the clean room fabrication or a “fab-in-a-box” or chemical factory on a chip. [13]

4.2 Organic Materials

A wide variety of materials ranging from Rotoxane and Benzenetiol nitroamina (shown below) to Bacteriorhodopsin, Nitroaminobezothiol, OLEPs (Organic Light Emitting Polymers) and other bistable molecules is under investigation. Picture 4 below shows as an example the realignment within the molecule serving as reversible switch changing with the internal structure also physical properties



Picture 4: Molecular switches [15]

The two molecules shown above alter their atomic configuration and conduct electricity if the switch is on, and thus be potential building blocks for molecular transistors.

While pure “Molectronics” is still a long way off the hybridisation between silicon and nanotube technologies is a more near term possibility.

4.3 DNA Computing

A special alternative idea to silicon-based computing is DNA-based computing. Over the past fifty years discoveries have shown the extraordinary capabilities of living cells to store and process information more efficient by many orders of magnitude than electronic digital computation.

An example of this is recombinant DNA technology. In rDNA technology, processes inherent to living cells are used to analyse or modify biological molecules, and to select those with desirable properties. In 1994 Len Adleman, performed an experiment in which a collection of DNA molecules was constructed to represent possible solutions to a combinational problem (a simple instance of the Travelling Salesman Problem) and rDNA techniques were used to sift through the molecules to select the correct solution. Besides the novelty value molecular computing has the potential to outperform electronic computers. DNA computers may use a billion times less energy than electronic computers, and storing data in a trillion times less space. Moreover, computing with DNA is highly parallel: in principle there could be billions upon trillions of DNA or RNA molecules undergoing chemical reactions, that is, performing computations, simultaneously. [4]

It is not surprising that DNA being tiny, cheap and fast, dense packaging and the potential of up to 10^{20} simultaneous operations does attract research worldwide. [15]

4.4 Molecular and Nanomanufacturing

Molecular manufacturing or nanofabrication research features two principal approaches:

- Top down: carving out of material or add aggregates of molecules to a surface
- Bottom up: methods which assemble atoms or molecules into nanostructures.

Molecular computing is in its early infancy but research has demonstrated basic capabilities, but still many questions are open as:

- suitable molecular building blocks must be found, which are stable physically durable, easily manipulated and to a certain extend functionally versatile,
- assembling of complex structures based on a particular design; economically using one of the approaches as AFM, lasers, chemical assembly techniques and
- systems design and engineering ,

have to be resolved. Some of them hold the potential of major shifts in manufacturing technology since they are suited to enable the integration of mechanical, chemical and electrical components on the same chip; leading chemical manufacturing in the future not to order a chemical but a chemical factory on a chip.

5 Quantum Coherent Systems (Quantum Computing)

Scaling further down leads to the dimensions where quantum effects and phenomena of quantum physics as entanglement and quantum coherence will become more and more dominant. Let us look at some phenomena of the quantum world and their as potential relevance for computing and communication.

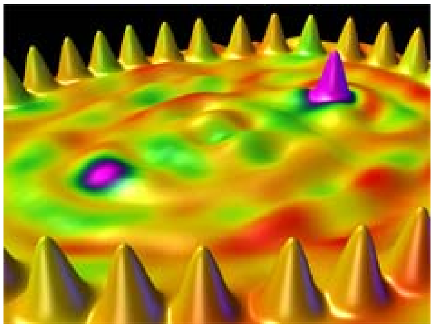
The first is the notion of quantum "state" as exhibited by the spins of atomic particles. Atomic particles have state also spinning clockwise or counter clockwise - but until that spin is observed, the direction is a probability of one direction versus the other. Thus a particle can be in two states at once; these particles are called qubits (quantum bits). Two qubits can be in four states and 20 particles in a million states. The quantum algorithms as the Shor algorithm have demonstrated that such devices can solve arithmetic problems as factoring numbers and search problems much faster than conventional computers by exploiting these properties of devices being in many states at once. In the steps that a silicon computer uses to seek a single solution for a complex problem, a quantum computer can potentially theoretically explore all the solutions at once - if research will find methods to harness the power of these quantum devices.

The second phenomenon is entangled states. Two particles can have linked spins even though they are at a distance. Manipulating one particle and then reading the spin of the other linked particle is the basis of quantum information teleportation. This has been demonstrated in laboratory conditions and could to be a way to securely distribute cryptographic keys over distances.

The research challenges and rewards of quantum computing are enormous and to date only experiments with few qubits have been realized. The quantum computer would have the simultaneous read, write, and calculate capability, but new types of algorithms are needed that utilize being in multiple states simultaneously, and new devices invented that have coherent spin states immune to environmental hazards. These massive parallel computers would be qualitatively different to the traditional computer and will require new architectures and software for realizing its potential in applications as cryptography, searching large data bases, pattern matching and simulation of molecular and quantum phenomena. So the advantage of speed of quantum computing is counterbalanced by the above mentioned unresolved problems and the questions of error correction, decoherence and signal input/output. [2]

Only future will show if quantum computing will be able to be practical and assume a major role in information technology beyond its scientific and intellectual attractiveness.

An impressive phenomenon and the application of quantum physics as a potential communication method is called quantum mirage. We are at a scale where the behaviour of electrons changes from particles as described in classical physics to wavelike behaviour as describes by quantum physics.



Picture 5: Quantum mirage, IBM Almaden Center D. Eigler, C.P.Lutz and associates

An example of this is IBM's new quantum mirage technique, which may prove to be a fascinating substitute for the wires connecting nanocircuit components as shown in picture 5 where 36 Co atoms on Cu surface forming an oval quantum corral are reflecting the copper surface electrons within the ring. When one single Co atom was placed at one focus a mirage including some of its properties appeared at the other focus where no atom exists. Will this be this information transport with no power dissipation in the transport channel? [8]

6 SUMMARY

Let a thousand flowers blossom
Mao Tse Tung

The richness of the nanoworld will enrich the macroworld. Presently we enjoy an oversupply of ideas. This richness comes in addition to the ongoing aggressive pursuit of downscaling leading the semiconductor industry from the micro into the nano-domain to Nano-CMOS supplementing the present technology.

We can look forward to a million-fold increase in the power of microelectronics at attractive costs, the integration of different technologies on a chip, and the expansion of the dynamics of the silicon-driven progress to other fields. This will enrich the scientific toolbox resulting in advances that combine the best of each world.

The microelectronic mould is now broken, but cost not only performance will to be the decisive criterion for future success.

The impact of this evolution is reaching beyond merely generating products and services, it changes how people live and interact. Increased miniaturization and sensorisation of items as clothing, appliances, housing or cars will likely change the way these devices interact with our lifestyle.

As technology becomes more interdisciplinary, education and training must adapt to enable participation in this development.

These effects might not proceed without issue. The pace of change is making it difficult for legal and ethical advances to keep up with technology. [3, 4, 6,34].

The race is already on to discover silicon's successor, since to the winner will not only come glory but also fantastic profits.

7 References:

[1] Ph .S. ANTON et alii, The global technological revolution, RAND, 2001

[2] R. BAJCSY, Quantum and molecular Computing, Comm. on Science U.S. House of Representatives, 2000.

[3] J.BEBSHOP, Trends in Microlithography, ASML,AH Veldhoven Nl, Wiley 2002

[4] C.BORCHARD and M.GROß, Was Bioelektronik kann, Wiley-VCH, 2002.

[5] C.M.L. DNA Computing, SciAm 9, 2001

[6] A. DELCHER, L.HOOD and R. KARP, Report on the DNA/Molecular Computing , Comm. on Science U.S. House of Representatives,,2001.

[7] D.J.EAGELSHAM, Issues in Scale for Semiconductors 2003

[8] D. EIGLER, IBM Almaden and San Jose Research Center, 2000 and 2004

[9] P.GELSINGER, Intel Corp., 2002

[10] GORONKIN, Motorola Labs, NSF Nanosymposium, 2002

[11] R. D. ISAAC, The future of CMOS technology, IBM J. Res. Develop. 44, No. 3, 2000

[12] IBM Research, Nanotechnology, 2004.

[13] J. JAFFE, Bell Labs perspective on global sc. investment, 2003

[14] R. W. KEYES, IBM J. Res. Develop. Vol. 44, 1 – 3, 2000.

[15] L.LANDWEBER, Beyond Silicon Computing, Comm. on Science U.S. H.of Rep.2000.

[16] E.J. LERNER, IBM Research Magazine, No 4, 1999

[15] Ch .M. LIEBER, The incredible shrinking circuit, SciAm 9, 2001

[16] Chr. W. LOESCH, Trend in Information Technology, Proc. of the IDIMT 2001.

[17] Chr. W. LOESCH, Trends in Technology, Proceedings of the IDIMT 2003.

[18] MANDELMANN, Challenges and future directions for the scaling of random access memory devices, IBM J. Res. Develop. 46, No 2/3, 2002.

[19] MEYYAPPAN, NASA Ames Research Center, 2000

[20] MIT Media Lab, IBM Systems Journal 38, no 2,3

[21] G. MOORE, Moore´s vision, Intel Corp., 2003

[22] R.NAIR, Effect of increasing chip density on the evolution of computer architectures, IBM J. Res. Develop. 46, No 2/3, 2002

[23] A. A. NETRAVALI, Bell Labs Technical Journal, 1 – 3, 2000.

[24] C.M.OSBURN et al., IBM J. Res. Develop. 46, No 2/3, 2002

[25] R. POOL, IBM Think Research Mag. 3, 1999.

[26] L. RABBINER, A glimpse into the future, ATT Labs Research, 2000.

[27] GEORGE A. SAI-HALASZ, RAMAN G. VISWANATHAN, HSING-JEN C. WANN, SHALOM, J. WIND AND HON-SUM WONG, CMOS scaling into the nanometer regime, Proc. IEEE 85, No. 4, 1997.

[28] M. ROUKES, Plenty of room indeed, SciAm, 9, 2001.

[29] R.R. SCHMIDT et al., High-end server low-temperature cooling, IBM J. R&D 46, No 6, 2002.

[30] NASA improves computers with carbon nanotubes, Space daily, 2004.

[31] G. TAUBES, IBM Think Research, No 1, 2000.

[32] Y. TAUR, Y.-J. MII, D. J. FRANK, S.A. RISHTON, GEORGE A. SAI-HALASZ, E.J.NOWAK, SHALOM J. WIND AND HON- SUM WONG, CMOS scaling into the 21st century, IBM J. Res. Dev. 39, No. 1/2, 1995.

[33] Th. THEIS, IBM Research T .J. Watson Res. Center 3 / 2003

[34] L.E. THURROW, Die Zukunft des Kapitalismus, Düsseldorf 2002

[35] P. VETTIGER, M. DESPONT, U. DRECHSLER, U. DÜRING, W. HABERLE, M. I. LUTWYCHE, H. E. ROTHUIZEN, R. STUTZ, R. WIDMER AND G. K. BINNIG, The “Millipede” More than a thousand tips for a future AFM data storage, IBM J. R and D. 44, No 3, 2000.

[36] H. - S. WONG, Beyond the conventional transistor, IBM J. Res. Dev. 46, No 2/3, 2002

E-Society

Perspectives and Risks for European Integration

E-SOCIETY - PERSPECTIVES AND RISKS FOR EUROPEAN INTEGRATION

G.I. Caesar: It is better to be the first in the last village then the second in Rome.

Petr Doucek[1]

E-society in common Europe. What are major expected opportunities and risks of IS/ICT improvement and use in new extended European community? E-government belongs to the most perspective areas for IS/ICT improvement. Digital signature and the process of its application into the European legal frame is the base for successful e-government. Some selected aspects of e-society, especially in relation to electronic signature and its practical utilization are discussed in this contribution. At the same time several legal and social aspects of certification authorities, their establishment and operation in conditions of the Czech Republic are presented.

1 Introduction into Actual Situation

European Integration Process – the great period of the European **economic** integration has started several years ago, permanently accompanied by proclaimed legal, monetary, cultural etc. partial integrations. This vibrant period is around us and offers to all European citizens' opportunities as well as risks and "threats".

What is the first visible major goal of the whole European integration? – **To establish common unique economic area in the Europe, that could be presented as basic element on the battlefield of the world economics.**

Opportunities

- to remove barriers for the free movement of persons, education, labor, knowledge, capital and goods,
- to improve international standards – for communication, law, finance, education, knowledge, etc.
- to unite European currency,

[1] Prague University of Economics, Department of System Analysis W. Churchill Sq. 4, 130 67 Prague 3, Czech Republic, E-mail:DOUCEK@VSE.CZ

- to play important roles of IS/ICT as heralds of international standards improvement, transfer, awareness etc.
- to permit rapid and flexible creation of international teams,
- to make possible common co-operation and development of the European society,
- hopefully to realize the decreasing rate of xenophobia and rate of increasing tolerance,

Risks

- to lose national and cultural identity – especially for small nations,
- to increase influence of large communities and nations,
- to establish the unique European culture – in the "American culture" style,
- to standard knowledge – it could imply standardization of any innovation process – in contradiction to creativity and variability of thinking, data (information) interpretation and genesis of fundamentally new ideas.

An anonymous power of the past use of IS/ICT is being permanently slowly complemented by anonymous control of the present and anonymous decision-making processes what is good and what is wrong for the future. So we are step by step realizing an Orwell's vision of our society. Remember – "Big Brother is watching You."

Questions related to IS/ICT improvement in the European Society

What is the IS/ICT role in this development?

- **Carrier of development** – ***e-government*** – standardization of state and public administration processes**,** ***e-commerce*** – competitive advantage, chance for small and medium enterprises.
- **Carrier of standards**, unification of contemporary standards - decreasing the variety.
- **Carrier of data** and its presentation – not important what kind of data (good or faulty, unhealthy).
- Important (the most important) **mediator** of society changes – changes in persons value chain, in individual (personal) goals.
- **Opportunity** for monitoring of the "conventional"(IS/ICT based) society.
- **"Discrimination" element** – if a person is not IS/ICT oriented (not IS/ICT literacy accepted) – lower possibility of self-realization (lower competitiveness, lower salaries, lower self-realization in the community).
- Faster orientation in different regions of Europe (of the whole world).

How are requirements for the future society fulfilled? – To be save and stabile.

- Possibility for manipulation – data, knowledge, tenets, behavior, freedom and its presentation.
- What is IS/ICT security? Standards issuing and control? Standards publication? Practically everybody is able to get modern IS/ICT security (not only security) standards. In the frustration and fear people tend to resign on part of their civil rights in behalf of somebody powerful (government) who promises to protect them. But wants to protect them really? Is not enough for them to get this anonymous power?
- Who does form market of IS/ICT security? Hackers, terrorists or research institutions, secret services, armies, polices, governments etc.?
- What are fictive and real dangers in and for the society of the future?

It is, of course, very difficult to select some areas from the all huge of problems and challenges that are related to information society aspects in the new common Europe, but let us try to discuss only two following selected:

- electronic (digital) signature,
- certification authorities (CA, resp. CAs), their establishment and purpose.

These two topics are related to my actual focus of work, other above presented questions, remarks, ideas and risks represent a global frame of the e-society of the future common Europe and participants are asked to present their opinions to them in the frame of the session.

2 Electronic Signature

Signing documents by electronic signature is one of the most modern ways how to authorize documents (possibly files). It – electronic authorization - is an advantage of digital world and the first very significant step towards information society and age. For better understanding in the contribution, let us unite terms at first. Are there any differences between digital and electronic signature? My opinion is, that **electronic signature is a sequence of digits** (generated according to some rules provided by computer or other machine), in the contradiction to **digital signature** that could be also **scanned copy of real** (by pen or pencil written) **signature**. The interpretation presented before eliminates our focus on electronic signature.

Electronic signature is the fundamental pillar of e-society – e-government as well as e- commerce. Without having rules for electronic signature, algorithm generation, allocation, its management and certification is no possible to use electronic signature with following essential properties:

- accountability,
- trustworthiness and
- non-repudiation.

The first group of problems associated to digital signature is **legal frame and environment**.

On the common level of electronic signature is the main question – "How to "emancipate" classic – non-digital" signature to electronic one?" The norm according to valid local laws in the Czech Republic is that if are any discrepancies in two documents – one in "paper" form and the second one in digital form – both signed, but legally binding is the document in paper form.

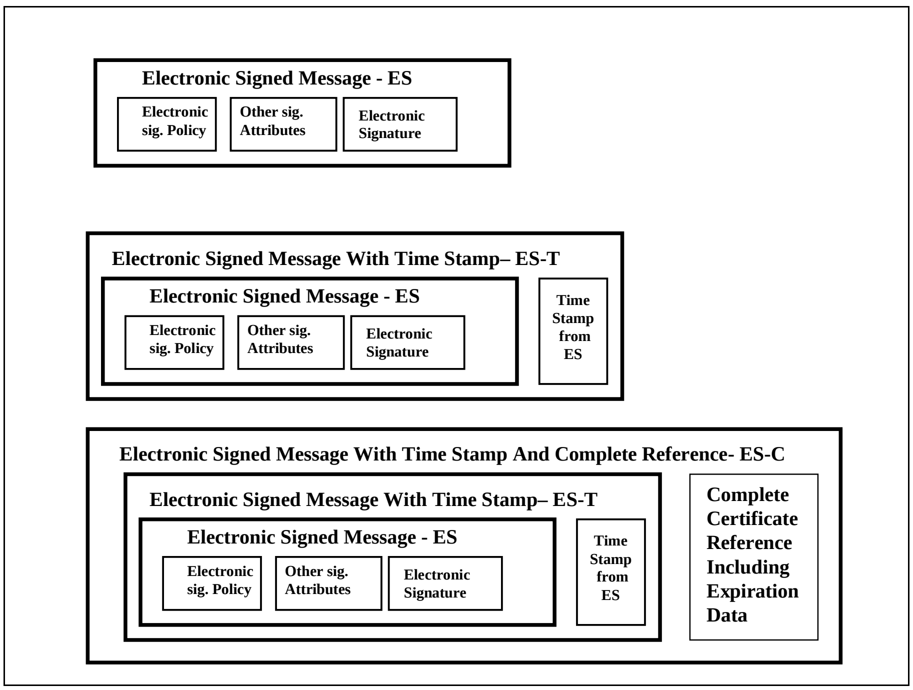
The Czech Republic started to build up the legal frame for e-society about ten years ago. There were prepared and proclaimed several acts in co-ordination with valid rules

It was proclaimed the Electronic Signature Act in the Czech Republic - Act no. 227/2000 Coll., on electronic signature. The Czech Republic became the second state in the world that proclaimed this act. Electronic signature was declared to be one possibility how documents could be signed. But how does the reality look like? What more is necessary to realize, more then to issue an act, more then to realize some political decision, for pushing electronic signature into the practice? Basic activity is to prepare demand on electronic signature. It does mean to build up an infrastructure of e-applications, where a large percentage of population could use the electronic signature advantages. The other side of the same coin is to establish a network of enough trustworthy certification authorities for issuing and distributing electronic signatures to population.

Further legal potential problem is the **expiration of the signature**. There is no problem to authorize and to check validation of concrete electronic signature, if it is not expired – in short time period. E-signature, issued by the entitled certification authority (CA), could be verified by using normal mechanisms. But how is or more exactly said could be interpreted the situation, when the signature is no more valid – its expiration date has been terminated. Is also valid the signed document using this signature and how does it look with its accountability - of course from the legal point of view. It is not possible to cast doubt on this document and its signature? After expiration of the signature, for example for long time archiving documents, could it be falsified? How must be a normal e-signature modified or extended in order to be secured?

From this – long time period archiving point of view - is not enough to use simple electronic signature as is shown at Pic. 1. The first row on the picture shows normal classical electronic signature - without any time identification (ES) when the document was signed. This scheme is frequently used for the majority of generally applied electronic signatures. The second row shows added time stamp derived from electronic signature – special way of time resolution. It is visible when the document was signed (ES-T). The more complex type of time stamped electronic signature use relation to its certificates and their validity – ES-C.

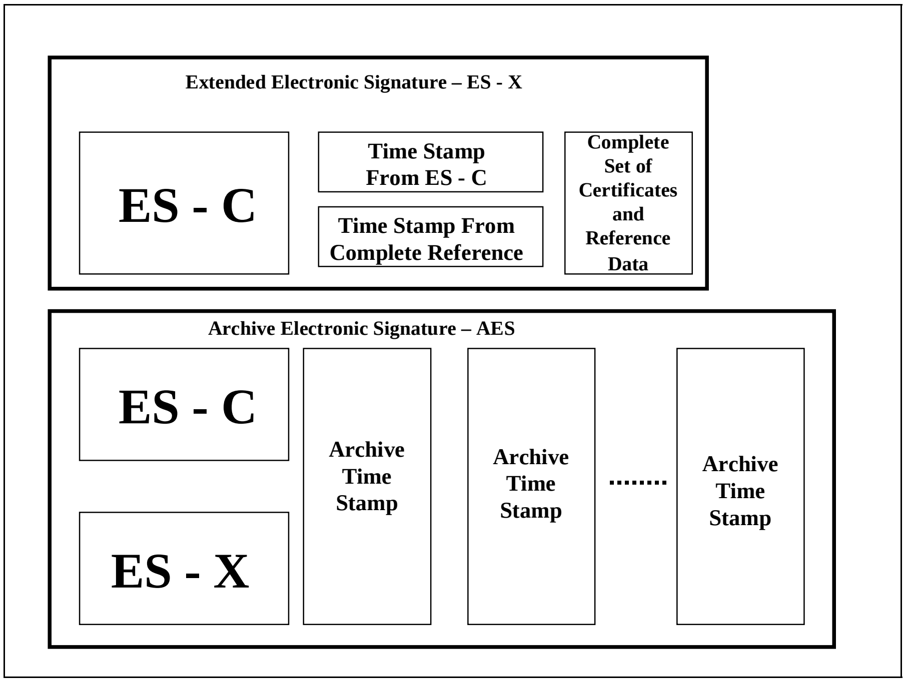
Only the last form of electronic signature (ES-C) can be used as semi-finished product for archiving process, because it bears with it all necessary attributes for basic long period archiving process.



Pic. 1 Electronic Signature – Short Time Formats[RFC]

The next step is the establishment ES- X format of electronic signature – see Pic. 2. To ES-C format there are added time stamps from itself (ES-C), from complete reference list and contemporary to this form of signature is added a complete set of certificates and reference data. This form could be also held as relevant source for archiving process. Final process of archiving electronic signed documents is shown at Pic. 2.

To ES-C and ES-X format of electronic signature are added archive time stamps and they set trustworthiness of electronic signed documents in archives for a longer period, without response to expiration date of some signature.



Pic. 2 Electronic Signature – Archive Formats [RFC]

3 Certification Authority

Certification authority and its establishment and functioning are typical examples of co-operation between state and private sector by forming the e-society. Scope of each certification authority depends on where by this authority issued certificate (e-signature in this case) will be used. The word "where" signifies the group of users where the e-signature is used and contemporary a level of legal obligation. E-certificate can be used for signing documents (files) in relative small community. Then the certification authority for issuing this certificate could be a credible person from this community without having other attests or certificates. A little different problem concerning certification is when e-signature serves for signing official documents (orders, invoices etc.) in relative limited (exactly said close) group of users – for example in two or more firms. The e-signed files have legal bindingness and the CA respected by all participated subjects must issue these e-certificates. Absolute another situation is when e-certificate is determined for free use in the whole community or society. Then the process of certification could be compared with the process of issuing paper documents (passports, driving licenses etc.). Other subjects - states and governments - must respect this certification authority and it represents official authority of the state where the e-certificate was issued. This CA issues certification in the name of the state practically.

It does mean, that state and government have important role in this certification process. Main duties on the states side are to:

- build up a legal frame for certification authorities,
- define rules for establishment of CAs, functioning, rights, duties and responsibilities,
- define rule for commercial CAs licensing process,
- create a market of e-applications – especially in state and public administration sector in C2A, A2A and B2A areas of e-society,
- develop a technological infrastructure for e-documents interchange,
- create a system of clerks education in the area of IS/ICT,
- innovate a system of life-long education for citizens in the state – focused on using IS/ICT in public and state administration.

CAs – their establishment - is the main problem for the Czech Republic in the e-society integration, because there is only one legal certification authority with general validity of its certificates. Its name is the 1.Certification authority and it issued according to official sources approximately 250 000 e-certificates (e-signatures) in last five years [MICR_04]. But funny is that the E-signature Act was proclaimed several years ago and the working edict to it more then one year later. Are all issued e-signatures trustworthy? What do You mean?

4 Conclusions

As is mentioned above, an electronic signature is an electronic "credit card" that establishes your credentials when doing business or other transactions on the Web. It is issued by a certification authority. It contains in minimum your name, a serial number, expiration dates, a copy of the certificate holder's public key used for encrypting messages and electronic signatures, and the electronic signature of the certificate-issuing authority so that a recipient can verify that the certificate is real. Some digital certificates conform to a standard, X.509. Digital certificates can be kept in registries so that authenticated users can look up other users' public keys. But all properties and attributes of concrete electronic signature are limited by range of use. There are different requirements to different levels of electronic signature use. One dimension of using e-signature is the political. The requested role of the state is to build up conditions and common legal frame for the use of e-signature. Other levels are more concrete and more depending on technological base for e-signature using.

Creation of credible certifications authorities network is an imperative for starting e-society exploitation in each legal area. CAs are usually private subjects in the Czech Republic, but the main CA that release certification of them is the Ministry for Informatics – state administration body. In this way the private CAs has got the formal authority of the state by issuing e-signatures certificates for legal binding operations.

5 References

[BSI_99] British Standards Institution: The British Standard on Information Security Management, BS 7799:1999, 1999

[CZL_00] Electronic Signature Act /2000 Sb.,

[ISO_1] ISO/IEC 17799:2000 - Information technology – Security techniques – Code of practice for information security management

[ISO_2a] ISO/IEC TR 13335-1 Information technology – Security techniques – Management of information and communications technology security –
Part 1: Concepts and models for information and communications technology security management

[ISO_2b] ISO/IEC TR 13335-3 Information technology - Security techniques –Guidelines for the management of information and communications technology security – Part 3: Techniques for information and communications technology security risk management

[ISO_3] ISO/IEC TR 19791 - Information technology -Security techniques - Security assessment for operational systems

[ISO_4] ISO/IEC 18044 - Information technology - Security techniques - Information security incident management

[ISO_5] ISO/IEC 15408-1-3 Information technology,Security techniques, Evaluation criteria for IT security,

[DEL_03] Delina, R., Grohol, M.: Performance Measurement of B2B Procurement with Focus on Dynamic Transaction Mechanisms

[DOU_03a] Doucek, P.: IS/ICT Security in Czech Firms, In: Strategic Management and its Support by Information Systems, VŠB Ostrava, 2003, ISBN 80-248-0405-0

[DOU_03b] Doucek, P.: IS/ICT Security Improvement Concept and its Auditing, In.: Informatika 2003, pp. 141 – 146, Bratislava, ISBN 80-233-0491-7 (In Czech)

[DOB_98] Dobda, L.: Data Security in Information Systems, Grada Publishing, Praha 1998 (In Czech)

[HAL_01] Halouzka, J., Racková, E., Seige, V.: Information Security – Manager Guidline, Tate International, Praha, 2001 (In Czech)

[NOV_99] Novotný, O., Řepa, V.: Metodická příručka ke „Standardu pro náležitosti životního cyklu informačního systému". In: Standardy státního informačního systému České republiky, I. díl. Praha : Úřad pro státní informační systém, 1999, s. 7–1 až 7-164. ISSN 1210-9975.

[PSIB_03] DSM, NBÚ, PWC: Stand of IS/ICT Security in the Czech Republic, 2003 (in Czech)

[RFC] Standard RFC- 3126 – Electronic Signatures Formats for Long Term Electronic Signatures (Issued by ETSI as ETSI TS 101 733)

Internal IS/ICT project materials

[MICR_04] www.micr.cz, Web pages of Ministry for Informatics of the Czech Republic – 25.2. 2004

E-SOCIETY: CHALLENGES FOR INTERCULTURAL MANAGEMENT OF FIRMS COLLABORATING IN EUROPEAN UNION

Jan Ehleman[1], Leo Vodáček[2]

By joining the European Union (EU) in May, 2004 the Czech Republic has been under urgent political, social and economic pressure to adapt its economy to the functioning of its key EU partners. One of these challenges is to develop effective and efficient forms for the collaboration of Czech firms in conditions of gradually developing E-Society of EU. In accordance with the economic policy of EU of particular importance are different forms of partnerships, supported by the extensive use of digital communication. As a systemic basis for the explanation of factors affecting results of partnerships the paper proposes particular model of "critical success factors" for Czech firms. In its context it analyzes and evaluates the impact of "soft" intercultural factors being typical for partners of different nationality and having relevant impact on the final performance of their partnerships. The paper is based on the evaluation of key theoretical ideas from the professional literature, EU materials and results of empirical research.

1 Introduction

At the present time Czech firms face – apart others - two complementary challenges for their further development. The first challenge is conditioned by the need to adapt to new political, social and economic conditions evolved by joining of the Czech Republic into the enlarged EU (since May, 2004). The second complementary challenge stems from the rapid development of digital communication in the world and its growing use for the purposes of cooperation between organizations in the global economy, incl. EU.

Czech firms, together with their partners from other 9 new member states of EU, are now faced with substantial changes in forms and methods of cooperation with their – sometimes very

[1] Technical University of Liberec
[2] University of Economics, Prague, email: vodacek@vse.cz

experienced – partners in other states of EU and emerging global economy of the world. These new challenges require substantial innovations in sets of managerial methods, techniques and technologies being traditionally used for the solution of cooperative tasks. Digital communication applied to solve cooperation tasks is one of perspective ways how to meet requirements of collaboration in new conditions of information society.

The need for more intensive and digitally supported cooperation processes of Czech firms with its foreign partners is now considered as one of key conditions for their future survival and prosperity. The current development toward the networked economy in the EU as well as in the global world of advanced market economies are stressing the importance of this processes [43,46,47].

2 Forms of cooperation between Czech firms and their partners

In order to provide our investigation systemic basis the praxeological approach to the formulation of partnerships was applied. The assumption has been that *processes of partnerships can be classified and analyzed as mutual cooperation between organizations* [17,39]. Such cooperation may be characterized as:

- *Positive cooperation*, enabling transfer of resources and activities between collaborating partners and having positive impact on their competitive positions,
- *Neutral cooperation*, representing situations when integration ties (links) of collaboration do not exist or are not activated,
- *Negative cooperation*, which can be interpreted in different forms and degrees of competition or conflicts between partners.

All cooperation processes take place, can be analyzed and controlled in a managerial space and time where digital communication can be applied. The intensity as well as character of cooperation processes can change in dynamics of their development. For example positive cooperation can switch to neutral or negative cooperation and vice versa. Such reality emphasizes the importance of dynamic approaches to investigation of cooperation processes in managerial practice [29,39].

From the practical economic point of view *different forms of partnerships can be expressed as models of positive cooperation and classified according to their integration intensity*. For example the following managerial classification begins with "week" integration forms and ends with "strong" forms:

- Occasional forms of communication and business collaboration,
- Informal collaboration with information sharing,
- Preferred suppliers and buyers,
- Production / assembly / buy back agreements,
- Management / marketing / service agreements,
- Joint ventures,
- Training, "start up assistance",
- Franchising,
- Licensing,
- Outsourcing,
- Merging,
- Acquisitions, takeovers.

The just mentioned managerial classification of positive cooperation forms is of high importance for concrete analysis of intercultural impacts on collaboration between Czech firms with their foreign partners. At the same time it provides a good economic basis for designing and using appropriate measures how to exploit advantages of positive cooperation and design remedies for reductions of negative intercultural impacts.

Because our paper does not intend to analyze intercultural impacts on different forms of negative cooperation (forms of competition and forms of fights) and of neutral cooperation – we do not introduce here concepts of possible managerial classifications of these non-positive forms.

Due to their higher organizational flexibility *some forms of positive cooperation between partners have proved as likely more appropriate to cope with intercultural challenges*. It is the case of different forms of strategic alliances encompassing informal collaboration with information sharing, preferred suppliers and buyers, production / assembly / buy back agreements, management / marketing / service agreements, joint ventures [1,4,13,14,38].

On the other hand there it is generally known *high vulnerability of "tight" forms of partnerships* (different forms of merging and acquisitions) to intercultural disaccords [3,10,13,39].

3 Factors affecting success of positive cooperation between partners

According to our analysis of empirical data and discussions with top managers of Czech firms having partnerships with foreign organizations one can estimate a high positive "correlation" of causes affecting success of positive cooperation between partners and sets of "critical success factors" (CSFs). We have in mind CSFs of firms participating in partnerships.

For the purpose of illustrative explanation we do introduce in Figure 1 the concept of CSFs, which proved to be successful in first phases of our empirical research.

In evaluating positive cooperation between two or more firms there is a need to evaluate *how far individual CSFs of participating organizations as well as their holistic outcome affect processes of gradual implementation and functioning of the analyzed partnerships.* CSFs are of eminent importance already in the first stage of analysis and negotiation with possible partners – sometimes leading to the decision not to develop ties of collaboration [38,39].

In performing concrete analyses of effectiveness and efficiency of partnerships between Czech and foreign partners it has proved as successful *to specify in detail their individual CSFs and / or to modify their formulation* in such a way as to correspond to needs of mutual understanding and comparability required by partners.

Corresponding to our experience we can illustrate one of such modifications as the set of following factors:

- Shared vision, strategic goals and key operative objectives,
- Shared and mutually recognized leadership, decision making processes and control,
- Requirements on IS/ICT, incl. external digital communication,
- Organizational structures and processes (if any),
- Participation on providing necessary resources,
- Participation on rewards and shared risks,
- Requirements on accountability,
- Requirements on cultural compatibility,
- Knowledge and innovation potentials.

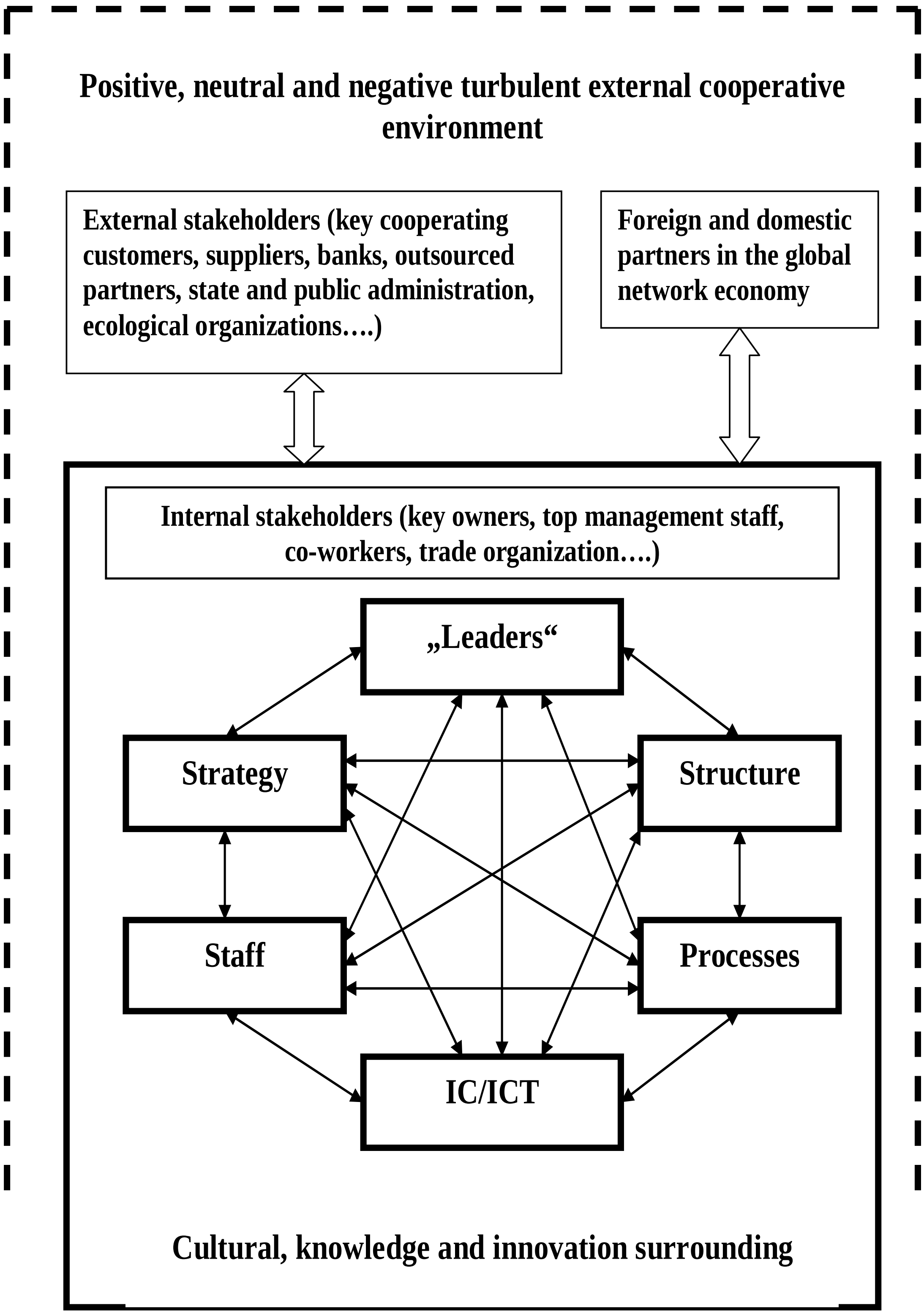


Figure 1: Critical Success Factors of an Organization and its Interfaces

4 Partnerships using digital communication and the role of culture

The contemporary rapidly increasing digital communication of collaborating partners has a substantial impact on the managerial climate of cooperation between partners, including their cultural accord and / or disaccord. It is evident that a *substantial part of cooperative ties is based on communication between partners.* It can be realized *in different forms and by different technical means of digital communication* [6,16,24]. But it does not deny the fact that the success of more or less anonymous digital communication requires consensus building between partners as human beings with their specific cultural background, professional and qualification characteristics, feelings, motivation, prejudices, etc.

According to repeated statements of the Commission of the European Communities competitive positions of organizations in the EU and in the global market will be more and more dependent upon their skills of using appropriate forms of positive cooperation (partnerships), particularly with effective support of IS/ICT [43,45,46,47]. At the same time business activities of cooperating organizations will be dependent upon *physical, as well as "virtual" elements* [6,8].

Physical elements may be represented by buildings, machines and facilities, people, materials, etc.. As "virtual" elements one can consider data, information and knowledge resources. Both types of these resources are mutually inseparable and are indispensable for all types of partnerships, incl. partnerships supported by digital communication.

The basis advantage of digital communication seems to be its speed of response and flexibility of the Internet world. It may have a variety of forms, like transfer of data, information and knowledge and their sharing, videoconferences, etc. There are all of importance for planning, organizing and implementing cooperative processes between partners integrated in different forms of partnerships.

Digital partnerships can function as simple *bilateral organizational forms*, but there is an obvious tendency to create *multilateral partnerships as networks of partners* [10,13,22,39,47]. It is mainly given by the fact that a single partner is rarely able to provide the total solution of the more complex tasks of effective and efficient cooperative effort.

Digital as well as traditional partnerships must co-exist and complement their functions, use their particular advantages and reduce their possible shortcomings and risks. *For both, digital as well as traditional partnerships, organizational culture of cooperating partners is of importance.*

One of the key problems of any partnerships, digital as well as traditional, seems to be to find out and respect *compromises between partners*. Such compromises are not only results of purely rational economic decisions but they are always to a certain degree affected by the influence of cultural background of partners [12,15,19,21,36]. It is the reason why cultural aspects of digital as well as traditional partnership should be considered when negotiating about the vision and major goals of mutual collaboration and about further organizational steps how the partnership should be created.

Consensus about vision and other strategic topics usually requires face-to-face meetings of relevant managers representing all partners and preceding starts of collaboration. It should be applied even in the case when the digital collaboration is considered. *Digital communication used in partnerships should not eliminate reasonable portion of direct contacts between top managers of organizations.* Face to face meetings cannot be sufficiently "replaced by Internet". We are again faced with a need to cope with issues of cultural differences between partners.

To make and to keep necessary compromises, to share goals and responsibilities in partnerships, to have necessary level of managerial caution as well as ethics and integrity in dealing with collaborating and sometimes at the same time competing partners – all these tasks have to be realized with reflections to cultural background of partners.

The fact that particularly distant foreign partners are sometimes little known and not visible to each other side make things more complicated than in the known domestic environment. All of this may be complicated by *problems in using foreign languages, necessary skills in computer communication and primarily by intercultural understanding and compatibility* [15,21,35].

5 Cultural compatibility in partnerships using digital communication

In a professional literature as well as in management practice one can meet rather different definitions and concepts of organizational culture [15,30,37]. In our further explanation we are using a widely accepted definition of organizational culture formulated by E. Schein:

"*The culture of a group can be defined as a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems"* [30, p. 12].

Schein's definition as well as practical experience [15,21,35,36] indicate, that the short time functioning of community of people – and therefore also some relative short time forms of partnership between organizations – are not able to develop their own organizational culture. They have not „enough time" to create common culture of participating organizations. At the same time several flexible forms of partnerships (free forms of strategic alliances) do not create autonomous organizational units at all. In such situations one has to calculate with *parallel existence, functioning and clashing of organizational cultures of firms during their partnership* [1,13,38,39].

In detailed practical analysis there is always a need to differentiate between individual forms of partnerships. As already said in more flexible forms of partnerships (most of strategic alliances) no new organizational forms appear – and it has little sense to speak about organizational culture of partnership at all. Beginning with organizational forms of joint ventures and ending with mergings and acquisitions new organizational forms usually appear, but even here statistics indicates the average short life span of these forms [39]. And in such conditions only very rarely there exists enough of shared history, values and jointly recognized leadership, which are necessary that culture formation can take place [2,15,30]. Then more typical seems to be the cooperation of organizational cultures of partnering organizations. As mentioned earlier each cooperation can be positive ("collaboration"), negative ("competition", "fight") and neutral ("indifferent").

The fact that part of the communication between partners is based on digital technology does modify but not eliminate the role of their organizational cultures. Even less personal digital communication requires managing mutual relationships between partners in context of their cultural differences. One can remind what was stressed by Fons Trompenaars: "*Culture is the way in which people solve problems"* [35, p. 6].

Classical as well as digital based partnerships offer powerful opportunities for value creation being not available if partners ignore possibilities of integration and try to go only alone. Some cultural dissimilarity of partners can be the source of some additional value, others can breed troubles, conflicts and distrust. *Successful leadership of partnerships means finding ways how to take advantages of some attractive positive differences and how to reduce negative impacts of others*. For the concrete analysis the modified CSFs mentioned above are of importance.

Possible *disaccords of organizational cultures of cooperating firms may appear in different stages of their cooperation.* Strife less initial agreements and even the good start of cooperation between firms does not exclude later generation of culturally evoked problems. And even *the art of compromising has been culturally conditioned.* Even doing it in a digital way - doing a deal between partners should be preceded by careful analysis of possible partners, including their cultural behavior towards other partners.

Partnerships supported by digital communication are not able to create their own independent organizational culture. It is conditioned already by design, short duration, high level of flexibility and separate organizational forms of participants in digital partnerships. Such cooperation is the typical *task of intercultural management*. Organizational cultures of partnering organization meet only indirectly and in the field of mutual collaboration. Usually one can speak of *partial "overlapping" and partial "distance" of cultures A and B* (see Figure 2). Possible analytical conclusions have probabilistic character and should be based on relevant sets of statistical data and expertise of professionals.

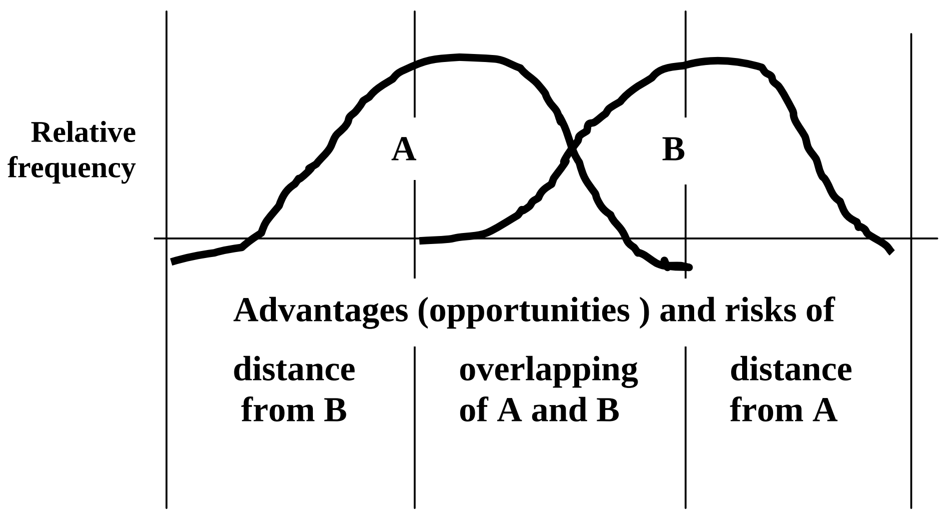


Figure 2: "Distance" and "overlapping" of organizational cultures A and B.

Cultural influences ("differences") relevant for positive cooperation of partners should be harmonized [15,21,35,36]. Harmonization has a role of reducing possible conflicts and vice versa utilizing possible positive effects of mutual cross-fertilization of cultures. In the absence of harmonization different effects of "cultural mismatch" may appear. Such "cultural mismatch" or "cultural misunderstanding" can play a role of "cultural landmine" [15,21,35]. Three factors are of primary relevance for the intensity of positive as well as negative effects stemming from cultural disaccords:

- Personalities of acting groups of people,
- "Distance" of organizational cultures,
- Specific situation of cooperation and its context.

Cultural influences (“differences”) have several faces and in specific conditions different positive or negative impact. It is useful to take into consideration possible impacts of:

- National and regional differences,
- Ethnic differences,
- Industrial differences,
- Organizational differences,
- Professional differences,
- Other specific differences.

The detailed description or analyzes of cultural differences is already going outside of our short characterization and one can here mention the very detailed explanations given by F. Trompenaars [35,36] and G. Hofstede [15]. Interesting and deep analysis of cultural differences between German and Czech collaborating firms was made by international team headed by I. Nový and S. Schroll-Machl [21]. They also discuss positive as well as negative sides of cultural distance and overlapping.

As Internet is and will in the future more and more transform classical forms of cooperation between partners – the danger of cultural disaccord of partnering organization will not disappear but “vice versa” it is going to increase. *Due to digitalization of communication new challenges for intercultural management will appear.* Most of them seem to be connected to possible “faceless” and “anonymous” communication of distant and little known partners.

In context with organizational cultures in the development process of “Internet age” and E-Society there are contemplations about the *gradual appearance of E-Culture* for certain regions, for the EU and even for the global world [16,23,39]. It will be dependent upon extend of digital communication penetrating into our lives and into functioning of organizations.

To cope with tasks of intercultural management in conditions of digitalization has been now appearing as competitive necessity, even for “bricks and mortar” companies [10,16,31]. There is no doubt that intercultural management is acute importance for several Czech firms many of which still underestimate the impact of the Czech Republic’s entry into EU [38,39].

The impact of cultural differences may be complicated by the fact that particularly *multilateral partnerships can rarely avoid existence of competitive relations between some partners in the network* [3,10,13,39]. Partners might even be at one time collaborators, at another time competitors and sometimes both at the same time. It requires good and frequent mutual *communication between* *partners, the skill to do compromises and different attitude to possible risks that are strongly affected by cultural backgrounds of partners.*

Requirements of the intercultural management applied to the cooperation of organizations in different member states of the EU and partners in the global world economy pose several new challenges for leaders of Czech firms. They have to cope with tasks of the right intercultural "match" and at the same time of possible "mismatch", caused by disharmony of socio-cultural components of nations and organizations. Of importance are different cultural values of foreign partners, different forms of communication, intercultural aspects of technology, use of local and common languages, reflection of different mindsets caused by religions, and other factors already mentioned in our paper.

6 Conclusion

There is no doubt that the *growing role of partnerships in the EU is accompanied by the growing role of their intercultural management.* New forms of digital communication and other symptoms of evolving E-Society do not decrease but vice versa increase the role of intercultural match based primarily on human, face to face communication and behavioral values of partners. It is particularly important for Czech firms (99,8 % of them are small and medium enterprises) while they face not only attractive possibilities of partnerships, but at the same time stiff competition from stronger and more experienced partners in the EU and the global world.

To acquire skills in developing digitally supported partnerships and at the same time to respect correspondingly requirements of intercultural match between partners are tasks of strategic importance. It is valid for cooperating activities of Czech firms as well as of Czech economy as a whole. Successful solution of these acute tasks seems to be one of the very important assumptions to enjoy social and economic advantages EU integration and endure new qualitative level of stiff competition on European as well as world global market.

7 Literature

[1] ASAP: The State of Alliance Management. The Special ASAP report of research into alliance capability. ASAP, New York 2003

[2] Ball D.A., McCuloch W.H.: International Business – The Challenges of Global Competition. Irwin – McGraw Hill, Boston 1996

[3] Bleeke J., Ernst D.: Collaboration to Compete – Using Strategic Alliances and Acquisitions in the Global Marketplace. John Wiley, New York 1993

[4] Child J., Faulkner D.: Strategies of Co-operation: Managing Alliances, Networks, and Joint Ventures. Oxford University Press, New York 1998

[5] Czech Agency for Foreign Investment: Inflow of Foreign Investment. Czechinvest, Praha 2001, 2002, 2003

[6] Czerniawska F., Potter G.: Business in a Virtual World – Exploiting Information for Competitive Advantage. Macmillan Business, Houndmills 1998

[7] Doucek P.: E-Society – Perspectives and Risks for European Integration. The position paper for IDIMT 2004. Proceedings of IDIMT 2004, Universitätsverlag Rudolf Trauner, Linz 2004

[8] Ehleman J., Vodáček L.: The Role of „E-Alliances“ for SMF. Proceedings of IDIMT 2003, Universitätsverlag Rudolf Trauner, Linz 2003, p. 287 - 295

[9] Gibson R.: Rethinking the Future – Rethinking business, principles, competition, control and complexity, leadership, markets and the world. Nicolas Brealey Publishing, London 1997

[10] Gomes-Casseres B.: The Alliance Revolution: The New Shape of Business Rivalry. Harvard University Press, Boston 1998

[11] Gougeon P., Gupta J. (ed.): Managing Joint Ventures – A Euro Asian Perspective. ESKA Publishing, Paris 1998

[12] Hamel G., Prahalad C.K.: Competing for the Future. Harvard Business School Press, Boston 1994

[13] Harbison J.R., Pekar P.: Smart Alliances: A Practical Guide to Repeatable Success. Jossey – Bass, San Francisco 1998

[14] Heck A.: Strategiche Allianzen – Erfolg durch professionelle Umsetzung. Springer Verlag, Berlin – Heidelberg 1999

[15] Hofstede G.: Interkulturelle Zusammenarbeit Kulturen – Organisationen – Management. Gabler, München 1993

[16] Kanter R.M.: Evolve! Succeeding in the Digital Culture of Tomorrow. Harvard Business School Press, Boston 2001

[17] Kotarbiňski T.: Praxeology. Academia. Praha 1972 (in Czech)

[18] Lavrin A., Zelko M..: ICT-Based Business Information Support Services for MSME Development - The position paper for IDIMT 2003. Proceedings of IDIMT 2003, Universitätsverlag Rudolf Trauner, Linz 2003

[19] Lynch R.P.: The Practical Guide to Joint Ventures and Corporate Alliances. John Wiley, New York 1989 (second edition 1993)

[20] Mills D.Q.: E-Leadership – Guiding Your Business to Success in the New Economy. Prentice Hall Press, New York 2000

[21] Nový I., Schroll-Machl S. and others: Intercultural Communication in Management and Business. Management Press, Praha 1999 (in Czech)

[22] Ohmae K.: The Global Logic of Strategic Alliances. Harvard Business Review, March – April 1989, p. 143 - 154

[23] Ohmae K.: The Invisible Continent – Four Strategy Imperatives of the New Economy. Harper Business, New York 1999

[24] Österle H., Fleisch E., Alt R.: Business Networking. Shaping Enterprise Relationships on the Internet. Springer Verlag, Berlin 2000

[25] Rigsbee E.: Partnershift: How to Profit from the Partnership Trend. John Wiley, New York 2000

[26] Rigsbee E.R.: Developing Strategic Alliances. Crisp Publications, New York 2000

[27] Rosenoer I., Armstrong D., Gates J.R.: The Clickable Corporation – Successful Strategies for Capturing the Internet Advantage. The Free Press, New York 1999

[28] Rosický A.: Emergence of Individual Knowledge – Challenges to Information & Knowledge Management. Proceedings of IDIMT 2001, Universitätsverlag Rudolf Trauner, Linz 2001, p. 91 - 102

[29] Savage C.M.: Fifth Generation Management – Co-creating Through Virtual Enterprising, Dynamic Teaming and Knowledge Networking. Butterworth – Heinemann, Boston 1996 (2. revised edition)

[30] Schein E.: Organizational Culture and Leadership – A Dynamic View. Jossey Bass, San Francisco 1992

[31] Scott Morton M.S. (ed.): Corporation of the 1990s – Information Technology and Organizational Transformation. Oxford University Press, New York 1991

[32] Segil L.D.: Fastalliances: Power Your E-Business. John Wiley, New York 2000

[33] Slywotzki A., Morrison D., Weber K.: How Digital is Your Business. Crown Business, New York 2000

[34] Thurow L.C.: Building Wealth – The New Rules for Individuals, Companies and Nations in a Knowledge-Based Economy. Harper Collins Publishers, New York 1999

[35] Trompenaars F.: Riding the Waves of Culture - Understanding Cultural Diversity in Business. Nikolas Brealey Publishing, London 1993

[36] Trompenaars F., Hampden-Turner Ch.: 21 Leaders for the 21st Century – How Innovative Leaders Manage in the Digital Age. Capstone, Oxford 2001

[37] Vodáček L., Vodáčková O.: Management – Theory and Practices in the Information Society. Management Press, Praha 2001 (in Czech)

[38] Vodáček L., Vodáčková O.: Strategic Alliances with Foreign Partners. Management Press, Praha 2002 (in Czech)

[39] Vodáček L., Vodáčková O.: Small and Medium Enterprises: Competition and Alliances. Management Press, Praha 2004 (in Czech)

[40] Yoshino M.Y., Srivanasa Rangan U. : Strategic Alliances : An Entrepreneurial Approach to Globalisation. Harvard Business School Press, Boston 1995.

MANAGEMENT SUPPORT BY ADAPTIVE FILTERS: A REMEDY FOR ENTERPRISES AND ORGANIZATIONS?

Karl-Erwin Grosspietsch[1], Tanya A. Silayeva[2]

For decision-making in enterprises or other organizations, the use of algorithmic solutions still plays a minor role. As a consequence, also stability criteria often were neglected over long time periods. In this paper we plead for a stronger use of adaptive control algorithms also in this sector of society, after they have successfully been applied in the field of real-time systems. One promising class of such algorithms is formed by adaptive filters. Their basic properties are shortly exhibited. Finally we discuss aspects of the potential application of adaptive filters for controlling the stability of enterprises or other organizations.

1 Introduction

In the Western world, one of the fundamentals of belief with regard to the basic principles of how to organize economy, is the belief in the market. It is argued that especially its distributed, uncontrolled regulation mechanisms are highly superior to the centrally planned economy approaches of Communism, and finally caused the win of capitalism. From this basic rule, many managers also conclude that there is no possibility of long term planning – at the level of companies, of national economy as well as planning of other issues of society. Current politics reflects this situation in so far that in practically all Western countries, the ruling governments provide no clear vision to the public what the goals are with regard to the long term development of society; government confine to a – often hasty – reaction to the needs of "the problems of the day". Some exception from this attitude is now the growing concern about the stability of state finances and social security systems. Here it is apparent that these systems are now far away from sustainable equilibrium points, the result of decades of a negligent handling of these systems.

Of course the market, with its flexible interaction of the offer of goods on the one hand, and the forming of prices on the other hand, is a highly adaptive system. Its only disadvantage is that this

[1] Fraunhofer Institute for Autonomous Intelligent Systems, D-53754 St. Augustin, Germany
[2] Moscow Aviation Institute, Volokolamsk Highway 4, 125871 Moscow, Russia

adaptive system is very chaotic, and produces and tolerates the occurrence of many smaller or even larger catastrophes: the bankruptcy of smaller or larger economic players. In case of the small ones, politics usually does not care about that too much, at least, as long as the number of these economic crashes is not increasing too strongly.

Most managers believe that this system is just the best system that is possible, and melioration is not realizable mainly due to the following aspects:

- the global market is a very complex system, thus causing an immense degree of different influences interacting with each other;
- many influences are not based on rational analysis, but on psychological moods;
- even if some rational long-term planning would be desirable, it is not possible due to the, sometimes daily, chaotic changes of the environment in which the enterprise has to act and to survive.

It seems that as a consequence of these arguments, many managers, as well as politicians, so far reject a larger degree of applying analytical methods for planning in their organisations. Thus, decisions are often finally made by “psychological gambling”, i.e. highly influenced by psychological kicks.

There are, of course, examples which show the tradeoff of the reliance on the market forces only. E.g. many theorists of economy demanded the retreat of the state from areas where it had intervened into the economic life. In the past these intervention fields were especially connected with those services which provide the infrastructure of society: energy supply, water supply, transport system, hospitals etc. From the past decade we can learn that privatization does not automatically (as it was argued) improve such services; one striking example is the privatization of British Railways one decade ago. The supporters of free market solutions in the last years also strongly requested the cutting of subventions for parts of economy which had been supported by the state due to strategic considerations. E.g. after the war, in the upcoming era of cheap oil, in Germany the state supported the national coal industry, to be able to guarantee electrical current production on the basis of local – and thus safely available – fossil resources, even if they were much more expensive than the coal offered at the world market. Now, after the end of Cold War, why not just rely on the offer of the global market? So, in the past decade, there was continuing pressure from neo-liberal analysts, to decrease the coal subventions, or even abolish them completely. As a result, German coal production steadily dropped, and recently, one of our most modern carbonization plants was sold to China, i.e. it is now being completely demounted, and transported to China, to be rebuilt there from its components. Surprise, surprise: Now we realize that our coal production appears to be not sufficient enough: The price of coke is exploding to a multiple of its former value, due to rising market requests from the upcoming industries in China and India, and there is a supply bottleneck due to the missing of a sufficient number of carbonization plants in Europe.

To summarize, the current practice of decision-making has several large disadvantages:

- The missing continuity is causing stress also for the decision-makers of companies or other entities which often cannot rely even just on the future existence of this unit.
- Due to psychological feelings or ideological beliefs, managers or politicians, when proposing changes, tend to binary decisions: i.e. either completely abolish or completely maintain a feature, instead of some continuous change of it. Such binary changes within system structure, however, usually produce as undesired secondary effects, oscillations somewhere else.

Also, political or economic decisions are often made just on the basis of some ideology-based belief in the benefit of certain measures ("reduce taxes") without a clear knowledge what the decision finally produces as effect. A remedy in this situation would be a stronger support for decision-making and also especially implementing decision details, by means of algorithmic methods: "Management by Mathematics".

Many managers are still reluctant or opposing to such application of mathematics in their enterprise, due to their belief in the validity of the previously stated convictions. However, it is just the well-running companies who provide the counter-examples: It has been remarked that it is exactly the top-ranking enterprises that show an enterprise policy opposite to the "chaotic" reaction patterns occurring elsewhere. Hirsch [1] remarks that these enterprises and their management usually can be characterized by a strong "theory of business". This notion stands for the basic principles which the enterprise is assuming and relying on, and for the goals which it is pursuing. Its essential ingredient is a mission philosophy supported by all employees of the enterprise, and updated in certain time intervals according to maintain the core competence for fulfilling that mission. So, we see that more work and money is invested there into issues to provide for a larger long-term continuity and stability of the enterprise, for its "sustainability", in contrast to the actual orientation towards short-term profit.

As it was discussed, this continuity does not mean a simple fixed running-course all the time. Depending on the changes in the environment of the enterprise or organization, some kind of adaptiveness is needed. It is here where some algorithmic means developed for other fields of control applications, might be an interesting solution. In the following, we shall discuss such approaches which were mainly developed and applied in the field of real-time system control, which, however, might also constitute promising support mechanisms for the field of enterprises and organizations.

2 Adaptronics and Adaptive Filters

2.1 Adaptive Methods

The idea of adaptive systems, of course, is quite old. For instance, fault-tolerant systems [2] are entities where especially in critical situations, some kind of system response by means of reconfiguration is possible. Usually, the implementation of fault-tolerant behaviour is confined to safety-critical system components as e.g. control microprocessors, memories or data base storage. With regard to mechanical systems, fault tolerance was usually implemented, either by some specialized solutions laid only for extremely complex and safety-critical systems as e.g. nuclear power plants, or by just massive material redundancy, e.g. in case of mountain railways.

Other approaches try to tailor certain properties to changing system needs, based e.g. on the exploitation of some kind of expert knowledge (expert systems [3]). Due to these basic prerequisites, usually a derived solution is not just applicable to other situations. Therefore, as an alternative to knowledge based methods, approaches based on heuristic, “blind” learning by training in the last two decades have been considered to an increasing degree.

In the eighties and nineties, especially artificial neural nets (ANNs) have been analyzed and proposed [4]. They usually consist of an off-line training phase where knowledge about sensed patterns is stored in some statistical sense in weights associated to the links between the neurons of the net. In a subsequent recognition phase the nets are confronted with some actual input pattern; it is the operation of the net then to classify these patterns according to their similarity / non-similarity to the patterns learned during training. In the meantime ANNs are used for many applications, especially pattern classification problems.

2.2 Adaptronics

A new approach has recently evolved at Fraunhofer Gesellschaft to enable a broader inherent dependable behaviour of certain systems [5]. So far especially computing systems themselves were in the focus of fault tolerance techniques, because of their wide use to realize control functions for other systems. In the last years, there was also already an increasing trend to embedded systems where there is no clear geometric border between control electronics and the components of the system to be controlled. This again raised additional requirements with regard to the dependability of the computing elements, as they are not any more separately, and easily accessible for fault diagnosis or error recovery. Now, a further extension of this approach is proposed: the material itself is to be made fault-tolerant, not by massive material redundancy, but by means of locally distributed compensation mechanisms, controlled by diagnostic components, distributed correspondingly.

Let us illustrate the basis of this new strategy by the example of the quickly increasing application of windmills for the generation of electrical current. The more windmills are rotating, the more current is generated. But if the wind changes to storm, the rotors of the windmills have to be stopped, otherwise there is the risk that the rotors will break. Usually it is too costly to hire a human operator team for continuous on-site monitoring of a windmill. So, there is nobody available who during the storm takes the right actions in time. Instead, the windmills are remote controlled, but this implies that for safety reasons, in case of storm often they are deactivated too early.

Here, now there is the idea to integrate sensors into the material of the rotors; these sensors can detect when the rotors blades are approaching their stability limit. Then, the angle of the rotor blade orientation to the wind direction is changed to reduce the risk, or the rotor is completely stopped. The sensors can be realized by means of piezo-ceramic fibers embedded in the material; they can transform pressures or tensions into electric signals which then subsequently can be augmented, processed and analyzed. Sensitive components can thus be permanently on-line diagnosed. Such on-line diagnosis by integrated sensors can be realized also for many other safety-critical components as e.g. the empennage wings of airplanes, or other mechanical machine elements which are under constant or frequently changing material stress.

Now, an additional step would be really “intelligent” material which is not only able to detect latent damages in time, but also to adaptively react to this emerging critical situation, without the need of system interrupt for off-line repair actions. As an alternative, to provide for the necessary compensation actions, it is proposed to integrate, in addition to the mentioned sensor components, also a huge number of locally distributed micro-miniaturized actuators, e.g. micro machine force actuators, again realized by piezo-electric technology. Here the inverse of the sensor effect is exploited: Application of a voltage to the piezo-electric fibers causes an extension of the fibers, and thus creates a pressure within the material to compensate stress from external forces.

Such material will play an increasing role for compensating the effects of material wear-out or of undesired oscillations in many future machine applications. According to this central property of adaptive reaction of the material itself, the entire research field has been named “Adaptronics” [5].

Of course, to provide for the compensation that is exactly necessary, to stabilize the system against the disturbances or material stress from external forces or torques, usually a simple direct feedback loop from the sensor fiber to the actuator fiber will not be sufficient. Instead, some kind of control algorithm is needed which is exploited to create, from local sensor inputs, the needed control signal for the micro actuators. These algorithms have to be carried out by digital controller elements which are also embedded in the material, in the same huge numbers as the sensor and actuator fiber elements. Due to their large number, with regard to needed chip area as well as to costs in general, relatively simple microcontrollers, usually less comfortable than the actual digital signal processors (DSPs), have to be used. For the control algorithms this has the consequence that they can use only

- limited data space due to the restricted memory capacity of the microcontroller;
- limited processing speed due to the time properties of simple microcontroller ALUs.

Nevertheless the control algorithm has to provide for a sufficiently exact solution, usually under real-time requirements, i.e. within a certain time bound.

To fulfil this requirement, a certain class of algorithms, the so-called adaptive filters, show promising properties. In the next section, we shall discuss these algorithms in more detail.

2.3 Adaptive Filters

The term filter usually denotes a device or system which takes a certain mixture of signals at its input and processes them according to given rules, to generate from them a specific output signal corresponding to the input. In traditional signal processing technology, filters are defined to let all signals pass which belong to a certain signal spectrum, while all others are rejected or annihilated. Signal flow might be either discrete or continuous in time. We shall confine the discussion here to discrete-time signals. This signal flow can be characterized as a sequence of signals generated at some subsequent time-points. With regard to the system-internal processing of input signals, we can distinguish two main classes:

- linear filters;
- non-linear filters.

Linear filters are characterized by the property that processing of signals is performed by multiplying the input signals by linear factors, while in non-linear filters more complex non-linear operations constitute the processing. Here we shall confine our discussion to linear filters, as they already provide interesting results, while, at the same time, due to the simplicity of their basic operations, signal processing is very quick, and thus, fulfils the needs of real-time requirements.

If a filter is used for controlling a system, it is the aim to derive from the generated output signal, one or several control parameters for the entire system which then provide for a stable system behaviour. E.g. in an airplane, some sensors denote the inclination of the wings against the horizontal direction. Depending on these sensor input, the algorithm should generate control signals for the turbine-drives of the airplane. As a feedback, then again it can additionally be sensed whether the desired stable orientation of the airplane (usually the horizontal one) is reached or which deviation angle is still existing. I.e. usually there exists some stability criterion which denotes in how far a desired system parameter is reached or not. Thus, by forming the difference between the desired output signal and the actually generated output signal, the actual error of the control can be evaluated.

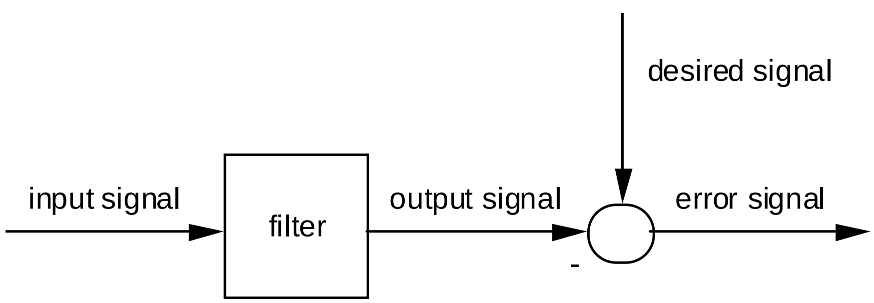


Figure 1: Scheme of the general function of an adaptive filter [6]: An output signal is generated from the input signal; its difference to a desired signal forms an error signal.

The basic approach of adaptive filters is to adaptively change the linear factors of the processing algorithm so as to minimize the resulting error. The most common class of adaptive filters is based on the use of a so-called transversal structure as depicted in Figure 2:

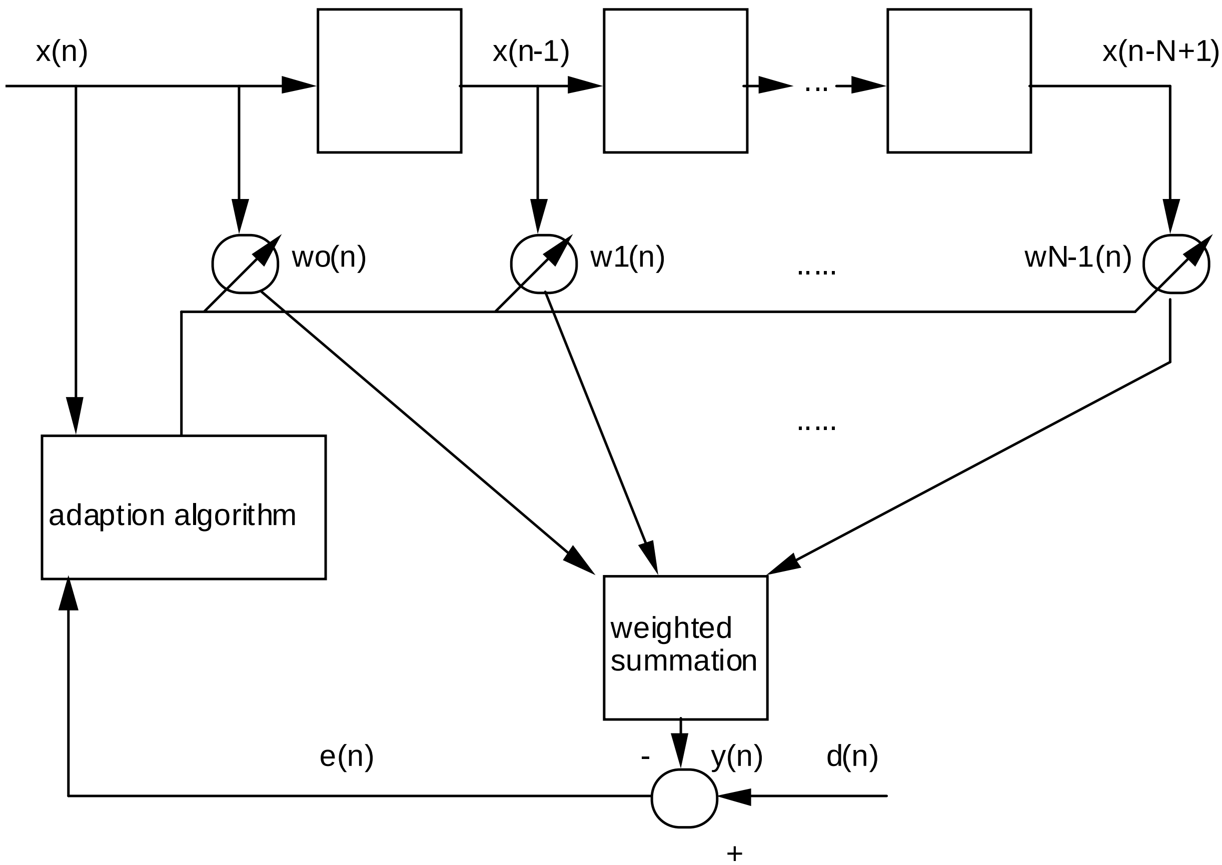


Figure 2: Adaptive transversal filter [6]
x input, y output, d desired output, e error, w weights

Under this scheme the adaptive filter has one input x and one output y. Generation of y from x occurs at given discrete time-points which we shall not denote by their absolute time value, but instead just by an integer index n. So y(n) denotes the nth element of the sequence of output values subsequently generated. This output y(n) is computed from the sequence of the input values x(1),..., x(n) according to the formula

$$y(n) = \sum_{i=0}^{N-1} w_i(n) * x(n-i) \tag{1}$$

where w_i (i=0,...,N-1) are the filter weights and N is the filter length. The filter weights are determined and updated by means of an adaptation algorithm.

There are also applications, where the filter inputs are not the delayed values of the single input, but parallel signals which are concurrently sensed and entered into the computation scheme. For this class of filters, the output is computed as a linear combination of the parallel inputs, where the coefficients are again the adaptive weights:

$$y(n) = \sum_{i=0}^{N-1} w_i(n) * x_i(n) \qquad (2)$$

Therefore, this structure is also called a linear combiner (see Figure 3). In its functionality, it is closely equivalent to artificial neural nets consisting of just one layer (the only difference is that the one layer net in its summation component additionally contains a thresholding element [4]).

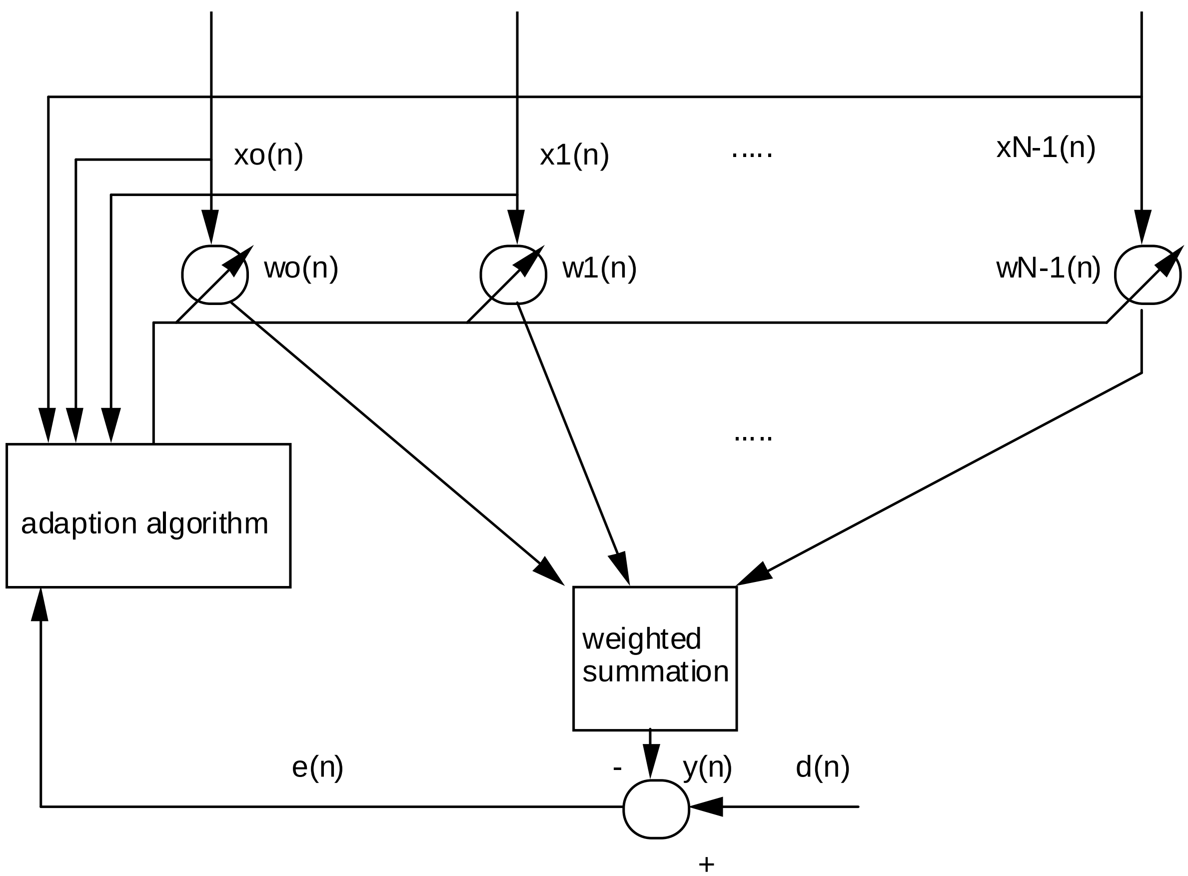


Figure 3: Adaptive linear combiner [6]

The standard adaption algorithms are usually are laid out to minimize the error e(n) according to the method of least mean squares (LMS); the corresponding filters are also called LMS filters. For LMS filters it can be shown [6] that the procedure for updating the weights at a given time step n, has a very simple computational structure:

$$w_i(n+1) = w_i(n) + 2\,k * e(n) * x(n-i) \quad (i=0,...,N-1) \tag{3}$$

Here k is step-size parameter of the algorithm [6].

So, the filtering procedure to be carried out for a time step n, in total consists of

- forming one weighted sum to obtain the actual output;
- forming one difference to obtain the actual error e(n);
- updating the N weights for the next time step n+1, according to formula (3).

This illustrates that the adaptive algorithms are computationally very simple. However, in spite of its simplicity, it has surprising value with regard to produce stable system behaviour. One standard example with striking properties is the use of an adaptive filter for stabilizing inverted pendulums, i.e. pendulums, where the bottom is completely turned up (so its angle with the vertical line equals 180 degrees). The pendulum is then in a highly unstable equilibrium, and already some minimal fluctuation of its angle to the vertical line would normally cause a fall-back into its stable ground position. It is a well-known demonstration effect that such an inverted pendulum can be held in that position by using small additional actuators the drives of which are controlled by an adaptive filter. The condition for this successful behaviour is the use of a sufficient filter length N. Adaptive filters applied to control a complex technical system might imply filter lengths of 1000 or more.

Under real-time conditions and in micro-miniaturized applications, it might be difficult to bring the requested response time behaviour into compliance with the limitations of the used controllers: For reasons of cost or limited area available to contain the controller, the controller might be not able to process the requested filter length N due to

- limited memory capacity so that data cannot be stored in sufficient size;
- limited computation speed so that the filter of length N cannot be processed within the given real-time bound.

For such bottleneck situations, the support of the algorithm execution by dedicated controller architectures tailored to its computation structure is currently being discussed. Such architectures can easily be realized e.g. by field programmable gate arrays (FPGAs).

3 Use of Adaptive Filters for Non-Technical Applications

Adaptive filters are currently a “hot topic” in the field of technical systems, being discussed for an increasing number of applications in that field. Their large advantage is their simplicity and the lack of a priori knowledge about system behaviour and possible deviations. Instead, the intelligence of the algorithms is gained by “blind training”, comparative to the approach of neural nets. Therefore, the question arises whether such filter algorithms with their interesting properties can also be applied to improve the stability behavior of non-technical systems as companies, business processes, state organizations etc. As pointed out in section 1, here very often the situation is characterized by

- a lack of models which are able to quantitatively forecast effects in these areas;
- quarrel among experts even about qualitative effects of certain parameter changes;
- when considering system parameter changes, a tendency to think in Boolean “all or nothing terms”; this behaviour then causes additional system oscillations.

As a consequence, often the resulting debates are confused by a mixture of

- fixed ideological positions;
- assumptions which, however, are proclaimed as proven truth;
- limitation by vague qualitative thinking
- etc.

Well-known examples from our current political situation are the discussions which system parameter changes would heal our

- deficit-shaken state budgets;
- unstable social assurance systems;
- unbalanced job market etc.

As a few examples of such binary approaches to system parameter changes we just would like to mention the recent discussion about e.g. complete abolishing subventions for private house-builders, car driving from home to the location of the job etc.

“All or nothing” decisions (often of course done just to follow ideological positions or to serve own client groups) usually neglect secondary effects, which, in reality, however, will cause again other unstabilities in other sectors of economy.

Here we would like to plead for a stronger use of adaptive methods like the described filter algorithms. By using them there might be the possibility to improve the forecasting capabilities also with regard to non-technical systems as the depicted examples. Especially for systems where no clear and unique expertise theory of system control is existing, the “blind training” properties of adaptive filters look interesting. Regarding the “history array” of annual data snapshots which are existing e.g. for the previously mentioned budget examples, it can easily be seen that in many cases the system control behaviour was not adaptive. I.e. for longer times (partially decades) deviations from equilibrium were continuously increasing, i.e. the error function e(n) was systematically maximized! This is ended finally either by collapse or by wild chaotic oscillations.

Of course one tradeoff of the use of adaptive filters for non-technical systems is that the effect of parameter changes is usually relatively slow, and so the training period of the algorithm has to be long. On the other hand, the slowness of increase or decrease of certain parameter values would allow for a counteraction by a fine-grain update of the weight factors already in a situation where the deviations are small, maybe even minimal!

As a consequence with regard to the structure of laws or other kind of treaties, we would plead here, to allow for systematic inclusion of adaptive rules in them. I.e. instead of having to fix certain parameter values in a law or treaty, this parameter should be included as a scalable factor which after some time – by regarding the error function is automatically and algorithmically updated (in the finance sector to a certain extent such use of scalable factors - e.g for interest rates- is usual, but the updates are still more or less non-algorithmic).

So, here a stronger use of adaptive methods might be quite interesting and promising. Of course, it will probably be regarded too risky to bind – without having gained longer experience – the fate of very large and complex system like an entire national economy on just one relatively simple algorithm. Therefore, we would plead here for a cautious and careful experimentation, using smaller systems or communities as field of experimental study. Even if the filters at the beginning are not used with their applicable full power for control generation and maintenance, already using them as an additional diagnosis tool and decision assistant would be already a progress step compared with the current “controlling the ship in fog”.

4 Conclusion

In this paper we have described the current state of decision processes in enterprises or organizations, and the potential use of adaptive control algorithms to improve the actual situation in this field. It was shown that the stability criteria provided by such methods, could also constitute a valuable support for solution finding e.g. in the field of economics, or politics. As one class of adaptive systems which recently has gained growing interest in the field of real-time systems, the so-called adaptive filters have been described, and their potential use for decision-making in the mentioned non-technical areas has been discussed. Future work is to focus its activity here on winning more experience with regard to such applications, by careful experiments in well-defined sub-entities of our society.

5 References

[1] HIRSCH, H., Mit Kopf und Bauch, Frankfurter Allgemeine Zeitung, Section “Management”, 24. 5. 2004, p. 20

[2] PRADHAN, D.K., Fault-Tolerant Computing: Theory and Techniques, Volume I and II, Prentice Hall, Englewood Cliffs, N.J., USA, 1986

[3] BUCHANAN, B.G., MOORE, J.S., Rule-Based Systems, Addison Wesley, Reading, Mass. USA, 1984

[4] MÜLLER, B., REINHARDT, J., Neural Networks, Springer-Verlag Berlin Heidelberg New York 1990

[5] MILLER, F., Adaptronik – wenn Material aktiv wird, Fraunhofer Magazin, 2/2003, pp. 8-14

[6] FARHANG-BOROUJENY, B., Adaptive Filters: Theory and Applications, John Wiley & Sons, Chichester New York Weinheim 1999

DIGITAL RIGHTS MANAGEMENT SYSTEMS

Sonja Hof[1]

Pushed by the fast development of technology and the modified users' needs and interests the usage of digital content has changed. The development of systems which support a download in combination with access restrictions and usage guidelines of appropriate data poses some questions concerning user rights, duties and responsibilities while designing and implementing applications. This article introduces the main idea of such systems and points out some important factors which should be taken under consideration.

1 Introduction

As technology is fast developing and more and more "non-technical" aspects become important, therefore also legal provisions and means have to be considered. More and more information is getting available in a digital format and thereby made available to many persons. One aspect of this development is that also material is made available in digital form that is actually copyrighted, e.g. digital music or film. Due to the worldwide discussions on copyright issues of copyrighted material also the development of corresponding systems are fast growing. Such systems are called DRM (digital rights management) systems. They are used not only in business sectors but can be found also in governmental organizations and are still a growing environment that is driven by needs for regulation.

2 What is a DRM System?

Digital Rights Management (DRM) systems are the technological measures built into the hardware and/or software of home computers, digital televisions, stereo equipment, and portable devices in order to manage the relationships between users and protected content. [1] They consist of a variety of copy protections and security measures that are embedded in digital content (i.e., CDs, DVDs

[1] University of Linz, Institute of Applied Computer Science, Division: Business, Administration and Society, University of Linz, Austria, sonja.hof@ifs.uni-linz.ac.at

and online music), electronics and computers to prevent the duplication, transfer, or any use of content undesired by the copyright holder. DRM ranges from data placed on music CDs to prevent their functioning on computers and replication on CD burners, to encrypted security codes and watermarks working in unison with electronic devices designed to prevent any copying or non permitted use by the end user. [2]

One goal of DRMS is to make the digital use of copyrighted content possible while keeping the requirements and desires of all involved parties at a well defined point. DRMs are used to make the cooperation between clients and hosts as easy and effective as possible using a set of technical tools and techniques. The idea of an easy to use, non-complicated access point for all users is demanding both from the technical as well as from the security side.

3 Ten laws of security

Dealing with DRMs security concerns must also be taken under consideration. Based on general rules covering the baseline of general security are listed:

1. You cannot eliminate risk.
2. Make more, spend less.
3. "Good" security: No. "Good enough" security: Yes.
4. Everyone is accountable for security.
5. Security isn't sexy and exciting; it's boring and routine.
6. There will never be enough budget.
7. Security is equal parts people, policy, process and product.
8. After you solve your top security problem, you'll still have a top security problem.
9. "Many hats, no hand."
10. The number of vulnerabilities is infinite. [3]

The listed points are applicable for all systems and are not complete but give a good baseline towards a secure system. As a DRM system might become more and more important in various areas (e.g. E-Government) an enhanced security will be defined and deployed. Taking these arguments under consideration will improve the system. Starting integrating and using a system its implementation and interfaces must be well defined and adjusted to the needs of the users.

4 General Security Concerns

DRM systems prevent illegal accesses and set diverse restrictions that have to be imposed on the use of documents/content:

- Read access. The system has to ensure that only authorized persons are allowed to see the content (of a document). Typical solution: encryption.
- Write access. The system has to ensure that only authorized persons can change the content (of a document). Typical solution: access control schemes. [6]
- Print access. The system has to ensure that only authorized persons can print a document, i.e. convert the content into a non-digital and/or non-protected state or burning a song onto a CD. Typical solution: digital rights management (DRM).
- Forwarding allowed. The system has to ensure that content/documents are only forwarded to correct recipients, i.e. a user in the middle of the process that handles the content/document should not be able to freely extend the set of valid recipients. Typical solution: DRM
- Time constraints. The system has to offer a mechanism that allows time based management of the other access rights, i.e. the possibility to automatically remove a user from the valid user list after a given point in time (subscription model) or after the document process stepped over a well-defined step. Typical solution: DRM
- Sequence constraints. The system has to offer a mechanism that allows the management of the access restrictions based on the current process state. Typical solution: DRM
- Traceability. The system has to offer a mechanism that allows a dedicated user group to trace the changes that were made to a document, i.e. to check who changed what and when. Typical solution: Audit and DRM [4]

DRM systems are a feasible way to ensure the listed constrain and still the main restrictions and limitations are not implemented for DRM systems.

5 Controlling Information?

A DRM system contains an access control set that limits the uses of digital content to a group of users and to a set of valid operations. Such control mechanisms do not only include the person itself, but also the conditions and circumstances of the access and the aligned information.

As the taxonomy, DRM systems can be categorized from very limited to very flexible [6]. There are still open questions that have yet to be fully answered or implemented in a "real" world technology. Currently, no DRM technology even tries to offer all the features as listed in section four.

A DRM reference model is the generic model for DRMs that give usage rights based on a policy system that is controlled by the originator/owner of the data. The assumption of the availability of standards and an infrastructure for identifying metadata, cryptography and authentication mechanisms is mapped to the DRM reference model. The process model follows several steps [5]

- The user gets the encrypted content using a download mechanism: download, progressive download or streaming.
- The user attempts on the desired type of usage and the application determines that the requested action requires authorization.
- If the policies are not found (within the users attributes) a message is send to the licence server of the DRM client component
- The license server determines the policies based on the request
- A financial transaction may be conducted (in case the desired usage requires a purchase)
- The license package is assembled
- The license is packaged and transferred to the client
- The DRM client authenticates the received policies and checks the policies.
- The content is used corresponding to the request

Expressions and evaluation of usage policies:

The transfer from one part (content provider/owner) to another (user) is one of the most important aspects of a DRM system. A DRM system is based on a set of different policies which are the mechanism to define the possible interaction and define users' rights. Such policies exist in machine formats (binary formats), as well as in format interpretable by humans, e.g. specially designed languages for expressing usage rights e.g. XrML 2.1; [5]

6 Hardware Support for DRM Systems

TCPA (trusted computer platform alliance): AMD, HP, IBM, Intel and Microsoft are the main members of the TCG (trusted computer group). TCPA is known as a security initiative from more that one hundred companies. TCPA supports an identification of the machine and is used as identifier and authorizing mechanism for the user and supports the encryption and decryption process. From a technical point of view the TCPA is an interesting development. A TPM chip (trusted platform model) inside a computer is working comparable with an integrated smart card. In this case the smart card is not bound to a user, but rather to a computer, i.e. it allows two new types of checks:

- A computer can be explicitly identified using keys material stored on his TMP chip.
- Checks executed during the computers boot process, along with the help of the hardware secured TPM, allows the recursive generation of a trusted operating system environment.

Microsoft defines a set of operating system features that build on top of the TCPA to define a trusted computing environment. This initiative (Palladium, NGSCB …) for the Microsoft Windows® platform uses certificates to identify the origin of all loaded software components. This type of controlled environment would also allow introducing authentication services for actual applications, e.g. verification of emails, introduction of a secured application storage space…

TCPA for Linux: The comparable security system to TCPA on a Linux side is the Linux Enforce Module. It provides several subsets of triple wire link functionality and exists as a beta version. Similar to the TCPA it was developed to integrate hardware and with a secure boot loader. [7]

Even though hardware supported DRM functionality has many advantages, one has to take care that the user's rights are not ignored. A set-up as described above actually moves the control of a computer away from the user to the owners of the key material in the TPM. This has several complicated consequences when examined in a user's privacy context.

7 Quality of Service and Other Aspects

For many tasks on a DRM portal the quality of service (QoS) is of minor importance. Of course, responsiveness and availability are not to be neglected. However, compared to other requirements, they are of minor importance. In contrast to that, there are tasks, for which QoS is of utmost importance. In certain cases it has to be guaranteed that a valid user is able to finish his task, e.g. finishing a download. Quite a few different research project started to develop security based measures to prevent security incidents. All businesses require – to some degree – a secure environment to work according to its specification. In some areas, they are quite detailed and clear but the whole range of security issues cannot be overlooked. From the security side, there are only few differences between an e-business transaction and an e-Government process. Depending on what the citizen/user wants to do, the process has to be more or less secured. The different approaches concerning security are that wide and diverse, that the question, which is typically discussed first, is on the relevant security area(s) itself: Social security, like relevant privacy concerns in combination with the wide range of trust issues, or, on the other hand, technical security issues, legal issues or questions about person to person interactions. A classification of the different areas and sub-issues within its complex structure seems to be the only feasible way to handle this complex area.

A classification of the different security assets, introduces a structure into the actual project that helps to make it manageable and eases the project's implementation audit. Different security assets have to be split into smaller security means and these results may have to be refined several times. The subdivision also enables the security engineer to find appearing security issues more easily and to hint into a direction for a solution. Additionally, it also offers a feasible way to approach the arising issue(s).

8 Is Technology Influencing Law?

It might be true that some policy agencies may still be busy with investigations, most are quite familiar with the role of such digital equipment in committed crimes. Agents, officers and technicians have actively sought specialized training in collecting, processing, storage and presentation of digital evidence. There are many academies sponsored by private and public sectors that have been providing this type of training for many years. As always, it is the responsibility of law enforcement agencies to upgrade their training and personnel to address emerging technologies impacting crime. Agencies are very aware that exchanging information will greatly assist in addressing crimes that are traditional or white color in nature. I think most agencies are taking steps in that direction as fast as their budgets and legislatures will allow. A major problem that policing agencies have from a global perspective is the lack of any international laws on cyber crime. This is being worked on, but currently hacking into another nation's computers is encouraged and kept legal by some governments while totally illegal in other countries. Therefore, to prepare to take on electronic crime committed by white collar and traditional criminals, the first major thing that is needed is solid international laws that focus on cyber crime. Once introduced and enforced, we need a solid computer forensics training program for these agencies, with the necessary budget. This will for sure take some time and is not done in a few months. Additional political hurdles that often impede development of such international cooperation will need to be overcome. Nevertheless it is also logic that law enforcement and judicial systems perform to the best of their abilities and are frequently like other areas restricted by budgets, treaties and legislatures.

Copyright and DRM technology are closely connected. Partly because DRM systems should enforce the applied copyright restrictions, e.g. preventing the copying and distribution of copyrighted content into the public-domain [8]. Some ongoing discussions concerning legal extensions and the possible implementation of DRMs goes hand in hand with the call of reforming DMCA [8][9]. From a legal point of view DRMs could be also seen as mechanism to display legal rights and its development is influenced by technology as well as by the law influencing processes which might push one or both aims. Critically seen a DRM is more restriction than support and will soon change the usage, exchange and production of all types of digital content.

9 Conclusion

As DRMs are, from technical and legal side, yet not fully developed possible solutions must contain both concerns. Although the implementation of systems is still going on and is raising some discussions until a feasible solution will be found in order to profit from the new technology. The advantages of combining different communities and interests in an implementation is interesting and challenging. The integration of some fair use rights and different policies levels might influence the development in a positive way. Currently, the most wide-spread use of DRM technology is probably found in the area of full length music downloads. Typical “fair use rights” like passing on the rights to a song, superdistribution or purchasing a song for another person in order to pass it on as a gift, are either not yet possible or are just being deployed. We see the DRM deployment as both a challenging as well as an interesting market/playground with many new developments and announcements during the very new future.

10 References

[1] http://www.law.berkeley.edu/institutes/bclt/drm/about.html

[2] http://www.publicknowledge.org/

[3] http://infosecuritymag.techtarget.com/ss/0,295796,sid6_iss386_art774,00.html by Andrew Britney

[4] S.Hof, P. Reichstaedter, Securing E-Government, to be proc. in proc eGov within Dexa 2004

[5] John S. Erickson, Fair Use, DRM, and Trusted Computing, in the Communications of the ACM, April 2003, Vol 46, Nr. 4, p 34ff

[6] C.M. King, C.E. Dalton, T.E. Osmanoglu, Security Architecture, 2001, p.93ff, RSA Press

[7] http://enforcer.sourceforge.net/

[8] P.Samuelsen, DRM{and, or vs.} the Law, in the Communications of the ACM, April 2003, Vol 46, Nr. 4, p. 41ff

[9] http://miladus.typepad.com/

Cooperative Information Environments

THE PAST, PRESENT, AND FUTURE OF WORKGROUPS IN A THEATRE OF WORK

Tom Gross[1]

The members of workgroups need information about each other in order to cooperate efficiently and effectively. In face-to-face situation this information is available and can be captured naturally. In other situations the distributed users need technological support for this awareness information. Such systems should provide information about things that are going on currently, but also about the history of the actions and interactions in the workgroup. Ideally such systems should also provide predictions about possible future events. In this paper we introduce the Theatre of Work Enabling Relationships (TOWER) environment, which provides an infrastructure for awareness information support. We then discuss how it can be used to present information on the workgroup's past, presence, and future.

1 Introduction

In the CSCW literature it has been emphasised for years that efficient and effective cooperation requires that the cooperating individuals are well informed about their partners activities [7]. They require information about the other persons they are cooperating with, about their actions, about shared artefacts, and so forth. This information is often referred to as awareness (sometimes with prepositions such as *group* awareness [3, 8] or *workspace* awareness [15].

In situations where the cooperating individuals are at the same place this information is often perceived automatically [18]. In other situations where individuals, who are at different places, have to cooperate as a group, technological support for the cooperation process as well as the perception of cooperative activities is essential.

The types of awareness that are supported by technology today range from informal awareness about other people (or presence and availability awareness; or shared awareness [6]; or general awareness [11]) to workspace awareness about shared artefacts [16].

1 Faculty of Media, Bauhaus-University Weimar, Germany
tom.gross(at)medien.uni-weimar.de

In the earliest attempts the information was captured and presented within one single application (e.g., [2, 19]). This first generation can be called *proprietary awareness systems*. In the second generation toolkits were developed that contained components for presenting awareness information. These *awareness widget toolkits* made the development of applications easier, because the software developers did not have to implement their awareness widgets from scratch (e.g., [23]). In the third generation, *awareness information environments* allowed capturing information from various applications and other sources and presented the information in a generic representation such as with tickertapes of pop-up windows on the computer desktop (e.g., [9, 21]). Recently many systems aim to address the users' peripheral perception and use *ambient interfaces* for the presentation of the information [12, 20].

Besides these important challenges concerning technical and psychological aspects of capturing and presenting the information, some fundamental challenges also lie in the structuring and modelling the information. Adequate structuring and modelling of the information has many advantages for the users: it allows to provide the information when it is of most value for the respective user and task; it allows to reduce the amount of less important information; and it allows to reduce disturbance of users.

It is also a prerequisite for the provision of past, present as well as future information. Especially the latter has received particular attention in the HCI and CSCW communities recently [4, 17]. Two important questions have to be answered in this respect: first, what are the parameters that influence the information need, and secondly, how is the information need influenced. Important influential parameters are the current situation of the user in terms of technical and social environment and the current task. These parameters influence the quality, quantity and granularity of the information needed, and particularly the timing of the presentation of the information.

In this paper we briefly describe the Theatre of Work Enabling Relationships (TOWER) environment, which provides an infrastructure for awareness support. We show how it captures and presents information on past and present presence of users, on their activities, as well as on the evolution of shared workspaces and on the artefacts contained in these shared workspaces. We then discuss how it can be used to present information on the workgroup's and their workspaces' future. Finally, we discuss some recent related work of other authors. These related approaches reach from systems that can analyse users' activities and infer their interruptibility, to systems that analyse and present patterns of online behaviour of uses, to systems that automatically adapt the users' reachability, and finally to systems that predict the physical navigation of users.

2 Theatre of Work

The Theatre of Work Enabling Relationships (TOWER) environment aims to support distributed work groups or virtual communities with group awareness in their current work context. It provides an infrastructure for facilitating chance encounters and spontaneous conversations among remote users.

For this purpose, the infrastructure has various sensors capturing information about users and their activities and a range of indicators notifying users about the presence, availability, and current activities and tasks of the other users. *Sensors* capture user activities within the TOWER environment (e.g., logins, logouts), user activities on Win* platforms (e.g., changes to files, sharing of folders and files, starting of applications, opening of documents), user activities in shared workspaces (e.g., a sensor for the Basic Support for Cooperative Work (BSCW) system [5] records all activities in the shared workspaces such as user logins and logouts, folder creation, invitations users to shared folders, document uploads), and access to Web servers. A broad variety of *indicators* present the awareness information. Examples are lightweight indicators such as pop-up windows with pure text or tickertapes displaying messages about the other users and shared artefacts; AwarenessMaps, which provide awareness information in the context of shared workspaces; the TowerWorld, which presents shared artefacts and users in a 3D multi-user environment; ambient interfaces, which present the information in the physical environment of the users; and mobile client presenting light-weight information for users on the road. In this paper we will only have space for briefly describing the TowerWorld. Information on TOWER as a whole can be found in [22]; information on the ambient interfaces can be found in [12] and other indicators can be found in [14].

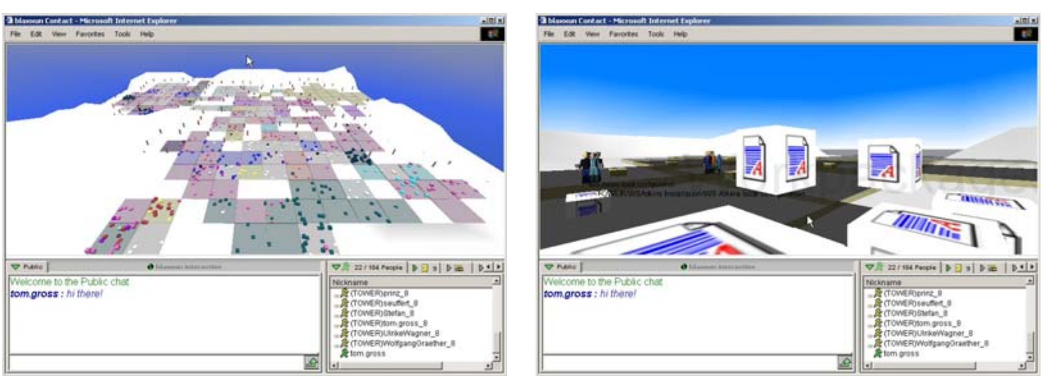


Figure 1. TowerWorld: (a) overview from a distance; (b) details in a close-up.

The *TowerWorld* is a 3D multi-user world; it consists of a stage that is dynamically created based on shared information space such as BSCW workspaces [5] or the content of other document management systems and avatars navigating on this stage and performing symbolic actions. Figure 1 shows screenshots of a TowerWorld: the first picture presents a view from the distance, where users can get a good overview of the whole stage with all its cubicles representing the documents; and the second picture shows a close-up of the same TowerWorld with more details (e.g., icons representing the file types, avatars positioned according to the current activities of the respective users).

The stage evolves in response to the patterns of use in the shared information space. The stage is generated and adapted according to rules and semantic mappings that can be specified by the users. Various attributes of the documents in the shared information space can be visualised such as the type of a document, the size of a document, the frequency of manipulations to a document, the creator of a document, the similarity among documents, and so forth. These attributes can be mapped to the size of the cubicles in the TowerWorld, their shape, their colour, their position, their clustering, and so forth. Another criterion for the stage creation is the granularity of the mapping of document sets into the stage. User workshops yielded different opinions whether a more detailed view or a more abstract overview provides better context for the visualisation of user activities. In the current implementation users can select between different worlds, each created by different selection criteria and rules for generation and mapping. In an overview world for example objects in the TowerWorld represent only folders of the shared information space, while the detailed TowerWorld provides a representation for each document. In the overview world activity spots are easier to recognise while in the detailed world clusters of objects with a similar semantic are easier to identified.

The stage of the TowerWorld is populated with avatars representing users and representing their current activities as symbolic actions such as automatic navigation through the TowerWorld and gestures. The emphasis in symbolic acting is to show the contextual information telling users about where the other users are, who they are and what they are doing right now. With symbolic acting the context dependent actions of all users are shown at all times so the world can seem like a more active place as well as more closely reflecting the activities of a user group. We let the system do the walking–and the acting. This is a very powerful and engaging way of solving problems in mediated communication.

3 Discussion

The TOWER environment it its current state provides a broad range of sensors capturing information, a variety of indicators presenting the information, and convenient means for specifying preferences.

Its particular strength lies in the modelling of awareness contexts and the entailed possibility for flexible adaptation of the information to the respective user, situation, and task. The TOWER environment allows users to specify their personal preferences with respect to the information they want to receive, with respect to the indicators used for the presentation of this information, and with respect to the timing of the presentation. A light-weight, but powerful, context model allows to structure the captured events into semantically coherent aggregations that make more sense to the users and abstract from, sometimes unwanted, details [13]. At the origin of events they are analysed and mapped to awareness contexts. Likewise, the events a user produces are analysed and mapped to a context. Now, the user can specify for each context which kind of information they want to receive, and how it should be presented. Furthermore, they can specify their preferences concerning the timing: they can opt for immediate presentation, for presentation in rhythms (e.g., once per hour, once per day), or particular moments (e.g., upon login, before logout). In order to facilitate the specification of the preferences and in order to allow for better co-orientation among users, the TOWER environment provides functionality for sharing preferences. That is, users can publish their preferences in shared workspaces, and other users can then subscribe to them.

So far, the TowerWorld provides *up-to-the-moment* information about the events and state of the users and their shared environment. A mechanisms, that is called DocuDrama allows to replay *past* states and evolutions of the TowerWorld [24]. An activity report provides a daily overview of the changes of the last 24 hours.

As far as the prediction of *future* events and states of the users and their shared environment are concerned, we have several ideas and plans for future work. One next step is to use the data of the BSCW shared workspace system to analyse patterns of behaviour of its users. The public BSCW server has already more than 100.000 registered users, who produce a vast amount of events. We have already extended BSCW to produce events that can be sent to and that are readable by the TOWER server. The following actions of BSCW users can be analysed: login patterns and patterns of cooperation on shared folders and documents (e.g., are there typical sequences of creating, reading, updating documents?). Furthermore, we can analyse events in the shared BSCW calendars, which are increasingly used since the introduction of the standardised iCalendar format allowing for the flexible exchange of calendar data with other calendaring systems.

As a result the users can then get predictions and warnings in this 2D indicators. For instance, once the system has identified the typical login and logout behaviour of a user, it can use the tickertape to warn other users who work in the same context that they should contact the colleague now (since she is leaving any minute). In an analogy to the fast replay of past states of the TowerWorld, we can animate the TowerWorld to play likely future events and evolutions of the TowerWorld. Finally, in many situations users expect something to happen, and can be notified when this is not the case. For instance, if the users are expected to put their deliverables into a certain workspace and nothing is happening in this workspace, then the corresponding region in the TowerWorld can be highlighted (with bright colours, or clouds over the respective landscape).

4 Related Work

There have been some recent approaches for analysing the behaviour of users of systems from computer-supported cooperative work and computer-mediated communication. This research has been stimulated by results from ubiquitous computing—in particular, the broad availability of sensing technology makes it possible to capture the behaviour of users in both the electronic world as well as in the real world.

Fogarty et al. [10] developed sensors, which run as a background process on users' primary computers and can capture users' activities on their computers (i.e., keyboard and mouse activity). Furthermore, audio sensors were used to detect the conversations and noise in offices; other sensors were attached to the doors and could measure the angle of the door (i.e., if the door was open, cracked, or closed). At the same time users had to do frequent self-reports—describing their interruptibility from highly interruptible (1) to highly non-interruptible (5). The automatically captured information was then compared with the results from the self-reports. The subjects were managers, programmers, and students on internships. On a whole 100 interruptibility self-reports were collected from each subject. On an average the interruptibility was more or less evenly distributed (about 16 to 19 percent per degree; with the exception of about 29 percent for the highly non-interruptible degree). The overall finding was that the model was reasonably adequate in inferring the interruptibility from the sensor data. There were 640 cases where the model correctly predicted values from 1 to 4. In 135 cases the system correctly predicted 5 (or highly non-interruptible). In only 43 it was the other way round—that is, the system predicted 1 to 4, but the users said 5. In 157 cases the model made the wrong judgement that the subject was interruptible (i.e., a value of 1 to 4), whereas the self-report showed non-interruptibility (i.e., 5). On a whole only these last 157 cases are really critical—since the users did absolutely not want to be disturbed, but the system judged that the users could be interrupted. On a whole the model showed an accuracy of 79,50 percent. With future versions of the inference can be improved by adding a component that allows the system to learn from explicit judgements of the users.

Begole et al. [4] also did some thorough analysis of users' activities on computers. This information was combined with information on the location of the activity, scheduling information from electronic calendars, and email activity. Here the goal was to derive typical patterns of user behaviour, which can then in turn be used for predictions of user behaviour. They developed a tool that can generate various visualisations of use patterns. The so-called actogramm shows a matrix with calendar days on the vertical axis and time of the day on the horizontal axis. For each interval, in which the user is active at the computer, the actogram shows a black bar. So, the individual rhythms per day can easily be identified. In another diagram, with the same coordinates both the actions and the meetings taken from the calendar are shown in the matrix. Furthermore, in an aggregated diagram with the aggregated online and meetings data on the vertical axis and the time of the day on the horizontal axis daily patterns can be identified (i.e., the typical time a user starts working, is out for lunch, or leaves in the evening). On a whole these visualizations provide great insight, but have two limitations—pointed out by the authors: the level of detail is one minutes and there is no more detailed information, and the pure information that a user is actively working on the computer does not necessarily mean that the user is interruptible.

The SenSay prototype by Siewiorek et al. [25] goes one step further: it does not only analyse the state of the user, but also performs some automated actions based on the inferences. Basically the Sensing & Saying (SenSay) prototype is a mobile phone, which is context-aware and modifies its behaviour based on its user's state and surroundings. It constantly adapts to the dynamically changing environmental and physiological states of its user. Furthermore, it provides the remote caller with information on the current context of the phone user, and lets the caller decide if the reason for the call is important enough to disturb a user in a given situation. It uses light, and motion sensors, as well as a microphone, which all are placed on various parts of the body of the phone user and connected to a central hub, which the user carries on his/her belt. The prototype then uses rules to infer the state of the user and then consequently adapts the profile of the phone to one of the four basic states: uninterruptible, idle, active, or normal (default state). Each state has influence on a number of phone actions (e.g., if the state is uninterruptible, the phone ringer and vibration are turned off). Although the system certainly is not always 100 percent correct with the inferences, it provides an interesting approach to facilitating the management of various settings of the increasing number of gadgets users are carrying around.

Ashbrook and Starner [1] provide a slightly different approach, but which has some similarity with our TOWER approach. They do thorough capturing of location data of users of GPS and WLAN technology, and then identify patterns of user movement in the real world, and use these patterns as a basis for predictions of the physical locations of users. This approach is analogous to our approach, since in TOWER the same predictions are made for the electronic world—that is, in TOWER we analyse the behaviour of users, try to identify patterns, and make predictions of future behaviour of users. These predictions are then mapped to movements of the avatars in the TowerWorld.

5 Conclusions

In this paper we have motivated the need for thorough analysis of the behaviour of users, which can facilitate the communication, coordination, and cooperation in distributed workgroups. We have described how the past and present behaviour of users are captured, analysed, and presented in TOWER. We have made suggestions as to how this approach can be used as a basis for predictions. Finally we have presented some recent approaches with similar ideas.

It is clear that already the analysis of the past and present behaviour of users has enormous implications on people’s privacy. Making detailed analysis and presenting typical behaviour and rhythms of users as well as making predictions on future reachability of users can add tremendously to these privacy challenges. In this paper we did not have the space to deal with these issues. However, there are some ideas on how improve the situation (e.g., reciprocity in the sense that all users are mutually informed about each other, and no users can only be observer of others without being visible to others).

ACKNOWLEDGMENTS

The research presented here was carried out by the IST-10846 project TOWER, partly funded by the EC. I would like to thank all colleagues from the TOWER team.

REFERENCES

1. Ashbrook, D. and Starner, T.E. Using GPS to Learn Significant Locations and Predictd Movement Across Multiple Usres. Personal and Ubiquitous Computing 7, 5 (Nov. 2003). pp. 275-286.

2. Beaudouin-Lafon, M. and Karsenty, A. Transparency and Awareness in a Real-time Groupware System. In Proceedings of the ACM Symposium on User Interface Software and Technology - UIST'92 (Nov. 15-18, Monterey, CA). ACM, N.Y., 1992. pp. 171-180.

3. Begole, J., Rosson, M.B. and Shaffer, C.A. Flexible Collaboration Transparency: Supporting Worker Independence in Replicated Application-Sharing Systems. ACM Transactions on Computer-Human Interaction 6, 6 (June 1999). pp. 95-132.

4. Begole, J.B., Tang, J.C., Smith, R.B. and Yankelovich, N. Work Rhythms Analysing Visualisations of Awareness Histories of Distributed Groups. In Proceedings of the ACM 2002 Conference on Computer-Supported Cooperative Work - CSCW 2002 (Nov. 16-20, New Orleans, LO). ACM, N.Y., 2002. pp. 334-343.

5. Bentley, R., Appelt, W., Busbach, U., Hinrichs, E., Kerr, D., Sikkel, K., Trevor, J. and Woetzel, G. Basic Support for Cooperative Work on the World-Wide Web. International Journal of Human Computer Studies: Special Issue on Novel Applications of the WWW (Spring 1997).

6. Borning, A. and Travers, M. Two Approaches to Casual Interaction Over Computer and Video Networks. In Proceedings of the Conference on Human Factors in Computing Systems - CHI'91 (Apr. 27-May 2, New Orleans, LO). ACM, N.Y., 1991. pp. 13-20.

7. Dourish, P. and Belotti, V. Awareness and Coordination in Shared Workspaces. In Proceedings of the Conference on Computer-Supported Cooperative Work - CSCW'92 (Oct. 31-Nov. 4, Toronto, Canada). ACM, N.Y., 1992. pp. 107-114.

8. Erickson, T., Smith, D.N., Kellogg, W.A., Laff, M. and Richards, J.T. Socially Translucent Systems: Social Proxies, Persistent Conversation, and the Design of Babble. In Proceedings of the Conference on Human Factors in Computing Systems - CHI'99 (May 15-20, Philadelphia, PE). ACM, 1999. pp. 72 -79.

9. Fitzpatrick, G., Mansfield, T., Kaplan, S., Arnold, D., Phelps, T. and Segall, B. Augmenting the Workaday World with Elvin. In Proceedings of the Sixth European Conference on Computer-Supported Cooperative Work - ECSCW'99 (Sept. 12-16, Copenhagen, Denmark). Kluwer Academic Publishers, Dortrecht, NL, 1999. pp. 431-450.

10. Fogarty, J., Hudson, S.E. and Lai, J. Examining the Robustness of Sensor-Based Statistical Models of Human Interruptibility. In Proceedings of the Conference on Human Factors in Computing Systems - CHI 2004 (Apr. 24-29, Vienna, Austria). ACM, 2004. pp. 207-214.

11. Gaver, W.W., Moran, T., MacLean, A., Lövstrand, L., Dourish, P., Carter, K.A. and Buxton, W. Realising a Video Environment: EUROPARC’s RAVE System. In Proceedings of the Conference on Human Factors in Computing Systems - CHI'92 (May 3-7, Monterey, CA). ACM, N.Y., 1992. pp. 27-35.

12. Gross, T. Ambient Interfaces in a Web-Based Theatre of Work. In Proceedings of the Tenth Euromicro Workshop on Parallel, Distributed, and Network-Based Processing - PDP 2002 (Jan. 9-11, Gran Canaria, Spain). IEEE Computer Society Press, Los Alamitos, CA, 2002. pp. 55-62.

13. Gross, T. and Prinz, W. Awareness in Context: A Light-Weight Approach. In Proceedings of the Eights European Conference on Computer-Supported Cooperative Work - ECSCW 2003 (Sept. 14-18, Helsinki, Finland). Kluwer Academic Publishers, Dortrecht, NL, 2003. pp. 295-314.

14. Gross, T., Wirsam, W. and Graether, W. AwarenessMaps: Visualising Awareness in Shared Workspaces. In Extended Abstracts of the Conference on Human Factors in Computing Systems - CHI 2003 (Apr. 5-10, Fort Lauderdale, Florida). ACM, N.Y., 2003. pp. 784-785.

15. Gutwin, C. and Greenberg, S. Design for Individuals, Design for Groups: Tradeoffs Between Power and Workspace Awareness. In Proceedings of the ACM 1998 Conference on Computer-Supported Cooperative Work - CSCW'98 (Nov. 14-18, Seattle, WA). ACM, N.Y., 1998. pp. 207-216.

16. Gutwin, C. and Greenberg, S. A Descriptive Framwork of Workspace Awareness for Real-Time Groupware. Computer Supported Cooperative Work: The Journal of Collaborative Computing 11, 3-4 (2002). pp. 411-446.

17. Gutwin, C. and Greenberg, S. A Desriptive Framework of Workspace Awareness for Real-Time Groupware. Computer Supported Cooperative Work: The Journal of Collaborative Computing 11, 3-4 (2002). pp. 411-446.

18. Heath, C. and Luff, P. Collaborative Activity and Technological Design: Task Coordination in London Underground Control Rooms. In Third European Conference on Computer Supported Cooperative Work (Amsterdam). Kluwer, 1991. pp. 65-80.

19. Ishii, H. TeamWorkStation: Towards a Seamless Shared Workspace. In Proceedings of the Conference on Computer-Supported Cooperative Work - CSCW'90 (Oct. 7-10, Los Angeles, CA). ACM, N.Y., 1990. pp. 13-26.

20. Ishii, H. and Ullmer, B. Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms. In Proceedings of the Conference on Human Factors in Computing Systems - CHI'97 (Mar. 22-27, Atlanta, GA). ACM, N.Y., 1997. pp. 234-241.

21. Patterson, J.F., Day, M. and Kucan, J. Notification Servers for Synchronous Groupware. In Proceedings of the ACM 1996 Conference on Computer-Supported Cooperative Work - CSCW'96 (Nov. 16-20, Boston, MA). ACM, N.Y., 1996. pp. 122-129.

22. Prinz, W., Graether, W., Gross, T., Kolvenbach, S., Klein, K.-H., Pankoke-Babatz, U. and Schaefer, L. TOWER: Presenting Activity Information in a Theatre of Work. In Supplement Proceedings of the ACM 2002 Conference on Computer-Supported Cooperative Work - CSCW 2002 (Nov. 16-20, New Orleans, LA). ACM, N.Y., 2002. pp. 91-94.

23. Roseman, M. and Greenberg, S. Building Real-Time Groupware with GroupKit, A Groupware Toolkit. ACM Transactions on Computer-Human Interaction 3, 1 (Mar. 1996). pp. 66-106.

24. Schaefer, L., Pankoke-Babatz, U., Prinz, W., Fatah gen. Schiek, A. and Oldroyd, A. DocuDrama. Virtual Reality 7, 1 (Dec. 2003). pp. 43-53.

25. Siewiorek, D., Smailagic, A., Furukawa, J., Moreveji, N., Reiger, K. and Shaffer, J. SenSay: A Context-Aware Mobile Phone. http://www-2.cs.cmu.edu/~aura/docdir/sensay_iswc.pdf, 2004. (Accessed 11/5/2004).

COMMUNITY SUPPORT IN COOPERATIVE INFORMATION ENVIRONMENTS FOR THE NEXT DECADE– WHY INVESTING IN LESS?

Konrad Klöckner [1]

1 SOME FOCAL POINTS OF THE RESEARCH FIELD

One of the main domains of Applied Informatics in the field of Distributed Systems is computer support for team work. Activities in that domain are known by the notions of groupware or computer-supported cooperative work (CSCW). It is a multidisciplinary research field including computer science, economics, sociology, and psychology and it focuses on developing new theories and technologies for coordination of groups of people who work together. Key issues are group awareness, multi-user interfaces, concurrency control, communication and coordination within the group, shared information space and the support of a heterogeneous, open environment which integrates existing single-user applications.

In order to build the integrated cooperation environments envisioned for the future, our goal is to define and develop a generic cooperation environment platform and to develop methods and tools for building prototypes of integrated cooperation environments on top of the platform more easily. Such a platform has to address integrated flexible coordination support that can deal with changing cooperation processes, making the environment situation-aware and adaptable to new usage situations, the integration of existing applications and information sources, and the provision of different cooperation modes - dedicated to work situations - as well as smooth transitions between them. The resulting methods and tools have to be tested and evaluated.

To achieve the full integration of cooperative work and cooperative learning the goal is to define an integrated architecture and to develop methods and tools for designing, implementing and maintaining integrated cooperative work and cooperative learning environments. Consequently, integration services have to support the re-use of knowledge and simple transitions between

1 Fraunhofer Institute for Applied Information Technology FIT, D-53754 Sankt Augustin, Germany,
Email: konrad.kloeckner@fit.fraunhofer.de

learning and working. The resulting environment will be an integrated but open environment that facilitates the use of learned knowledge and expertise by and within a distributed virtual organization. It must offer sufficient flexibility to support different styles of working and learning that may be developed within organizations and in this context the Web is an unforeseen chance to enhance group collaboration.

The field of CSCW sets out to define and enable new ways of work in the area of cooperative knowledge generation. But up to now there are only a few products which have penetrated the market. One of the main tasks in an (Inter-) networked society is to support people in working together in an electronic world. Providing the right piece of knowledge to the right person at the right time is a primary goal of knowledge management. Norms and conventions that have been established in an electronic world have to be obeyed. Work in the areas of business process management and of computer supported cooperative work holds a high potential for contributing to this goal, but so far, there are only few interactions among these fields. Thus, although innovative systems for business process support require the convergence and integration of tools and techniques from both areas.

2 Our Approach for a Knowledge Based CSCW Application

Instead of highly sophisticated single user applications we developed a Web based workgroup system that provides cross-platform collaboration services to groups using existing Web technologies. Despite the growth of interest in the field of CSCW, and the increasingly large number of systems which have been developed, it is still the case that few systems have been adopted for widespread use. This is particularly true for widely-dispersed, cross-organizational design teams where problems of heterogeneity in computing hardware and software environments inhibit the deployment of CSCW technologies. The combination of a global addressing system, network protocol, document mark-up language and client-server architecture provides for a simple method to search, browse and retrieve information as well as share information of their own with others. However, while clearly powerful and useful, this approach does not directly support more collaborative forms of information sharing, where widely-dispersed working groups work together to jointly author, comment and annotate documents, and engage in other forms of collaboration such as group discussions.

The aim of our WiKo research project is the design and implementation of a communication and collaboration platform for cooperative knowledge generation where the people that have this knowledge are dynamically internetted in Web based communities [2].

Together with industry partners from the E-commerce domain, the E-learning domain and the knowledge management domain we have specified relevant scenarios in cooperative knowledge generation. We are designing tools that will be integrated in a cooperation platform that supports those electronic knowledge generation processes.

We are concentrating on cooperative consultancy by the members of a community specialized in a focused community as well as for experts in a virtual dynamically reconfiguring project team. Our platform supports the cooperative knowledge generation by:

- localizing the experts for building project teams with adequate competence profiles;
- maintaining the generated knowledge structure by the community members.

The platform is intended to be adapted in an evolutionary way to the demands of the application partners and as well tested and evaluated by them.

WiKo improves cooperative knowledge management for knowledge-intensive services. Today's systems for online consultancy, for example, put clients into a rather passive role, due to restricted interaction possibilities with Web forms, e-mail or telephone. Services for cooperative creation of knowledge are lacking, but are necessary for a successful service completion.

The result of WiKo is the conceptual design, development, testing, and evaluation of a platform for cooperative online consultancy. The WiKo platform provides services, which makes online consultancy as rich as real-world consultancy. Community building and management is supported. Members have means for self organisation - they can cooperatively collect, structure, and maintain knowledge while getting information about the activities of others. Functions like adding documents to the community or contacting other community members are directly accessible:

- Community building and management
- Means for membership management and structuring and organizing the knowledge of a community are provided. For example, the definition of roles allows controlled access to the community and the knowledge base.
- Support for cooperation
- Both synchronous and asynchronous interaction between community members is supported.
- Collecting and structuring of information

- The knowledge base of a community could consist of different types of documents, web pages, e-mails, chats, etc. Annotations and ratings are also possible. Content-based access to the knowledge is supported through a network that links together the documents. The network is based on a collection of concepts built jointly by the community members.
- Enabling of group awareness
- An event and notification infrastructure collects and distributes events, so that clients can keep track of the dynamic developments in the community [4]. The notification about activities is adapted to the social and organisational context and depends on personal preferences.

Development partners in the WiKo project are Fraunhofer ISST, IG Metall, Deutsche Telekom AG and ProcessWare GmbH. The project started in April 2002 and acted until April 2004.

An essential part of the WiKo platform for community support was the BSCW system. The basic idea of the BSCW system is the autonomously managed shared workspace which the members of a community use for the organization and coordination of their tasks [3]. The community members can upload documents from their local computer to the workspace as well as access documents in the workspace, e.g. for processing them. Such a workspace can contain different types of (electronic) objects such as folders, documents, tables, graphics or links to WWW pages [1]. In addition to the comfortable document management, there are a notification service providing information about current activities and a great number of functions and object types for more extensive support of cooperation. The user of the system only requires one of the usual browsers such as Netscape Navigator or Microsoft Internet Explorer.

In order to keep all community members informed about changes in the knowledge base (who, what, when) an awareness infrastructure is set up in order to inform everybody about object modifications he is interested in and he is allowed to access. The result of comparing various collaboration platforms for the WiKo project resulted in choosing BSCW for our further development, because the set of basic procedures for the knowledge co-production purpose seems to be most promising for our design environment.

The concept of awareness defines the essential difference between systems supporting groups and on the other hand pure database application. For groupware applications like shared workspace systems it seems to be crucial to recognize immediately what has happened in a shared workspace in order to determine the participants' further actions.

3 Some Conclusions

We are convinced that investing in “single-user-minded” group applications does not lead to solutions demanded by knowledge based groupware systems for the next decade.

In the WiKo project we studied the application field of knowledge based collaboration support and collected some basic requirements for knowledge co-production and showed some mechanisms to enhance awareness in communities that generate this knowledge. The experiences gathered in the last year show that WiKo is able to solve some of the main tasks in the large field of electronic collaboration support.

I sincerely want to thank our development partners in the WiKo project i.e. Fraunhofer ISST and our application partners i.e. IG Metall, Deutsche Telekom AG and ProcessWare GmbH for discussions and ideas brought on this subject.

4 References

[1] Bentley, R., Appelt, W., Busbach. U., Hinrichs, E., Kerr, D., Sikkel, S., Trevor, J. and Woetzel, G., Basic Support for Cooperative Work on the World Wide Web, in: International Journal of Human-Computer Studies 46(6): Special issue on Innovative Applications of the World Wide Web, 1997.

[2] Gräther, W.; Klöckner, K.; Kolvenbach, S., Community support and awareness enhancements for cooperative knowledge generation, In: IEEE Proceedings of the 29th EUROMICRO Conference, Belek (Turkey), September 1–6, 2003 / Chroust, G.[Hrsg.], IEEE, Los Alamitos, p. 165-170, 2003.

[3] Horstmann, T., Bentley, R., Distributed Authoring on the Web with the BSCW Shared Workspace System, in: ACM Standards View 5(1), ACM Press, 1997.

[4] Kolvenbach, S.; Gräther, W.; Klöckner, K., Making Community Work Aware, In: IEEE Proceedings of the 12th Euromicro Conference on Parallel, Distributed, and Network-Based Processing, A Coruna (Spain), February 11-13, 2004, IEEE, Los Alamitos, p. 358-363, 2004.

BRIDGING GAPS IN COOPERATIVE ENVIRONMENTS

Gerhard Chroust, Christoph Hoyer [1]

1 MOTIVATION

The growing complexity and interdisciplinarity of problems require cooperative [2] team work in order to synergetically combine the know-how of specialists from different areas [1][21] [27]. This need is strongly felt in the area of systems and software engineering, due to the growing dependency of our society on systems solutions provided by Information and Communication Technologies (ICT).

Face-to-face meetings (classically "multi-person, same-place, same-time collaboration events") were and are the standard means of cooperation. Despite their disadvantages (cost and f travelling time, ineffectiveness and parallelism of group discussions, disruption of one own's work, ...) one still needs them to accomplish subtle human interactions like building trust, removing underlying emotional barriers, motivating highly creative team work, etc. Managers and knowledge-workers spend more than half of their time in meetings [35] [44].

Running a face-to-face meeting (cf. Fig. 1) has the consequence of

- removing participants from their original work environments,
- reducing / disabling contacts to their original work environment, and
- bringing participants together in a new work environment which is strongly oriented towards internal communication.

Convening a meeting thus generates several *gaps* with respect to the original cooperative structure of these persons. Additionally in their new meeting environment the participants will exhibit numerous differences and due to these differences other gaps will arise in their cooperation. These gaps can be caused by differences in language, mentality, educational, level of information, creativity, attention, perception, capability to provide inputs, to receive outputs etc. On the other

[1] J. Kepler University Linz, Institute for Systems Engineering and Automation, Altenbergerstr. 69, 4040 Linz, austria,, e-mail {gc, hoc} @ sea.uni-linz.ac.at

[2] We use the term *cooperation* for all types of human interaction striving for a common goal and we reserve the term *collaboration* to situations where the cooperative effort is concentrated on one common artifact.

hand if a person is unable to join the meeting (for any reason) or has to leave the meeting, a *gap* occurs in the cooperative structure of that meeting.

In the past mostly the physical presence/absence was considered as a gap. Many methods and tools have been invented to *'bridge'* such gaps (e.g. telephone-conferences, video-conferences, chat-rooms, etc.).

The tremendous boost of technology in networking ("pervasive" and "ubiquitous" computing), in alternative computer interactions (Personal Digital Assistants, virtual realities, mixed realities, wearable computing, software agents, ...) and powerful computational support (search engines, simulation, ...) has provided us with new ways of *bridging these gaps* and has at the same time stimulated changes in the form and methods of cooperative work (technology push). These new forms and methods in turn have been the source for new technological requirements and solutions (technology pull).

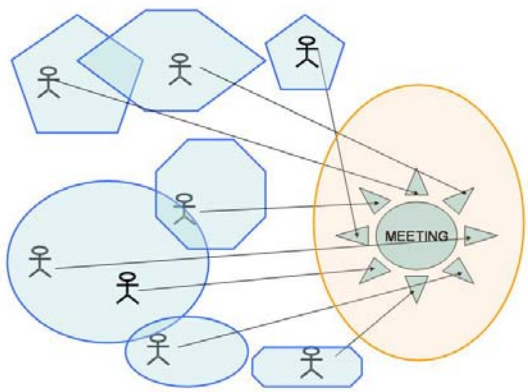


Figure 1: Work environment boundaries

It is our feeling that the possibilities of the latest technological advances (technology push) have not yet fully and creatively been translated into new cooperative paradigms (cf. Brigg's Thinklets [4] [15]). Special efforts are needed to study and implement the new opportunities and options offered by technology, but at the same time the psychological underpinning has to be taken into account. In one sentence: *Cooperation Engineering* as an systemic and engineering approach is called for to succeed in this arena.

The rest of the paper is structured as follows: In chapter 2 we discuss several dimensions of cooperative work in relation to space, time and intensity of cooperation. Chapter 3 analyses gaps and classifies them into different categories. In chapter 4 we present past and present generations of technological meeting support aimed at reducing gaps with respect to meetings. Research issues and an outlook are presented in the concluding chapter 5.

2 Dimensions of Cooperative Work

In order to identify and classify gaps it will be necessary to understand the dimensions relevant to cooperative work. We start off with the classical face-to-face meeting as the primitive and ancient form of cooperation. Traditionally cooperative work is considered in 3 dimensions (Fig. 2): time, space and intensity of cooperation [10] [16] [32] [41] [58].

space : The most obvious one is distance. In general we only distinguish three manifestations:

- collocated
- dislocated, but predictable locations
- dislocated and unpredictable locations

time : With respect to time we make a similar distinction:

- synchronous
- asynchronous, at predictable time instances
- asynchronous, at unpredictable time instances

intensity of cooperation : Cooperative work can take place on several levels of intensity where the higher levels need the support of subsidiary levels.

- **Coexistence** : Independent use of common resources (e.g. with respect to an operating system) without explicit knowledge or consideration of one another
- **Communication** : Information exchange between participants (e.g. via E-mail)
- **Coordination** : Achieving agreement on structural and procedural forms and protocols (e.g. via an electronic meeting scheduler)
- **Consens** : Achieving agreement on the contents of given issues or artifacts achieved (e.g. using a decision support system)
- **Collaboration** : Performing work on common artifacts concurrently (e.g. by use of a shared editor)

In Fig 2 the three dimensions are depicted. Fig. 3 shows an intuitive picture of the 5 levels of cooperation. Basically each level is concerned with sharing some artifact or piece of information under the control of a participant. Multi-person situations are similar, but with more interconnections.

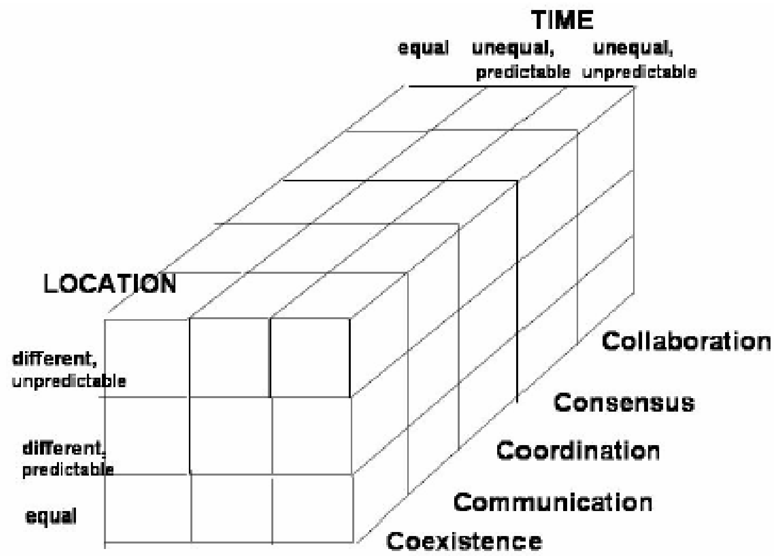


Figure 2: The three major dimensions of cooperation

The levels of cooperation are closely related to the semiotic levels of language: The syntactic level covers essentially Coexistence, Communication and Coordination. Semantics is involved in Coordination, Consensus and Collaboration, while Pragmatics is related to Consensus and Collaboration.

We should note, however, that strictly speaking the levels of cooperation do not form a true hierarchy but a recursive bootstrapping situation: e.g. in order to have some communication, there is some a-priori coordination needed to avoid complete chaos and confusion. For the time being we ignore this secondary effect.

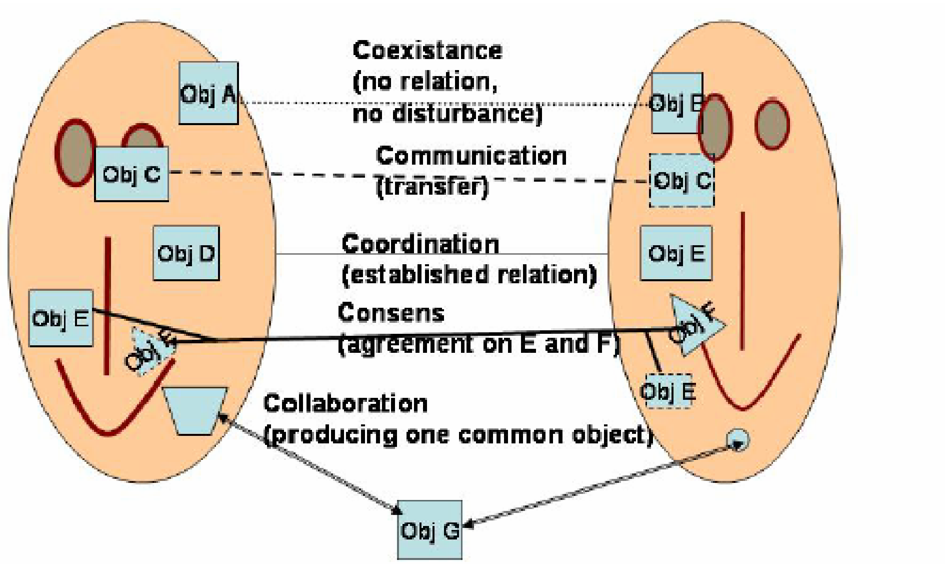


Figure 3: An intuitive picture of the 5 cooperation levels

In cooperative situations the *channel(s)* are also of considerable concern, the most basic ones being the visual and the acoustic channels. Additional channels are body language, printed documentation, etc. Gaps affect the various channels in different ways. Gaps can often be bridged by switching to a different channel. Different channels also show different properties with respect to the technological possibilities of supporting the various levels of cooperation.

3 Gaps with respect to cooperation

An initial classification of gaps is shown in Fig. 4.

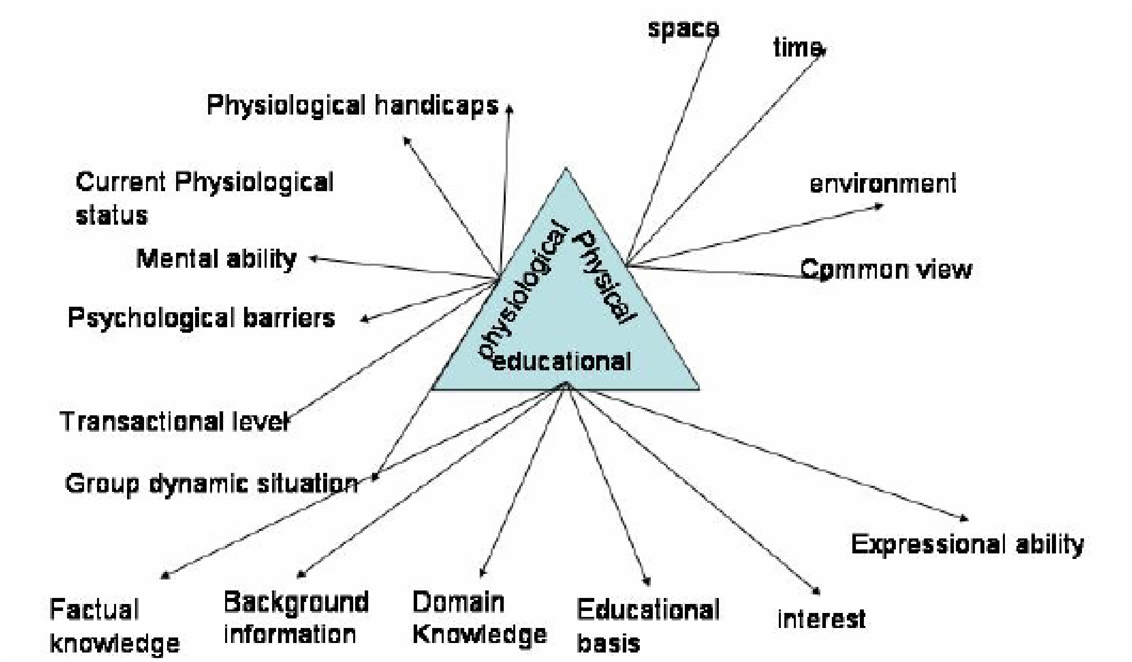


Figure 4: Dimension of gaps in cooperation

Seen from the viewpoint of an individual participant three essentially different classes should be separated:

physical dimension : This class includes factors which are largely outside of the participants immediate control. They include

- space e.g. dislocated participants
- time e.g. time zones
- environment e.g. noise, light , channel quality
- commonality of view e.g. does everybody see the same thing?

physiological dimension : These are related to an individual's predisposition, and influence the ability to receive and to give communications. Factors are

- physiological handicaps hearing, sight, ...
- physiological state tiredness, illness, ...
- mental abilities ability to abstract, to imagine etc.
- psychological barriers e.g. prejudice, cultural inhibitors, psychopathological dispositions etc. [53]
- transactional level transactions with respect to the theory of Transaction Analysis
- group situation position of the individual within the group and group dynamics [2] [17] [42]

cultural/educative dimension : Here we include all factors which are basically formed by education, social integration, professional training, formal education and training, etc. The most important ones are:

- factual knowledge learnt from briefings and/or preparation or even desinformation
- background knowledge additional information not directly contained in the 'official briefings' but supplied as an add-on etc.
- domain knowledge general background on the domain in which the actual topics of the meeting are situated
- educational basis acquired knowledge related to the meeting
- expressional ability dialectic ability, mathematical ability, drawing ability
- interest in the topics personal motivation and involvement

4 Generations of Gap-bridging Tools

Initially only collocated and synchronous participation guaranteed cooperation (e.g. the ancient tribal group meeting [52]). Therefore the bridging of gaps was primarily oriented toward time and space gaps. Telephone conferences, video conferences and virtual meetings are ample evidence of this. Looking back we notice a mutual licitation between new technologies providing new opportunities ("technology push") and - often triggered by new technology - new demands ("technology pull") caused by the need to communicate more effectively and to apply additional tools to support cooperation.

The generations of cooperative tools listed below demonstrate this effect and show the tendency to replace one or the other aspect of face-to-face collaborative work by methods and supportive technology, enlarging collaborative contributions both from participants/stakeholders and information sources, also discussed as "Collaboration Engineering". Each generation tried to reduce gaps, but as one can see most of it was concerned with dislocation.

4.1 1st generation: shared view by using individual computer support :

Pre-prepared information, static or animated, was presented from individual computers, using LCD-Panels and beamers, interactive blackboard/white boards [30] [13] and ’white board tracers’ [14] [http://www.mimio.com/]. This yielded higher editorial and graphical quality and could be shared by the group.

Gaps addressed:

- common view
- expressional ability

4.2 2nd generation: shared workspace/networking - LAN-support :

Locally interconnecting individual computer allowed parallel input, working in a shared workspace and improved clerical support.

Gaps addressed:

- common view (with respect to individual user’s data)
- expressional ability
- factual knowledge
- psychological barriers (by allowing individual views, anonymity etc., unobtrusiveness of technology (typically generation 2B)
- expressional ability due to different group supporting tools
- space (typically generation 2B)

Generation 2A: permanently mounted monitors :

Since approx. 1993 Electronic Meetings Rooms [32] [48], [38], [39], [43] were equipped with special furniture and disturbingly obtrusive monitors, like SEA’s PQS-Room (Fig. 5) [9] [24][25] [40].

Figure 5: SEA's PQS-Room – arrangement

Generation 2B: Notebook-based support :

Notebooks achieved a certain degree of unobtrusiveness (Fig. 6) and added mobility by allowing the 'room' to travel to customer sites[3] . [18][18b].

Figure 6: PQS-Room in Linz, generation 2A

4.3 3rd generation: Internet-connection - communication with the outside world :

External partners are able to participate via virtual meeting software [34] [18b] [46] [56]. A participant can access just-in-time necessary information in his/her home environment and also a wealth of information on the Internet.

Gaps addressed:

- space
- factual knowledge
- background information

[3]funded by a grant from the Land Oberoesterreich this was also implemented at the authors' institute.

Generation 3A: limited ubiquity - notebook technology :

Notebooks reduced the space gap and allowed limited ’everywhere access’ but still needed a table-like support, good light, two free hands, etc.

Generation 3B: full ubiquity - PDA-technology :

Personal Digital Assistants (PDA), built for true mobile use, eliminate a loss of communication and allowed an "anywhere and anytime" collaboration, but showed limits in performance and functionality due to display size, computing power and bandwidth [6] [50].

4.4 Generation 4: Mixed reality support :

In a mixed reality environment the reality and the virtual reality are overlaid and give one homogeneous picture. Mixed reality environments bridge the information gap between the reality and the available virtual information. This allows different views and insights which are not available to pure reality or virtual reality. High-tech meeting rooms with video and immersive techniques [20][26] [55] [60], high resolution cameras, tracking systems, large interactive screens, holoscreens [4] , Mobile CAVEs [5] bridge the emotional gaps due to more realistic virtual environments but at enormous costs and the lack of spatial mobility.

Gaps addressed:

- common view
- expressional ability
- factual knowledge
- psychological barriers (by being able to draw some virtual constructs on top of the ’real world’)
- mental ability

Generation 5: Wearable Computing - ubiquitous mixed reality collaboration :

Wearable computing [57][51] eliminates the haptic gap between the use of a computer and the desire/need to communicate just-in-time. They also provide usage of mixed reality devices (e.g. see-through goggles (Fig. 7 [6]) at (relatively low) cost and in a (soon) unobtrusive way, making this

---

[4] http://www.barco.com/projection_systems/virtual_and_augmented_reality/content/products/overview.asp?TreeID=116

[5] http://www.pmsmicro.com/plasmaKioskV1a.html

[6] http://www.microopticalcorp.com/

effect available everywhere [11][45] [47] [51] [54] (Fig. 8). Numerous, sometimes trivial problems (incompatible light, "not enough hands", noise level) have to be solved to effectively use such techniques.

Fig. 7: Microoptical's mixed reality glasses

Fig. 8: Mixed Reality Meeting Support

Gaps addressed:

- space
- factual knowledge
- procedural knowledge
- mental ability (memory)

Generation 6: Active Collaboration Support - Software Agents

Software agents are able to accomplish many of today's tasks autonomously on behalf of their masters, both clerical, low-intellectual repetitive tasks and certain highly intelligent tasks like information provision, advice giving, negotiating [3] [5] [7] [12] [29] [59]. They also alleviate the problem of multiple types of interactions to take place simultaneously: human-human, human-agent [59], and agent-agent [12].

Gaps addressed:

- factual knowledge
- background information
- expressional ability
- mental ability
- psychological barriers

5 Directions and Open Issues

For the near future we have to *investigate different types of collaboration and related gaps* especially with respect to their mutual influences.

In more detail this means:

- Provide an ontology of typical gaps with respect to various communication channels and cooperation levels. This ontology should identify important phases in the collaboration processes (e.g. problem analysis), the methods used and their susceptibility to cooperational gaps (cf. [4]).
- Identify, analyse and prototype means to bridge such gaps using current and emerging technology.
- Establish feasibility, usability and psychological acceptability, ergonomic suitability and basic physiological requirements. It offers the special chance to bridge gaps for handicapped persons [37]. Economic affordability (especially for SMEs!) and the return on investment justify intensive analysis [8] [23]][22] [28] [30] [31] [32] [36] [49].
- Investigate the substitution of different channels in order to overcome gaps by 'circumvention'.
- Investigate the useability of new technology with respect to collaboration and identify the respective limits (e.g. bandwidth and screen size of PDAs [50]). This includes observing the technological market for applicable leading-edge technological support, making a list of available (or soon coming) technological achievements which are economically feasible and study their applicability to bridge certain collaborative gaps [33].
- Consider financial, temporal, psychological and ergonomic limits for such technology especially in the area of SMEs.
- Prototype technological means to bridge these gaps in order to open the obstructed channel for collaboration.
- Adapt and re-evaluate old methods and practices which were infeasible at the time of inventions but might - due to the technological advance - provide today superior support.

6 Summary

In this paper we approached the problem of cooperation from an analytical point: based on an existing hierarchy for cooperative interaction we identified gaps in cooperative work due to missing communication media or channels. We further identified technological means to overcome them. It is believed that this approach will bridge many of the existing gaps making cooperation more effective and productive.

7 References

[1] ARMOUR, P.G. *Matching Process to Types of Teams* Comm. ACM vol. 44 (2001), No. 7, pp. 21–23.

[2] BERNE, E. *Struktur und Dynamik von Organisationen und Gruppen* Kindler Taschenbücher, München.

[3] BIC, L. F., M. FUKUDA , M. DILLENCOURT *Distributed Computing using Autonomous Objects* IEEE Computer vol. 29 (1996) no. 8, pp. 55–61.

[4] BRIGGS, R.O., G. DEVREEDE , J. F. J. NUNAMAKER *Collaboration Engineering with ThinkLets to Pursue Sustained Success with Group Support Systems* Journal of Management Information Systems Vol. 19 (2003), No. 4, pp. 31–63.

[5] CASSEL, J. *Embodied Conversational Interface Agents* Comm. ACM vol. 43 (2000), no. 4, pp. pp 70–78.

[6] CHAWATHE, Y. , S. FINK *TopGun MediaBoard - A Shared Whiteboard for PDA's* http://www.research.att.com/ yatin/publications/docs/cscw/main.html, (May 2003).

[7] CHEN, H., A. HOUSTON , J. NUNAMAKER *Towards Intelligent Meeting Agents* IEEE Computer vol. 29 (1996) no. 8, pp. 63–70.

[8] CHROUST, G. *Motivational Issues in Component Based Software Development* in: *Trappl, R.: EMCSR 2002, Proc. European Meeting on Cybernetics and Systems Research, Vienna, April 2002*, pp. 165–170 ISBN 3 85206 160 1.

[9] CHROUST, G. , A. PAMMINGER *PQS-Team-Room, Need or Annoyance?* in: *G. Chroust and Doucek, P. (eds.): IDIMT-96 : 4nd Interdisciplinary Information Management Talks, Schriftenreihe der Österr. Computergesellschaft, Oldenbourg 1996*, pp. 140–148 ISBN 3–85403–094–0, ISBN 3–486–24033–1, ISBN 3–7029–0424–7.

[10] CHROUST, G. *Is there Groupware beyond E-Mail?* in: *Sugar, P., G. Chroust (eds.): CON'96: Future Information Technologies - 11th Austrian-Hungarian Informatics Conference*, pp. 137–145 Schriftenreihe der Österr. Computergesellschaft, No. 95, Oldenbourg 1996 ISBN 3-486-24059-5.

[11] FLEISCHMANN, M. , W. STRAUSS *Linking between real and virtual spaces: building the Mixed Reality stage environment* in: *Proc. 2nd Australasian User Interface Conference (AUIC'01)* IEEE 2001.

[12] FLORES, R.A. , N. WINJGAARDS *Primitive interaction protocols for agents in a dynamic environment* in: *in B.R. Gaines, R.C. Kremer, and M. Musen (Eds.): Proc. of the 12th Workshop on Knowledge Acquisition, Modeling and Management (Kaw '99), Banff, Canada, Vol. 1, 1999*, pp. 3–2–1:3–2–20 – also http://sern.ucalgary.ca/KSI/KAW/KAW99/papers/Flores1/.

[13] GMD-IPSI *Workspaces fo the Future* http://www.darmstadt.gmd.de/IPSI/cospace2.thml (März 2000).

[14] GROENBAEK, K., K. GUNDERSEN, P. MOGENSEN , P. OERBAEK *Interactive Room Support for Complex and Distributed Design Projects* http://as15.iguw.tuwien.ac.at/desarte/IRoomForDesign-21.pdf, (Feb. 2003).

[15] GROUP SYSTEMS.COM *The Birth of Collaboration Engineering* http://www.groupsystems.com/success/reports/GS_report1.htm.

[16] GRUDIN, J. *Computer-Supported Cooperative Work - History and Focus* IEEE Computer May, pp. 19–25

[17] HEIGL-EVERS, A., (ed.) *Gruppendynamik* VR- Kleine Vadenhoeck Reihe, G/"ottingen.

[18] HOFER, C. , H. TLUSTY *creativeMEETING: Concept and Architecture of a Web-Based Electronic Meeting Room* in: *Proceedings of i3 Spring Days, Athens, Greece, March 2000*.

[19] HOFER, C. , H. TLUSTY *creativeMEETING V+: A Virtual Extension of an Electronic Meeting Room.* in: *Grzech, A. and Wilimowska, Z. (Eds.): Information Systems Architecture and Technology. Proceedings of the 22nd ISAT-2000, Szklarska Poreba, Poland, 2000. pp. 184-194* ISBN 83-7085-502-4.

[20] HOLM, R., E. STAUDER, R. WAGNER, M. PRIGLINGER , J. VOLKERT *A Combined Immersive and Desktop Authoring Tool for Virtual Environments* in: *Virtual Reality 2002 , Orlanda, Florida 2002*.

[21] HOLSAPPLE, C.W. , K. JOSHI *A Collaborative Approach to Ontology Design* Comm. ACM vol. 45(2002), no. 2, pp. 42–47.

[22] HSU, C. YEE L. *Model-Based Visualisation for Enterprise Information Modelling* Rozenblit J. (ed.): AIS-93, 4th Conf. on AI, Simulation, and Planning in High Autonomy Systems, Tuscon Sept, IEEE C/S Press, pp. 324–327 ISBN 0-8186-4020-0.

[23] HUDSON, NN. *Input (Part I : devices)* http://www-2.cs.cmu.edu/ hudson/teaching/05-631/slides/slides05-input-devices.ppt, (Dec. 2003).

[24] HUMER, N. *Die Elektronische Fakultät - Neue Kommunikationsformen und -techniken bei Sitzungen und Konferenzen* Diplomarbeit, Kepler Universität Linz, Sommer.

[25] HUMMEL, T. *Chancen und Grenzen der Computerunterstützung kooperativen Arbeitens* Gabler Edition Wissenschaft 1996, Wiesbaden.

[26] ISHII, H., M. KOBAYASHI , J. GRUDIN *Integration of Inter-Personal Space and Shared Workspace: ClearBoard Design and Experiments* Turner J., Kraut R. (eds): CSCW-92, Sharing Perspectives Proc. Conf. on Computer-supported Cooperative Work, Oct.13-Nov.2, Toronto., ACM Press, pp. 33–42.

[27] KATZENBACH, J.R. , D. SMITH *The Wisdom of Teams* Harvard Business School Press, Boston.

[28] KELLER, P.R. , M. KELLER *Visual Cues - Practical Data Visualization* IEEE Copmputer Press, 1993, Los Alamitos, USA ISBN 0-8186-3102-3.

[29] KERSTEN, G. , ET AL. *Negotiation and the Web: Users' Perceptions . . ..*

[30] KIRSCHNER, P. A., S. J. B. SHUM , C. CARR, (eds.) *Visualizing Argumentation - Software Tools for Collaborative and Educations Sense-Making* Springer , London 2003 ISBN 1-85233-664-1.

[31] KUNDA, D. , L. BROOKS *Human, Social and Organisational influences on Component-Based Software Engineering* in: *ICSE 99* http://www.sei.cmu.edu/cbs/icse99/ papers/19/19.htm.

[32] LEWE, H. *Computer Aided Team und Produktivität* Deutscher Universitäts Verlag, Gabler Edition, Wiesbaden ISBN 3-8244-6186-2.

[33] LYYTINEN, K. , Y. YOO *Issues and Challenges in Ubiquitous Computing* CACM vol. 45 (2002), no. 12, pp. 63–73.

[34] MCCARDLE, E. S. *Nonverbal Communication* Marcel Dekker, New York ISBN 0-8247-6126-X.

[35] MÜLLER-BÖLLING, X *Soziologische Studie durchleutet: Manager Alltag* Bild der Wissenschaft, 1:1.

[36] MYERS, W *Why Software Developers Refuse to Improve* IEEE Computer vol. 31 (1998) no. 4, pp. 112ff.

[37] N.N. *Alternate Inputs* http://www.jan.wvu.edu/media/altinput.html.

[38] NUNAMAKER, J. *Information Technology to Support Electronic Meetings* MIS Quarterly 12/88.

[39] NUNAMAKER, J.F. et. al. *Electronic Meeting Systems to Support Group Work* Comm ACM, 34:7:40–61.

[40] PAMMINGER, A. *Der Electronic Meeting Room* Master's Thesis, , Kepler Univ. Linz, Austria, 1997.

[41] PANKO, R.R. , S. KINNEY *Meeting Profiles: Size, Duration, and Length* 28th Hawaii INt. Conf. on System Sciences (HICSS'95, pp. 1002–1011.

[42] PENLAND, P.R. , S. FINE *Group Dynamics and Individual Development* M. Dekker, New York 1973.

[43] PETROVIC, O. *Workgroup Computing - Computergestützte Teamarbeit* Physica-Verlag 1993.

[44] POLLARD, C.E. , S. HAYNE *The Reality of Meetings and Use of Electronic Meeting Tools* http://hsb.baylor.edu/ramsower/ais.ac.96/papers/pollard.htm.

[45] POUPYREV, I., D. TAN, M. BILLINGHURST, H. KATO, H. REGENBRECHT , N. TETSUTANI *Tiles: A Mixed Reality Authoring Interface* in: *Proc.Interact'01 (Tokyo, Japan, 2001)*, pp. 334–341.

[46] REGENBRECHT, HOLGER T. , M. T. WAGNER *Interaction in a collaborative augmented reality environment* in: *Conference Extended Abstracts on Human Factors in Computer Systems*, pp. 504–505 ACM Press.

[47] SCHMALSTIEG, D. *Projekt Studierstube* http://www.studierstube.org.

[48] SCHWABE, G. *Objekte der Gruppenarbeit* Deutscher Universitätsverlag, Gabler Edition, Wiesbaden.

[49] SELVIN, A. M. *Forstering Collective Intelligence: Helping Groups Use Visualized Argumentation* in: *Kirschner, P. A. and Shum, S. J. B. and Carr, C.S. (eds.): Visualizing Argumentation - Software Tools for Collaboartive and Educations Sense-Making*, pp. 137–163 Springer , London 2003 ISBN 1-85233-664-1.

[50] SEYFF, N. *Risikoorientierte Software-Entwicklung für mobile Systeme: Die Realisierung des ARENA-M Systems* Master's Thesis, , J. Kepler University Linz , Spring 2003.

[51] SHELL, J.S., T. SLEKER , R. VERTEGAAL *Interacting with Groups of Computers* Comm ACM vol. 46 (2003) no. 3, pp. 40–46.

[52] SOPOVA, J. *In the shade of the palaver tree* http://www.unesco.org/ courier/1999_05/uk/signes/txt2.htm.

[53] STEWART, I. , V. JOINES *TA - Today, A new Introduction to Transactional Analysis* Lifespace Publ., Nottingham, Chapel Hill ISBN 1-870244-00-1.

[54] STRAUSS, W., M. FLEISCHMANN, T. M., J. NOVAK, U. ZLENDER, T. KULESSA , K. PRAGASKY *Staging the space of mixed reality - Reconsidering the concept of a multi user environment* http://www.c-lab.de/vrml99/vrml99papers/strauss.pdf.

[55] TAKEMURA, H. KISHINO F. *Cooperative Work Environment Using Virtual Workspace* Turner J., Kraut R. (eds): CSCW-92, Sharing Perspectives Proc. Conf. on Computer-supported Cooperative Work, Oct.13-Nov.2, Toronto., ACM Press, pp. 226–232.

[56] TERVONEN, I., L. HARJUMAA , J. IISAKKA *The virtual logging meeting: a web-based solution to resource problems in software inspections* Proc. ADV-SQ-99, Vienna, pp. 10.

[57] VERTEGAAL, R. *Attentive User Interfaces* Comm ACM vol. 46 (2003), no. 3, pp. 31–33.

[58] WARD, KAREN, C. R. MARSHALL , D. G. NOVICK *Applying Task Classification to Natural Meetings* Technical Report No. CS/E 95-011, Dept. Computer Science and Engineering Oregon Graduate Institute of Science & Technology.

[59] YAMADA, S. , T. YAMAGUCHI *Mutual Adaptation to Mind Mapping in Human-Agent Interaction* in: *2002 IEEE Int. Workshop on Robot and Human Interactive Communication, Berlin, Sept 25-27, 2002*, pp. 105–110 IEEE.

[60] ZHANG, MAOJUN, L. WU, L. SUN, Y. LI , B. YANG *VCS: a virtual environment support for awareness and collaboration* in: *Proceedings of the seventh ACM international conference on Multimedia (Part 2)*, pp. 163–165 ACM Press.

EMPIRICAL EVALUATION OF CYCLADES: A COOPERATIVE KNOWLEDGE MANAGEMENT ENVIRONMENT

Tom Gross[1], Dian Tan, Wido Wirsam[2]

Knowledge management is often viewed as a structured process of eliciting knowledge, storing knowledge, and later retrieving by individuals. In this paper we argue that knowledge management should be seen as a dynamic process—an interaction between experts. We start with a motivation for this cooperative perspective of supporting knowledge management through support for the creation and exchange of knowledge in communities. We introduce the CYCLADES environment—an open cooperative virtual archive environment based on open archives—and we present an empirical study of its use. A final discussion will reveal some important lessons for the design of cooperative knowledge management environments.

1 Introduction

Knowledge management is often viewed as a structured process of eliciting knowledge, storing knowledge, and later retrieving by individuals. In this paper we argue that knowledge management should be seen as a dynamic process—an interaction between experts. We would like to depart from some epistemological considerations. A thorough discussion of epistemology would go beyond the scope of this position paper; nevertheless, we need to clarify some basic notions: in the context of this paper data is seen as raw; information is data with meaning; and knowledge is verified information. Expertise is seen as the 'embodiment of knowledge and skills within individuals' [11]. Whereas data and information can be easily processed by and exchanged via computers, the verification that is inherent in knowledge is typically a human activity, which can only be delegated to computers and mediated through information systems and knowledge management system to some extent. Expertise is *per definitionem* human. It is important to also see the 'knowing' and not only the 'knowledge' [1]. Therefore, sharing and exchanging knowledge and expertise cannot be

[1] Faculty of Media, Bauhaus-University Weimar, Germany
tom.gross(at)medien.uni-weimar.de
[2] Fraunhofer Institute for Applied Information Technology FIT, 53754 St. Augustin, Germany
{dian.tan, wido.wirsam}(at)fit.fraunhofer.de

automated totally. In a study Twidale and associates [13] identified several tactics of information seekers. Information seekers can consult colleagues and ask them for information and references; they can wander around to search for information and hope to meet others coincidentally; they can do brainstorming to generate numerous ideas; or they can bibble—that is, they can look for existing bibliographies to the same or a similar topic (this strategy is often used on the WWW, when users use the bookmark list of other users with similar interests).

The results of the above studies have clear implications for the design of systems that aim at supporting the flexible sharing and exchanging of knowledge. First, technology has to extend the reach of the single knowledge worker; so, she can easily and flexibly contact other persons and share and exchange knowledge when needed. Flexible switching between solitary work and information seeking and spontaneous contacts and dialogues with others are a core requirement for flexible sharing and exchange of knowledge. Kuhlthau [8] developed the notion of zone of intervention as an area in which users are very efficient in gathering the information needed. She defines a zone of intervention as: ‘that area in which an information user can do with advice and assistance what he or she could not do alone’. Secondly, technology needs to empower communities of knowledge workers to establish a common knowledge base over time—often called community memory. Marshall and associates [10] argue that ‘when people work together—whether in designing a product, or creating training materials from video-based documentation, or writing a coherent analysis of a complex situation in the world—they require, and put effort into constructing and maintaining, shared understandings of what they are doing’. They define a community memory as an ‘open-ended set of shared interpretations and understandings developed and maintained by the group’.

Subsequently, we introduce the CYCLADES environment, which supports this cooperative approach to sharing and exchanging knowledge. The CYCLADES environment is an open collaborative virtual archive environment that supports knowledge workers with functionality for searching and browsing in pre-print (e-print) archives as well as for sharing and exchanging their findings in virtual communities. Existing systems typically only provide a part of the functionality needed. CYCLADES combines functionality that is partly available in other, more or less isolated systems. For instance, some systems support the information retrieval of online literature such as the digital libraries of the ACM and of IEEE for computer science, Math-Net for mathematics [3], or arXiv for physics [15]. Other systems such as Wikis [16] or BSCW [2] allow users to share and exchange documents in groups or communities, but do not provide functionality for information retrieval of online literature. In general, most of these systems are designed and implemented as stand-alone, closed applications. The CYCLADES environment combines functionality for information retrieval and for sharing and exchanging information in groups and communities. It is compliant to the Open Archive Initiatives (OAi) standard—a technical and organisational framework facilitating the discovery of content stored in distributed e-print archives [12]—and can connect to any e-print archive. The main focus of this paper is on an empirical evaluation of the CYCLADES environment.

2 CYCLADES

The CYCLADES system integrates functionalities that support a knowledge worker in searching a large number of different digital archives. The most important features are: retrieval of information from many large, distributed digital archives; feedback on the degree of relevance of the retrieved articles; regular information about new publications; automatic retrieval of users' long-term information needs (user profiling); automatic dissemination of relevant information to community members through recommendations; quick on-line annotations on search results; support in carrying out community services such as peer review. Those community functionalities enable the members to learn from, contribute to and collectively build upon the community's knowledge. More information on the CYCLADES functionality can be found in [4, 7].

The users' requirements were surveyed and accounted for in the design of the CYCLADES functionality: the system concept was presented to prospective users, and the users' feedback was captured via a Web-based questionnaire. Results were reported in [6].

CYCLADES is implemented as several interoperable services. The communication among these services is based on standard Internet technology using the XML-RPC protocol [14]. This specification also gives a great flexibility to integrate new functionality as well as the possibility to easily update existing components. The distributed architecture allows the different servers to achieve the best performance for the specific task:

The Mediator Service (MS) manages the communication among all other services. Through this the system gains flexibility and transparency. The MS is also responsible for the registration and login of users via the Web front end.

The Access Service (AS) is responsible for accessing all connected archives. It harvests, indexes and retrieves metadata records from the underlying archives.

The Collaborative Work Service (CWS) provides a folder-based environment for managing metadata records, queries, collections, annotations as well as links to external documents. The CWS supports users in managing their individual and shared folders. It enables communication among community members including special awareness features reflecting the groups' activities in the shared information space.

The Rating Management Service (RMS) handles ratings of items stored in the CWS and provides this information to users as well as to the other services.

The Search and Browse Service (SBS) supports searching for records from the various collections, formulating search queries and browsing the results.

The Filtering and Recommendations Service (FRS) provides personalised filtering of queries and query results, as well as recommendations of relevant records, collections, users and communities. The FRS analyses a user's behaviour, generates a user profile describing the user's interest, and provides information according to this profile.

The Collection Service (CS) supports the creating and editing of collections. Collections partition the information space according to the users' interests and make the individual archives transparent to the user.

The breakdown of the CYCLADES functionalities into several distributed services was hidden from the user. From the users' perspective the CYCLADES user interface acted as one homogenous system. The only technical requirement for potential users is a Web-browser. Further details on the design and implementation of the CYCLADES environment can be found in [5].

3 System Evaluation

The user evaluation aimed at gathering information about the users' satisfaction concerning the usability and usefulness of CYCLADES. The CYCLADES prototype was available on the Internet. Anyone was allowed to register and test the system. We spread the information in Usenet newsgroups, on mailing lists, on Websites and in journals. We prepared a 'QuickStart to CYCLADES' as a fast introduction into the system. After reading this the user could easily explore the system. The data collection took place from May 5 to July 5, 2003.

3.1 Methods

We created a Web-based questionnaire. The questions were implemented using four point Likert scales [9]. These are apt to elicit subjective data about how the users perceive the system. But since the data are ordinal scaled, it is not permissible to perform further statistical calculation with them. Free text fields were offered for further explanations, suggestions for improvement or remarks.

A pre-test was conducted to gain information about the suitability and comprehensibility of this questionnaire. Considering the user comments the questionnaire was redesigned and released for the public.

The final questionnaire contained questions regarding the responding user group as well as some general information about the system use (e.g., how much time the user had spent with the system, the browser environment). The principal part consisted of six sections, each covering a set of services and features that users typically use together (Communities and Folder Handling; Searching Archives; Collections; Advanced Search Features; Community Management and Recommendations). At the beginning of each section the user stated if she had used this function. If a function had not been used, the user specified her reasons for not using it, and then proceeded to the next section. For those who used a function, some specific questions about the according function and a concluding appraisal followed. After assessing the single functions the user rated the usefulness and usability of CYCLADES as a whole.

Technically the questionnaire was implemented as Web pages using PHP scripts to fill the values entered by the user in a MySQL database. For the data acquisition SQL queries were performed to extract the specific information needed.

In addition to the questionnaire we recorded all actions the users performed during the system use, to get an impression about the frequency and area of use of the particular functions.

3.2 Results

Altogether 238 new users created an account that was needed to use the CYCLADES system. The high number of registrations shows the substantial interest in CYCLADES. About one third of all registered users started to fill in the questionnaire, but only 35 completed most of it and were included in the analysis. We assume that this was due to the complexity of CYCLADES; some experience with the system was mandatory to reasonably answer the questions. Still there were some blank fields, these are referred to as "not specified".

The age of the respondents spread from 21 to 60 years, with an average age of 29 years. Although the CYCLADES system and the QuickStart were accessed from countries all over the world the questionnaire was answered mainly from German residents. There were also respondents from Greece, France, Brazil and other countries. The majority of them worked in computer science, but there were also among others respondents from physics, business administration, and librarianship.

Firstly, the respondents gave a *self-assessment* how good they could handle the system (cf. Figure 1). Every respondent categorised herself as beginner, intermediate, advanced or expert in handling the according function. The function ‘Recommendations’ is an exception, since the user is passive in the actual process of creating the recommendations. She only chooses if she wants to get recommendations and which kind of recommendations when creating a new folder or community. The recommendations are then created by the CYCLADES system. Therefore the recommendation service is not accounted for in this analysis. The figure shows that only few users reached an advanced or expert level. This is supposedly due to the relatively short time of exploration.

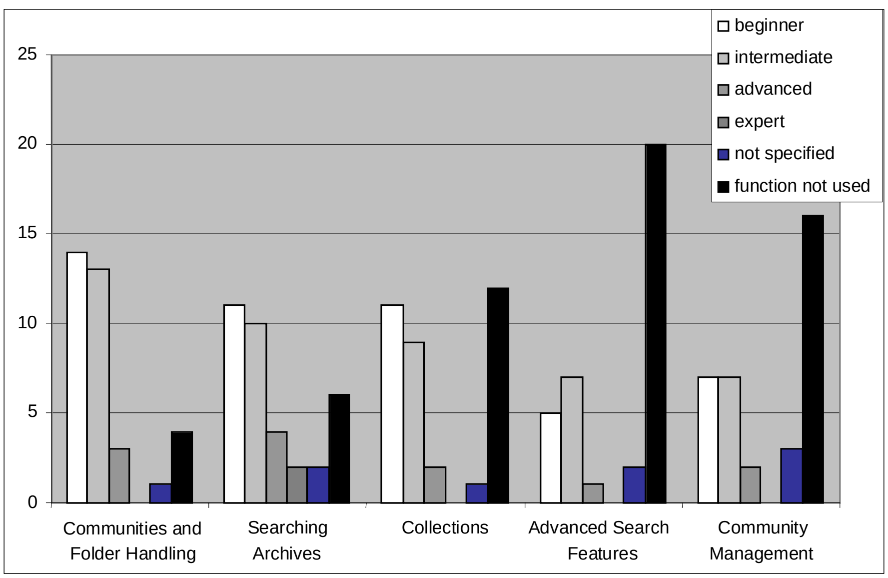


Figure 1. Self-assessment concerning system expertise.

Finally, the users reconceived each function under the aspects of usefulness and usability. For the overall appraisals we combined closely related function sets to larger categories. The resulting sets were Community Support, Search Functions, Collections and Recommendations. Additionally the CYCLADES system as a whole was rated. The evaluation of the *usefulness* per function set is mapped in Figure 2.

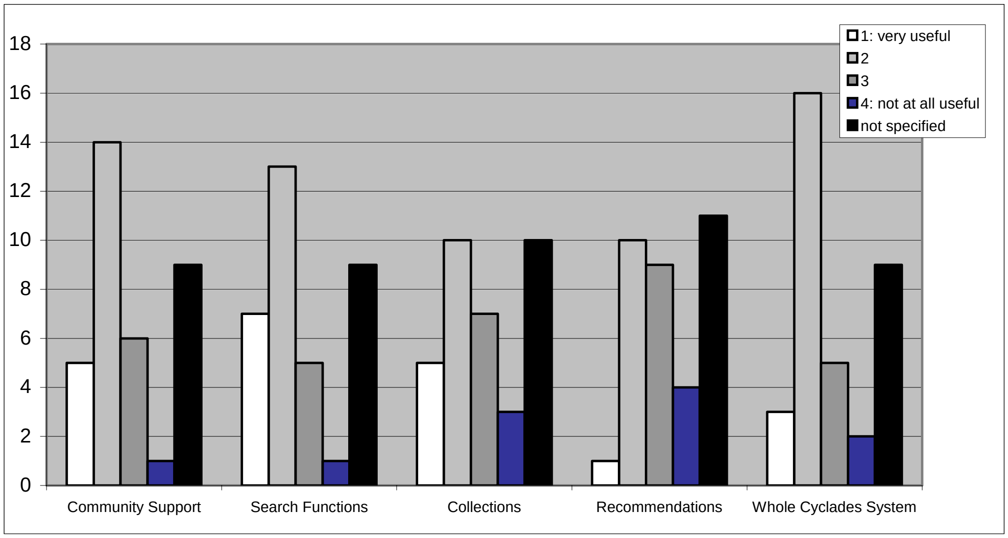


Figure 2. CYCLADES overall usefulness per function set.

The majority of the users assessed most function sets as very useful or useful. The search functions received the best rating of all functions; one third of the respondents chose the best benchmark ‘very useful’. The community support was also appraised as useful, 54 percent of all respondents chose the best or second best benchmarks. CYCLADES as a whole, considering the combination of all functions, made a good impression: only five persons selected the benchmark ‘3’ and two users the ‘4’, the median is ‘2’. The most often chosen benchmark, the mode, is ‘2’ for each function set as well as for the whole CYCLADES system.

A lot of users thought functions sets to be useful for their work, even though they did not use it in the exploration. Reasons for this low use were among others the lack of time, but also that the users did not to know how to use the function or they could not find the function. Some users stated that certain activities within CYCLADES caused trouble with their computer.

The *usability* of CYCLADES (cf. Figure 3) was assessed on a scale ranging from ‘self-explaining’ to ‘difficult’. Since the usability can only be judged by those who know a function the extra option "not used" was offered. Regarding the usability the Community support received the best rating. The collections function was the most difficult to use. The usability of the whole CYCLADES system received a good to intermediate grate.

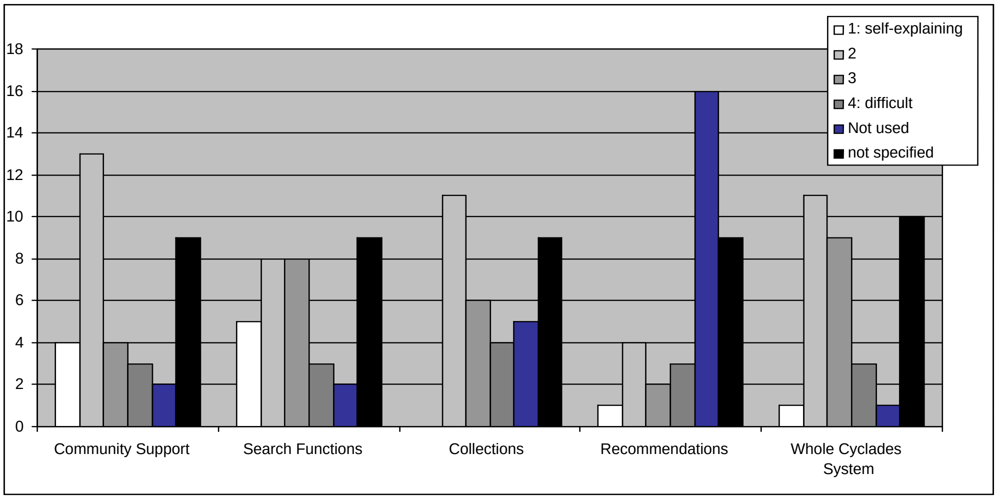


Figure 3. CYCLADES overall usability per function set.

4 Discussion

On a whole the evaluation clearly showed that users used the community support and the search functionality. The functions related to these two sets also received the best results concerning usefulness. We think that this is the case for two reasons: first, these functions are basic for any cooperative knowledge management system—that is, they are real prerequisites for successful sharing, exchanging, and learning on demand—and, secondly, they were easy to use. While some functions related to collections might be interesting for long-term and/or experienced users, these functions are either too difficult to use for non-regular users and the benefit of these functions is not clear if the system is used for a short- to medium-term duration only. With the recommendations it is similar: for novel users the system, the information, as well as the communities are new, and therefore novel and interesting. It is only after a longer time (around six months) that the users have a very good overview of the contents offered and the communities around. Only then, the recommendation of other users, communities, and so forth that are still not known is a positive surprise. Furthermore, recommendations often require a thorough understanding of users about their genesis; otherwise, users do not accept them.

All in all we are satisfied with the evaluation: on the one hand it gave us some positive feedback on designs and implementations that are accepted by users, and on the other hand we got valuable feedback concerning possible improvements of some functions.

5 References

1. Cook, S. and Brown, J.S. Bridging Epistemologies: The Generative Dance Between Organisational Knowledge and Organisational Knowing. *Organisation Science 10*, 4 (1999). pp. 381-400.

2. FIT. *BSCW Home Page*. Fraunhofer FIT and OrbiTeam Software GmbH, http://bscw.fit.fraunhofer.de, 2004. (Accessed 28/5/2004).

3. Groetschel, M. *Math-Net*. http://www.math-net.org/, 2004. (Accessed 28/5/2004).

4. Gross, T. CYCLADES: A Distributed System for Virtual Community Support Based on Open Archives. In *Proceedings of the Eleventh Euromicro Conference on Parallel, Distributed, and Network-Based Processing - PDP 2003* (Feb. 5-7, Genova, Italy). IEEE Computer Society Press, Los Alamitos, CA, 2003. pp. 484-491.

5. Gross, T. Design, Specification, and Implementation of a Distributed Virtual Community System. In *Proceedings of the Twelfth Euromicro Conference on Parallel, Distributed, and Network-Based Processing - PDP 2004* (IEEE Computer Society Press, (accepted).

6. Gross, T. and Kreifelts, T. Sharing and Exchanging Knowledge in Virtual Communities: The CYCLADES System. In *Proceedings of the Tenth International Information Management Talks - IDIMT 2002* (Sept. 11-13, Zadov, Czech Republic). Universitaetsverlag Rudolf Trauner, Linz, 2002. pp. 71-81.

7. Gross, T. and Wirsam, W. Distributed Development of a Distributed Virtual Community System. In *Proceedings of the Eleventh International Information Management Talks - IDIMT 2003* (Sept. 10-12, Budweis, Czech Republic). Universitaetsverlag Rudolf Trauner, Linz, 2003. pp. 103-113.

8. Kuhlthau, C.C. Inside the Search Process: Information Seeking from the User's Perspective. *Journal of the American Society for Information Science 42*, 5 (May 1991). pp. 361-371.

9. Likert, R. A Technique for the Measurement of Attitudes. *Archives of Psychology 140* (June 1932).

10. Marshall, C., Shipman, F.M. and McCall, R.J. Putting Digital Libraries to Work: Issues from Experience with Community Memories. In *Proceedings of the Digital Libraries Workshop - DL'94* (May 19-20, Newark, NJ). Springer-Verlag, Heidelberg, 1994.

11. McDonald, D.W. and Ackerman, M.S. Just Talk to Me: A Field Study of Expertise Location. In *Proceedings of the ACM 1998 Conference on Computer-Supported Cooperative Work - CSCW'98* (Nov. 14-18, Seattle, WA). ACM, N.Y., 1998. pp. 315-324.

12. OAi. *Open Archives Initiative*. http://www.openarchives.org/, 2004. (Accessed 28/5/2004).

13. Twidale, M.B., Nichols, D.M. and Paice, C.D. Browsing is a Collaborative Process. *Information Processing and Management 33*, 6 (1997). pp. 761-783.

14. UserLand Software Inc. *XML-RPC Home Page*. http://www.xmlrpc.com/, 2003. (Accessed 28/5/2004).

15. Webmaster. *arXiv.org*. http://arxiv.org, 2002. (Accessed 28/5/2004).

16. Wiki. *Wiki: Welcome Visitors*. http://wiki.org/, 2002. (Accessed 28/5/2004).

Creditworthiness as a Requisitely Holistic/Systemic Information?

INFORMING THE MANAGEMENT BY A REQUISITE HOLISTIC ASSESSMENT OF THE CREDITWORTHINESS OF AN ENTERPRISE

Jozica Knez-Riedl, Matjaz Mulej

One-sided information makes a misleading impact. It must therefore be requisitely holistic. Information from an assessment of the creditworthiness of an enterprise is the same case. But the requisite holism is much less easy to attain than one-sidedness. Therefore this contribution explains creditworthiness assessment and puts it in the shade of our version of systems thinking. We find that it is in line with the basic effort of Ludwig von Bertalanffy, the father of the General Systems Theory, which was to fight the exaggerated specialisation [3] because it causes a dangerous one-sidedness. A worthwhile creditworthiness assessment is based on a dialectical system of viewpoints rather than on the financial ones only, in order to provide a requisitely holistic information, hence a requisitely reliable decision-making and resulting action.

1 Selection of the Problem and the Viewpoint of its Considerations

Informing the management can be considered from a number of viewpoints, which may even be found complementary to each other and make a dialectical system of the interdependent and essential viewpoints / aspects including, e.g.:

- The objective need for a well-informed decision-making aimed at meeting the demands of the requisite holism [19] and requisite variety (see: [7], which would together prevent mistakes, failures, bankruptcy and similar forms of realisation of the natural entropic tendency of everything toward ruining;
- The objective possibility of providing information satisfying the above needs, including by the way of the requisitely holistic assessment of the creditworthiness of an enterprise or another existing or pending partner, be in the business or in the private life (see: [14] and earlier, for details);

- The human values, culture, ethics, and norms, which make a person or an organization like or dislike to apply the given knowledge and information in a selected manner (see e.g. [11]; [24]);
- The human knowledge, both the know-what and the know-how, which a person or an organization possesses and can apply, if they decide to do so (see e.g. [27]; [12]; [17]), perhaps in order to attain the best possible economic growth (e.g. [5]).

A requisitely holistic assessment of the creditworthiness of an enterprise will here be considered as a part of the human knowledge, which is found important in the human values, and is able to provide also a part of the objective possibilities to satisfy the objective need for a requisitely well-informed decision-making, by the management.

2 The Circumstances Emphasising the Need for Creditworthy Partnerships

Today's generation of entrepreneurs, owners, and managers is more than earlier aware of the importance of knowing their business partners, but also of their personal credibility, especially in the case of strategic decision-making that causes multiple long-term consequences. That is very evident in the era of virtual transactions and partnerships because of the newly emerging risks (fraud, cyber crime, etc.).

Variety of stakeholders (financial communities, different professional and civil groups, local government and non-government institutions, and public in general) is becoming more interested in the creditworthiness information, too. As strategic information it is needed in severe and changing business circumstances (e.g. Basel II, EU enlargement, restructuring, and globalisation). As a matter of fact, stakeholders are very dynamic groups with changeable demands and expectations. For that reason key stakeholders should be mapped and monitored permanently.

On the other side, entrepreneurs, managers and owners care a lot about their own enterprise creditworthiness that should be communicated to both external and internal stakeholders. They are concerned about the improvement of their creditworthiness (their rating) knowing very well how decisive it is in a range of different transactions (not only in credit arrangements, but in case of e. g. investments decisions, bond issues, supply, sale, leasing, as well as in building of partnerships, alliances, networks, and public opinion). By knowing their own creditworthiness as well as creditworthiness of their partners they can manage complexity better, in a proactive way that can be demonstrated especially in the strategic choices they make.

The heterogeneity and complexity of the real world demand new understanding of creditworthiness, which exceeds its financial context. The broader theoretical foundation, especially trends in system thinking, the theory of a firm (e.g. knowledge-based theory of a firm) and evolving management concepts (e.g. like value-based management, knowledge management) demand broader, improved and expert knowledge, as well as financial and non-financial database and information, especially the future oriented ones. Additionally, interdisciplinary knowledge and a set of skills are indispensable. By leaning upon variety of data, information and knowledge, the creditworthiness assessment can become more effective and reliable tool in building and maintaining business relationships in the risky society. The strategic orientation, sustainability and social responsibility, existing and evolving knowledge, innovation, and the need for enhanced quality have been gaining emphasised importance in the cases of both internal and external rating.

The so-called sustainable performance, which consists of economic, environmental, ethical and social dimension, is becoming critical for enterprises and other institutions. It attracts attention and raises interest of possible business partners, interested into sustainable society, too. It is decisive for fostering long-term trust in internal and external relationships, which have critical positive economic consequences (e. g. [11]).

3 Creditworthiness of the Modern Enterprise

A modern enterprise uses scarce resource, of both tangible and intangible nature, and combines them in a flexible, innovative way, as well as by outsourcing and good timing. The enterprise's mobility and global business activity make its many transactions appear and cause a number of relationships with some already known, nearly familiar business partners and, parallel, permanently also with new, less known or completely unknown enterprises and institutions. Especially in a long-term, when strategic decisions upon business partners and decisions about business orientation in general are made, information about creditworthiness is of critical importance. In this case only a set of financial information is not enough. Methodology should take into account a dialectical system of relevant aspects, which need explanation and proving of many facts. For that purpose several data, information and other analytical tools are needed. Decision-makers and those who support decision-making are confronted with data and information overload and the problem of bounded rationality.

The question of criteria is a topic of permanent vivid debate in many fields. When an enterprise could be called as a creditworthy one? Which properties does it have? What expectations does it meet? The answers tackle the diversity management. Flood and Romm [9] explain it in the context of managing the growing diversity of issues that confront humankind in contemporary organisational and societal affairs. Reasons why an enterprise or institution is interested in the rating both of the creditworthiness of themselves as well of the others are numerous. According to Fight [10] the access to capital market, building up market reputation, lower cost of funding and preparing groundwork for share floatation or privatisation, and distinguishing oneself from the competition could be the most important reasons. Some additional reasons of increasing importance could be mentioned, too. Among them strengthening the negotiation position and improving bargaining power, as well as building a positive public opinion are worth mentioning.

The creditworthiness assessment criteria can be distinguished into quantitative and qualitative ones. We speak also about financial and non-financial criteria. As a modern enterprise does not follow only financial goals and because of the enterprise's broader social role the set of criteria becomes more complex. Criteria supported by new or renewed dialectical system of measures and indicators are continuously evolving (e.g. customer, values or knowledge relative criteria, environmental criteria, etc.).

3.1 Some Methodological Characteristics of the Creditworthiness Assessment

As a society we become more risk aware and sensitive. The need to recognize the early warning signs, as well as early signs of favourable phenomena (hints) is driving enterprises to search for credit information in time or, better to say, even just before the time. That is of course more demanding regarding methods applied data and information needed, as well as regarding expert knowledge and skills. Both, hardware and software should cover interdependency and complexity stemming from the modern context of an enterprise the success of which depends on a variety of critical success factors.

Digitalisation of transactions can be found in the process of creditworthiness assessment (so-called rating process): The interactive communication, on-line search and on-line reporting are becoming contemporary ways of doing business, too.

There is no single one single best methodology of creditworthiness assessment. Just on the contrary, many methodologies are developing and evolving at the same time in institutions like rating agencies, banking, insurance and other financial institutions, and intermediaries. In spite of the variety of approaches a lack of criteria, e. g. regarding intangibles and a lack of system approach is evident. Additionally, the methodologies, criteria chosen, opinions and judgements reflect not only knowledge, but also values, the understanding of success (success paradigm), and strategies and goals of those who assess the creditworthiness of an enterprise.

Analytical assistance of the applied methodology could contribute quite a lot to the objective judgement and opinion. Different methodologies are based, implicitly or explicitly, on evolving theoretical assumptions and principles, in the field of the theory of a firm, business and financial economics, concept of sustainable development, recent managerial trends and system thinking approach.[1]In this way a plurality of methodologies is typical for a modern creditworthiness assessment, applying knowledge from a variety of disciplines with a specific aim, namely, to achieve more relevant, objective result.

Methodological pluralism demands not only a broader theoretical foundation and knowledge, it requires interdisciplinary and team work (e.g. in the case of including environmental aspect of a creditworthy enterprise). It depends on (tacit) ability to explore (by analysis and synthesis) all relevant interconnectedness among relevant aspects chosen.

Nearly all methodologies use a definite model. Some of them have tradition of many decades, but they are often renewed or adopted to the changing business world circumstances. Some models were developed recently and they aim to meet demands of strategic decision-making. For that purpose a view on an enterprise as a (dialectical) system and on its system dynamics should be taken into account. In this context the qualitative aspects of the creditworthiness are becoming increasingly emphasised. Thus, the final opinion on the creditworthiness of a firm (leaned upon judgment of parameters defined) can be supported by an arguments chain, coming from the results of a deeper analysis of selected fields.

Besides, this broader aim of the creditworthiness assessment - to enable better decision-making, nowadays, in the era of value management - the information should create business value [16]. In this context the creditworthiness should increase business value. For this purpose the creditworthiness should cover several important business segments being decisive as value drivers. Value-based management presents at the same time a management philosophy that takes into account the balance of financial and non-financial goals, the importance of all relevant segments of an enterprise as well as the internal and external relations for achieving the so-called economic value added (EVA).

[1] Some of them were already presented and discussed at IDIMT'2000 [14]

Managers should develop the right mindset concerning information management, information system, and information technology ([16]. Support of creditworthiness assessments by information system and technology is critical. Creditworthiness information can be used also for driving the innovation process, oriented both to the existing and potential needs as well as to the enterprise market value. For that purpose enterprises should disclose not only their results but also their goals, strategies, and even problems.

3.2 Criteria Used in Creditworthiness Assessment

There are different criteria used for creditworthiness assessment, depending on knowledge, values, strategies, and last but not least, on kind of business activity (industry) of the enterprise or institution, which has been assessed for its.

As a rule, attention has been paid to the earning power, financial strength, market and industry, (competitive) position, customers and other relationships, management quality, macroeconomic circumstances, and further enterprise development. Recently the attention is paid to the environmental and broader social performance of an enterprise, including the ethical/ moral dimension of business activity and results.

Different rating agencies and institutions distinguish financial risks from the operating ones and industry related risks. They pay attention to the specific business risks. But increasingly they pay attention to the unique events and potentials, as well. Because of the great emphasis put on knowledge as a strategic asset in general many companies are becoming aware of their knowledge and values. In the creditworthiness assessment knowledge can be involved into a set of criteria rather implicitly, in the context of other criteria, e.g. innovativeness, research activities and results, intellectual property or quality certificates (e. g. [14] and knowledge [26]. More explicitly formulated criteria regarding knowledge are developing especially in the frame of intellectual capital.

Scandia's Intellectual Capital Measures [4] modified the Balanced Scorecard. Knowledge related criteria are included among in the so-called innovation capital, e.g. in form of several ratios related to the training expenses, educational investments, ratio of new products, R&D invested in basic research, product design and application, investments in new products support and training, average age of company patents and patents pending. In the context of the Human Capital time for training (days/year), IT-literacy of staff, per capita cost of training, communications, and support programs for full-time permanent employees, percentage of company managers with advanced degrees, etc. are taken into account.

Some explicit knowledge related criteria can be found in the Sveiby's Intangible Asset Monitor [4] in the field of the so-called Growth / Renewal: e. g. time devoted to R&D, educational level of professionals, training cost as percentage of turnover, number of days devoted to education per professional, proportion of professionals in company, even profit per professionals.

Besides knowledge related ratios environmental ratios are included step by step into their creditworthiness assessment methodology [14], [26]. Social responsibility and social responsiveness [15] are other aspects where additional ratios have been developed enabling assessors to make further step, namely from the financial rating to the social rating.

3.3 The Process of the Creditworthiness Assessment (Rating Process)

The rating process essentially depends on data processing possibilities and communications development. But for the rating procedure the art of rating is especially decisive, too. There are some differences in the case of solicited or unsolicited rating. It is important whether the rating is made for the first time or not.

The rating process consists of steps (phases) following each other. Sometimes some phases can be done in parallel by the members of an assessment team.

The initiatives or claims for a rating come from different institutions and individuals. In the case of an enterprise different organisational units or departments can set them. Generally they express interest, definite degree of risk awareness, in some cases an obligation, even from legislation. In some cases enterprises should bring creditworthiness assessment already made by an external rating agency (e. g. in some credit arrangements). Not only in that case is the choice of credible rating agency important. It becomes even more important because of the Basel II [28](coming into force in 2006).

The creditworthiness assessment procedure can be different in the case of internal rating than in the case of external rating. It is possible that each enterprise and institution can organise its own rating process with the purpose to be efficient. That means that it should lead to the trustworthy opinion transmitted to the audience as quickly as possible. It should be written in an understandable style. The methodology and rating symbols explained should contribute to the rating transparency. Thus, they can increase trust needed between the enterprise assessed and the assessment team (within or outside an enterprise).

Important time and attention are devoted to the meetings of the assessment team (analysts) and management of the enterprise assessed, to the building of assessment team of analysts, to the enterprise and industry analysis (including data collection from publicly available and non-public information and information processing for the so-called basic research).

Analytical procedures combine different analytical approaches. They have still been in form of more fragmental or so-called segmental analysis. Recently, some benchmarking comparisons are also made. They demand a broader database and also some tacit knowledge besides the explicit one. The tendency to more holistic analysis cannot be overseen [14]. Depending on the purpose of the creditworthiness assessment some emphases in the analysis are generally taken into account. There are specific items relevant e.g. in the case of bank or insurance rating or investment fond rating.

3.4 The Need to be Prepared for the Creditworthiness Assessment

Several partners and an increasing number of other stakeholders assess enterprises creditworthiness nearly all the time. Especially the new Capital Accord called Basel II [28] creates a climate of higher awareness. It requires monitoring and analysing the risk in banks, which are vitally dependent on the quality of their clients (and vice versa). Especially some enterprises belonging to the SMEs or to the specific industry (e. g. trade, catering) are concerned about the consequences of Basel II on their future performance.

Basel II, especially the first of its three pillars, the so-called Minimal Capital Requirements, emphasises the need of being well prepared for the creditworthiness assessment [28]. In other words, it means that an enterprise should see itself as it is seen in the eyes of rating analysts and investors. For that purpose the self-rating procedure should be done according quantitative and qualitative criteria. Many qualitative factors are coming into force, expressed by means of (un)conventional ratios and indicators. This raises the question of data and information kinds and flows, of the parameters of the models for creditworthiness assessment, and, last but not least, of theoretical and methodological knowledge and skills.

The Basel II is expected to emphasise the importance of qualitative criteria, besides timely financial information and early warning signs, in all fields of business activity. Additionally to the financial information and ratios several non-financial ones will be relevant. For that reason the market share and prospects, organisational aspects, strategic orientation, and innovation capability and results are important.

Capital Accord Basel II is one additional reason (for some enterprises and banks a predominant reason) why enterprises should be prepared on the creditworthiness assessment. But there is an important additional benefit. In that way enterprises management can take a more active role in the assessment procedure. Preparing for the creditworthiness assessment could be seen also as an opportunity for enterprises to review their existing information systems and to find their information gaps. Taking creditworthiness and its assessment seriously can also initiate the building of effective information search strategy and disclosure strategy.

In all the questions mentioned the role of management is essential. Managers are very important initiators of creditworthiness assessment, they organise the internal assessment (rating) procedures, they communicate with stakeholders, among them with rating agencies, and some managers participate in the rating process. They have a decisive role in the managing (planning, analysing, controlling) of the enterprise creditworthiness, which could be of a very dynamic nature. In this way they are to a definite extent competent and responsible for the viability of an enterprise and its business and financial partners.

4 The Requisitely Holistic Assessment of the Creditworthiness of an Enterprise – In the Light of the Contemporary Systems Thinking

Over the last five decades the global process in the markets of the advanced parts of the world have increasingly required enterprises to meet an increasingly complex system of criteria of an optimal enterprise (see [7] for details):

- In 1960s the over-the-average good care for cost/price made an efficient enterprise.
- In 1970s the over-the-average good care for cost/ price and quality made a quality enterprise.
- In 1980s the over-the-average good care for cost/price, quality, and range made a flexible enterprise.
- In 1990s the over-the-average good care for cost/price, quality, range, and uniqueness made an innovative enterprise.
- In 2000s the over-the-average good care for cost/price, quality, range, uniqueness, and sustainable development make a sustainable enterprise.

All the preconditions listed here do not make a sum or set, but a system, which means that they are interdependent and none of them is allowed to be zero for the enterprise to survive.

This fact requires an appropriately more complex and clear creditworthiness and its assessment. It is no longer enough to consider the supply-production-sales chain only, although it makes the basic process. The management and the information processes must also and equally meet high standards for the enterprise to be a creditworthy partner.

The market presses enterprises and humans to change in the same direction. But the recently published cases of nonreliable behavior of extremely big companies in the most advanced market economies, not only in the less advanced ones, demonstrate that the market pressure alone is not sufficient. One might better go back in history and learn that in the 19th century economy has been neither an independent nor a mathematical science, but rather a component of the study program called The Moral Science Tripos. The latter consisted of studies in moral philosophy, political philosophy, logic, psychology, and economics [11]. Thus, the economic, environmental, and the broader social performance must include a moral / ethical dimension, as we said above (see also: [25], [13], etc).

Such an objective need suggests the need that a requisitely holistic thinking is used. This fact reminds us of the many different streams in the evolution of systems theory toward a number of mutually different systems theories. Most of them forget that Bertalanffy has explicitly demanded systems theory to be regarded as a tool against the exaggerated specialization [3] rather than a tool of mathematical formulation inside single specializations. We expressed this demand as follows ([21]; further elaboration in [22]) – Fig 1:

No	**Systems / Systemic / Holistic Thinking**	**Un-systemic / Traditional Thinking**
1	Interdependences, Relations, Openness, Interconnectedness, Dialectical System	Independence, Dependence, Closeness, A single viewpoint/system
2	Complexity (& Complicatedness)	Simplicity, or Complicatedness alone
3	Attractors	No influential force/s, but isolation
4	Emergence	No process of making new attributes
5	Synergy, System, Synthesis	No new attributes resulting from relations
6	Whole, Holism, Big Picture, Holon	Parts and partial attributes only
7	Networking, Interaction, Interplay	No mutual influences

Figure 1: The Seven Interdependent Basic Sets of Terms of Systems / Systemic / Holistic vs. Un-systemic Thinking (as a dialectical system)

A requisitely holistic informing of management and business partners obviously requires the assessment of creditworthiness of an enterprise under investigation to be assessed by application of the systems thinking, as it is summarised in the left column of the Fig. 1.

At the very beginning of our contribution we briefed the interdependence of the subjective and objective starting points and the very decisive role of values inside of the starting points. Later on, we were able to detect that one must be prepared for the creditworthiness assessment, which includes values. Actually, one can put the role of values in the interdependence chain, which we are briefing in Fig 2 as follows:

Individual values	→	Culture = group/community/society values
↑		↓
Norms about right and wrong	←	Ethics = criteria about right and wrong

Figure 2: Interdependence of values, culture, ethics, and norms

If the economic conditions demonstrate a growing complexity and interdependence of the unavoidably narrow specialists, as the case is today, then the values, culture, ethics, and norms are facing their transition – toward more values/culture/ethics/norms of interdependence than ever before in the times of the market economy. Actually, this process is bringing humankind back to the Adam Smith, the first economist of a worldwide and seminal importance. His sentence that everybody should take care of them-selves, and the market will take care of the common good – actually means no right of a narrow selfishness, but a duty of ethics of interdependence. Why? The market consists of suppliers and customers who mutually need and serve each other, i.e. they are interdependent. (See: [23]; [21] ; [6] ; etc.). Ethics of interdependence is therefore a right rather than a duty.

A requisitely holistic informing of management and business partners is so, too: it obviously requires the creditworthiness of an enterprise under investigation to be assessed by application of the systems thinking, as it is summarised in the left column of the Fig. 1, to the interdependence briefed in Fig 2, too.

Of course, modern people are not happy, if they are required to not be selfish, but altruistic. We do not require them to be altruistic for the sake of altruism, but for their own selfish reasons. The creditworthy partners:

- Do not require e.g. the cost of double-checking; they are therefore more efficient partners.
- Provide a reliable quality and require the same from their (business) partners.

- Provide a range as required by their customers and require the same from their (business) partners.
- Provide uniqueness as required by their customers and require the same from their (business) partners.
- Provide sustainable development as required by their customers and require the same from their (business) partners.

This makes them more competitive. In other words, a requisitely holistic creditworthiness pays, and it is worth a requisitely holistic assessment. On its basis, management can be informed requisitely holistically to make right decisions.

5 Conclusions

Attention paid to the creditworthiness of an enterprise is increasing for several reasons. It can strengthen the trust needed for long-lasting relationships and long-term success in the form of high quality performance (economic, environmental and recently of the social and ethical one). Knowing and managing creditworthiness can help avoiding several risks, but so does the identification of several opportunities, too. Drastic changes especially in the financial market but also in the global environment emphasise the need for creditworthiness assessment in accordance to the new Capital Record Basel II. It refers to the management of credit and operational risks.

Along with such trends many questions are raised. Among them the questions of an appropriate methodology, based on multiple theoretical foundation and rethought criteria are critical. Implicitly, the question of information systems capability and lack of data, information, knowledge and skills (analytical, social skills) is tackled, too. The opinion about enterprise creditworthiness made on the basis of objective judgment is of highest importance. They should not be predominantly oriented to the past, just on the contrary, they should be more anticipative, with predictive elements.

Regarding the opinion of experienced theoretic and, at the same time, practioners choices of methods will continue to depend on idiosyncratic combinations of factors [1]. In parallel, system thinking shift towards a more holistic view of an enterprise and its environment.

A wide range of very different data and information exposes the questions of their access and of their economics (costs and benefits), of the IS architecture, of data mining, and of many other specific questions related to IS management and economics of information.

Analytical skills are important more than before. But without sufficient disclosure and information culture the creditworthiness cannot reach its aim, namely, to improve performance and possibilities of an enterprise. The degree of voluntary disclosure, especially of data related to intangibles, is connected with the willingness to share sensitive and even confidential information.

The need for refining creditworthiness assessment methodology is evident in rating agencies, banks and insurance companies, enterprises and other institutions. Among several aspects involved the role and support of information management is especially exposed.

6 References

[1] BENNET, P. et al.: Analysing Litigation and Negotiation; Using a Combined Methodology in Mingers, J., Gill, A. (1997): Multi Methodology The Theory and Practice of Combining Management Science, Wiley, New York, pp. 59 – 88

[2] BENTHAM, J.: One Size Doesn't Fit All: Reflection on Using Systems Techniques in an Operational Setting in Mingers, J. Gill, A. (1997): Multi Methodology The Theory and Practice of Combining Management Science , Wiley, New York, pp. 89 – 104

[3] BERTALANFFY, L.: General Systems Theory. Foundations, Development, Applications. Revised Edition. Sixth Printing. Brazillier. New York

[4] BOYET, J. and BOYET, J.T.: The Guru Guide to the Knowledge Economy, John Willey & Sons, Inc. New York

[5] CHRISTENSEN, C. M., RAYOR, M. E.: *The Innovator's Solution. Creating and Sustaining Successful Growth.* Harvard Business School Press, Boston, MA

[6] DYCK, R. G, MULEJ, M., and co-authors: *Self-Transformation of the Forgotten Four-Fifths.* Kendall/Hunt, Dubuque, Iowa

[7] ECIMOVIC, T., MULEJ, M., MAYUR, R., and authors: *System Thinking and the Climate Change System (Against a Big Tragedy of Commons of All of Us).* SEM Institute for Climate Change, Korte, Slovenia

[8] ESPEJO, R.: Teorija zivih sistemov. In: Mulej, M., and co-authors: *Dialekticna in druge mehkosistemske teorije (podlaga za celovitost in uspeh managementa).* Univerza v Mariboru, Ekonomsko-poslovna fakulteta, Univerza v Mariboru, Ekonomsko-poslovna fakulteta, Maribor, 467-480

[9] FLOOD, R., ROMM, N.: From Metatheory to "Multimethodlogy"in Mingers, J. Gill, A. (1997): Multi Methodology The Theory and Practice of Combining Management Science , Wiley, New York, pp. 89 – 104

[10] FIGHT, A: The Ratings Game, John Wiley & Sons., Ltd., Chicester, New York

[11] GREER, w. b.: Ethics and Uncertainty The Economics of John M. Keynes and Frank H. Knight, Elgar, Cheltenham, Northampton, 2000

[12] KAWALEK, J. P.: Systems Thinking and Knowledge Management: Positional Assertions and Preliminary Observations. *Systems Research and Behavioral Science*. 21, 1, 17-36

[13] LAURENT, J., ED.: *Evolutionary Economics and Human Nature.* Edward Elgar, Cheltenham, UK, Northhampton, MA, USA

[14] KNEZ-RIEDL, J.: The assessment of the creditworthiness of an enterprise, IDIMT-2000/8th Interdisciplinary Management Talks, Linz: Universitaetsverlag Rudolf Trauner, pp. 347-360

[15] KNEZ-RIEDL, J.: Corporate Social Responsibility and Holistic Analysis, IDIMT-2003/11th Interdisciplinary Management Talks, Linz: Universitaetsverlag Rudolf Trauner pp. 187- 198

[16] MARCHAND, D. A.: Competing with Information, John Wiley & Sons., Ltd., New York

[17] MEIJA, A.: The Problem of Knowledge Imposition: Paulo Freire and Critical Systems Thinking. *Systems Research and Behavioral Science*. 21, 1, 63-82

[18] MULEJ, M., PALCIC, R.: A Success Story: Modern Management Production productivity in a Plant in a Less Developed Area of Slovenia, Public Enterprise, 1994, vol. 14, 1-2, pp.121-131

[19] MULEJ, M., and co-authors: *Dialekticna in druge mehkosistemske teorije (podlaga za celovitost in uspeh managementa).* Univerza v Mariboru, Ekonomsko-poslovna fakulteta, Univerza v Mariboru, Ekonomsko-poslovna fakulteta, Maribor,

[20] MULEJ, M., KAJZER, S.: Ethics of Interdependence and the Law of Requisite Holism. In: Rebernik, M., Mulej, M., eds. *STIQE 98: Proceedings of the 4th International Conference on Linking Systems Thinking, Innovation, Quality, Entrepreneurship and Environment. Pp. 129-140.* University of Maribor, Faculty of Economics and Business, Institute for Entrepreneurship

[21] MULEJ, M. et al.: Informal Systems Thinking or Systems Theory. *Cybernetics and Systems.* 34, 2, 71-92

[22] MULEJ, M. et al.: How to Restore Bertalanffian Systems Thinking. *Kybernetes,* 33 Forthcoming in 2004.

[23] PETZINGER, T., Jr.: *The New Pioneers. Men and Women Who Are Transforming the Workplace and the Marketplace.* New York. A Touchstone Book, Simon&Schusters

[24] RADONJIC, D., ed.: *Etika v Managementu. 6. MBA posvetovanje.* Univerza v Mariboru, Ekonomsko-poslovna fakulteta, Institut za razvoj managementa, in Izobrazevalno drustvo „KLUB MBA“

[25] TAVCAR, J., MULEJ, M. et al.: Novel Concept of Holistic Sustainable Regional Development Planning. In: Demsar Mitrovic, P. (ur.): *Consequences of the EU Enlargement: Proceedings of the International Seminar, Side Event of the 13th European Conference of Ministers Responsible for Regional Planning (CEMAT) of the Member States of the Council of Europe, at* Maribor, Slovenia. Ministry of Environment, Spatial Planning and Energy, Ljubljana, pp. 56-61

[26] VITEZIČ, N., KNEZ-RIEDL, J.: The assessment of the creditworthiness of an enterprise in the knowledge economy, Proceeding of the International conference An Enterprise Odyssey: Economics and Business in the New Millennium, Graduate School of Economics and Business, University of Zagreb

[27] WARREN, L.: A Systemic Approach to Entrepreneurial Learning: An Exploration Using Storytelling. *Systems Research and Behavioral Science*. 21, 1, pp. 3-16

[28] www.basel-zwei.at

ASSESSING ICT FOR SOCIETAL GUIDANCE AND INNOVATION

Employing the Phase Space Concept and Bayesian Syllogism

A Proposal to Explore ICT as a Systemic Societal Phenomenon

Hellmut Löckenhoff[1]

ICT and society mutually shape each other; ICT an essential element within the network of factors influencing societal change. Numerous studies have been published addressing virtual social institutions, e.g. the Virtual Corporation, of the ICT Networked Society in its entirety. While there is no lack of aspectual assessments, an in tendency comprehensive approach seems still in the cradle. One of the reasons behind appears the particular complexity of the topic; complexity as well in detail as in dynamics and in value bases. Extending concepts from strategy controlling a comprising assessment model is proposed here. It combines the Bayesian Syllogism in systems modelling with the Phase Space Model [PSC] (POINCARÉ) of representation. Thus it creates an heuristic tool for exploration, assessment and evaluation of possible future 'ICT societies'. The approach presupposes a host of basic assumptions; respectively poses basis questions relating to the very principles how human beings see and understand themselves in their worlds. The paper focuses on the future of the ICT society.

Prologue: Questioning and Representing Societal Complexity

To explore highly complex phenomena encounters its necessary, *first*, to establish appropriate *heuristics*. Heuristics is used here in the broader meaning of the term: Modes of exploring the 'right' approach from sensible issues/targets and according questions up to an ordered set of approaches, finding how to interconnect and to interpret them. Any particular approach concerning

[1] Research Consulting. Ossietzky 14, D-71522 Backnang FRG / fax +49 7191 83113
Loeckenhoff.HellK@t-online.de

ICT owns an ‘environment’ that to needs be identified as to be connected with by clear cut interfaces. *Second*, the complex results, the complex answers carrying various possible variations, differing courses of interpretation and a multitude of interfaces, need be transparently and interpretable *(re)presented*. To qualify for policy support complex tasks the interconnections of many indicators and parameters need be transformed into an in tendency issue integrated body of commonly understandable knowledge.

As to be explicated below, the *Phase Space Concept (PSC) [Fig.1,2,]* originating in mathematics and physics, requests a meticulously explored fore field. A focus given, PSC undertakes to integrate complex variety of courses e.g. of the ICT impact on dialogue culture into a single macroscopic time sequence of values. That concerns issues, concept, hypotheses, indicator systems, quantitative/ qualitative assessment, interfaces and interconnections. When attempting a focussed phase space graph, all material and methodical aspects by methodical necessity need be dealt with systematically. When a phase space representation is accomplished, few if any aspects have not been pervasively questioned. For the outcome of such explorative navigation, the PSC provides a flexible multi-approach mode of two-dimensional (geometrical flat world) mode of representation. Such an extremely condensed – <u>not</u> necessarily reduced - single indicator will be complex in itself and stimulate questions as to the underlying indicator values behind. Eventual weakness in argumentation easily shows and can be questioned. [Note: in so far PSC shares the regrettable fate of facts in policy support. Politicians normally decide a ‘political’ solution, which is by certainty non-optimal, short sighted and better serving the political group itself than the clients. So they will at best not be interested in data and normally defensive.]

1 Modelling the ICT Society for Innovative Policy Support

The general purpose behind modelling the mutual impacts of ICT and society appears roughly the same as with other modelling efforts. It is the necessity to orientate, to understand, to identify possible developments as to control them. In addition, the background of rapid and fundamental change requests a particular attention to *creative, innovative potentials*. The society, worldwide and locally, is not only rapidly changing. Local and semi-global wars indicate, even more seriously, global faults on nearly all social, power, ideology and religion levels. To meet challenges, to solve problems, to prevent respectively to minimize conflicts it needs explicitly innovative attitudes, creative approaches. As a base for such innovative insights a thorough and comprehensive exploring and understanding of the given situation, its history and its inherent potentials. [Fig. 3].

ICT is implied to innovation twofold. ICT, first, is one of the essential factors driving and shaping the contours of change. ICT, second, offers essential advantages as a carrier concerning the distribution of innovative information or the need for such. ICT may also, is a fundamental way, help to further the educational/ cultural foundations of learning and creative learning.

Though evolution and history of mankind are essentially shaped by the emergence of phenomena like language, writing and symbolic languages like mathematics, the recent evolutional step of ICT owns historically new qualities. For example it comes up global, intercultural, highly dynamical and socially/ societally pervasive. Namely the (re-) evolution of ICT accords to, actively triggers, enhances and interacts with other societal developments. It exerts deep impacts on the very foundations of societal structures from institutional choice to constitution and democracy. Any political decision, more or less directly and materially, will be linked with ICT, in particular any strategy design. Thus the way of modelling the interaction of ICT and societal development must meet specific demands. Among others it needs be explorative as to further a more thorough understanding from the grass roots. It needs, moreover, creative, modes to detect, understand and assess potentials and their possible employ in policy design. It should enable feasibility studies, that is encourage an also pragmatically oriented multi-aspect, multi-value and multi-method approach; that is towards realizing creative potential, meeting challenge and, operationally, problem solving. It should provide the base for constructive, evolutional learning.

To meet these expectations ICT, that is its potentials, its interconnections e.g. with societal development and societal learning need be thoroughly explored and analysed. To transform the complex findings, they need represented in forms transferable in communication, in dialogue and discourse. One of the more promising approaches both as a heuristic as a presentation mode is provided by a sophisticated PSC as below.

2 Linking Space Phase Concept, Bayesian Syllogism and Natural Drift

Following systems analysis uncertainty may be coped with by understanding the systems in case either ‘in situ’, in their actual state; or, complementing, as the result of an historical/ evolutional course. As V.V. NALIMOV proposed, *Bayesian* statistics can be turned to a syllogism hypothesising probability fields structured, networked and assessed during the course of history. Since Herodotus and Thukydides history sciences developed what could be called a systemic approach, for example various approaches to identify typical courses of ‘rise and fall’ of civilisations. In the meso- and micro-level differentiated models of human institutional and group behaviour will contribute. (But caution: 'History always and never repeats itself'.) To handle such extremely complex networks of multi-aspectual analysis the presentation geometry of Phase Space (POINCARÉ) proves an excellent heuristic tool. It depicts the resulting value of numerous and in se complex factors for development in a single curve between the coordinates 'Time' and 'Measure of developmental [Fig 6] success', thus encouraging a qualified explorative and creative learning dialogue between data presented and researcher. To complement and conclude the concept of Natural Drift Learning variatis variandis might be applied in analogy; which is evolutional learning developed originally from systems biology (MATURANA; VARELA) transferred to societal development.

The Phase Space Concept attempts to integrate differing aspects of highly complex phenomena and represent the resulting macroscopic curve in a two-dimensional coordinate system. Originated from mathematics and physics (Poincaré) it is increasingly employed in social/societal domain. It undertakes to describe the actual states of elements/ aspects etc. of a system and to compress them into a single macroscopic curve. The states of the system change in the course of time; they may be seen from the view of an e.g. an individual person (micro), from institutions (meso) or from national economies (macro). States are shown as rendered conclusive for the actual situation. The coordinate system assigns one parameter of the two-dimensional representation space to the *flow of time*; the other to a defined *macroscopic property*. The latter incorporates the resultant of an integration of different phase space states of the research subject, named $S_1 \ldots S_m \ldots S_k$. The phase state of any actual element S_m is assumed to be conclusively described by the qualities $q_{m1} \ldots q_{mr}$. Details have been dealt with elsewhere. [Fig 1,2]

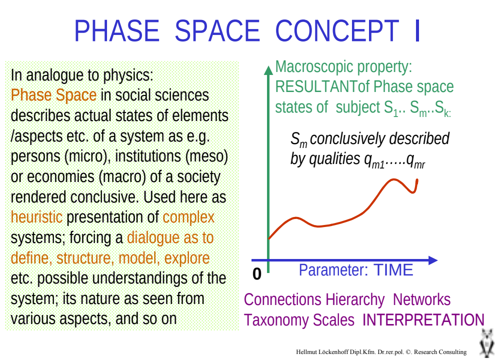


Figure 1

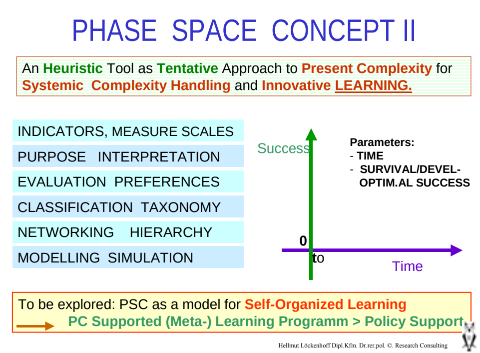


Figure 2

As other fuzzy and complex phenomena, including the societal domain, Phase Space qualifies as a methodical and an heuristic tool likewise for ICT.

3 Behavioral Basics: Value Bases, Preferences, Target Functions

The application of the above described extended Phase Space Concept *heuristic research* tool enforces a thorough reconciliation of modelling assumptions taken for granted. Some central examples only: Which kinds of measures might be given to the 'result' coordinate (as rectangular to 'time') coordinate? Formal measures like 'sustainability'? Which scales will the 'time' coordinate use? Different value bases, distinct preferences lie behind measures and scales. They will, for example, influence the choice of target functions and the postulation of connectivity between factors. Still more profoundly, basic qualities concerning the nature of man and human behaviour in general shape the models influencing expected human systemic or historical conduct. These models incorporating the assumptions behind the development curves must bee seen, in addition, under the auspices of human value domains: from religious /quasi religious convictions to rationally founded scientific findings. Which, and how strong will be human propensities to act at a given historical situation within a given developmental phase? [Fig. 6]

The specific 'human' qualities of social systems behaviour take place within the constraints of the *general regularities governing the complexity* of those systems. In particular *chaos* theories, used her in the extended meaning of the concept, will be implied in PSC employs. Targeting functions, for example, will be subjected to the impact of 'strange attractors'.

4 Principles, Taxonomies, Universals, Networking

Any model of societal dynamics presupposes degrees of regularity. Regularities constitute the very base of natural sciences as physics. They can, in a more complex and confined extent, also be extracted from the course of history, from the structure of living systems including societal institutions; from societal roles, from human behaviour irrespective of cultural inheritance. Often it is but the shared quality which makes obvious the 'difference which constitutes the difference'. In terms of (radical) constructivism we perceive ourselves in our world – consequently using also as perceptional patterns – following universal basic patterns and *principles* our world is built upon. The systems generating the *systemic* approach provide an example, as do physics extending into *social physics*. Concomitantly orders and *taxonomies* which science abstracts arise from such assumptions into the unity of our world.

On a more concrete level principles and the laws of complexity appear as *‘universals’* shaping for example human basic biological traits and human behavioural qualities. They manifest e.g. in individual colour perception, basic structures of language, societal intercourse. Consequently the can be found, too, in qualities of institution building up to the universals of cultures and entire societies. On a still more specific level assumed universals lead to ‘rise

and fall’ models. Famous are the models of Spengler and Toynbee in history [Figure 6]. More specifically they can be found in for example in economics of theories of the enterprise.

Developmental curves can be suspected and are in fact proposed also in the emergence (hence chaos), the rise and the quantitative/qualitative changes in ICT development. The topic can be pursued constrained to the immediate domain of societal communication. Following N. LUHMANN’s model (society is predominantly connected by communicative acts) the scientific approach extends to mutual impact of ICT to societal development in general. From the dynamic

of societal development and the necessity to guide and control it. Again the particular role of *ICT for societal innovation* comes into focus.

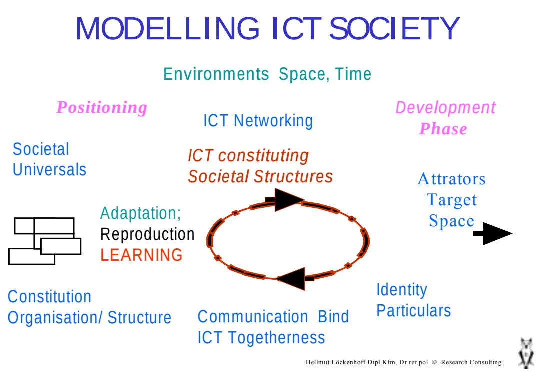


Figure 3

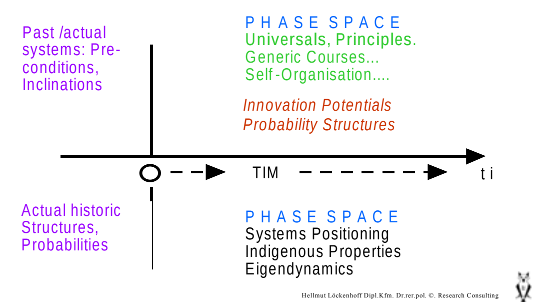


Figure 4

5 Exploring Potentials; Courses for Political Intervention

Savoir pour prévoir pour pouvoir : models to understand possible future courses are tools to be employed for societal control. They procure the raw material, as do the design procedures and planning tools for strategies. They deliver blueprints for intervention. Exploration of a specific constellation means also targeting potentials inherent both for their qualities and the possible modes to transfer them into political success. A meta-consideration may – or must – even reconcile chances and pitfalls of a policy, and its necessary adaptations form a strategy point of view. In terms of the control dialogue demanded: the dialogue and presentation modes need be suitable as well to hold distinct as to integrate different levels of potential observation, assessing and transforming them into interference activities. Right here the Bayesian augmented Space Phase dialogue displays its strength: retraceable steps from defined data to transparent integration; also transparency to assumptions, conditions, aspects and targeting. In general the concept provides a reliable modelling base for subsequent simulation to explore also eigen-qualities of the system in question: dynamics, sensitivities, possible bifurcation points or phase transitions.

A look into any newspaper or television program that ICT on all levels and from many aspects is used as the means for opinion shaping and thus directly or indirectly for intervention. Since the 50th the general model : ICT being the means of intervention and control, has changed so rapidly a comprehensive systematic research need be continued and intensified. The modern war uses information technology from strategy modelling computers to remote targeting control. As e.g. Afghanistan and Iraq exemplify wars are led essentially on the ICT level, from exposure to systematic misinformation.

6 Concept of a (Meta-)Learning Program

The qualifications to be met as discussed above ask for a discursive meta-learning system. Comprehendingly ICT could serve such a device: worldwide, local. The systems logic at the base of PSC is well suited to help generate a PC supported learning program, which is both highly flexible and transparent as to the underlying assumptions and procedural stages. It also permits controlled interception at any phase of the procedures. F. ex. deliberate navigation by the researcher is furthered. The program user/observer may heuristically choose alterations to find out what happens when defined parameters, (non-) variables, valuations or procedures are changed. Over the time the program needs even learn and meta-learn from past experiences.

A possible model is proposed by the concept of Guided Evolutional Control Learning (GECL) explained in detail elsewhere. In analogue for example from strategy controlling in industry GECL models a recursive learning cycle [Fig. 5]. It stipulates first, a phase for general *orientation* on the given situation where the learning sets on and its inherent potentials. The mappings gained, second, are transferred into possible *targets*, from which under policy preferences a set of *objectives* are decided upon. *Planning*, third, transfers objectives to be achieved into measurements within a defined policy. The results on implementation, fourth, are compared with results planned, differences *analysed* as to their causes and eventually *corrective measure programs* executed. This last phase moves on to the next recourse of the entire cycle. [Fig. 6]

The outstanding role of ICT as means and driver and designer of the learning process needs be analysed and eventually transferred into a political proposal, that is ICT qualities used to enhance societal learning. Under ICT vistas a methodical and practical a combination of the GECL and the PSC model seems worthwhile to explore

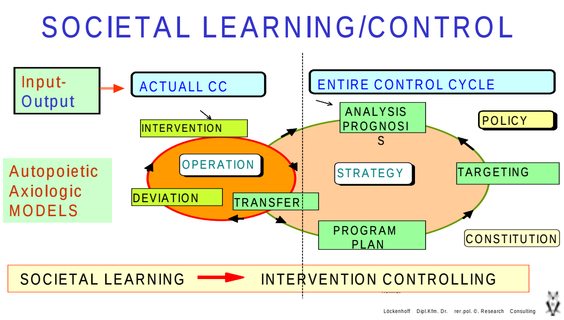


Figure 5

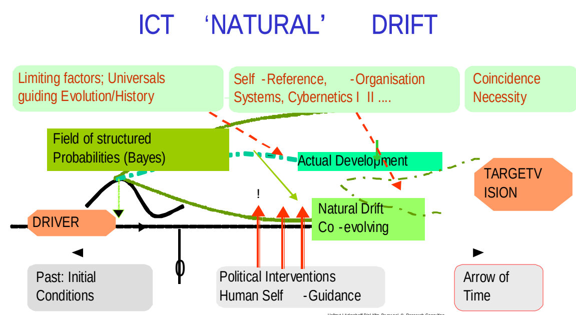


Figure 6

7 Epilogue: ICT Furthering Inertia, Fuelling Emotion.

When in the sixtieths' of the previous century K. DEUTSCH wrote the famous 'Nerves of Government', the political instrumentation of ICT still was dominated by television and voice broadcasting. A comparison with today's political ICT implications indicates a qualitative leap in the powers of information and (mass)-communication tools in political control- or often political uncontrollable turmoil. The last ten years of open warfare from former Yugoslavia to Afghanistan and Iraq provide examples for the overwhelming influence of ICT concerning for global policy. This is valid, irrespectively whether the reasons and causes behind appear humanitarian, democracy, nationalism, oil and resources, or quasi-religious and religious ideologies alike. ICT incited and fuelled emotion wins more often than not seemingly and unavoidably over ratio and reasoning. There is little chance for guidance; control seems scarcely possible. Obviously the challenge cannot be met in the political arena itself. Basic social attitudes must be accomplished within the family, in the kindergarten and the university. The long disputed revival of what could be called a political culture lies rooted in the competence for sober reasoning of each voter.

The same is true for policy in home affairs. There is a straight line from the 'television president' de Gaulle to the recent 'media chancellors'. Its not so much the quality but the chance to be 'sold' by ICT which makes a proposal or a measure successful. ICT, however, is to a much too high degree controlled by lobby and corporatism. Reforms and any other innovative change is stifled at the very beginning.

In many aspects ICT reflects the state of a society: the basic values, the ethics, in sum the understanding of wo-men in their world. Mode and content, the preferences in topics and themes also mirror the deeper levels of : those of the potentials, the propensity to adapt and actively, innovatively to change to change following the historical change. So far ICT often and in central areas acts more as a palliative, a means of self-deception and an excuse to remain inert than as an instrument to stimulate creative discourse.

Just as a beginning: a comprehensive research using the concepts described above may support to lift the fog of missing awareness and insight. Nothing but an courageous, even audacious dialogue not excluding controversial as e.g. social welfare systems or religion will save democracy and the dependent culture and civilisation. To implement such a discourse- don't we need to establish a code of ethics parallel to the international conventions on warfare?

8 References

[1] BUBER R.; J. ZELGER,. ed.: GABEK II. Zur Qual. Forschung. Innsbruck 2000

[2] CAPRA F . Verborgene Zusammenhänge. Scherz 2002

[3] CONTE R. et al. ed. 1997..: Simulating Social Phenomena. Springer 1997

[4] CORNING P. Natures Magic, Synergy in Evolution…Cambridge Univ.Press 2003.

[5] DIAMOND Jared. Guns, Germs and Steel. The Fates of Human Societies. Norton 1997

[6] DUBOIS D.M. New Developments in Computing Anticipatory Systems; p.3 Proceedings Casys 03, Chaos Liége 2003

[7] DE ZEEUW G..; Discovering social knowledge, Cybernetics and Human Knowing 10, No 3-4 2003

[8] GIERER, A.: Im Spiegel der Natur erkennen wir uns selbst. Rohwolt 1998

[9] HABERMAS, J. Theorie des kommunikativen Handelns. edition suhrkamp 1502, Bd 1.2; 1988

[10] HAKEN H.. Synergetics. Springer 1978

[11] HEITMEIER W. Hrg.: Was treibt die Gesellschaft auseinander .suhrkamp Frankfurt 1997

[12] LASLO E.. The Wispering Pond. Element B. Ma. USA 1996

[13] LÖCKENHOFF H.: Modeling Innovation for Creative Control by Bayesian Syllogism. In: R. Trappl ed. Cybernetics a. Systems 2004, Austrian Society for Cybernetic Studies. Vienna 2004

[15] LÖCKENHOFF, H.: GABEK. Exploring Change of Societal Value Systems. In: J. Zelger ed.: Forthcoming proc. of GABEK conference, Sept 2004, Innsbruck University, Dpt of Philosoph

[16] LOECKENHOFF H.. Measuring Sustainable Performance for Societal Control. Paper, 14^{th} Intern. Conf. WACRA Europe e.V. Madrid, Espana Sept 16-19 1997

[17] LUHMANN, N: Soziale Systeme. Suhrkamp 1984

[18] MATURANA, H. VARELA F..: Der Baum der Erkenntnis. Scherz, München 1987

[19] MULEJ M., et alii: A Worried Look at CEEC's: e.g. Slovenia's Accession to European Union After 15 Years of the Two Generation Cycles of Law. Manus ; Maribor 2003

[20] KAJZER S. Ethics of Interdependence and the Law of Requisite Holism. In: STIQUE 1998, Inst. of Syst. Res. Maribor 1998

[21] NALIMOV. V.V. Space,Time a. Life. The Probabilistic Pathways of Evolution ISIPress 1985

[22] OLIGA, J. C.: Power, Ideology and Control. Plenum Press 1996

[23] PALLY, M: Lob der Kritik. Berlin Vlg 2003

[24] PINKER, St.: The Blanc Slate. Viking 2002

[25] POSTMAN, Neil: Das Verschwinden der Kindheit. Fischer 1987

[26] ROSEN R.. Anticipatory Systems, Pergamon NewYork 1985

[27] SCHWANINGER M.. Integrated Systems Methodology: H*Int. Trans. Oper. Res* Vol.4 No. 4, pp 109-123, 1997

[28] STARKERMANN R. Freund und Feind Zwei Archetypen der Evolution. Eine Brücke zw. Physis u. Psyche. Editions à la Carte Zürich 2003

[29] TRAPPL R. ed. Cultural Systems in Cybernetics and Systems, p. 367 –432; Vienna 2002

[30] WOLFRAM Stephen. A New Kind of Science. Wolfram Media Inc. 2001

[31] ZELGER, J in R. Buber. J. Zelger, ed.: GABEK II. Zur Qual. Forschung. Innsbruck 2000

SYSTEMIC (CONCEPT OF) INFORMATION & KNOWLEDGE:
Meaning of credibility and/or beliefs within social systems

Antonín Rosický[1]

Outlined concept of information coming from systemic point of view gives new groundwork for education that is able to explain as well as computers (technology) as social information processes. It also amplifies traditional focus oriented to (computer based) information system towards information management. Accepting systemic principles it covers also human cognition including critical (system) thinking that is a possible way for managing complexity and/or dealing with credibility and creditworthiness.

1 Information or mere words?

The topic connecting enterprise's creditworthiness with information can be readily restricted to financial items and/or to inquiry of truth of shared information at least. The aspiration after wider – holistic and/or systemic – concept and understanding of both terms mentioned above is representing an important contribution to contemporary business. This tendency points out the necessity of a new (systemic) approach not only to creditworthiness itself but also to business, management, economy… and information in the same time. Systemic thinking constitutes – as I understood it – a principally new paradigm and framework for the often proclaimed necessity radical changes. However the understanding of systemic theory or better individual (individual's) assumption about it stand for the changes of weltanschauung and culturally inherited perception, habits and consequently also the undertaken activities. Such intrinsic 'paradigm shift' is extremely hard to do and constitutes a growing gap between words on the one hand and acts on the other hand. In other words: Awareness of many (managers) goes along with a new speech while their doing routine work (and some use the 'new speech' to improve their business success).

[1] Prague University of Economics, W. Churchill Square 4, 130 67 Praha 3, CR;
e-mail: rosicky@vse.cz, (mobile) phone: + 420115512

Typical example of such a situation is a devaluation of information that is verbally derive from data, while our daily activities ignore the misty understood distinctions. In practice the concept of information stems from its static concept of given objects that represent relevant facts from the reality. Despite its definition as '*meaning that human assigns to data*' (BS 3527) the usual 'dealing with information' is oriented to use (or design) of information (and communication) technology or technologically based tools (systems). Both assumptions mentioned above are incorrect and eliminate the essential nature and role of (individual) human knowledge that affects emerging meaning.

2 Systemic theory, knowledge and information

Basic principles of systemic approach arise from evolutionary worldview that reflects material nature of the universe and accents various systems complexity. Its emphasis on natural (spontaneous) processes points out - consistently with the second order cybernetics as well as phenomenology – the distinction of real world (system) and pragmatically based human knowing (and knowledge). The just outlined distinction is source of problems:

- Human knowing that - along with advancing (human) cognition – obtains abstract nature far from immediate empiric experiences by growing way. Abstract concepts (including also '*information*') embodied through symbols are interpreted individually and enhance fluctuations within social systems.
- Abstraction moves human thinking beyond (material) reality and emergent distinctions brings possibility to muse on '*possible worlds*', to anticipate future and to design large artificial systems. However at the same time it opens problems of verity, in the sense of congruence with the substantiality (rather than truth).
- Natural constitution of human cognition (its origin that is closely tied up with individual experiences is generalized within processes of human communications based on language) generates knowledge that is rather '*belief*' than '*truth*'.
- Fundamental character of an insight complexity of contemporary – global and extremely complex – world is energized thanks to increasing amount of shared data and distinctly interpreted information. Among more newly viewed problems it brings also such issues as trust – which term is more often used in socially systems than creditworthiness and/or similarly credibility is more apposite than truth.

In the sense of the presented idea the meaning does not found in lexical descriptions (in the sense 'content') neither illumination but it is entirely tied up with human activities. However it is not possible to restrict these activities to apparent behavior and it is necessary to accept hidden – mental processes including (spontaneous) re-creation (rather than creation) of implicit (tacit) knowledge. One from essential problems lies in the recursive relationship between information and knowledge (see figure): Interpreted meaning (of information) depends on individual knowledge and such information re-creates this knowledge at the same time.

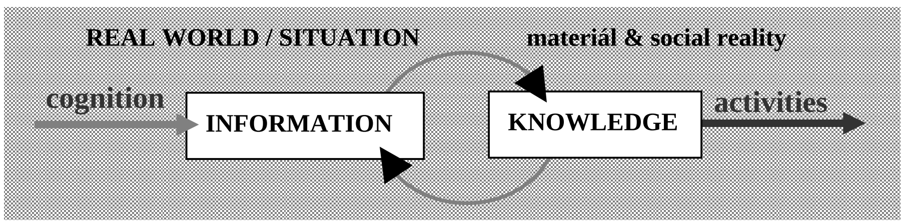


Figure 1 – Circular relation between information and knowledge

Not only the circular relation (and mutual dependency) of information and knowledge, that belongs the fundamental aspects of complexity is evident from the figure. The biological (material) nature of (individual's) human cognition associates past and generalized experience with an environment and turn to be shareable. In this way human knowledge gains social dimension and new kind of 'social reality' emerges beside the traditionally considered material reality. It covers culturally shared (abstract) concepts… that initiate actual activities and interaction of various '*agents*' whether individuals or economics subjects. Along with these aspects of knowledge also stunning and unique aspect of social complexity emerges. It covers such affairs as mistakes, inaccuracy, generality, flam… and opens problems of - among other things – problems of validity and credibility. As a result we are usually not able to simply distinguish information from des-information and they both initiate activities aimed not only at social but also at material reality. Information and its communication affect particular activities of individuals that represent the main kind of interaction which is there in social systems and backwardly constitutes environment for our everyday (personal a professional) life backwardly. A new kind of uncertainty and turbulence results from natural features of (human) information emerges and calls for treatment of its credibility. Accordant and described problems develop in conjunction with origin of language and they gain a quite new dimension and importance due to changes in social information processes. These are dramatically accelerated through use of information technology and also various information institutions (systems) inc. education play no less role.

The briefly suggested framework we will explain some holistic and systemic aspects of information and their consequences for the emergence of the trust, credibility in social systems. At the same time the traditionally reduced concept of creditworthiness will be explained in relation to use of information and communication technology and knowingly based tools.

3 Sharing knowledge, information environments and social reality

Other commonly shared concepts also prove pragmatically reduced with regards to humane experience. One of such ideas that need a more realistic view is the concept of synergy as cooperation that strives for purposeful reconciliation of human activities and for elimination of undesirable agents. These aspirations seem to be comprehensible but they puts questions of used knowledge – its rightness, credibility and/or adequacy. In conjunction with the intention itself it connects with the actual concepts of rationality and its support through sharing of knowledge.

Appropriate topics are newly timely due to misleading idea knowledge that is attributed to group in many concepts of knowledge management and also with use of (software) tools named groupware. In spite of the fact that the discourse constitutes environment for emergence of new knowledge, the knowledge is fundamentally individual affair moreover it is changing in holistically perceived situation… We would keep in mind these and other facts including various aspects of discourse that is social process when considering critically the groupware… Using the term 'groupthink' some point out the fact hat the same process can eliminate more valid but less typical knowledge (perhaps the one based on a new paradigm).

Systemic notion of information and knowledge points out the topics creation of systems that have (misleading) concept of generally (and unconditionally) valid knowledge. Common education presents knowledge deductively as a set of given facts and objectively valid laws and creates framework that cannot deal with (manage) the social complexity successfully. Today speaking about the growing meaning of information we pay attention to appropriate topics that are based on misty concept of information and appropriate education is restricted to dealing with technological tools (or computers) largely. Also the newly emergent information science usually persists in a vague notion of information as an entity and its quantitative aspects but it ignores meaning. The high education of informatics (or information systems), too remains in similar framework that is based in a misleading (meta)knowledge of information (knowledge).

4 Circular dependence of information and knowledge

Systemic thinking is based on the evolutionary point of view that is far from the traditionally known Darwinian Theory and covers evolution of the Universe inc. physical (inanimate) world (systems). From many aspects it overreaches familiar perception comporting with the Newtonian world of material bodies and entities that are distinguished and defined by people. In understanding the appropriate principles we should accept internal interactions of systems components, systems dynamic and also many various aspects of (inner) complexity. We must replace considered 'states' by 'processes' and 'structures' by '*maintained and evolved patterns*'. Conformable paradigm shift points out the properties and role of *observer* well known from the second order cybernetics as well as the nature of (human) cognition, knowledge, language and also information.

From this point of view the information is given by (dynamic) diversity of material structures (processes) the meaning of which approves (to observer) as visible changes (behavior) of system usually denoted as *receiver* (of considered information). From internal (systemic) position the meaning emerges from the interaction and it is not only a matter of (given) information itself but also of the nature (features) of its receiver. In the common (anthropic) conditions the human is the position of observer or receiver of information and it's the meaning that emerges from mental/cognitive processes of nervous systems. What is essential is the biological (material) nature of these processes which are substantively tied up with the (human) organism and its singular interaction within environment.

However some phenomena emerging from such internal and invisible cognitive processes are qualified by people from different positions. From the systemic position briefly sketched above they have the identical fundamental however the ascribed properties depend upon executed position, the view held and/or observer's knowledge (opinion).In this sense such entities and or concepts as consciousness, mind, knowledge, thinking… and also memory are similar and accent only some specific aspects and activities. Some from the presented ideas may appear to be very dramatic, probably most expressive is idea of memory strongly influenced by computer terminology. However human memory – unifying in dynamic processes (of learning) as well as in previous patterns (fluctuating states) and newly constituting patterns – is far from static storage (changing internal states only by external inputs).

The substantiality of knowledge can be explained in the sense of internal (or tacit) knowledge as inner cognitive processes depending on actual perception including subjective feelings and experiences as well as previous processes (patterns). In this processes the received information(s) has an essential role however its meaning depends on original knowledge and changes it at the same time. Such theory comports either with notion of circularity which plays an essential role in systemic theory or with hermeneutic circle known from phenomenological philosophy and points out to the actual and constitutional force of human knowledge. Its individual (biological) substance has the intentional nature resulting just from individual's activities and experiences (interactions) within his environment…

However human cognition and/or *knowing* (Maturana and Varela, 1998 use this term to stress dynamic nature of knowledge) bring another essential properties emerging from the use of language. Thanks to it we are able to externalize our ideas and/or knowledge and present them through symbols (words). Using the syntax (grammar) we can create advanced symbolic structures bearing conceptual information [Rosicky, 2002] having abstract character. The meaning is tied up with human concepts that have disposition to be a stumbling block of human thinking. On the individual domain the concepts emerge as generalized patterns of perceived situations (states) coupling with suitable behavior.

However language cannot be restricted to '*the set of word and rules for their linking*' what is typical for common linguistic arising from the tradition of analytical philosophy and/or for artificial intelligence (and/or computer science) with single valued rules and given content of words… The meaning of words not only depends on the position within higher structures (sentences, texts), individual knowledge and actual context, but it emerges and evolves through human interactions /communications). In similar sense Maturana and Varela use the dynamic *languaging* in place of static language and the presented distinction points out two faces of language: The first (*langé)* comports with the mentioned linguistic sense while the other (*parole*) stands for speech or utterance and lies near to the meaning of bore (shared) information.

Let us emphasize the abstract nature of symbols (and language) however their form is ponderable in the sense of signals as (variety of) physical quantity. Such symbolic structures initiates (biological) cognitive processes and are primarily closed with individual knowledge inc. particular language… Emerged associations are not oriented directly towards the real world in material sense but rather to cognitions and ideas forming social reality and emerging from it at the same time. The abstraction includes another level of generalization resulting just from long terms and recursive interactions of many people.

In this way advanced and commonly shared frameworks of human knowledge emerge and they are usually denoted as cultures but they have also sense of different paradigms and theories and ideologies… These frameworks are usually undervalued and our pragmatic and often rather utilitarian intentions restrict knowledge to professional expertise in the sense of diagnostic situation and presentation of proofed behavior (method…). However diverse ideologies, paradigms and theories constitute not only social reality including human knowledge and consequently also human activities making as well social as material reality. In spite of problems to attest their verity that increase together with growing complexity of systems (and culminate in social systems) we do so…

The problem of creditworthiness discussed in this conference lies primarily in the nature of conceptual information and of its meaning is constituted by individual but socially formed knowledge. However this knowledge has the nature of belief [Rosický, 2004] in all forms from the connotations of this word, i.e.:

a) Faith (víra) in the sense of ideology (religion) as culturally shared (framework of) belief.
b) Presupposition and remising
c) Feeling in the sense of assumption
d) Opinion producing common ways of thoughts
e) Conviction concerning ideas of faultless, and/or proper (fit);
f) Credibility of used and shared knowledge enthroning issue of trust.

In other words – conceptual information that represents common sense of this word – is not the material entity, thing being apt to (mechanistic) manipulation and it is neither the fact. It cannot be simply differentiated from des-information however it initiates our activities and our participation / responsibility in the process of (co)evolution.

5 Few topics in fine

Now we could discuss many particular aspects and mistakes associated with our understanding and consequently also with shortcomings of our dealing with information. Many from them have just the nature of 'validity errors' and emerge for example from the misunderstanding of many cognitive activities such as measurement and quantification and/or incorrect dealing with numbers (that have not the nature of numbers but only symbols). Similarly we could ponder on the nature of computer programs and algorithms that are based on finite mathematical models that are not able to represent natural world faithfully…

Inserted ideas are based on recent systemic theory that pervades all contemporary scientific disciplines from physics through biology to management and sociology. They point to the nature of conceptual information immediately tied up with human cognition and language and explain new aspects of complexity that inhere just and only to social systems. Briefly sketched problems go along with human history however recently they receive new and dramatic contingency. It results from the use of information technology (that actually only manipulate with binary symbols) designed information systems (that overreach computer based IS and include also human institutions) and involve communication of conceptual information. Our being in recent global world is based on the trust and beliefs…

Let us briefly present some topics that require higher attention. We should:

- Support critical thinking (narrowly connected with systemic theory) and 'scientific theories' in the sense of the consistent framework of knowledge that aspire to collation. Contemporary informatics as well as *best practices* well known from business are far from such effort.
- Ponder over the influence of information and communication technology to human activities. And similarly we should give higher eye to the nature of various (information/knowledge) institutions that unify sharing of fickle knowledge and need growing trust (belief).
- Differ between computer and information literacy and or education. Common way of thinking is oriented to ability to manipulate with computer and some (software) tools. Without the appropriate information theory and culture we cannot face the turbulence and reliance in beliefs and intentions of others.

Perhaps presented beliefs run off the rails of common concepts of informatics strongly focused on technological issues far from the congenial theory… Systemic thinking proposes to change and to improve such situation however – shifting paradigm - it is not easy. It also – seems to me at least – presents shift from informatics and computers to information (and/or knowledge) management.

6 References:

Berger, P. & Luckman, T. [1966]: The Social Construction of Reality. A Treatise in the Sociology of Knowledge, Doubleday, New York;

Boisot, H. [1999] Knowledge Assets: Securing Competitive Advantage in the Information Economy, Oxford University Press`

Combs, A. [1996]: Consciousness: Chaotic and strangely attractive. In. Sulis, W. & Combs, A. (eds.) Nonlinear dynamics in human behavior. World Scientific, London;

Goldberg, S. [1998] Consciousness As Meaning: A Solution To The "Hard" Problem, In: *Consciousness, Information, and Meaning: The Origin of the Mind*, Med Master, Inc. 1998.

Hofkirchner, W. (ed.) [1999]: The Quest for a Unified Theory of Information, Gordon & Brecach;

Maturana, H., Varela, F. [1998]: The Tree of Knowledge, Shamhala, Boston.

Migdley, G. [2001] Systemic Intervention: Philosophy, Methodology, and Practice, Kluwer Academic;

Pstružina, K. [1998]: Svět poznání: K filosofickým základům kognitivní vědy (*The Universe of the Science: Towards the Philosophical Principles of Cognitive Science*; Nakladatelství Olomouc, Olomouc (Czech);

Rosický, A. [2002] Information generating system: Towards concept of information generating social systems, *EMCSR, Vienna, 2002*;

Ulrich, W. [1994]: Critical Heuristics of Social Planning: A New Approach to Practical Philosophy, J. Wiley, Chichester;

Vickers, G. [1983]: Human Systems are Different, *in. Journal of Applied Systems Analysis, Vol 10, pp. 3-13;*

Vopěnka, P. [2001]: Meditace o základech vědy (*Meditation on gourdwork of the Science*), Práh Pub. Praha, CR (Czech);

Winograd, T. and Flores, F. [1986]: Understanding Computers and Cognition, Ablex Pub. Norwood.

THE PROCESS OF THE ASSESSMENT OF AN ENTERPRISES'S BUSINESS PARTNERS' CREDITWORTHINESS

Vesna Čančer[1]

As the evaluation of creditworthiness is a very complex goal, systemic thinking in the form of multi-criteria decision-making methods should be applied. This contribution presents the process of the assessment of an enterprise's business partners' creditworthiness that is made by a firm itself (so-called internal rating) where the problem is approached step by step. The Analytic Hierarchy Process (AHP) technique is applied, which allows the decision makers to consider not only quantitative but also qualitative criteria. It can help decision makers to understand the relationships among factors that influence the creditworthiness of business partners, to investigate possible misunderstandings and to improve the model for the selection of business partners by the evaluation of their creditworthiness.

1 Introduction

Decision-making in an enterprise – a part of a complex and heterogeneous environment - requires knowledge of its business partners. A requisitely holistic information about them can be acquired by a requisitely holistic assessment of their creditworthiness with respect to different, conflicting criteria. As the evaluation of creditworthiness is a very complex goal, systemic thinking in the form of multi-criteria decision-making methods should be applied. Several practical systematic approaches for dealing with complexity have been developed; supported by user-friendly computer programs they enable structuring complexity, measurement on ordinal, interval or ratio scales, and synthesis.

Saaty (see e.g. [14], [15], [16]) developed a practical systematic approach for dealing with complexity - the Analytic Hierarchy Process (AHP). It provides an organized but complex framework that allows for interaction and interdependence among factors [16]. Because both the

[1] University of Maribor, Faculty of Economics and Business, Razlagova 14, SI-2000 Maribor, SLOVENIA, E-mail: vesna.cancer@uni-mb.si

deductive and the systems approach contribute to our understanding of complex systems, the AHP combines these two approaches into one integrated, logical framework. It enables us to structure a system and its environment into mutually interacting parts and then to synthesize them by measuring and ranking the impact of these parts on the entire system (see e.g. [16]).

Broad areas in which the AHP has been successfully employed include selection of one alternative from many, prioritization/evaluation, benchmarking, resource allocation, forecasting, public policy, total quality management, business process re-engineering, strategic planning, etc. Further, the AHP has already been applied for financial analysis to deal with transitional enterprises, for bank performance evaluation, for selection among environmentally-oriented business alternatives [4] and for the valuation of a company in relative value, which can be transformed in monetary units [1].

This contribution presents the process of the assessment of an enterprise's business partners' creditworthiness that is made by a firm itself (so-called internal rating) where the problem is approached step by step. Since qualitative factors are coming into force in the creditworthiness evaluation (see e.g. [2], [11]), the Analytic Hierarchy Process (AHP) technique is applied, which allows the decision makers to consider not only quantitative but also qualitative criteria. They can be compared using informed judgements to derive weights and priorities and to determine the benefits of each business partner.

The process of the creditworthiness assessment is introduced with a practical case from a small enterprise that evaluates the creditworthiness of its business partners – alternatives. Managers' and experts' judgements are taken into consideration when structuring the problem. Special attention is given to the assessment of the criteria importance. Since decision makers are often inconsistent in making pairwise comparisons, the procedure for the improvement of the decision makers' consistency will be briefly introduced and discussed. Some developmental tendencies and further application possibilities are introduced as well.

2 How to Apply the Process of the Creditworthiness Assessment

When selecting its business partners, an enterprise should evaluate their creditworthiness with respect to different, conflicting criteria. The AHP method provides for a user-friendly consideration of the quantitative as well the qualitative dimension of the business partners' creditworthiness with pairwise comparisons of the attributes' importance and alternatives' preferences: weights or priorities are not arbitrarily assigned, but are derived from verbal, numerical or graphical judgements. This way of making decisions is supported by computer programs that involve it as one of the multi-criteria decision-making methods. Expert Choice [5] is a computer program, developed specially for applying the AHP method.

The method is based on the principle of constructing hierarchies, the principle of establishing priorities, and the principle of logical consistency [6]. It enables decision makers to represent the simultaneous interaction of many factors in a complex environment of their business partners. In the creditworthiness evaluation the criteria are measured on different scales or are even intangible. Prioritization (expressing the importance or preference) is one of the major advantages of the AHP; it solves the problem of having to deal with different types of scales, by interpreting their significance to the users' values. A weighting and adding process is used to obtain overall priorities (final values) for the alternatives as to how they contribute to the goal (see e.g. [16]).

When verifying the applicability of the process of the creditworthiness assessment for the selection of an enterprise's business partners, we concluded that it should involve the following steps: problem definition, elimination of unacceptable alternatives, problem structuring (building a model), establishing priorities (on importance and preferences), synthesis and sensitivity analysis with verification.

2.1 Problem Definition

When the problem arises, we should describe it accurately. We should define quantitative and qualitative criteria (factors) and alternatives (in our case business partners).

2.2 Elimination of Unacceptable Alternatives

We should define the requirements for the alternatives that are to be fulfilled. We assess all possible alternatives; when the alternative does not fulfil the requirements, it is defined as unacceptable and therefore it should be eliminated.

2.3 Problem Structuring

In the AHP we structure a complex situation in a hierarchical model. For each problem it consists of goal (in our case the assessment of business partners' creditworthiness), criteria, very often some levels of sub-criteria, and alternatives. In a hierarchy, criteria can be structured in more levels so that lower levels specify sets of sub-criteria related to the criteria of the higher level.

2.4 Establishing Priorities

We have to establish the criteria importance in order to define the criteria weights. This step involves the judgements about the alternatives' preferences and the calculation of the alternatives' values with respect to each criterion on the lowest level as well. One of the major advantages of the AHP is the use of pairwise comparisons to derive accurate ratio scale priorities, instead of using traditional approaches of assigning weights. This process compares the relative importance of two criteria or the preference of two alternatives with respect to another element on the level above.

When making pairwise comparisons between the importance of quantitative and qualitative criteria with respect to the criterion on the higher level, even experts are often inconsistent. The main reason is that they are not aware of the relationships among different factors, taken into account for the evaluation of the enterprises' creditworthiness. Additionally, the more factors in a level, the greater the chance of inconsistency and the more taxing the comparison process. With the (in)consistency ratio, calculated after entering the intensities with one of the appropriate computer programs, experts and managers can be warned that their understanding of the criteria importance is not good enough. In the case that this (in)consistency measure is greater than 0.1, they can conclude that the importance, assessed to the considered criterion, is over- or undervalued. Considering the intensities of other criteria importance, they can calculate the acceptable intensity. The inconsistency ratio, displayed in Expert Choice [5], can be lowered by selecting *Best Fit* that shows the intensity for the current judgement that would best improve the decision maker's consistency. But we are not allowed to enter the suggested *Best Fit* value unless we believe it to be true [5]. Namely, judgements can be deduced from one another in perfect consistency depending solely on the observance of formal, linear relationships between them. Saaty [16] warns that thus one may develop a consistent deductive system with no real validity. Therefore we recommend the procedure based on the judgements about which the decision maker is completely positive. By considering only the judgements that represent the decision maker's best understanding of the problem the transitivity characteristic can be used to set right other intensities of the criteria importance (for details see e.g. [3]).

2.5 Synthesis

In synthesis the additive model is used where the reciprocal preferential independence of criteria importance (for details see e.g. [17]) is assumed. The synthesis is the process of changing the local priorities of the alternatives using the global priorities of their parent criteria. These are summarized at the model's last level for each alternative and thus the final values of the business partners' creditworthiness are obtained. Two ways or modes of synthesis are the distributive mode and the ideal mode. As we want to evaluate the creditworthiness of all business partners who are included in the model as alternatives we have to apply the distributive mode: the results show which business partners are more (or less) creditworthy than other business partners. They can show the necessity to insure or to cancel the business relationships with some partners. If an enterprise wants to select the business partner that is the most creditworthy, it should apply the ideal mode of synthesis.

2.6 Sensitivity Analysis

Sensitivity analysis is used to investigate the sensitivity of the business partners' creditworthiness to changes in the criteria weights (priorities). It can be performed from the goal or from other criteria in the model.

3 A Practical Case

The method for the evaluation of the creditworthiness of an enterprise's business partners has already been applied in a small Slovene enterprise (let us call it X). The relationships with its business partners are based on the one-year contracts, therefore it is very important for X to evaluate the creditworthiness of its top business partners (let us call them A, B, C and D). It is very important to study the results of the annual creditworthiness in more than one (at least two) years to obtain the dynamic picture of the enterprises' creditworthiness. Therefore we built two models for two years; to make the results comparable, the same criteria were included in both models. The structure is shown in Figure 1.

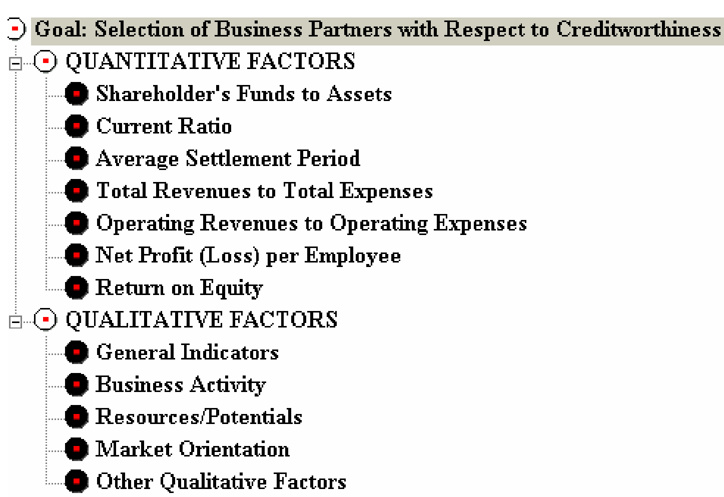
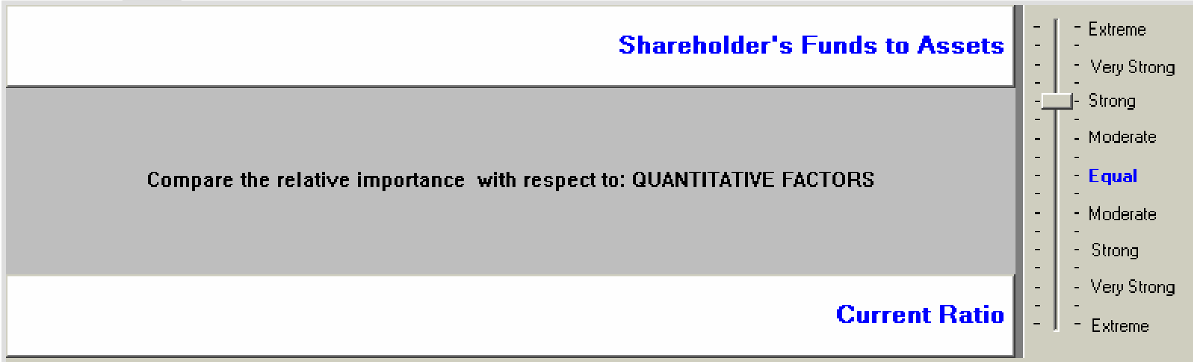


Figure 1: Treeview of the criteria structure

The quantitative factors that impact the creditworthiness of the business partners were assessed by the enterprise's X financial experts. They chose 7 financial indicators that can be found in the financial data base FIPO [7]. It is very important for small and medium-sized enterprises to get the data with which they can evaluate their business partners themselves. The enterprise's X experts that make business with the considered business partners most closely evaluated the impact of qualitative factors on their creditworthiness. These experts fulfilled a questionnaire about the qualitative factors, decomposed by following [10], for each year so that they evaluated the impact of the particular qualitative factor on the business partners' creditworthiness as strongly negative, negative, neutral, positive or strongly positive.

When comparing the relative importance of the lower level criteria with respect to the criterion on the higher level, the experts' judgements were taken into consideration. They judged that the relative importance of quantitative factors and qualitative factors is equal. Comparing the relative importance of quantitative factors by using verbal, numerical and graphical modes of pairwise comparisons and by regarding the (in)consistency ratio, we obtained the matrix that is presented in Figure 2. In the first row of the comparison matrix it is written that the criterion Shareholder's Funds to Assets is strongly more important than the criterion Current Ratio, moderately to strongly more important than Average Settlement Period, moderately more important than Total Revenues to Total Expenses, equally important as Operating Revenues to Operating Expenses, moderately to strongly more important than Net Profit (Loss) per Employee, and equally important as Return on Equity. Other intensities of the relative importance can be read similarly by using the numerical representations of verbal judgements as follow: 1 – Equal, 3 – Moderate, 5 – Strong, 7 – Very Strong, 9 – Extreme. When a numerical intensity is written in light gray, it represents an inverse intensity; for example, the criterion Operating Revenues to Operating Expenses is strongly more important than Current Ratio.



	Shareholde	Current Ra	Average Se	Total Reve	Operating I	Net Profit (I	Return on I
Shareholder's Funds to Assets		5,0	4,0	3,0	1,0	4,0	1,0
Current Ratio			1,0	1,67	5,0	1,25	5,0
Average Settlement Period				1,33	4,0	1,0	4,0
Total Revenues to Total Expense					3,0	1,33	3,0
Operating Revenues to Operating						5,0	1,0
Net Profit (Loss) per Employee							4,0
Return on Equity	Incon: 0,00						

Pairwise Verbal Comparisons

Figure 2: The final comparison matrix of the quantitative factors' importance

The matrix of the intensities of the relative qualitative criteria importance is presented in Figure 3. It is obtained similarly as the matrix in Figure 2.

	General Inc	Business /	Resources	Market Ori	Other Qual
General Indicators		1,0	2,0	1,0	1,5
Business Activity			2,0	1,0	1,5
Resources/Potentials				2,0	3,0
Market Orientation					1,5
Other Qualitative Factors	Incon: 0,00				

Figure 3: The final comparison matrix of the qualitative factors' importance

Final matrices in Figures 2 and 3 were obtained with some corrections of the initial judgements; we transformed corrected numerical intensities into verbal intensities and ask the experts to express their opinion about them. They concluded that some of their initial judgements were not consistent. The method and the appropriate computer program can thus help the decision makers to understand the relationships among factors that influence the creditworthiness of business partners and to investigate possible misunderstandings.

To evaluate the alternatives A, B, C and D with respect to each covering qualitative and quantitative factor (attribute) on the lowest level in the model, we used the appropriate formula types. We entered the qualitative and the quantitative factors' data, first in the model for the first year and then in the model for the second year.

Final values of the business partners' creditworthiness, obtained by the distributive mode of synthesis, are presented in Figure 4a for the first year and in Figure 4b for the second year. It can be concluded that business partner D is more creditworthy than all other business partners and that business partner B is less creditworthy than all other business partners in both considered years. Moreover, the final value of B's creditworthiness is lower in the last year.

Figure 4a: Final values of the business partners' creditworthiness for the first year

Figure 4.b: Final values of the business partners' creditworthiness for the second year

With Performance Sensitivity Analysis it can be concluded that D is followed with B, A and C with respect to quantitative factors, whereas C is followed with A, D and B with respect to qualitative factors in the first year. Since B is better than A and C in quantitative factors in both considered years, it would be interesting to determine the quantitative factors' weight at which B has no longer the worst overall creditworthiness. With Dynamic Sensitivity Analysis it can be concluded that the quantitative factors' weight should be more than 63,2 % in the first year and even more than 94,5 % (!) in the second year to remove B from the place with the worst creditworthiness. However, these increases of the quantitative factors importance would not be in accordance with the real-life growing importance of qualitative factors.

With dynamic analysis we can also determine the qualitative factors' weight to replace D on the first place: it should be 74,5 % in the first and 72,6 % in the last year.

It can be concluded that the decision makers in the enterprise X should think about insurance or even canceling the business relationships with B. Following the results of the models for the selection of business partners on the basis of their creditworthiness evaluation, X can continue business relationships with business partners A, C and D. Further, when qualitative factors are moderately more important than quantitative ones, business partner D would not be more creditworthy than all other business partners. By changing the importance of quantitative and qualitative factors, the ratings of business partners with respect to creditworthiness are changed as well.

Similarly, we can analyze the sensitivity of the creditworthiness of business partners to changes in the attribute weights on the lowest level.

4 Some Conclusions and Possibilities of Future Research

The multi-criteria decision-making method presented in this article enables Systems/Systemic/Holistic Thinking (to diverse Systems/Systemic/Holistic Thinking vs. Un-systemic/Traditional Thinking see [11], [12], further elaboration in [13]). It is a method for solving complex problems that are considered as a whole. Using this method a problem is structured into a hierarchical system considering several criteria on different levels. The structure can be completed with new criteria (attributes) regarding the type of business partners and several (ethical, social, economic, environmental) dimensions. By pairwise comparisons of the attributes' importance and alternatives' preferences the elements of the model are related.

This method can be used for internal rating to select among business partners of a small or medium sized enterprise on the basis of their creditworthiness evaluation. It has turned out that approaching the problem step by step, described in this article, enables experts and managers to use this method for the goal fulfillment.

Using this method, decision makers can identify and set priorities on the basis of their objectives and their knowledge and experience of assessing their business partners' creditworthiness. For a better understanding of the problem, they need to represent the problem from and use the knowledge of different experts and to debate with others who hold different views comparisons of the attributes' importance and alternatives' preferences. Business partners' creditworthiness should be assessed with a group. The group should have a positive interest in understanding the complexity of the problem and possible approaches to its solution. Selection of an enterprise's business partners requires a small group of well informed and highly motivated participants who are in agreement on the basic question being addressed. They can also test the sensitivity of the creditworthiness evaluation and therefore of the selection of their potential business partners to variations in their individual judgements, what is often of great value in group decision-making. By sensitivity analysis decision makers can study the increasing impact of the qualitative factors on the business partners' creditworthiness, as well.

Using this method and the appropriate computer program can help decision makers to understand the relationships among factors that influence the creditworthiness of business partners, to investigate possible misunderstandings and to improve the model for the selection of business partners by the evaluation of their creditworthiness.

In our case the model is structured for short-term business decision-making. It can be improved for long-term or strategic decision-making (see e.g. [8], [9], [11]). Moreover, since strategic alliances are increasingly gaining favor over go-it-alone strategies (see e.g. [8]), critical success factors in alliance-making with special consideration given to the specific situation of small and medium-sized enterprises should be identified and included in the model.

In our case the emphasis is given on different factors of the economic dimension of the so-called sustainable performance. The method presented in this paper enables consideration of environmental, ethical and social dimension as well; however, enterprises will complete their models for the creditworthiness assessment with these dimensions only if they are prepared for and interested into sustainable society.

5 References

[1] AMEN, M., Using AHP for the Valuation of a Company: Combining Success Factors and Financial Numbers, in: Proceedings of the Sixth International Symposium on the Analytic Hierarchy Process ISAHP 2001, Bern 2001.

[2] B&P, Neue Spielregeln im Finanzierungsbereich für KMU's, http://www.basel-zwei.at.

[3] ČANČER, V., Analiza odločanja (Decision-making analysis. In Slovene), University of Maribor, Faculty of Economics and Business, Maribor 2003.

[4] ČANČER, V., The Multicriteria Method for Environmentally Oriented Business Decision-Making, Yugoslav Journal of Operations Research, Vol. 14, No. 1 (pp. 65-82) (2004).

[5] FORMAN, E. H. (et al.), Expert Choice 2000, Expert Choice; Inc., Pittsburgh 2000.

[6] FORMAN, E. H., GASS, S.I., The Analytic Hierarchy Process – An Exposition, Operations Research, Vol. 49, No. 4 (pp. 469-486) (2001).

[7] GOSPODARSKI VESTNIK, Finančni podatki (Financial Data), http://www.gvin/com/fipo2001.

[8] HOFFMANN, W.H., SHCLOSSER, R., Success Factors of Strategic Alliances in Small and Medium-sized Enterprises – An Empirical Survey, Long Range Planning, Vol. 34, No. 3 (pp. 357-381) (2001).

[9] KNEZ-RIEDL, J., Innovation capability as a component part of the creditworthiness of a firm, in: S. Hofer and P. Doucek (eds.), Proceedings of IDIMT-1997 the 5h Interdisciplinary Information Management Talks, R Oldenburg, Wien Muenchen 1997.

[10] KNEZ-RIEDL, J., Pojmovanje in presojanje bonitete podjetja (Considering and Assessing the Creditworthiness of a Firm. In Slovene), ZFRD, Ljubljana 2000.

[11] KNEZ-RIEDL, J., MULEJ, M., Informing the Management by a Requisite Holistic Assessment of the Creditworthiness of an Enterprise, in: IDIMT '04 (available in advance).

[12] MULEJ, M., et al., Informal Systems Thinking or Systems Theory. Cybernetics and Systems, Vol. 34, No. 2 (pp. 71-92).

[13] MULEJ, M., et al., How to Restore Bertalanffian Systems Thinking, Kybernetes, 33 (forthcoming in 2004).

[14] SAATY, T. L., The Analytic Hierarchy Process, McGraw-Hill , New York 1980.

[15] SAATY, T. L., Fundamentals of Decision Making and Priority Theory with the Analytic Hierarchy Process, RWS Publications, Pittsburgh 1994.

[16] SAATY, T. L., Decision Making for Leaders, RWS Publications, Pittsburgh 1999.

[17] VINCKE, PH., Multicriteria Decision-Aid, John Wiley & Sons, Chichester 1992.

WHICH MANAGEMENT INNOVATION CONCEPTS CAN BE FOUND AND TRUSTED IN SLOVENIA?

Dusko Ursic[1]

Innovation of management takes place, once the suggested methods are found requisitely trustworthy / creditworthy. The managers' dilemma is: which concepts to use and what they solve in the practice. We investigated ISO 9000, TQM, Business Process Reengineering, and 20 Keys on a comparative empirical basis over seven years. In Slovenia, the use of management concepts represents an active component in renovating the Slovenian society as a whole. Basically, it concerns modernising the way of thinking about the manners of (business) life and assessment of its quality from the aspect of the ever-present need for introducing reasonable novelties to assure competitiveness. In Slovenia it is practically impossible to speak about the use of »pure« management concepts in their original form.

1 Introduction

Creditworthiness may apply to management innovation concepts, too. During the last two decades we have been witnesses to a series of management innovation concepts offering various "new and innovative" solutions for business problems in the conditions of rapidly changing business and social environment. Therefore, managers have a dilemma which concepts to use and what they solve in the practice. As more rapid are the changes in business, as more difficult is the decision on the methodology selection. We have been coming across this problem in the Slovenian business practice, too. The problem seems to be even bigger because all the concepts under consideration have received a larger attention in last decades only, and it is therefore difficult to monitor their practical results and related managerial experiences. The lack of the business tradition in this area requires analytical assessment of each management concept. At the beginning of the 1990s ISO 9000 standards released an avalanche of mass interest of the Slovenian managers for contemporary business concepts. A 10-year period allows us to make conclusions about its influences on the business practice and their international comparability.

[1] University of Maribor, Faculty of Economics and Business, Razlagova 14, 2000 Maribor, Slovenia, dusko.ursic@uni-mb.si

Over the last ten years, author of this contribution has frequently met experts on management from both Slovenia and abroad. First of all, we have analysed the background of concepts and ways of their introduction into practice. We found that this was insufficient either for an argumentative critique about concepts or for a valid assessment of company competitiveness and exposing opportunities for improvements in business and other innovations. In Slovenia, we came across no research on this topic, which would be theoretical and applied at the same time. An additional research motivation was offered to us by facts that the government of Slovenia supported research on management concepts actively through Ministries of Science and Technology, of Economic Activities, and of Small Business and Tourism. This fact gives our research a broader societal importance and a chance to experience a rather active impact over effects of transition of the Slovenian economy. We also must mention the capability of our work to be internationally comparable, which is provided by our co-operation in the international project Process re-engineering in Europe: choice, people in technology - PRECEPT (Clausen et al., 1998-2002). On the pages to come we wish to let you see our theoretical and practical views of management concepts development in Slovenia.

2 Present-day challenges in Slovenian organisations

In order to constantly respond to changing conditions, the company must have an innovative management approach to managing change in organisation (See: Nonaka, Takeuchi, 1995; OECD, 1996; Peters, 1986). It is also relevant to recognize that the prerequisite for managing change in organisation is a radical modernisation of the management approach. (Mulej et al., 1987; Mulej, ed., 1983-2003; Mulej, 1994; Christensen, 2003; Afuah, 1998; Likar, 2001; Markic, 2003; Ecimovic, Mulej, Mayur, 2002; Mulej et al., 2000; Mulej, Zenko, 2004)

In Slovenian organisations management is still a relatively new concept, not only for most of minor shareholders but also for the majority of newly established state and private institutions. These new shareholders have played a major role in the historical process of property transformation (Prasnikar, 1999). The ownership structure of the companies with transformed ownership is dispersed and conflicting interests between the internal and external owners often arise.

An analysis of the ownership structure in Slovenia has demonstrated that in 63% of cases the internal owners, i.e. the employees of the companies with transformed ownership, are in majority. Together they hold over a 50% stake of the organisation. The organisation supervision via the representatives in the supervisory boards operates as in the German system, yet its efficiency is limited due to considerable percentage of internal owners, unprofessional conduct, vaguely defined situation and the policy of the investment, parastate funds and different forms of internal connection between the company management and the supervisory board. (Zenko, 1999)

The key issue of numerous Slovenian companies is the formation of a long-term working relationship between the management and the employees-owners, which would not encumber the development of organisation. Up till now the Slovenian managers have not been favourably disposed to, neither expected or planned domestic or foreign organisation takeovers. As a result the concern for the equity policy of organisation has been steadily growing among the Slovenian managers.

Problems and weaknesses of Slovenian companies are not new. Not far ago the most important task of a Slovenian manager was to manage growth. Now when growth has been slowed down and it is hard to stimulate, new problems have arisen. If companies do not prosper, the problem is that its employees do not perform their tasks, as they should do. The basic reason for poor quality of Slovenian management is manifest mostly in disregarding knowledge and understanding the importance of result evaluation while managing business change in organisation. (Udovicic, 2004; Rosi, 2004; Germ Galic, 2003)

Our diagnosis of business difficulties of Slovenian companies is simple and touches the core of the organisation activity. It is based on the supposition that organisation, which is more efficient at the basic aspects of business management (design of products, manufacturing, supply, sale, handling orders) will surpass its competitors.

Having analysed the quality of managing change in Slovenian companies, a conclusion has been made that the basic difference between a successful organisation in acute difficulties is the fact that successful companies know how to perform their work better. Thus in the future many Slovenian companies will have to modernise the way they conduct business (Davenport, Prusak, 1998; Collins, Porras, 1997). This realisation seems very simple and presents itself as a kind of “universal cure”. Yet practical experience has manifested that the necessary treatment of organisation in acute difficulties, especially when innovativeness is in question, cannot be applied simply. Slovenian companies in acute difficulties still firmly believe in traditional and proven methods, while as a rule being suspicious of solutions at least tried out abroad; some even reject them categorically.

Nonetheless lately improvements have been detected in the field of strategic development orientation of Slovenian companies. These are gradually abandoning the classical approach to managing change, which is supported by medium-term plans, not formulated clearly enough. Among the Slovenian managers the predominant production orientation has been superseded by the marketing concept of organisation, although from practical experience this has often been mistaken for the sales orientation. Slovenian companies have enhanced production efficiency mostly by reducing the number of employees.

Slovenian managers still improve operations by using standard concepts of business operation, being based considerably more on experience than on knowledge of contemporary management concepts (Pivka, Ursic, 1999; Pivka, Ursic, 2001; Pivka, Mulej, 2004; Ursic, Nikl, 2004). Thus when evaluating business operation Slovenian companies and their managements still use classical range of accounting indicators and a lot less other quality criteria, gaining importance from the point of view of contemporary business operation. (Knez-Riedl, 2003) The final conclusion of the research into competitiveness as well as of practical experience is that most of Slovenian companies up till now have not mastered contemporary elements of international competitiveness and that it is the Slovenian managers who are basically responsible for the current situation (Mulej et al., 2003).

3 The most influential management concepts used for business changes in Slovenia

An overall evaluation of successfulness has yet not been made for most of the widely adopted management methods in Slovenian economy, where the strategic management, benchmarking, TQM, BPR, ISO 9000 and the 20 Keys Method are prevalent (Pivka, Ursic, 1999; Pivka, Ursic, 2001). The reasons for this are, that the methods have just been introduced, and that companies keep them to themselves, and they are particularly reluctant to pass on information on competitive advantages, for the possibility of it being disclosed to competitive companies. (Cater, 2003)

Many Slovenian companies poorly understand and master the procedures, approaches, tools and methods, which can enable greater competitiveness (Ursic, 1996). The reason is double, at least: (1) Slovenian companies have poor knowledge of other methods, also unsystematically introduced save for the ISO 9000 standards of quality, (2) companies have little capital to invest into development of business management with the emphasis on constant provision of creative working environment. Thus in short term one cannot expect the Slovenian managers to start developing their own methods of reengineering. Though one can expect them to improve their knowledge and enhance the quality of business change management, thus instigating international comparativeness of business operation of Slovenian companies. The third reason may be the fact that 98 % of all business entities in Slovenia are micro and small, another 1,5 % are small ones, and less than 1 (one) % employ more than 250.

By comparing individual methods on the basis of our findings and practical experience, we can deduce that the ISO standards facilitate only the standardisation of business process and can be understood as a string of regulations, which in itself is not significant enough to augment competitiveness of business. (Pivka, Mulej, 2004) ISO standards 9000 can be understood as a base of the pyramid of complete quality management. To gain a competitive advantage in terms of quality and business management enhancement, one needs to select other methods, enabling realisation of the key potentials in the business operation (Kobayashi, 1995). Thus we have compared BPR, TQM and the 20 Keys Method. Particularly these methods are nowadays most widely adopted in the process of Slovenian economy renewing. From the comparison of individual methods some of their basic aspects have been given, so as to draw conclusions on the competitiveness of their applicability in business.

Table 1*:* A comparison of management concepts

	ISO 9000	**TQM**	**BPR**	**20 KEYS**
1. MANAGEMENT	Defines guidelines and provides support, yet is not actively involved in its implementation.	Provides convincing support to the system introduction	Defined guidelines and shows support, yet is not actively involved in its implementation, though it is actively involved in execution.	☺Active involvement in introduction and execution.
2. STRATEGY	Strategy recorded	Reflects and supports target attainment and quality values for short-and long-term period.	Reflects and supports target attainment, though no direct connection exists.	Reflects and supports target attainment and quality values for short-term and long-term periods.
3. EMPLOYEE POTENTIAL MANAGEMENT	Oriented on the system/entity; employees help in drawing up documents and ensure their implementation.	Development and engagement of the entire work force for improvement within the organisation; employees are involved in improvement activities.	Processes are mostly refashioned / reengineered by external specialists; employees are trained to manage changes.	☺Development and engagement of all employees for improvement within the organisation; the employees are the crucial factor for improvements.
4. RESOURCES MANAGEMENT	Oriented on the system; the employees help in drawing up documents and ensure their implementation.	Key resources of an organisation (finance, IT, material and new technologies) are coordinated with the quality targets and organisation values.	Oriented on business process reengineering / remodelling	Key resources of an organisation (finance, IT, material and new technologies) are coordinated with the quality targets and organisation values.

5. PROCESESS	Records	Critical processes administering, demands for management, improvement, documentation and estimation of processes.	☺ Critical processes administering, demands for remodelling or improvement of existing processes.	Overview of all processes in a company and change of the existing combination of processes, emphasis on shortening the circulation time.
6. CUSTOMER SATISFACTION	Built system for collecting information to determine customer satisfaction.	☺Actual evaluation and determining of customer satisfaction.	Determining of customer satisfaction – indirect connection.	Indirect connection.
7. EMPLOYEE SATISFACTION	Has not been dealt with.	Organisation will be successful only if it motivates its employees.	Organisation will be successful only if it adequately motivates its employees.	Organisation will be successful only if it adequately motivates its employees.
8. IMPACT ON SOCIETY	Has not been dealt with.	☺Organisation's activities influence the wider community and society (ecology, donations…)	Has not been dealt with.	Has not been dealt with.
9. BUSINESS RESULTS	Keeping and gaining new customers	☻Gradual improvement of quality, customer satisfaction, increases in competitiveness, enhancing market share and profitability of sales.	☻Rapid, dramatic improvements of quality, quantitative evaluation as follows: lower costs, greater customer satisfaction, greater efficiency owing to new processes.	Quantitative evaluation as follows: better quality, increase of productivity, reduced stocks.

On the basis of our experience in counselling we have developed our own model of criteria for the comparison of different approaches to managing constant improvement of quality of business operation (see Table 2). This model has so far enabled efficient selection of management concept on the basis of an analysis of the current situation of organisation and its development strategy. The criteria of our model are as follows: method targets, initiatives or motives for change, role of the information technology (IT), role of the customer, degree of business process remodelling and rate of change implementation.

According to our criteria, the TQM and BPR are the management concepts that stand out as integral concepts of business operation reengineering. TQM is founded largely on a normative theoretical basis. It treats changes in an organisation as changes in human behaviour. Yet the theoretical background of BPR is mostly structural, creatively endeavouring for changes in business processes, thus improving competitiveness of business. Therefore we are confident that exchanging practical experience in reengineering can spare majority of us the constant learning by the most expensive method of “trial and (not always necessary) error”. Therefore both methods could be complementary in practice, though as a rule they are used separately owing to complexity of their nature and execution.

Table 2: A comparison of management concepts on the basis of our criteria

	ISO 9000	TQM	BPR	20 KEYS
TARGETS	Defining the prior conditions, requisite for congruence of products or service with demands for quality.	☻Improvement of products, services, quality in longer period of time, customer satisfaction.	Improvement of business process performance with same targets as TQM, though short-term.	Improvement of entire organisation performance, to become the best in the world.
INITIATIVE	Customer demand	Poor quality of products, services, management or to become better.	Poor quality of products, services, management and poor performance of processes or to become better.	Poor quality of products, services, management.
IT ROLE	Help with system regulation.	Has no decisive role, helps with analysis.	Important role	Important role
CUSTOMER ROLE	Demands standard	☺Customer satisfaction is the objective.	☺ Customer satisfaction is the objective.	Indirect connection
DEGREE OF BUSINESS PROCESS REMODELLING	Only a record of the current situation.	Ameliorates and improves existing processes.	☺Radical remodelling of business processes.	Change in combination of the existing processes.
RATE OF IMPLEMENTATION	Fast	Gradual	☺Fast	Gradual

Legend: ☺ Advantages of a particular approach; ☻ Marked differences

In practice BPR is often understood as a general term for substantial, revolutionary improvement of business operation (Hammer, Champy, 1993). Lately there have been cases when companies have not used the BPR term for the BPR concept, but influenced by the generally adopted TQM idea, they have been intensively satisfying the market needs and adapting all business processes to this purpose constantly (Oakland, 1995). It is true, though, and demonstrated by the above tables, that the characteristics of the BPR, TQM and the 20 Keys Method are quite similar. Management of Slovenian companies thus often leaves the naming of the applied method to the consultants, who on behalf of the owner estimate which name will succeed already at the beginning in motivating the key members of staff, that play a leading role in the process of reengineering (Ursic, Nikl, 2004).

A comparison between TQM and the Method of 20 Keys is also interesting. Kobayashi even vigorously insists that TQM is the basic element of the 20 Keys Method (Kobayashi, 1995). The basic difference between the concepts is the customer approach. TQM is oriented mostly towards the organisation's business environment and favours the customer, while the 20 Keys Method is oriented mostly towards the internal environment and especially the aspects of its operation. Thus these two concepts are complementary and can be hardly treated separately in an integrated project in business practice. The microclimate is of course reciprocal / in interdependence with the macroclimate factors, since both of them are supposed to produce a synergy effect of the reengineering.

The advantages of each concept have also been examined when deciding on a concept for developing business process in Slovenian economy. We have primarily taken into account the criteria that emphasize the role of management in development and thus significantly influence the attained result and the ability to maintain the introduced approach (Coulson-Thomas, 1994; Prigogine, Stengers, 1984; Senge, 1990; Tang, Bauer, 1995, Ursic et al, 2001; Ursic, Nikl, 2004). The criteria are as follows:

- **Management**: the management is actively involved in the introduction and execution of the 20 Keys Method to greatest extent, since it is under an obligation to actively participate in the introduction of the method throughout the entire period. With TQM the management sets target and the strategy and is then completely responsible for motivating the employees adequately. With BPR management defines the guidelines and offers support to the project, but is not actively involved in its execution.
- **Management of the employees' potentials**: In the 20 Keys Method, all employees become the key factor of the reengineering process due to minutely devised programme of training. In TQM and BPR the employees are involved in the improvement processes as necessary and even on the basis of interest.
- **Role of the information technology**: in the 20 Keys Method and BPR the business process reengineering approach tends towards automation of production and other business processes by introducing new technologies or computerized system of business operation, while the TQM does not place emphasis on a computer-supported system of business operation.
- **Rate of the project implementation**: since the BPR is introduced by means of external specialists, the rate of change effectuation is the most intensive among all discussed methods.

On the basis of the presented approach to comparison of potential concepts, the BPR has been opted for. This concept enables most solutions to the problems of the organisation to be reengineered. We were confident that a complete business process reengineering, following the BPR criteria, has at the very start posed the right question to the management: Are we producing the right products the right way? While searching for the answer to this crucial question we have undertaken to formulate the BPR essence in the specific medium-sized Slovenian organisations in difficulties.

4 The method of investigation on management concepts in Slovenia

Between 1999 and 2003 we used a letter survey in Slovenian organisations. In 1999 about 300 organisations were addressed and in 2003 more than 400 of them. In 1999 our response rate was 135 (45%), in 1999 was 216 (54%) valid responses. In our judgement these samples are big enough to meet criteria of statistical evaluation of results obtained (Pivka, Ursic, 1999; Ursic, Bucar, Mulej, Pivka, 2000; Ursic, Nikl, 2004).

We divided our questionnaire in two parts. In the first part we analysed the measurement of factors of management and a programme of continuous introduction of new impact of management concepts. The second part includes our analysis of the impact of management concepts over more than 20 factors of business success. Both parts, in terms of contents, are defined on the basis of the theoretical concept of investigation of management trends defined earlier and briefed in chapter 2 of this contribution. We tested our questionnaire on a pilot sample of organisations, all items being closed qualitative questions. Data from questionnaire were entered into Lotus Notes data base and from it into excel and SPSS for a statistical analysis.

4.1 Factor analysis of management concepts

The management concepts were analysed using the factor and discriminant analysis. Both enabled us to comprehend the quality of the principal management concepts in the Slovenian economy. We wanted to find out the following: 1) which management concepts are the most influential in the Slovenian economy during the period of transition; 2) which management concepts used in the business practice are understood by the management and argumentatively compared with other most frequently used concepts; and 3) the possibility of an argumented presentation of the correlation among the business results and practical effects of individual management concepts.

In our case we used the factor analysis to reduce the great number of measured parameters of management concepts with influence on the business transformation (more than 100 in total!) to a smaller number of independent factors, which would explain well enough the management concepts in Slovenian organisations in transition. From the rotated matrix of factor loadings it follows that 83% - 92% of the total variance are explained by 4 management concepts in majority of Slovenian enterprise according to our survey. We wrote them also in Table 3, from which it is evident how individual concepts were explained in % of variance. Due to space limitation the rotated component matrix of factor loading is not shown here.

The transition of Slovenian organisations can be explained by 4 major management concepts, thereby losing only 8-17 % of the explained variance.

We would like to mention a few facts from our research findings (Ursic, 2000; Ursic, Nikl, 2004):

- In the last decade, the modernised management concepts and practices in Slovenia have led to an approximately 50% increase in business effectiveness and simultaneously to a 20% decrease in employment (bankrupt companies excluded).
- The process approach to business replaced fragmentation of companies into rather indepent business units. Thus it has decreased the duration of the business processes (cycles) in companies at a rate of up to 75 %.

Table 3: Total variance explained the management concepts in Slovenian organisations

Management concept 1999-2001	Management concepts 2002-2003	% of variance 1999-2001	% of variance 2002-2003
ISO 9001 (2000)	ISO 9001 (2000)	90.362 (1)	87.353 (3)
TQM	TQM	84.211 (3)	85.743 (4)
BPR	BPR	87.749 (2)	92.326 (1)
20 Keys	20 Keys	83.245 (4)	88.749 (2)

Examples from the every-day practice are convincing us, that managers understand the systems approach as a concept that might have a major influence over transformation of the business processes. This influence might further increase the above business results. For that reason, the Slovenian managers are very often convinced in advance, that success comes with the introduction of modern concepts of management on its own. But when they start to implement management concepts in their practice, their enthusiasm usually disappears. Our analysis also shows, that Slovenian managers are not familiar with the potential of the systems based concepts and their use, from the point of view of the specifics of Slovenian business.

It's the ignorance of the content and the possibilities of management concept that leads to conflicts in Slovenian companies. In forefront there is the cognition, that a pure management concept cannot be implemented in many Slovenian organisations whose development trends differ from (above all) European and American conditions. We tend to see causes of this impossibility in the general social trends: even managers refuse changes, which require downsizing, especially the surprising (revolutionary) managerial cost-cutting innovation.

Inspite of that, we often still find problems with many managers in Slovenia and their perception of the up-to-date concepts of work. At the first sight we could say, that this is a paradoxical situation: on one hand the investment in modern management concepts has been for quite some time one of the most important development trends in Slovenian organisations. Slovenian government or some of its ministries also support it.

On the other hand, the modern management concepts aren't used very often, in the Slovenian business practice. It looks like a need for some kind of a lead-time until the transfer of international management concepts into Slovenian business practice is found needed. The practical managerial approach, which tends to be in the forefront, is based on incremental changes in business processes. The concept, hence, creates a new situation in organisations: there is a need to introduce new concepts of understanding the contemporary business partners from the 'west'. The international influences over management are a good example of a broader social adaptation to competitive pressures by the advanced ones. They, on the other hand, support the use of Slovenian knowledge and pay tribute to the Slovenian organisational culture. This summary reflects thinking of most management teams in the over-average organisations in Slovenia.

Basically, the point is the managers' new awareness of the change of management concepts, from the traditional to the modern ones. In the recent past, the practice in average Slovenian companies was to standardise practically all management processes. Now, the focus is on potential advantages of management, which result from the development of the organisation culture and related understanding of differences in individual concepts of management style.

5 Conclusions

In Slovenia, the use of new/innovation oriented management concepts represents an active component in renovating the Slovenian society as a whole. Basically, it concerns changing the way of thinking about the manners of (business) life and assessment of its quality from the aspect of the ever-present need for introducing reasonable novelties to assure the competitiveness. If methods are found creditworthy / trustworthy, they have a chance to be accepted. Our several-years lasting analytical examination of the Slovenian companies transition in the area discussed shows that there is a recognizable specific situation in the Slovenian economy. On one hand there is the development of companies being already at the top according to international competitiveness criteria, and on the other hand there are other companies with more or less successful beginnings in this direction. Therefore in Slovenia it is practically impossible to speak about the use of »pure« management concepts in their original form. Good organisations by themselves actively develop management concepts, corresponding to their development levels, and others are still getting acquainted with them or are only partly introducing them, in any case not requisitely completely and less efficiently than the competitors. As a rule, in the business practice the contents of management concepts are interlacing in the way stimulated by the level of the individual organisational culture. Taking into account the fact that there are considerable differences among the Slovenian organisations regarding the development levels of understanding and the use of management concepts, which is shown by our analysis, the carrying into effect of individual concepts under different commercial names can be better understood. Though equally named, in the business practice these concepts often contain large differences in the content and application. Therefore the understanding of management concept transformation in Slovenia is first of all the consequence of understanding and considering the integrated development level of the Slovenian economy in general and individual manager teams in the organisation separately.

6 References:

Afuah, A. (1998): Innovation Management. New York, Oxford. Oxford University Press

Clausen, C., et al. (Ursic, D.,) (1998-2002): Precept Process Re-engineering in Europe: People, Choice and Technology (PRECEPT): European Commission, Directorate General XII (science, research and development), Brussels, 1999-2002

Collins, D.J., Montgomery, C.A. (1997): Corporate Strategy – Resources and the Scope of Firm. Irwin, Chicago

Collins, J, C, Porras, J. I. (1997): Built To Last. Successful Habits of Visionary Companies. New York. HarperBusiness

Coulson-Thomas, C. (1994): Transforming the Company: Bridging the Gap Between Management, Myth and Corporate Reality, Kogan Page, London

Cater, T. (2003): Konkurencna prednost podjetja: za kaj v resnici gre? Nase gospodarstvo 49, 5-6, pp. 481-499 (Competitive Advantage of a Firm: What is it Really All About)

Davenport, H. T., Prusak, L. (1998): Working Knowledge, How Organizations Manage What They Know, HBS Press, Boston

Drucker, P. (1998): Managing in a Time of Great Change. Butterworth-Heineman

Ecimovic, T., Mulej, M., Mayur, R. and co-authors (2002): Systems Thinking and Climate Change System. Korte. SEM Institute for Climate Change

Germ Galic B. (2003): Dialekticni sistem kazalnikov inoviranja in kakovosti poslovanja. (A Dialectical System of Indicators of Innovation and Business Quality.) M.A. Thesis. Univerza v Mariboru, Ekonomsko-poslovna fakulteta

Hammer, M., Champy J. (1993): Reengineering the Corporation: A Manifesto for Business Revolution. Harper Business, New York

Hammer, M., Champy J. (1995): Preurejanje podjetja: Manifest revolucije v poslovanju. Gospodarski vestnik, zbirka Manager, Ljubljana, (Company Reorganisation: A Manifesto of Business Operations Revolution.)

Knez-Riedl, J. (2003): Kakovost, inovativnost in boniteta podjetja – presibko upostevanje kakovosti poslovanja in inovativnosti pri presojanju bonitete podjetja (Quality, Innovativeness and Creditworthiness of a Firm – On Too Poor Consideration of Business Quality and Innovativeness in Assessment of the Creditworthiness of a Firm). Organizacija, 36, 9, pp. 620-627

Kobayashi, I. (1995): 20 Keys to Workplace Improvement. Productivity Press, Portland

Likar, B. (2001). Inoviranje. 2. dopolnjena izdaja. Visoka sola za management Koper (Innovating. 2nd reworked edition)

Markic, M. (2003): Inoviranje procesov kot pogoj za odlicnost poslovanja. Nase gospodarstvo 49, 5-6, pp. 454-464 (Innovation as a Basis for Business Excellence)

Mulej, M. et al. (1987): Inovativno poslovanje (Innovative Business). Ljubljana. Gospodarski vestnik

Mulej, M., et al.(1994): Inovacijski management. I. Knjiga: Inoviranje managementa. (Innovation Management. Book I., Innovation of Management). Univerza v Mariboru, Ekonomsko-poslovna fakulteta. Several reprints, incl. 2004

Mulej, M. (2000): Basics of Systems Thinking. University of Maribor, Maribor

Mulej, M., and coauthors (2000): Dialekticna in druge mehkosistemske teorije. Podlaga za celovitost in uspeh managementa. (The Dialectical and Other Softsystemic Theories. Basis for Holism and Success of Management.). Univerza v Mariboru, Ekonomsko-poslovna fakulteta

Mulej, M. Zenko, Z., Rebernik, M., Potocan, V., Bucar, M. (2003a): Dvogeneracijski cikli in podjetnistvo v Sloveniji. Nase gospodarstvo 49, 5-6, pp. 436-453

Mulej, M. ed., (1981-2003) PODIM Conferences on Innovation Issues, yearly. Different co-editors. Published partly in Nase gospodarstvo, partly as books of Proceedings. Recently by Univerza v Mariboru, Ekonomsko-poslovna fakulteta, Institute for Entrepreneurship and Small Business Management

Mulej, M., Bastic, M., Belak, J., Knez-Riedl, J., Mulej, N., Pivka, M., Potocan, V., Rebernik, M., Ursic, D., Zenko, Z. (2003 b): Informal Systems Thinking or Systems Theory. Cybernetics and Systems. An International Journal. 34, pp. 71-92

Mulej, M., Potocan, V., Zenko, Z., Kajzer, S., Ursic, D., Knez-Riedl, J., Lynn, M., Ovsenik, J. (2004). How to restore Bertalanffian systems thinking. Kybernetes. The International Journal of Systems & Cybernetics. 33, 1, pp. 48-61

Mulej, M., Zenko, Z. (2004): Introduction to Systems Thinking with Application to Invention and Innovation Management. Maribor. Management Forum

Nonaka, I., Takeuchi, H. (1995): The Knowledge Creating Company. UP, Oxford

Oakland, S. J. (1995): Total Quality Management. Heinemann, London

OECD (1996): Measuring What People Know, Human Capital Accounting for the Knowledge Economy. OECD, Paris

Peters, T. (1986): Thriving on Chaos. Harper & Row, New York

Prasnikar, J. (1999): Poprivatizacijsko obnasanje slovenskih podjetij. Gospodarski vestnik, Ljubljana (Post-privatisation Conduct of Slovenian Companies.)

Pivka, M., Ursic, D. (1998): ISO 9000 and competitiveness of SMS and large organisations in Slovenia (in Slovenian). Repulic of Slovenia, Ministry of Science and Technology

Pivka, M., Ursic, D. (1999): ISO 9000 and competitiveness of SMS, large and other organisations in Slovenia (in Slovenian). Repulic of Slovenia, Ministry of Science and Technology

Pivka, M., Mulej, M. (2004): Requisitely holistic ISO 9000 Audit leads to continuous innovation / improvement. Cybernetics and Systems. An International Journal, 35, 1, pp.

Prigogine, I., Stengers, I. (1984): Order Out of Chaos. Bantam Books, New York

Rosi, B. (2004): Prenova omrežnega razmišljanja z aplikacijo na procesih v železniški dejavnosti. Dr. Diss. Maribor. Univerza v Mariboru, Ekonomsko-poslovna fakulteta

Senge, M. P. (1990): The Fifth Discipline, The Art and Practice of the Learning Organization. Doubleday, New York

Tang, Y., Bauer, R. (1995): Competitive Dominance, Beyond Strategic Advantage and TQM. Van Nostrand Reinhold, New York

Udovicic, K. (2004): Metode nematerialne motivacije za inoviranje managerjev. (Methods of Immaterial Managerial Motivation for Innovation). Dr. Diss. Maribor. Univerza v Mariboru, Ekonomsko-poslovna fakulteta

Ursic, D. (1996): Innovation of Enterprise. Linea, Maribor (published in Slovenian)

Ursic, D. (2000): Organisational Renovation of Slovenian Enteprises. University of Maribor, Faculty of Economics and Business

Ursic, D. (2000): The holistic model of management of quality. Republic of Slovenia. Ministry of Science and Technology

Ursic, D., Bucar, M., Mulej, M., Pivka, M. (2001): Business Process Reengineering – National Uptake Report. DGXII Brussels, Project PRECEPT

Ursic, D., Nikl, A., (2004): Learning Organisation – Theory and Practice. (Published in Slovenian) Maribor. Management Forum Mariboru, Ekonomsko-poslovna fakulteta

Educational Aspects of Computer and Information Science

THE COMMON HIGHER EDUCATION REFORM OF THE EUROPEAN SPACE

Educational Aspects of Computer and Information Science

Maria Raffai[1]

As we are getting closer to the EU membership date it is becoming more and more important to introduce effective, comparable higher education solutions. The leaders responsible for the higher education in the different European countries are convinced that the Bologna-declaration and its fulfillment will have a large impact on the European higher education system, so it is urgent to discuss the results overtaken in the different countries, the activity of the Committees having come to existence in order to work out and define the curriculum of the different courses at the Information Science. I would like to call the attention of the conference participants to the importance of this actual theme, and I intend to describe the two-cycle model as an outcome of numerous professional meetings with professors of higher education and with experts in business life as representatives of the labour market. With my keynote lecture I intend to start talks about the key questions we have to face day by day, and to find solutions taking into consideration some special problems, such as:

- *What kind of talent the students have?*
- *Where are these students come from?*
- *What kind of background and culture do they have?*
- *What are the educational goals in the different countries?*
- *What kind of knowledge and skills does the labor market need?*
- *How is it possible to accept, compare and evaluate the different diplomas?*

[1] *Professor at the Széchenyi István University, ☎Tel/Fax: (+36) 96-613-525, 💻 E-Mail: raffai@sze.hu, HomePage: http://rs1.sze.hu/~raffai/raffai.htm*

1 Introduction – the Bologna Process

After one year that four Ministers of Education (English, German, French and Italian) stated in Paris in 1999, that Europe means not only the union of euro, banks and economy but even the union of the knowledge (Sorbonne Communiqué, 1998) and agreed about the need of harmonization of different educational systems, 29 countries signed the Bologna Declaration. With regards to the new situation of the European Union it is urgent to discuss the questions of the Bologna process, which aims to give an answer to the common problems of higher education. The process originates from the recognition that the European higher education systems are facing common internal and external challenges related to the growth and diversification, the employability of the graduates, the shortage of skills in the key areas, the expansion of private and transnational education etc. The Declaration (based on the Magna Charta Universitatum, 1988) adopts the valuable reforms, compatible systems and the common actions. It defines that the higher education policy in Europe has to be coordinated in order to create a convergence besides respecting the fundamental principles of autonomy and diversity.

The bachelor-master two-tier structure offers several advantages in comparison with often inflexible curriculums leading straight up to the master level. The main benefit is that the students can choose from among different programmes, and in the age of life-long learning one of the most significant factors is that the young people are allowed to interact between studies and working space. The two-tier structure makes room for national and international mobility by contributing to the modularization of study programmes. The well-planned and efficiently realized BSc programmes reduce the number of students discontinuing their studies without any qualification and thus facilitates their placement in the labor market while possibly contributing to shortening the overall study duration time. There is a considerable lack of comparability in the European degree structures which is an impediment of the mobility.

The European Space for Higher Education should be completed in 2010 with performing a set of objectives, such as:

- the adoption of a common framework of readable and comparable degrees,
- the introduction of undergraduate and postgraduate levels in all countries (getting the first degree can not be shorter than 3 academic years and has to be relevant to the labour market),
- ECTS-compatible credit system with covering lifelong learning activities,
- a European dimension in quality assurance with comparable criteria and methods and

- the elimination of remaining obstacles to the free mobility of students and teachers (see Figure 1).

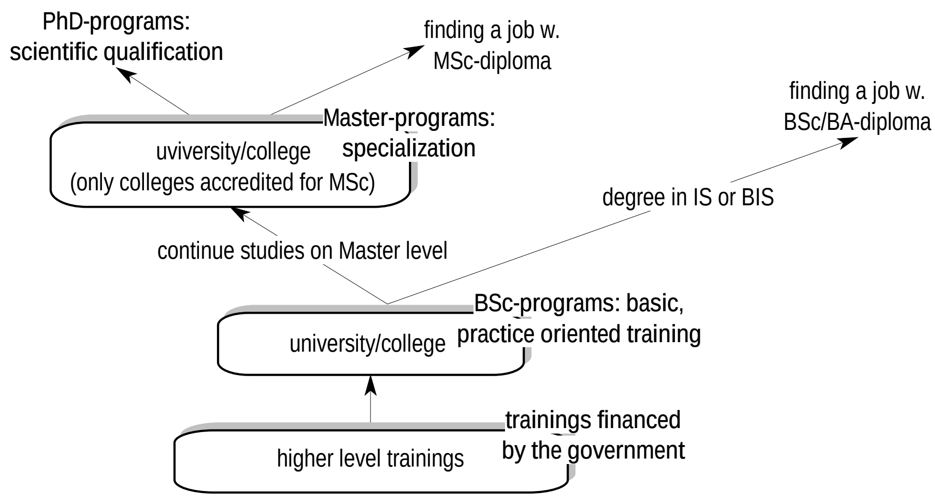


Figure 1. The walk through possibilities between the different higher education programs

After some important milestones (Paris 2000, Lisbon, Salamanca and Prague 2001, Berlin 2003) the Committees responsible for the higher education reforms in the different countries started to work on the qualification requirements and the basic curriculums for a two-tier degree structure. The BSc/MSc levels of higher education gives a possibility to the students to interrupt the learning process with a base university degree (BSc) and to continue on a higher level after getting some experiences in practice, maybe on another special field or in other institute or country (MSc). As the participants of this conference all are interested in the field of IT and Information Science it is expected to report about the present situation in different countries and to discuss and harmonize the programs. First I present the new Hungarian BSc/MSc program in the field of computer and information science. The course types had been defined, the qualification requirements and the base curriculums had been developed, and they have already been accepted by the Ministry of Education and the Hungarian Accreditation Committee (HAC) in December of the Year 2003. The courses in the 3 special fields of CIS (course of technical informatics, course of programming design and course of business information systems) will be introduced in the Hungarian higher education system in the next academic year (2004/2005).

2 Preliminaries in Hungary

After Hungary has joined to the Bologna Declaration in the Year 1999, she has committed herself to realize a higher education reform in order to harmonize her higher education politics and strategy, and to make the diplomas issued in the different institutes comparable. The first real step taken was the Statement of the Hungarian Rector's Conference (HRC) in December 2002, where the signers defined the most important tasks concerning to the introduction. This Statement emphasizes, that the change-over of the higher education system has considerable importance in the Hungarian society. The HRC established the Bologna Committee (BC) in order to take the responsibility

- for reorganization of the traditional higher education system,
- for reducing the number of the courses in one scientific field considerable[2] and
- for satisfying the market needs and the expectations of a profession based education system.

This Statement also emphasizes, that instead of the dominant local and private interests the BC delegates has to cooperate with the representatives of the employers in different sectors and regions of the country, such as with the experts from various professions. The aim is to work out curriculums for a two-level linear teaching system, in which the first (basic university) level is the Bachelor's cycle with maximum 4 academic Years and the second level is the Master's cycle with maximum 2 academic Years of education. The HRC calls the attention stressed on the creation teaching programs capable for the labour market. The BCs need to take into consideration that the new education system has to result the expansion of the institute autonomy, has to give wider motion space to the professional venture and the intention for fitting to the demand of the knowledge market not only in Hungary but even in the EU.

By the beginning of the Year 2003 the events concerning the development of the new programs has been speeded up. The HRC's BC defined the actual tasks in 12 points, and established the HRC's Special Committees (HRC BC SC) on different scientific fields such as economics, engineering, agriculture etc. The SCs discussed first the course structure, agreed the number and the specification order of the courses in each specific field, declared the qualification requirements (QR) and began to work on their specialization

During the change-over process the curriculums in the field of the technical/engineering studies have been worked out as a precedent of this reform. The Special Committee for the Information

[2] As an example in Hungary we have now more than 400 different courses in the field of technology and engineering.

Sciences (or in a European English: Informatics) started to work in April 2003 with the leadership of D. Sima, professor at the College of Technology, Budapest. The members of the Special Committee for IS are A. Benczur (ELTE) M. Raffai (SZE), E. Selényi (BME) and B. Dömölki (KFKI)[3]. During the spring and summer months the Committee prepared several course structure and qualification requirements versions, and discussed them in different levels with the specialists and professionals. The accepted final version based on a wide mutual understanding was brought to the Ministry of Education for accreditation in October 2003.

3 The Two Stage Model

3.1 The Basic Conception

In the present Hungarian education system the boys and girls have to make decisions connecting their future in the age of 18. At this age most of the people can not look forward far, and their human nature, their knowledge and interest on the different things and also their skills are in continuous change in the foregoing years. The higher education system can not handle these features because if a student has applied to a special university course then he or she has not any possibility to change for another educational path after a year or so. This means that in our dual system there is only one way: to leave the university/college without getting any diploma or degree, or to finish the studies after 3 or 5 years fulfilled their dreams true.

Instead of the above detailed system there is a much more efficient and appropriate way. The linear, 2 or 3 tiered, well thought-out education architecture is capable to solve all the present problems. It gives the possibility for the students to make decisions for shorter periods, and also the opportunity to continue their studies on a higher level a year later or more if they are forced to do it.

At the first stage of this new structure (Bachelor diploma) the students get practical, usable knowledge and skills after 3 Years of studies, and are able to undertake a good job. Having enough experiences after a while the young people are able to continue their studies and learn more about the selected professional field. The graduates having had already a BSc degree apply from several expert fields for Master programs, where the students extend their knowledge and get a Master degree after 2-2,5 Years. The HRC BC defined the guidelines for the elaboration of the course structure, the qualification requirements and the curriculums as follows [7]:

[3] ELTE: Eötvös Lóránd University of Natural Sciences; SZE: Széchenyi István University; BME: Technical University, Budapest; KFKI: Software Development and Consulting Coorporation

- The Hungarian higher education with the exception of some special fields such as medical and juristic courses has to change-over to the two staged linear education system.
- The curriculum model of the BSc courses has to be worked out for maximum 7 semesters.
- The specification of the qualification requirements has to base on the mutual agreement of the employers, the professors, the researchers and the chambers, scientific associations responsible for the professional work.

The Special Committees has to work out their initiatives on the base of the HRC BC guidelines.

3.2 The Course Structure

The Figure 2 shows the course structure of the linear education system.

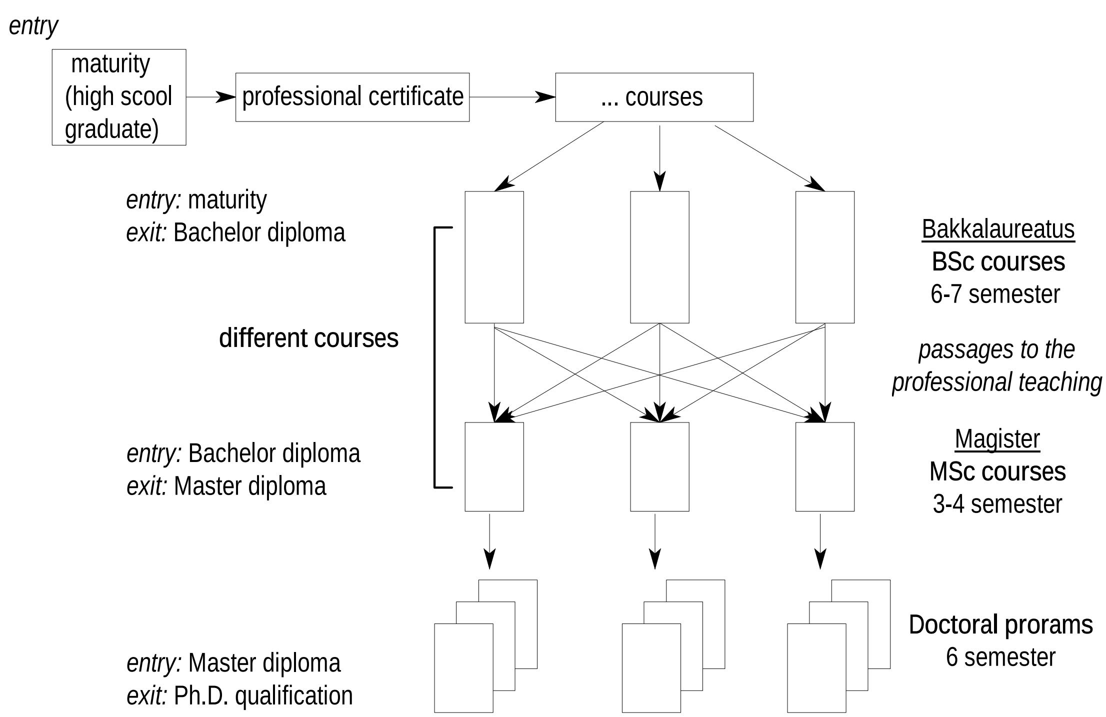


Figure 2. The model of the linear education structure

The HRC's Operative Task Force declared the general course structure by the international educational standard, the ISED. Taking into consideration the different ISED levels the higher education modernization process has to be realized on the following way [13]:

- The first cycle is the basic university level which takes 3 academic years with 180 credit points (ISED V. level). During this period the students learn the basic knowledge components, obtain competencies and skills, that are convertible and fit to the labour market's demands.

- The second cycle built on the BSc level takes 2 academic years with 120 credit points (ISED IV: level). It aims to give higher level of multidisciplinary knowledge necessary for the scientific research. In this phase the academic themes are separated from the real expertise modules.
- The third cycle is for getting a doctoral degree. During the 6 semesters long course the students make their doctoral dissertation, they prove their thesis, and finally they get a PhD/DLA degree.

3.3 Qualification Requirements – Knowledge Structure

The Bologna Declaration clearly stated that in the new education system the diversity of cultures, languages and educational traditions can remain, the universities keep their independence and autonomy and it is also defined that this new system requires constant support, supervision and adaptation to the continuously changing needs. These basic concepts were the key starting points by defining the qualification requirements.

Adjusting to the fundamental principles laid down in Magna Charta Universitatum (1988) we specified the main tasks in 6 phases as follows:

1. definition of the study aim and the competences,
2. determination of the level of classification and the diploma qualification,
3. planning the learning period and the number of credit points,
4. describing the main course characteristics,
5. designing the controlling system of the acquired knowledge level and
6. the knowledge structure.

The requirements with competence values assure the homogeneity and the comparability of the courses and the diplomas and create the right conditions for the student's mobility. The main characteristics of the education system can be expressed by describing the principal fields of the study and the knowledge structure. These features have to be put down more precise in the case of designing a market oriented linear education program. This means that the main blocks of the knowledge material and the relation to each other have to be described more detailed even on subject level if necessary. The Figure 3 shows a possible model of this structure.

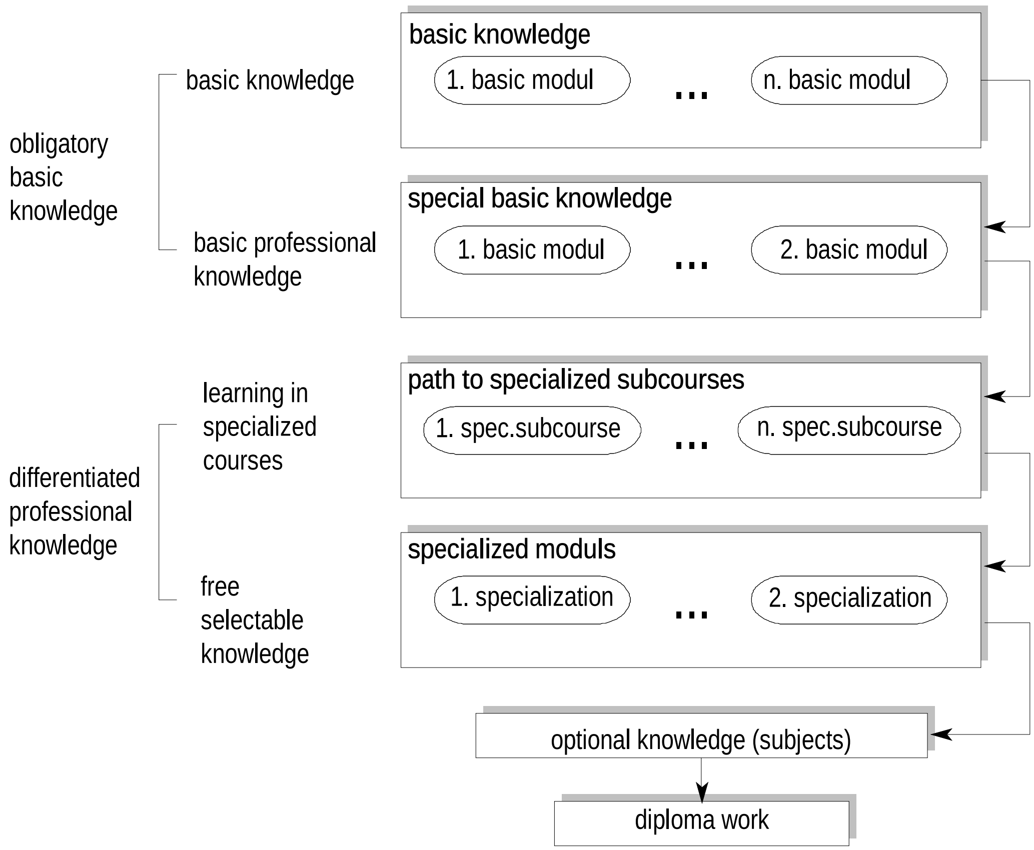


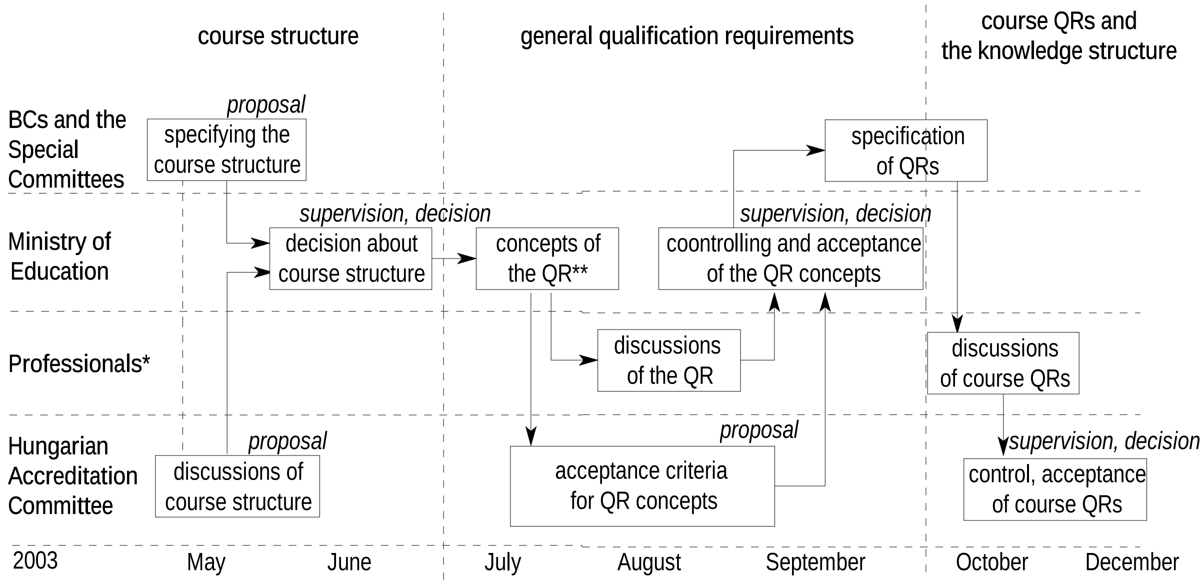
Figure 3. A possible model of the knowledge structure

3.4 The Course Foundation Process

The tasks completing the specification and the acceptance of the qualification requirements play key role during the change-over process from the dual to the linear education system. In order to perform a correct educational reform many organizations and institutes have to control the plans and cooperate in the acceptance process. The Figure 4 illustrates the key actors and the most important tasks of this procedure.

As the closing date of the change-over process is getting closer and closer the executives of the HRC BC are decided to improve the qualification requirements and the knowledge structure by the two level planning and the iterative development concepts. That is to say that

- first the BSc's QRs were precisely specified with a generous forecast of the MSc's QRs,
- then during introduction of the BSc courses the MSc's QRs, the knowledge structure and the conditions of the admission to the MSc courses will be refined and accredited.



*Professionals: Hungarian Academy of Sciences, different chambers, representatives of the scientific associations and the enterprises
**QR: Qualification Requirements

Figure 4. The P-graph of the qualification requirements creation process

4 Courses in the Field of IS

4.1 The Present Situation of the IS-Courses

The present higher education issue in the different fields of Information Sciences is almost 4 000 students per Year. Most of the technical universities and colleges take part in this process, the 45,5% of the graduates get university diploma. As it is shown at the Table 1 and the Figure 5 most of the students graduate on the field of technical informatics (almost ¾ of them), 22% of them graduate as program designer and only 3,3% (or altogether 5,8%) as specialist on BIS.

Table 1. The distribution ratio of the present courses

course groups	*university*	*college*	*altogether*	*ratio*
technical informatics	970	1990	2960	74,74
program designers	600	170	770	19,44
business informatics	130	0	130	3,28
programmers w. the specialty of economics	100	0	100	2,52
altogether	*1800*	*2160*	***3960***	*100,00*
the ratio in %	*45,50*	*54,50*	*100,00*	

The figures and the present course structure reflect the unsuitable situation, that the leading universities try to fit into the market demand, and instead of harmonizing the course and knowledge structures the different institutes compete and entice the youth to choose their institute. This behavior led to create continuously new and new courses with only small differences but with great divergences in skills, qualification and degrees making impossible the change-over during their studies as the students (see Figure 5).

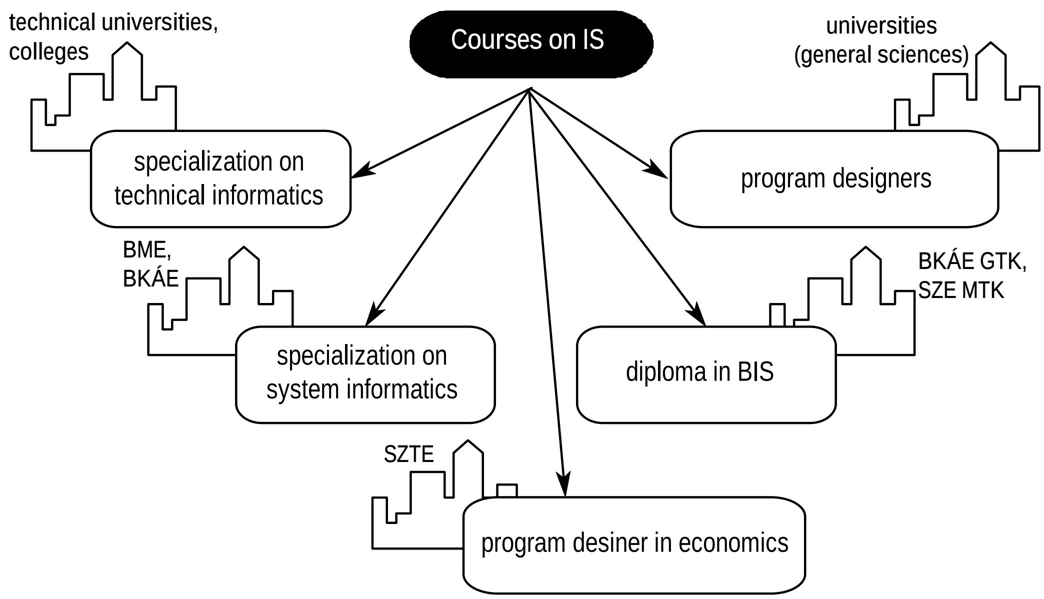


Figure 5. The present course structure in the field of IS

Summarizing the problems we have to state, that there is an urgent need to carry out a radical convergent reform in the higher education system because of the following:

- The present available IT infrastructure of the universities is very heterogeneous in the different institutes and even it is not up to date.
- The level and the modernity of professor's knowledge is different, there are even institutes without qualified teachers.
- The degree of support in financing strongly depends on the lobby ability of the university leaders.
- There is great lack of teacher because of low salary.
- The dual system makes impossible to move from one course to other or even from one university to another.

- The quality assurance is exhausted and stops at the accreditation process, thus the teaching materials (books, slides, exercise-books, samples, case studies etc.) are missing they are old-fashioned and not updated.

4.2 The IS-courses Establish Process

The Special Committee for IS-courses discussed the main principles and the qualification requirements in several sessions. After hard and long discussions with teachers, researchers, employers and professionals in May 2003 the Committee decided on three main courses in the field of IS/IT on the BSc level. Instead of the present varied picture of IT courses we established (1) *a course for technical informatics,* (2) *a course for program designer* and (3) *a course for business informatics* on the first level of the 2-tier education system. Only these courses should be introduced into the Hungarian higher education. By the creation of the qualification requirements and the curriculums of the three accredited courses we took into consideration the regional needs as well as the present specialties of the universities.

4.2.1 The General Qualification Requirements

By designing the knowledge structure we have to set out from the labour market needs, and we have to define all the requirements laid claim by the employers against the graduates in the field of IS/IT. There are of course general skills and abilities the students are expected to have but there are differences as well. We defined the qualification requirements in two groups. By designing curriculums the universities have to choose at least 3 competencies from each group for which the students will be prepared, but they have a freedom in the choice of specialization that fulfills the regional needs.

General basic competences:

Designing, analyzing algorithms, and implement them by different programming paradigms

1. Knowledge of the computer architecture, the components and the solutions for building networks
2. Knowledge of system software (concepts and tasks of operation systems, protocols) and the system close software (programming languages, data base management systems, utilities etc.) and skills for application
3. Knowledge of software development methodologies and techniques and skills to put them into practice

4. Knowledge and skills in visual modeling tools (UML) and CASE technologies
5. Data- and object modeling skills, ability for designing, creating databases, knowledge of DBMSs
6. Knowledge of logical programming, artificial intelligence techniques and skills to use them
7. Ability for recognizing the problem space, and skills for solving problems
8. Usage of distributed systems, Web programming ability

Special competences:

9. Ability for modeling and designing organization information systems, for planning computer environment and for operating IS/IT infrastructure
10. Knowledge of intelligent enterprise applications (MIS, EIS, DSS, CRM etc.) and the skills for using them
11. Knowledge of standards and skills for using OMG's MDA framework (MOF, EAI, UML, CWM, XMI/XML, CORBA)
12. Ability for adoption business information systems in practice, skills for cooperate with the users and for managing application development projects
13. Skills for organizing and managing units responsible for IS/IT tasks within an organization
14. Knowledge of expert systems concepts, skills in development and application
15. Ability for designing multimedia applications, expertise in operating
16. Knowledge of juristic questions concerning to the development and application of different IS/IT solutions

4.2.2 The Knowledge Structure

As it is seen from the Figure 3, the different knowledge fields have been separated in 4 main parts. We defined the general knowledge requirements that are needed to study in all three courses in the IT group, and we stated that the significance and the emphasis should be different. The committee members responsible for one special course ordered a credit interval to each knowledge field which should be performed in different curriculums. Let us see the 7 semester knowledge structure first and compare them from the view of components and credit ratios (see Table 2).

Table 2. Credit points in the different IT courses

Knowledge fields	Technical Informatics	Program Designer	Business Informatics
fundamentals	60-90	55-100	55-90
– natural sciences	40-45	55-85	20-35
– social and economics	20-25	0-15	35-55
special fundamentals	55-95	50-135	70-100
– system theory	25-45	10-20	15-20
– programming, Sw Techn.	15-25	30-45	10-15
– information systems	15-25	10-20	45-65
differentiated prof. knowledge	25-45	25-50	30-55
free selectable	10-15	10-20	5-15
diploma	10-25	10-20	15-25

The knowledge structure of the IT courses:

1. fundamentals – basic knowledge

a. *natural sciences:* analysis, discreet mathematics, probability theory, mathematical statistics, linear algebra, operation research, information theory, physics etc.
b. *basic knowledge in the field of computer sciences:* computing theory, algorithm theory, analysis and design algorithms, automation theory, formal languages, artificial intelligence etc.
c. *social and economics knowledge:* economics theory, enterprise economics, juristic, organization and management knowledge, decision theory, financing, controlling etc.

2. special fundamentals – basic professional knowledge

a. *system theory and technology module:* digital systems, computer architectures, operation systems, computer networks, info communication technologies, internet services etc.
b. *programming and software technology module:* programming paradigms, languages, design and implementation methods and techniques, etc.
c. *information systems module:* information systems (architecture, components, information flow, relevancy etc.), IS analysis, modeling and design, database architectures, information management, integration, intelligent systems etc.

3. **differentiated professional knowledge**

   At this differentiated professional block the universities have freedom to select those appropriate knowledge fields which fits both to their research specialty and the educational traditions, as well as to the regional needs.

4. **free selectable subjects**

   The curriculums have to contain subjects from among the students can select the most interesting ones.

Studying the knowledge structure of the different courses we can recover remarkable differences expressing mainly in credit points. Improving the reason for the existence of the three courses we worked out a quite complex algorithm to define the course distance. The Hungarian Accreditation Committee defined this degree in 40% that means: all the courses in the IS/IT course group have to be at least 40% far away from each other. As the expected differences have been verified the course foundation documents were handed over the HAC. The courses on BSc level in the filed of IS/IT and some curriculums have been accepted in November 2003, and the education on this fields will start already at the 2004/2005 Academic Year.

5 Bologna and Beyond – Conclusions

The Bologna process gives a common answer to the common European problems concerning to the higher education. It originates from the recognition that the European higher education systems are facing common internal and external challenges. It means that in spite of the valuable differences all countries have to solve problems related to the growth and diversification, the employability of graduates, the shortage of skills, the expansion of private and transnational education possibilities etc. Following the common signed Bologna Declaration the signers committed themselves to carry out coordinated reforms and to introduce compatible, credit based education systems making possible a free mobility for the students and the teachers as well. Although the European space for higher education should be completed in 2010 the first graduates will get their diploma earliest in 2007. Herewith the common goal of the results of the Bologna process will perceptible before 2010 realizing the employability and mobility together with increasing the international competitiveness of the European higher education. But during this change over process we have to count with risks, and the executives of higher education in the Ministries and in the RCs of different countries have to undertake the responsibility for giving support enough to solve the unexpected problems that derive from the probable events influencing the execution.

6 List of Abbreviations

BC: Bologna Committee
BIS: Business Information System
BSc: Bachelor of Science degree
CASE: Computer Aided Software Engineering
CIS: Course for IS/IT
CORBA: Common Request Broker Architecture
CRM: Customer Relationship Management
CWM: Common Warehouse Metamodel
DBMS: Data Base Management System
DSS: Decision Support System
EAI: Enterprise Application Integration
EIS: Executive Information System
EU: European Union
HAC: Hungarian Accreditation Committee
HRC: Hungarian Rector's Conference
IS: Information System
ISED: Institute for Study of Education and Human Development
IT: Information Technology
MDA: Model Driven Architecture
MIS: Management Information System
MOF: Meta Object Facility
MSc: Master of Science degree
OMG: Object management Group
PhD: Doctor of Philosophy
QR: Qualification Requirements
SC: Special Committee within the Bologna Com.
UML: Unified modeling language
XMI: Extended MetaDdata Interchange

7 References

[1] Barblan, A.: Academic Co-operation and Mobility in Europe: how it was, how it should be – CEPES 30th Anniversary, European University Association, http://www.unige.ch/eua/welcome.html, publications

[2] Directives to the Qualification Requirements Definition – HAC's work document, 2003.

[3] Dobay, P.: University, Region, Business Community: the Environment of the Higher Education on BIS – GIKOF Journal, No. 1. August 2002.

[4] Kiss, Á.: The Higher Education's Development Goals of Overriding Importance – The Hungarian Higher Education No. 8. 2001.

[5] Raffai, M. – Dobay, P.: The Education Concept for the Two Level Linear Business Information System Course based on the Paradigms of the Bologna Declaration – GIKOF Journal, No 1/2. December 2002.

[6] Raffai, M. – Gábor, A.: The Curriculum of the BIS-course – BSc Level, Version 2.0., – May 2003.

[7] Sima, D.: BC Proposals to the Preparation of the Two-Tiered Education System – BC's Presidents Document, Budapest, 10th of September 2002. FBBajanlas0910/2002-09-10

[8] Sorbonne Declaration – www.europedu.org, 1998.

[9] Sursock, A: Reflection from the Higher Education Institutions' point of view: Accreditation and Quality Culture – Working on the European Dimension of Quality: International Conference on Accreditation and Quality Assurance, Amsterdam, 2002. March

[10] Tauch, Ch. – Rauhvargers, A.: Survey on Master Degrees in Europe – European Commission, EUA Joint Publication, http://www.unige.ch/eua/welcome.html; 2002 September

[11] The Bologna Declaration on the European space for Higher Education – Confederation of EU Rectors' Conferences and the Association of European Universities (CRE), 2000. FCREebruary

[12] The Decision of the Hungarian Accreditation Committee about the Naming and the Scientific Category of the First Level IS/IT Courses – 2001.

[13] The Modernization process of the Higher Education – The Conception for Joining to the European Higher Education Space – 6th of July 2003. Ministry of Education http://www.om.hu/letolt/users/matiscsaka/2003/07/MagyFelsoktKoncjuli06.pdf

[14] The Standpoint of the Hungarian Rector's Conference on the Introduction of the 2-tier Higher Education System – Hungarian Rector's Conference, 17th of December 2002.

[15] Voit, P.: The Results of the Bologna Process – http:www.mutf.hu/bologna/bologna.html

[16] Work and Discussion materials of the BC w. Specialty on IS/IT – April – September, 2003.

INFORMATION EDUCATION IN THE TIME OF CHANGES

Jan Činčera[1]

The article argues the importance of preparing the students of information services for the future. It describes three trends that may deeply influence the information environment and make the most part of professional knowledge useless, whereas other important skills will be missing. It suggests the way for teaching at information services schools and describes one example of teaching about the future in praxis.

1 Future trends and information work

1.1 Various faces of the future

We learn neither for the past, nor for the present, but for the future. This is the crucial challenge for any school and this is the crucial challenge for the higher vocational school of information services where I work as well. Schools had been catching up with the demands of the past for a long time and only then started to call for curriculum that would reflect demands of the present. Nowadays, in the time of rapid changes, when it is difficult to say what the present really is, we should try to teach students to cope with the challenges of the future.

However, it is very difficult to say what we will need to know in 10 or 20-years horizon. Any forecasts are absolutely uncertain because of the enormous speed of technological progress. We can only forecast some trends that may seriously shape the face of information work. However, we must be also very carefully aware of the broader frame of the future changes: global terrorism or environmental problems may influence the environment of information services more deeply then a contemporary WWW revolution.

I like playing games with my students. In one of them (I will refer it again in the last part of this paper) we discuss the probability of eight different scenarios of the future. The important

[1] Higher Vocational School of Information Science; Faculty of Education at the Technical University of Liberec

experience of the game is the realization of total uncertainty we have about the future. All of discussed scenarios are possible. Each of them leads to different information environment, with different information needs and means. Do we have a chance to prepare our students for all of them? Do we have a chance to prepare them for the future? I try to describe these difficulties on examples of three trends that seem to be very probable up to 10 years from now. None of them supposes any drastically changes in western society, they are close to 'successful globalization' scenario.

1.2 Changes in the information work

1.2.1 Digitalization

We live on the edge of two worlds: the paper and the electronic. However, we can see the shift from the first one to the second one. Consider just the growing hill of electronic documents on the WWW: many of them will be printed but many of them will never know the paper. There are two reasons why we have not yet been confronted with the ultimate victory of the electronic world:

- Paper is quite cheap so everybody can buy printed newspaper or print interesting WWW pages in spite of the fact he / she can read them on the screen. It is still apparent that the building of information society is accompanied by increasing paper consumption. However, if we increase the price of paper (for example as a result of our environmental policy), this alarming paper wasting will come to an end.
- Devices for reading electronic documents are far from being user-friendly and readers are quite conservative. Nobody likes looking at the screen but we read paper books for relaxation. Students usually say something like "I like touching a paper and turning pages in a book and I can't imagine taking an e-book to my bed." However, in a short time we will probably have a chance to get cheap and practical pocket - devices for reading and storing electronic texts. They may look like the E-paper, which was announced in 2001 by the Bell Laboratories [2] or any other. E-paper will be cheap and comfortable and very probably will become popular. We can stretch our imagination and suppose a revolutionary spread of the new technology – as we can see on the example of mobile phones revolution nowadays. Very probably it will be possible to download electronic versions of most items of the book market – and for a lower price. Imagine situation when we choose whether to download an

e-version of a book for fifty Kc or to buy a hard cover one for five hundred. If this happens, where will be the place for libraries? How it will change the book market? Electronic world needs nobody between author and his/her reader… Another possibility is that e-books will follow the way of music. In this case we will be witnesses of a long battle between copyright watchers and Internet users storing thousands of illegally burnt e-books. The victims will again be libraries – as we can see nowadays. The chance to survive for libraries in the electronic age is sinking.

1.2.2 Laicization of information retrieving

Secondly, consider possible results of a contemporary trend of laicization of information retrieving. I have been teaching information retrieval at library service school for nine years and I know the effort which must be made to get completely clear the difference between AND and OR, or to learn correctly the use of proximities or truncations. But then searching of the Internet is getting very easy lately. Using Google or another search engine we can suppose that the work of a specialist – searcher may become useless in a few years: it seems that literally everybody will be able to find relevant information without (almost) any help.

Of course, something to learn and practice still remains. However, the trend very clearly shows to the future without professional experts for information retrieving.

How does it influence information work in academic or specialized libraries? Is there any future for them in this field?

A historical reason for foundation of the most part of information services was the expensive (measured in time or money) way to information. However, after removing this obstacle, most part of information services will loose their purpose.

In contrast, students of information schools spend their study mainly in practicing traditional information skills (like information retrieving or document storage), which are at risk of extinction. This is something what we have to change.

1.2.3 The end of credibility

If we think about future changes which should be considered in developing curricula at information schools, we should not miss out the serious social problems that are caused by the information work itself. As McLuhan [8] recognized, information technologies are not a simple tool but rather the extension of a man – they change us in unpredictable way. The problems with modern technologies are connected with information credibility, with the problem of understanding and with the existential level of being.

The problem of information credibility may be linked with what the French philosopher Jean Baudrillard [1] calls "*simulacrum*". Simulacra are signs that do not refer to real-world objects, but rather to the mixture of reality and simulation – 'a copy of a copy whose relation to the model has become so attenuated that it can no longer properly be said to be a copy.' [6]. In the time of information explosion we live in a *hyperreality*; it may be seen as very easy to find relevant information, but very difficult to decide what is credible and what is not. In some way all information is incredible – and the credibility is more than any time before seen as the matter of convention. One part of the information education must be therefore focused on the methodology of information credibility assessment. This may be one possible reason for survival of libraries in the future.

The problem of understanding is the second important topic for information education. Being influenced by the phenomenological background and confronted with the simplicity of relevant information seeking, it seems that it will be more important for information specialists to help to understand rather than to help to find. What I mean is something like "*hermeneutical translation*", the transfer of retrieved information to the code used by the user, to help the non-present authors to change (to *in-form*) the horizon of the user – reader. To manage this, the information specialist must get some pedagogical and psychological education, as well as high language skills. Last but not least, the information specialist who works directly with the users must be also quite broadly educated, open-minded person.

The existential level is connected with a moral dimension of the information work. Information technologies have become a new power which takes its part of responsibility for the future. It has the power to decide the balance between the world of riches and the world of poverty, between environmental depletion and sustainable development. Our dependence on communication symbols has ditched a growing gap between real and virtual world. The Internet Addiction Disorder or spreading of cybercities is only the top of an ice-berg. It all raises deep ontological questions. Information experts in the time of virtuality have crossed the frontier of challenges such as authenticity of human - being, corporality vs. the world of pure ideas, etc. Students should study these questions and should form their own professional moral codex – it calls for a good philosophical and ethical education, as well as for a change in the style of teaching, preferring dialogic forms rather then teacher - oriented lessons.

2 Future trends and information education

2.1 Changes in curriculum

If I analyze two schools for information professionals I know – The Higher School of Information Services in Prague and The Institute of Information Science and Librarianship (Faculty of Arts, The Charles University in Prague), I can see rare, but after all some attempts to face these challenges. At The Institute of Information Science and Librarianship I should mention the course of rapid reading. A few years ago it was an excellent seminar on creativity. At The Higher School of Information Services in Prague it is an excellent social communication seminar, where students learn to have a speech, to articulate her/his ideas, etc. Among these examples, I hopefully can count subjects on information ethics and information science, which I teach. The following example comes from the information science – the subject is taught for students of bachelor program at The Higher School of Information Services.

2.2 Examples of the change

One of the goals of the Information Science is opening a discussion about the future, its impact on the information work and the impact of the information work on the future. For opening the discussion we use the Forecasting Game – fully described in Green Teachers [3]. During the game the students are confronted with eight possible scenarios of the future:

- Doomsday – which is the most pessimistic scenario but in the time of global terrorism and bacteriological and chemical weapons may still be possible;
- Overshoot and collapse – scenario based on The Limits to Growth [9] and subsequent predictions of The Club of Roma and other environmentalists;
- United peoples – a bit fantastic scenario which comes from works of James Lovelock [6] or Teilhard de Chardin [10];
- Omnipotent individual – which is connected with the highly controversial extropian's philosophy [4] but which thoroughly takes into account scientific research in the fields of genetics, robotics or nanotechnologies;

- Technology slavery – which also considers the same research but is more pessimistic and close to neoluddists' position;
- Sustainable development – fragile strategy of international community looking for balance among environmental, social and economical aspects of development;
- Successful globalization – which believes in the victory of technological progress and western civilization.

Students are divided into smaller groups and asked to rank the future scenarios according to their preferences or (the other groups) according to their probability. (We use a quite common ranking principle called The Diamond Ranking.) Moreover, they should decide what effect would have any scenario on the information work and what aspects of the information work contribute to the scenarios.

After this, we start working together. The groups compare their results and ideas. They are confronted with questions: 'What is the future I prefer for me and for my children? Is it probable? How is it influenced by my work? How will the conditions for information work change if this future scenario becomes reality? What do I have to learn to adapt for this future?'

The Forecasting Game is an easy activity, but provokes to difficult questions. Last but not least, students enjoy it.

3 Conclusion

As we could see, the changes in the information field give us one certainty – the certainty of a change. The most important skills for the information specialists become flexibility, open-mind, creativity, communication skills, and team-working skills. This is what we generally do not teach our students – and this is also something what we should change. Personal competencies may become the part of curricula in two ways – direct (e.g. in the form of special creativity courses) and indirect (as so called "hidden curriculum" – by the style and forms of teaching and school environment).

In conclusion, the information education should be shaped with the respect to the future needs. The information specialist for the future may need more flexibility, open-mindness, communication abilities, and philosophical, ethical or pedagogical overview than narrow ICT skills. The future needs are the challenge for information professionals of tomorrow – and for information educators of today.

4 References

[1] BAUDRILLARD, Jean. Dokonalý zločin (Le crime partaif). Olomouc: Periplum, 2001. 180 p.

[2] BBC News. E-paper moves a step nearer [online] 2001-04-23 [Cit. 2004-05-20]. Available at http://news.bbc.co.uk/1/hi/sci/tech/1292852.stm

[3] ČINČERA, Jan. Forecasting Congress: Envisioning the Future. *Green Teacher*, Fall 2003, Issue 72, p. 30-33. ISSN 1192-1285.

[4] EXTROPY INSTITUTE [web site]. 2004 [Cit. 204-05-20]. Available at http://www.extropy.org/

[5] HEIDEGGER, Martin. Bytí a čas (Sein und Zeit). Praha: OIKOYMENH, 1996. 477 s.

[6] LOVELOCK, James. Gaia (The Ages of Gaia). Praha: Mladá fronta, 1994. 221 p.

[7] MASSUMI, Brian. Realer than Real. The Simulacrum According to Deleuze and Guattari [online]. The Australian National University,1987. [Cit. 2004-05-20]. Available at http://www.anu.edu.au/HRC/first_and_last/works/realer.htm

[8] McLUHAN, Marshall. Jak rozumět médiím (Understanding Media: The Extension of Man). Praha: Odeon, 1991. 348 p.

[9] MEADOWS, Donnela H.; MEADOWS, Dennis L.; RANDERS, Jørgen. Překročení mezí (Beyond the limits). Praha: Argo, 1995. 319 p.

[10] TEILHARD DE CHARDIN, Pierre. Vesmír a lidstvo. Praha: Vyšehrad, 1990. 264 p.

TEACHING SOFTWARE MAINTENANCE TO COMPUTER SCIENCE STUDENTS WITH THE AMEISE ENVIRONMENT

Christoph Hoyer, Gerhard Chroust, Harald Rafetseder[1]

AMEISE is an environment for simulating software development based on an existing project simulator SESAM. Students take the role of a project manager – they have to hire personnel with specific experience, assign tasks to the hired personnel, review progress and quality of work. AMEISE adds a powerful infrastructure around the existing simulator SESAM and provides an improved user interface, storage functionality, reporting/analysing features and much more. One further aspect of the AMEISE project was the development of additional simulation models for the core-simulator. The field of software maintenance, often in teaching and research underrepresented, was chosen and a maintenance model was developed at the Institute for Systems Engineering and Automation.

This paper outlines the concepts behind the developed maintenance model and especially takes into account teaching aspects of the maintenance model by describing the learning objectives underlying the maintenance model and providing a first experience report from the use of the AMEISE maintenance model in teaching.

1 The AMEISE[2] Environment

AMEISE – A Media Education Initiative for Software Engineering [2] – is a project to develop an environment for simulating software development based on the SESAM simulator [3] of the Stuttgart University, which addresses current problems existing in the teaching of software development and teaching of software project management [9]. The greatest lack in current teaching of software project management is the missing practical experience students can gain during their

---

[1] Kepler University Linz, {hoc, hc, hr}@sea.uni-linz.ac.at

[2] Project AMEISE (No. NML_1-77) funded by the Austrian Federal Ministry for Education, Science and Culture: coordinating partner is Fakultät für Wirtschaftswissenschaften und Informatik - Universität Klagenfurt, further partners are the Institure for Systems Engineering & Automation – University of Linz, Fachhochschule Technikum Kärnten and the Institut für Informatik – University of Stuttgart.

studies. Students acquire a lot of theoretical knowledge, but do not have the possibility to apply this knowledge in practical training.

The Software Engineering Lab of Stuttgart University (Head: Prof. J. Ludewig) addressed this issue by developing the SESAM simulator. SESAM provides a basis environment with a rule based model definition language, a model simulator and a simple user layout to interact with the simulator. Students take over the role of a project manager – they have to hire personnel with specific experience, assign tasks to the hired personnel, review progress and quality of work. The actions the students perform are afterwards interpreted and commented by an instructor. It serves as core engine around which AMEISE is built.

AMEISE extends the scope of the SESAM-Simulator by wrapping the SESAM-core in a new environment, which allows self-assessment and self-directed learning. Students are provided with means to analyse the consequences of their actions and have the possibility to compare their project trajectory with decisions and results obtained by peers [8].

The AMEISE-Environment allows the simulation of SESAM project models in a comfortable way by providing a JAVA-based user interface. Figure 1 shows a screenshot of the AMEISE client.

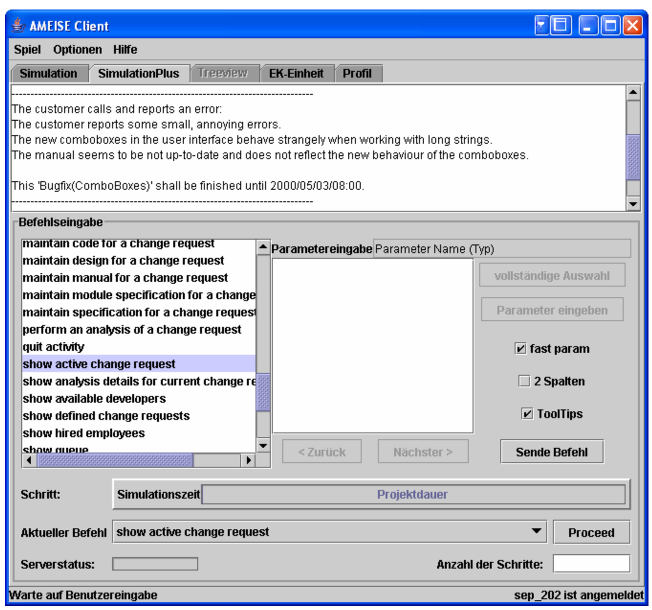


Figure 1- The AMEISE client

Basis for the simulation within the AMEISE environment are models developed in the SESAM language ("SESAM Hochsprache"). The most mature model for the AMEISE/SESAM simulator is the QS-QA Model, which was developed in Stuttgart and allows the simulation of a classical forward engineering software development project [3].

The Institute of System Engineering and Automation was responsible for defining and developing a new maintenance model based on the existing QS-QA Model.

2 Maintenance – the unloved Child of Software Management

Although nearly every organisation developing software has to deal with maintenance, maintenance is underrepresented in the field of software engineering. Almost no empirical data can be found that would help us to better understand the nature and consequences of software maintenance on the maintaining organisations and the maintained products. Looking in detail at software maintenance efforts and furthermore trying to find detailed guidance for the maintaining organisations, we often find an ad-hoc and pragmatic organisation of the maintenance effort. The following characteristics are typical for software maintenance:

- Maintenance is the continuation of the development effort with other means.
- Maintenance is the unloved child of software development.
- Maintenance is determined / influenced by the product characteristics resulting from the preceding development.
- Maintenance follows different rules than normal software development.

The following sections will detail the developed maintenance model and will try to show how maintenance differs from classical software development.

3 The developed Maintenance Model

In order to show the connection of maintenance to the development process and to reduce separate implementation effort, the developed AMEISE maintenance model was built by basically modifying the existing forward engineering model (the “QS-QA model”). This promised the integration of the knowledge and empirical data material of the existing QS-QA model and ensured the compatibility to the AMEISE environment that was built on the SESAM core with a special focus on the QS/QA model.

Using the QS/QA Model as the basis for the maintenance model made it necessary to implement in the model some additional quality attributes relevant for maintenance. Investigation and review of maintenance literature and standards showed that two different sources for maintenance quality attributes exist:

- Metrics/Methods for Software Measurement (e.g. COCOMO [2] or Capers Jones [6]) that try to calculate the effort to maintain a software product from the effort of the development of the software product.
- Software Quality Models (e.g. Boehm [1], McCall [7] resp. the ISO Standard 9126 [4]) that try to characterize the quality of software and furthermore to measure these characteristics.

First attempts to the definition of such maintenance attributes identified *Readability* and *Structural Quality* as possible maintenance-relevant attributes, but further investigation and literature search showed that *Readability* and *Structural Quality* are hard to define and almost no literature/data material for their definition is available

The Software Quality Models have shown to be more adequate for the AMEISE maintenance model as the calculation of the maintenance effort from the existing data was not possible, and the quality models provided the information necessary to define maintenance quality attribute. ISO 9126 is the most up-to date quality model and furthermore provides concrete metrics for maintenance that could be reused for the AMEISE maintenance model.

The metrics of ISO9126 for Maintainability [5] provided the basis for the definition of the AMEISE maintenance quality attributes. Following attributes have been defined for the maintenance model:

- **Analysability:** describes the quality/maturity of the Software respectively the effort/problems expected during maintenance to analyse the errors and the causes of errors in the documents and furthermore to identify the required changes in the documents.
- **Changeability:** describes the quality/maturity of the Software respectively the effort/problems expected during maintenance to implement the required corrections/changes in the documents.
- **Stability:** determines the state of the Software in respect to the probability of necessary changes respectively the probable undesired behaviour after changes to the Software.

Complementing these main quality attributes following quality attributes characterise the ongoing maintenance effort:

- **Average Analysis Duration** is the average duration of the analysis phase of the finished change requests.

- **Average Change Duration** is the average duration of the maintenance of the finished change requests.

Based on these maintenance attributes a simple maintenance model has been implemented. Conceptually the maintenance within the AMEISE maintenance model is done on software development artefacts/documents (following documents are defined: Specification, System Design, Module Specification, Code, and the Manual). A set of so called change requests is defined. Once a change request becomes active, the project manager (i.e. the student using the simulation model) has to first analyse the change request and then has to assign his developers to the maintenance of the documents. When maintenance for all affected documents is done, the fulfilment of the change requests is communicated and the changes are delivered to the customer.

Figure 2 show the lifecycle of a simple Bugfix in the maintenance model: after the activation of the change request *1.)*, the project manager assigns a developer to the analyse of the change request *2.)*, followed by the real maintenance of the documents *3.)* and the final delivery of the implemented changes to the customer *4.)*.

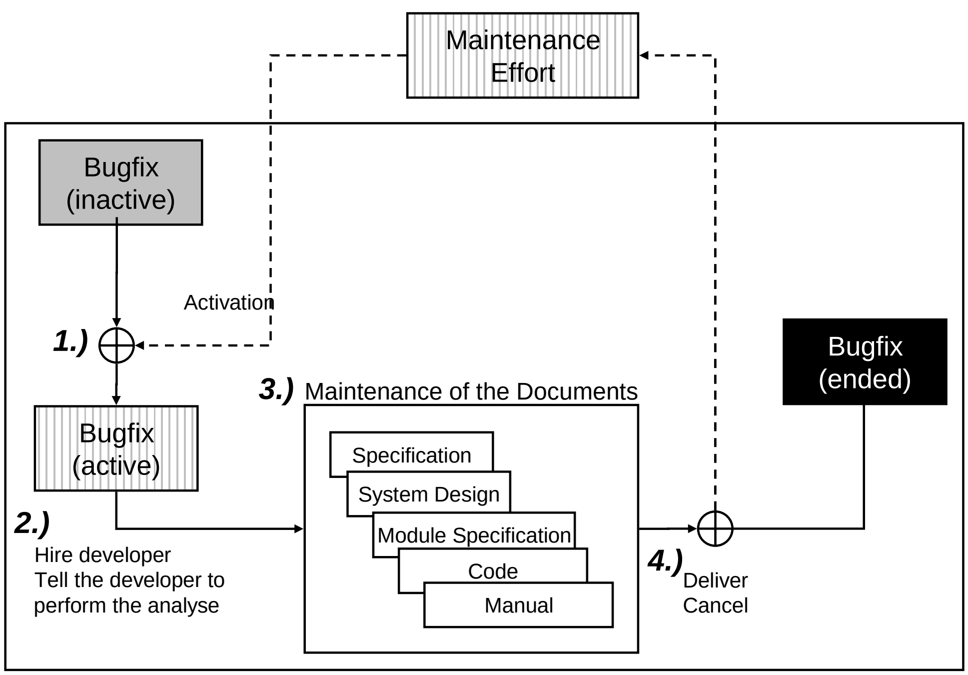


Figure 2 - Maintenance lifecycle of a change request

4 Learning Objectives behind the Maintenance Model

One central goal of the whole AMEISE environment is to improve and support the teaching of software project management. The primary use of the maintenance model is for teaching software maintenance and especially some of its specifics. Following section outlines the learning objectives behind the AMEISE maintenance models and how these objectives are met within the model.

4.1 Different Types of Maintenance

The student shall get to know to the different kinds and characteristics of maintenance – we do differ between corrective, adaptive, preventive and perfective maintenance.

The different kinds of maintenance are realised through different types of change requests. They differ in that they either correct or add functionality. Furthermore, the effort distribution over the maintenance phases differs from change request to change request (e.g. correcting a coding error (a ’Bugfix’) requires major changes to the code). At this time, only corrective maintenance has been implemented.

4.2 Difference of Maintenance to Forward Engineering

Maintenance always requires the consideration of the whole product and all the documents produced during a development effort. Changes have to be implemented in different documents. This is realized in the maintenance model through the (task) description of the change requests. Depending on the change request type, the maintenance effort is distributed on several phases/documents (e.g. a Bugfix requires major changes in the code, but only little changes in the specification).

4.3 Time Pressure

Maintenance is often done under time pressure and pressure from the customer. The customer – or his operating environment - often dictates a very short time frame for realisation of his/her request. This is realized in the maintenance model through customer defined end-dates and its ongoing monitoring, if necessary by warning of the project manager when these dates are going to be exceeded.

4.4 Influence of the Past

Maintenance is always done on or after a performed development effort and is done on a given qualitative state of development documents. The quality of these documents and the ‘crimes’ of the past do influence the maintenance effort. This is realized in the maintenance models by implementing the maintenance model ‘on top’ of and as a continuation of the QS-QA model. An existing run of the QS-QA model (the simulation of a simple forward engineering project) forms the starting point of the maintenance run. The maintenance is done on the documents of the QS-QA model and the maintenance quality attributes are defined on these documents.

4.5 Maintenance influences the current Product

Maintenance influences the state of the existing development documents. Errors are corrected but also new errors are produced. Functionality is added and existing functionality is changed. This is realized through working on existing documents – errors are corrected and new errors emerge, the quality attributes change during maintenance.

4.6 Maintenance Quality Attributes

One key goal of the maintenance model is to show the students the influence of maintenance attributes on the effort and how these maintenance attributes change because of maintenance. This is realized through the re-calculation of maintenance attributes outlined in the previous section and through the visualisation of the changes to these maintenance attributes.

4.7 Reading-in in other's Person Documents

Maintenance efforts are often confronted with the problem that the persons maintaining are not the authors of the maintained documents and that additional effort is required to be able to understand the documents. This undesirable effect is realized in the maintenance models through the consideration of the authorship of the documents: the author of a document needs less effort for the maintaining of a document than the developer who does not know the document and needs some time to understand and work in.

4.8 Customer Contact during Maintenance

One important aspect of maintenance is the contact to the customer during maintenance. This is realized through the analysis phase necessary for every change request: the analysis of an active change request can be done with or without the customer, influencing the result of the analysis as the analysis with the customer takes longer time but is more precise and more errors are found.

5 The Use of the Maintenance Model in Teaching and the Student's Reaction

The main development phase of the maintenance model was finished in February 2004 going over into a 'maintenance phase' of the model aiming to continuously improving the model by mainly playing the maintenance model and by allowing students of computer science to participate in this 'maintenance phase' through practical trainings. At the time of writing this paper 3 Students are performing a practical training in the context of the AMEISE maintenance model.

The first application of the maintenance model in teaching was in the university course "Special chapters of Systems Engineering – Project Simulation with AMEISE" in the summer semester of 2004. Accompanied by two theoretical lessons on general project management topics, 2 half-day workshops were performed. Starting with playing one run of the QS-Model the students played several runs of the maintenance model. The experience and the feedback gained in these 2-half day workshops can be summarized as follows:

- The AMEISE environment as a whole and especially the provided user interface received very positive comments and its use is felt to be very intuitive and comfortable.
- The use of the model and the AMEISE environment for teaching makes sense, especially the „playing character" smoothes the way for getting awareness for and discussions about this highly important, but often neglected field, of software engineering – software maintenance.
- The defined maintenance attributes are well understood by the students. Their influence on the ongoing maintenance effort is seen, but could be further worked out and especially commented (e.g. further reports and visualisation of changes to the attributes).
- The students requested the need for an improvement of the summary reports after the finishing of a single change requests and after the end of one run of the maintenance model. Especially the final summary report is in the current maintenance model only partially supported by the AMEISE environment and must be done to the greatest extent per hand by the game instructor.
- Some students missed a visualisation of the organisation and its employees and the tasks they perform in a given situation. They would have appreciated some kind of concrete visualisation of the developers and their current work which could help to improve the awareness of the situation the project manager is faced with.
- The students enjoyed the playing in groups of two and the support provided. The workshops were held at our institute with an active guidance of one course instructor and a further tutor.

This extensive support of the students during playing has proven to be very useful and also led to fruitful discussions between the students and instructors as well as between the several student groups.

The maintenance model and the AMEISE environment is planned to be used in several courses during the next teaching semesters.

6 Conclusion

The AMEISE environment and the developed maintenance model form a sound basis to support the teaching of software project management and at the same time shows a different and interesting approach to teaching project management as the AMEISE environment gives the students the possibility to apply the acquired theoretical knowledge in a practical training situation and provides the students feedback on their actions. The students as ‘AMEISE project manager’ are in the favorable position real project manager often wish to be: they can lead a project, try their actions and have a second chance to manage an almost same project and to do right.

7 References

[1] B. Boehm: Characteristics of Software Quality, North Holland Publishing Co., New York, 1978.

[2] Boehm, et al.: Cost Models for future Software Life Cycle Process: COCOMO 2.0, Annals of Software Engineering Special Volume on Software Process and Product Measurement, J.D Arther and S.M. Henry, Eds., J.C. Baltzer AG, Science Publishers, Amsterdam, The Netherlands, Vol 1, pp. 45 – 60, 1995.

[3] Drappa, A.; Ludewig, J.: Quantitative Modeling for the Interactive Simulation of Software Projects, The Journal of Systems and Software 46, April 1999, P.113-122

[4] ISO/IEC TR 9126: Software engineering –Product quality, 19-12-2000.

[5] ISO/IEC TR 9126-2: Software Software engineering –Product quality – Part 2: External metrics, 19-12-2000.

[6] C. Jones: Estimating Software Costs, New York, McGrawHill, 1999.

[7] J. McCall, et al.: Factors in Software Quality, Volumes 1, 2 and 3, Springfield Va., NTIS, AD/A-049-014/015/055, 1977.

[8] Mittermeir R.;Bollin A.: AMEISE – Project description, accessible via the AMEISE Project website at http://ameise.uni-klu.ac.at/, Version 1.0, 25.09.2002.

[9] Mittermeir, et al.: AMEISE – Concepts, the Environment and Initial Experiences, ICL2003 Workshop, Interactive Computer Learning Workshop, Villach, 24.9-26.9 2003.

METADATA IN E-LEARNING: AUTOMATIC EXTRACTION AND REUSE

Michael Sonntag[1]

The concept of metadata is not new, but currently its use is rather restricted. One of the areas it is actually employed, although usually only to a small extent, is E-Learning. Reasons for this slow adoption are the additional work required for adding it and a lack of applications providing direct advantages to end users. Some approaches to ameliorate both problems are presented in this paper together with applications realizing them: Automatic extraction of metadata from learning resources and the use of metadata to create an index, roadmaps and cross-references between learning units.

1 Motivation

One problem of E-Learning is finding appropriate courses. As the investment in a completely new course is higher compared to creating a conventional course, this aspect is very important. Through the last years a large number of widely differing courses was developed using many different learning systems, pedagogical approaches, content formats and topics. However, relying on current search engine technology to find a matching one for a specific need is rather difficult: Only full text search is supported. This does not work with some course formats, e.g. binary encodings or when compressed. Also, it is useful only when searching for certain topics. Retrieving courses in a specific language might be successful, but when requesting an educational level (e.g. an undergraduate course) or for a certain didactical approach (self-organized learning), this doesn't work at all. A solution for this could be methods introduced by the semantic web, especially the use of ontologies and the annotation of material with metadata. Through explicit marking with metadata matching courses (or elements thereof) can be found more easily and with better precision. However, even with these methods, metadata poses problems (see also [4]):

[1] Institute for Information Processing and Microprocessor Technology (FIM), Johannes Kepler University Linz, Altenbergerstr. 69, A-4040 Linz, Austria. E-Mail: sonntag@fim.uni-linz.ac.at

1. Search engine support: General search engines do not yet support metadata. However, repositories or dedicated E-Learning search engines employ them, although these might be hard to find themselves. This problem can be relied upon to change over time, however.
2. Missing metadata: When creating a course, authors rarely add this additional information. Some of the reasons are that its benefit is not immediately visible and does not improve the initial use of the material (no added value now, only for potential later reuse). Moreover, additional work is required by using an (often different or cumbersome) editor for inserting or composing the metadata information at the different elements (the whole course, individual parts like lessons or resources, etc.). This is an area where the individual author is required for improvement and where a competitive advantage can be gained through findability and ease of assessment of suitability as well integration.
3. Lots/Differing standards: Several metadata standards/specifications exist [10], and even though many are rather similar (most are, like IMS [7] and ARIADNE [2], based on LOM [11]), they differ in details (both naming and structure). They also exist in several versions already (e.g. IMS: 5th version). Making matters worse, they are based on vocabularies often unknown to authors who should annotate their materials according to them. One example is the learning resource type (IMS): The exact difference between "diagram", "figure", and "graph" can be difficult for non-native speakers or those unfamiliar with the specification. Another issue is the format of the metadata: Whether RDF or "pure" XML is much disputed (e.g. [15] and [13]).

This paper will present some approaches to ameliorate these problems in chapter two and focus on two of the strategies shown, reuse for other areas and metadata as help for certification in different forms, in the following chapters. Chapter five presents some tools implementing several of the approaches. The paper ends with some conclusions.

2 Reducing problems of metadata

One way to reduce the additional work required for adding metadata to an otherwise finished course is automatic extraction. Some metadata can be extracted from other information (e.g. the content) or converted from other metadata formats, obviating the need for explicit (re-)annotation. Examples for exact derivation are the language of the content, its structure and type. Other elements can only be extracted with a lesser degree of certainty or depending on the format/content. Examples for these are the title or keywords. Keywords e.g. can be extracted perfectly if specified in file properties of documents (e.g. Microsoft OLE 2 Compound Document format or PDF), very well when explicitly marked as such (on separate line and preceded by "Keywords:"), but only very roughly from plain content text trough automatic and unsupervised text analysis.

Another way to enlarge the use of metadata is tool support for authoring. Providing additional information (and especially examples) in easy-to-use tools for adding metadata according to different standards as well as support for conversion between them would be very helpful. Especially the latter is a difficult field because of the fragmentation of standards and their often subtly different meanings, so just syntactically converting it to another structure (e.g. renaming the content or moving it into added elements) will sometimes be not enough but require additional changes to the content (selecting a different value).

The reluctance to invest the additional work for adding metadata could be overcome when focusing not only on searching (which is often a rather remote use for developers), but also on other uses, especially such providing immediate benefits during the initial use, and especially for singular courses.

3 (Re-) Use of metadata for other areas

Reuse of metadata is in my opinion the best incentive for adding it, as immediate benefits are gained. Some ideas for this are presented, which partly have already been implemented (see below).

3.1 Automatic index creation

Creating an index for learning material is a lot of work, especially as there is usually little or no support from the editor. Text processors mostly support this, but for other elements (graphics, animations, sound files, etc.) this is unavailable. Integration is also lacking: At most an index for several individual files of the same type can be created, but none spanning a whole course, which in most cases consists of many different kinds of content. An index provides an alternative and learner-dependent (instead of defined by the teacher) approach of navigation for the course content, which is especially important in the area of continuous learning ([21]), where quickly locating parts of interest is desired. If the complete course is assembled from several independent parts, it also strengthens the integration. As the parts are independent, there are no cross-references or links between them. An index is at least a first approach to integrating them more fully by allowing finding related issues in different parts of the course.

However, if metadata is available for the individual elements (and depending on its quantity and quality) an index can be created automatically. Keywords of all the learning material elements are collected and arranged together with links to the content. As in a full index, duplicates are merged to a single entry with several references. To avoid problems with slightly different words (the courses need not be completely homogenous, e.g. when assembled from parts of different authors), this can be supported by taking into account the language of the keywords and using an appropriate stemming algorithm. For grouping similar keywords therefore only the word stem should be used. This introduces some uncertainty, as different words (or when incorrectly guessing a non-specified language) could result in identical stems. Therefore when using this approach, the full keywords should be listed alongside the references.

A drawback of this "reuse" is that this is a meta-index in the sense that it only links to individual learning resources as a whole, but not to locations within them. Implementing this is difficult as it would depend on both the actual structuring of the content (its file type) and the navigation on the specific software used to display the resource. Quality therefore depends on the content's granularity: Many small and annotated resources yield a large and useful index, while a few large documents result in few entries leading to a single large document, which is less advantageous.

Subentries are possible but probably not very accurate unless the content is very finely partitioned (so keywords apply only to small elements). Here the same methods as for collapsing similar entries could be used. However, it would depend on subentries starting with a longer identical substring or word; different but related words could only be grouped together with the use of an extensive ontology containing both words under consideration. As such ontologies are currently rare or only available for small and isolated areas, this is at the moment not a very promising approach, but could be of help in the future.

3.2 Relations between elements (automatic cross references)

When learning material is created by assembling individual parts from several sources, cross references are missing (each part must be self-contained; e.g. a requirement for submanifests in IMS). However, links between parts referencing related topics or additional information are essential parts of web-based training: One reason for the Internet's success is its abundance of cross-links in addition to often strict hierarchical navigation, allowing pursuing topics independently of the main and pregiven structure.

This also facilitates explorative learning, where learners take a more active role by selecting their individual way through the material which need not be hierarchical. With a history showing visited and especially unvisited areas (a rather simple task if the LMS supports adaptation, but otherwise quite difficult) even completeness of learning is achievable. These cross connections can be added either manually through some effort (identifying for each part all the other elements which might be of interest), or automatically based on metadata (see [17] for a system using explicitly provided metadata and an ontology). Links can be derived from several elements of metadata:

- Keywords: Learning units with similar keywords focus on similar topics and can therefore be connected and marked as "related". This produces a list of related elements which can also be enriched with additional metadata (e.g. the referenced items title or description). This is especially useful and working well if the same content is presented in different ways, e.g. units providing a textual, a graphical, an audio or video description of the same content or one in a different language.
- Explicit relation data: E.g. the LOM standard contains several predefined relation types. Especially the "references" and "requires" elements could be used for creating links to other elements (or checking for completeness). This probably only works for parts, which were at least potentially intended for combination, else this annotation would not be contained. As they were explicitly created, no margin for errors remains so this should be used whenever present.
- Classification: If elements are described in detail by their position in a subject area, this can also serve to connect material. In common hierarchical and numerical classifications even a measure for the distance is possible by taking into account the difference in numbers and hierarchy steps between the two items. This allows better annotation of the links and e.g. presentation in different degrees of importance (location, color, size, …). An example is the ACM classification (already converted into an ontology [18]), which could be used directly for teaching modules classified accordingly at each sub-part.

The same restrictions as with automatic index creation apply: References can only originate at and target complete units. As reuse will mostly combine numerous small units and rather less frequently group a few big items, this is of less concern here. Another drawback is that their annotation (i.e. the type and meaning of the reference) is only weakly ascertained unless it is based on explicit relation information.

Both for creating links according to keywords and classifications extended ontologies about the topic area could be helpful for ascertaining the degree of similarity and the kind of relation.

3.3 Annotated course lists

Information about courses in listings of those available is often separated from the course itself: Data (topic, prerequisites, technical requirements, etc.) must be entered separately and is stored independently, resulting often in inaccurate data and duplication of effort for entry and update. For E-Learning courses these could be partially extracted from metadata of the learning material (if present there). Through this the problem can be ameliorated and metadata reused.

However, not all required information is contained therein (e.g. the LOM metadata standard does not provide information about the room of the course, schedules for different activities, or the teacher), as usually only the material itself is annotated, excluding organizational data. This information is commonly part of the learning management systems (LMS) instead, which is responsible for lifecycle and presentation of courses. Here also specifications exist, but these are far less universally used than those for meta-data or content aggregation.

3.4 Personalized course delivery

Some parts of the metadata could be used for personalizing course delivery, e.g. again keywords and classifications, or other metadata like interactivity type/level, end user role or difficulty. However, this provides only a small base for adaptation and additional specific metadata is required for comprehensive personalization (see e.g. [3] for such an extended system).

4 Metadata and certifications

Metadata can improve comparability between courses and curriculums: A detailed structured description of the content as well as the method of delivery and pedagogical models employed is contained. But not only materials can be compared, also examinations and to some extent even results. When a course according to certain material (including associated tests) has been finished, its metadata describes the proficiencies of the students and can be seen as describing the certificate issues based on this in detail. This allows easier comparison of results between courses with similar content not only according to the verbal description of the course but also automatically through comparing metadata of the course or its individual elements, while avoiding the need to introduce separate assessment metadata (e.g. [6]; probably better results but requiring again more metadata entry and management). This however works only on one of the two elements of certification: contents and achievement with respect to the content items. Only the former is comparable, while although the latter can be measured (e.g. percentage of questions answered correctly), comparing it between courses is difficult. A measure for the difficulty of a course is defined in metadata standards, but it doesn't necessarily apply to the examination. Additionally, the assessment standard need not be identical between different authors, institutions or target groups. A specification for "Re-usable Definition of Competency or Educational Objective" by IMS [8] exists, however it only defines an unstructured set of independent statements. Compared to a complete ontology with a hierarchy (competencies consisting of smaller parts or alternatives) this is probably only slightly useful. However, if this (or any similar information) is integrated into metadata it would improve the method outlined above considerably, as comparisons could then be made with exactly the same accuracy as used for the definition of the competencies.

Metadata can also be useful when comparing materials to decide which one to use for a course (or for inclusion in larger material; after it has been found), although often established standards are insufficient. E.g. in Austria the ministry of education has recently adopted its own extensions to the LOM metadata standard ([1]). Every electronic supplemental for officially approved schoolbooks (or completely electronic teaching material) must be annotated according to this standard, resulting in at least some annotation of electronic material. This intends to allow easier comparison and selection between them by teachers. The specification is based on LOM (using RDF binding; a pure XML binding was developed at this institute) and defines additional elements and some additional values for existing elements (e.g. contributor roles: sponsor, publisher, author, editor, creator). It is modeled after the "application profile" pattern ([5]), consisting of several namespaces optimized for local applications.

Additional elements of importance in this context are:

- School type, educational level and curriculum coverage: This defines for which level of competence and which target group the material is appropriate and includes taxonomies respectively exact content definitions. As assessment standards are also defined in these categories (although not included in the specification), comparison of results is then possible reliably. The only variations remaining are from the individual assessment of the teacher (which is unavoidable).

- Certifications: In Austria all school books (and electronic material) must be approved before they can be used in schools (usually several approved books/courses exist from which the teacher can then select according to her/his preferences). This certification status is included as metadata, providing a different kind of certification missing in other standards. It is stored in plain text and cryptographically unsigned, however, and therefore relies on a trusted server (as is the case in Austria). This is a serious drawback as it prevents the passing on and reuse of modules with reliable certification. If a new course is assembled from pieces (or whole units) of approved content, it must be certified in detail and completely again, instead of only checking the scope of the compilation or any additional elements which are not certified themselves (or excerpted from certified base material).
- Relation to schoolbook: Some material is intended as a supplement to conventional books, other as replacements. For the former the relation with the book must be specified in detail: Is it the same content as the book, additional examples, additional content or does it provide more details? Also, to which chapters/sections in the book an entity is related must be specified. If the book is known to the person comparing two students, results in electronic tests can then be compared with a high degree of certainty and even to students learning with the physical book only. Still, this is a very restricted use of classification for assessment as it relies on a single reference element, the physical "base" book.

Tool support for automatic comparison of metadata between two units or courses is currently missing. Still, manual comparison of results of students or courses can be eased if metadata is available.

5 Practical example: Extraction and use of metadata

At the institute several tools for furthering the use of metadata have been implemented and other ones are currently in development. These span the "lifecycle" of metadata from extraction/creation to use.

5.1 Creation

Metadata can be added to learning material either manually or through automatic extraction. For the latter a tool was developed. It extracts the content language, the title and keywords from several file formats. Supported are Microsoft files (Word, PowerPoint, Excel), PDF, CPS-Manifests (according to LOM final draft and IMS specifications in versions 1.1 – 1.2.2), HTML files (as META tags or as contained Dublin Core data; referenced external data is not extracted) and plain text files. The software can be easily extended to support more languages or to extract and add different metadata. Extraction relies primarily on metadata already contained in the different formats in some kind, but as fallback also extraction from plain content text is implemented and used if other methods fail.

Language detection is based either on directly contained language specification, but in contrast to the other elements this is rather rare (e.g. the Microsoft formats do not provide this in their metadata). Therefore an approach using stop word lists is used. Stop words are words which are very common in a certain language but possess little meaning (e.g. articles like "the"). These lists are commonly used by search engines to filer out unimportant words from queries. Here the exact opposite approach is taken: Everything but stop-words is filtered out. The list with the most matching words is assumed to be from the same language as the text. Testing showed this to be very reliable if the input is a complete text and not just a list of phrases, not too short and consists of a single language (individual foreign words are no problem: these are almost never stop words).

Keyword and title extraction is mainly based on existing metadata, except for plain text. There it should not be used as a final result but rather a starting point for human revision: A relatively simple custom algorithm is used. All words excluding stop words are counted in their base form (word stemming algorithms specific to the language used). Afterwards the top 5% words are discarded, as they are probably of less importance (very common words, although not stop words), as well as all words with a relative occurrence below 80%. All keywords are however required to occur at least four times. These values result from tests of the algorithm but are only rules of thumb; they can be changed easily. This algorithm can also be replaced completely by another (e.g. commercial) implementation without changing the code.

Input for the tool is a complete manifest and the base directory for the actual content files. It then extracts the metadata from all files referenced and integrates it into a copy of the manifest in the same standard that is already used (IMS Version 1.2.2 as default if no metadata was present previously). The software can be used either stand-alone with a command line interface or be integrated into other software, as planned for the new version of WeLearn.

It must be noted that metadata extraction is used here in the sense of "creating new metadata from content", not sharing already existing metadata in a defined format (e.g. [14]), which is the next step.

5.2 Offline presentation

Most E-Learning standards are geared towards online and dynamic delivery. Sometimes the content should also be provided offline, e.g. on CD-ROMs, with most of the functionality still available but without installing any software (other offline viewers usually contain an embedded web server to install, e.g. the SCORM conformance test suite [19], or the Reload SCORM Player [16]). For this application a converter was developed ([9]) producing different views (Applet, DHTML and simple HTML; for catering to different user groups and browsers), which employs metadata in several ways:

- Integration into output: Any metadata item can be individually accessed and rendered on the pages created through an XPath expression referencing it. The provided examples employ this to display German or English description and keywords depending on the actual template used.
- Creating a course roadmap: Based on the aggregation level of the content items as well as submanifests, a graphical view of the course is created [12]. This is an alternative to the main navigation; it need not be a tree, but can also be a network, depending on the actual content (see *Figure 1*).

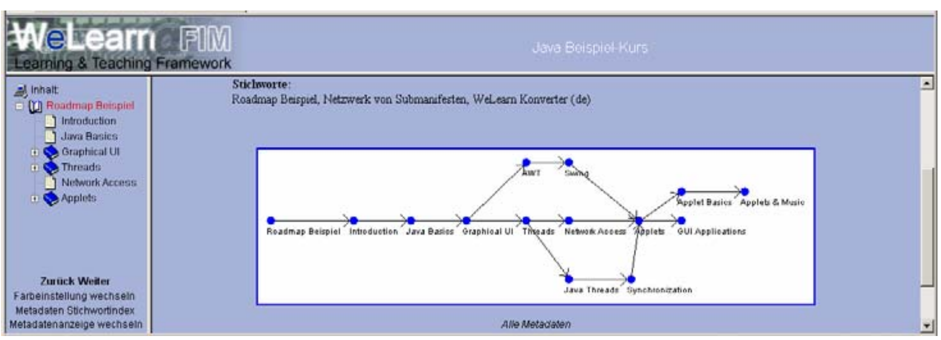


Figure 1: Example of full roadmap (German template)

- Filtering out certain elements: The content can be filtered upon conversion to only show items of a certain classification. This allows creating smaller courses, e.g. for certain target groups, from a larger course without internal changes. Basing them on a single main unit avoids problems when updating content, as different versions are automatically updated on the next conversion (see *Figure 2*).

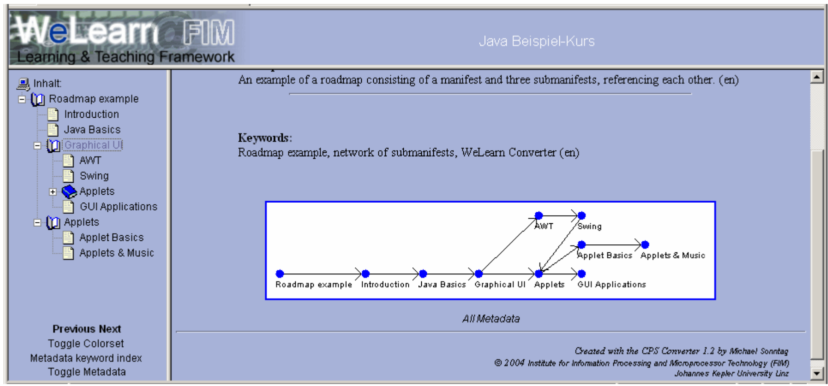


Figure 2: Example of filtered roadmap (English template)

- Content index: An index of the content is created fully automatically, based on metadata keywords. These are linked directly to the individual items they refer to (see *Figure 3*). Depending on the navigation used, this is also connected back to the navigation structure (both Applet and DHTML navigations support this feature).

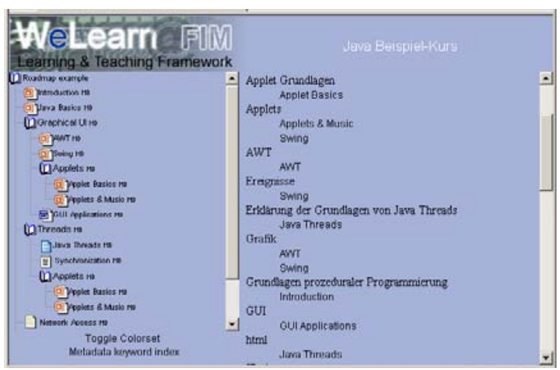


Figure 3: Index page

5.3 Online use

For the next version of the institute's Online Learning Platform (OLP) called WeLearn (currently in development), metadata is employed more extensively. Already implemented is providing learners with a personalized page according to their interests (derived from the keywords associated with the materials they visit and derived e.g. from the text of their posts in forums). Base data is extracted either from metadata provided by the author in the course material, or (if missing) through the tool described above. Planned is finding learners with similar interests, which improves cooperative learning [20]. Another use is creating an image of the current position of other learners within the learning material in the vicinity. This is based on the roadmap presented above with additional graphical indications: coloring nodes for current location and number of near students and additional textual information.

Producing cross-connections between items within a course and between courses is currently under consideration. As the content in a LMS might be large, comparing all data with each other requires too much time with often little chance of success. This would be a task specifically suited to agents as it requires a larger degree of intelligence. Also, integration into the systems user interface is yet unclear.

6 Conclusions

When metadata is actually available for a larger amount of resources (either through manual addition or automatic derivation) search engines will be more inclined to actually support it. In the meantime, other benefits can be used instantly: Metadata need not only be used to show a description of the content but can serve different other purposes. One example is adaptation to the actual user in several forms. This starts from rather trivial selection of equal content according to the media type (text or video) and ranges over identifying similar or related content and providing additional navigation structures like an index up to automatically deriving interests of users and selecting matching content.

Metadata is a very important element especially for learning content and learning management systems, as this is data to be reused often (and possibly in different contexts). It is also naturally associated with other data like different lessons, information for the teacher, or exercises. What is currently still missing, or available only in rudimentary form, is information on connections with other metadata. Here the natural barrier is that only data known in advance (i.e. existing and known courses) can be explicitly referenced. Therefore methods for automatically creating such cross-connections are of prime importance. The methods and tools presented here can serve as an initial stepping stone for approaching this goal.

Acknowledgment

This paper is a result of the project "Integrating Agents into Teleteaching-Webportals" sponsored by the FWF of Austria (Fund for the support of scientific research; Project number P15947-N04).

7 Literature

[1] Austrian Metadata specification for electronic Teaching-/Learning materials, Version 1.32 from 12.1.2004 http://elearning.bildung.at/statisch/bmbwk/de/elearning/metadatenmodellversion1_3_2.pdf

[2] ARIADNE Educational Metadata Recommendation: http://www.ariadne-eu.org/en/publications/metadata/index.html

[3] CONLAN, O., HOCKEMEYER, C., WADE, V., ALBERT, D.: Metadata Driven Approaches to Facilitate Adaptivity in Personalized eLearning Systems. Journal of the Japanese Society for Information and Systems in Education, 2003, http://www.cs.tcd.ie/Owen.Conlan/publications/JSISEv1.23_Conlan.pdf

[4] CURRIER, S.: Metadata Quality in e-Learning: Garbage In – Garbage Out? http://www.cetis.ac.uk/content2/20040402013222

[5] HEERY, R., PATEL, M.: Application Profiles: Mixing and matching metadata schemas. Ariadne, Issue 25 (24.9.2000) http://www.ariadne.ac.uk /issue25/app-profiles/intro.html

[6] HSIEH, C., SHIH, T. K., CHANG, W., KO, W.: Feedback and Analysis from Assessment Metadata in E-Learning. In: Proceedings of the 17th International Conference on Advanced Information Networking and Applications (AINA'03). http://www.mine.tku.edu.tw/scorm/hsiehct_assessment.pdf

[7] IMS Meta-data specification: http://www.imsglobal.org/metadata/index.cfm

[8] IMS Reusable Definition of Competency or Educational Objective: http://www.imsglobal.org/competencies/index.cfm

[9] LOIDL-REISINGER, S., SONNTAG, M.: Using metadata in creating offline views of e-learning content. In: AUER, M. E., AUER, U. (Eds.): Interactive Computer Aided Learning. Kassel: Kassel university press 2003

[10] LOIDL-REISINGER, S., PARAMYTHIS, A.: Distance Education - A Battlefied for Standards; In: SZÜCS, A., WAGNER; E., TSOLAKIDIS, C.: The Quality Dialogue. Integrating Quality Cultures in Flexible, Distance and eLearning; Proceedings of the 2003 EDEN Annual Conference, Rhodes (Greece)

[11] IEEE WG12: Learning Object Metadata. http://ltsc.ieee.org/wg12/

[12] MÜHLBACHER J. R., SONNTAG, M.: Roadmaps - Navigational Aids and Tools for Reusing Content in Distance Education. In: SZÜCZ, A., WAGNER, E., TSOLAKIDIS, C.: The Quality Dialogue. Integrating Quality Cultures in Flexible, Distance and eLearning. Proceedings of the 2003 EDEN Annual Conference, Rhodes, 16-18.6.2003

[13] NILSSON, M., PALMER, M., NAEVE, A.: Semantic Web Metadata for e-Learning – Some Architectural Guidelines. In: Proceedings of the 11th World Wide Web Conference. Royal Institute Of Technology, Stockholm, 2002.

[14] Open Archives Initiative. http://www.openarchives.org/

[15] QU, C., NEJDL, W.: Integrating XQuery-enabled SCORM XML Metadata Repositories into an RDF-based E-Learning P2P Network. Educational Technology & Society, 7 (2), 2004 http://ifets.ieee.org/periodical/7_2/8.pdf

[16] RELOAD: Reusable eLearning Object Authoring & Delivery: http://www.reload.ac.uk/

[17] RONCHETTI, M., GIULIANI, A., SAINI, P.: De-Fragmenting Knowledge: Using Metadata for Interconnecting Courses. http://eprints.biblio.unitn.it/archive/00000407/

[18] SAINI, P., RONCHETTI, M.: Deriving ontology-based metadata for E-Learning from the ACM computing curricula. http://eprints.biblio.unitn.it/archive/00000405/01/017.pdf

[19] Advanced Distributed Learning Initiative: SCORM http://www.adlnet.org/

[20] SONNTAG, M., LOIDL-REISINGER, S.: Cooperative Agent-Supported Learning with WeLearn. In: CHROUST, G., HOFER; C. (Eds.): Euromicro 2003. New Waves in System Architecture. Proceedings of the 29th Euromicro Conference. Los Alamitos, IEEE Computer Society 2003

[21] ZANG, D., ZHAO, J. L., ZHO, L., NUNAMAKER, J. F.: Can E-Learning replace classroom learning? Communications of the ACM 5 (47) May 2004

ROLES TRANSFORMATION WITHIN A SOFTWARE ENGINEERING MASTER BY IMMERSION

Vincent Ribaud, Philippe Saliou[1]

Learning the software engineering (SE) profession is a difficult task. Most SE professionals will say that they learned it "by doing". Hence, the main paradigm used is teaching software engineering by doing. Most academic curricula address this issue through projects, but academic projects are not sufficient to achieve the goal. Beyond the SE learning, more general questions arise : how can we teach/learn engineering ? What is a "long-term education", particularly in computer science ? And in a general sense ?

Since September 2002, Brest university has offered a dedicated second year of Master in computer science, called "Software engineering by immersion". The main objectives are : mastering software engineering activities and skills, working in a team, coping with change. Except for English and Communication, no courses are offered. The plan of action is built on a 6-month team project, lead and tutored by an experienced software professional. A real corporate baseline (by the courtesy of a software services company) has been tailored to the apprenticeship paradigm and now sustains engineering activities and products delivery. The apprenticeship process is achieved in two iterations. During the first iteration (4 months), students are swapped around the different tasks needed by engineering activities and strongly guided by the tutor. During the second iteration (2 months), roles are fixed within each team and teams are relatively autonomous when completing the project, the tutor performing mainly a supervising and rescuing activity. The assessment process is essentially formative, due to the permanent feedback of tutoring.

After a very positive first year, the outcome of the second year is rather disappointing. This year, we met with unexpected difficulties and this may be due to the roles transformation needed in the immersion paradigm, for the students as well as for the tutors. This paper attempts to present the new roles. Teachers have to deal with several kinds of tutoring activities : coordination between teams, software project management, individual and collective apprenticeship during the first

[1] EA2215, Computer Science Departement, Faculté des sciences, 29285 Brest Cedex, France
E-mail:{Vincent.Ribaud, Philippe.Saliou}@univ-brest.fr

iteration; peer review, sustaining the student acting as software manager, programme management during the second iteration. Students have to learn new skills but above all play new roles namely : citizen, builder, explorer, team member.

Assessing the role playing process formally is very difficult, first in a purely quantitative manner and second in such a short time. Moreover, we are aware of very few similar experiments. So, this paper tries to evaluate the new roles within the constructivism paradigm, especially the apprenticeship paradigm described by Jacques Tardif. The teacher and student roles defined in this paradigm are compared with those defined in our immersion paradigm. Some problems are reported and possible improvements are drafted.

As a conclusion, if the immersion system is exciting and innovative, on the other hand the system is fragile if both teachers and students are unable to play the new roles required. In addition to these first conclusions, the professional insertion and career evolution of students need to be observed over several years in order to evaluate the real benefits of this system.

1 Introduction

Among possible definitions of software engineering, we kept the following : “Software engineering includes the different types of knowledge, processes, scientific and technical experiences used for the manufacturing of software. This starts with the software order from the contractor and ends with its exploitation”.

Teaching software engineering is hard, but learning software engineering is much harder. Lethbridge and al. [8] surveyed software professionals to learn which educational topics have proved most important to them in their careers and to identify the topics for which their education or current knowledge could be improved. The survey indicates that employees are likely to lack skills and knowledge in fundamentals areas of software engineering such as requirements gathering/analysis, human/computer interfaces, project management, configuration management and in people skills (attitudes) such as leadership and negotiation. Most SE professionals will say that they learned it “by doing”. Hence, the main paradigm used is teaching software engineering by doing. Moreover, several analyses of software engineering teaching emphasise the benefit of a long-term team project (one semester or a year) [1] , [9], [11]. Beyond the SE learning, more general questions arise : how can we teach/learn engineering ? What is a “long-term education”, particularly in computer science ? And in a general sense ?

Brest University has been providing since September 2002 a second year of Master in software engineering. The opportunity to offer a dedicated year allows us to cope with some missing skills which are however well-identified by the professional branch. The main objective is mastering software engineering activities and skills. Moreover, among the characteristics and practices recommended for computer science graduates (Computing Curricula 2001, Computer Science Volume), we kept as additional objectives : working in a team, coping with change, and being able to appreciate a perspective in a whole [2]. The pedagogy used to achieve these objectives breaks with the usual teaching paradigm to rely on an learning paradigm [14].

The main idea of the system is to let professional realities into our university walls. Students work in teams to analyse, design, implement, test and document a software project relying on strong software engineering principles. The pedagogical system imitates as closely as possible real-world phenomena: a professional working environment, the client-supplier relationship, the application of a development baseline, the use of methods and associated tools, the cooperation within the team, ... We call this education system « Software engineering apprenticeship by immersion ». This system is presented in sections 2 and 3, a digest of [12].

During the first year of our Master in computer science, students experimented with the “learning by doing” paradigm through two mini-projects (2 weeks each) in distributed systems and in information systems. Each mini-project follows a classical development cycle starting with software specifications as defined by the teachers and ending with deliveries and a demonstration. But in the immersion paradigm, the whole year is devoted to the project. No courses are offered, except for English and Communication.

The need for significant changes in the character of engineering education emerged in the mid-1980s. As an example, from 1989, the National Science Foundation supported six major Coalitions of U. S. institutions to pursue the vision and goals outlined in their proposals [13]. The Université de Sherbrooke has totally redesigned its electrical engineering and computer engineering programs, following an original learning approach that combines problem-based and project-based learning [7]. However, we are not aware of similar experiments in a MS in software engineering. However, the good and bad results that we observed probably apply to various disciplines using engineering. Yet, providing professional working environment and processes is much easier and cheaper in software engineering education than in other fields.

After a very positive first year, the outcome of the second year is rather disappointing. This year, we met with unexpected difficulties and this may be due to the roles transformation needed in the apprenticeship by immersion paradigm, for the students as well as for the tutors. New roles are depicted in section 4.

We were not able to assess the role playing process formally, firstly because the assessment is more qualitative than quantitative and secondly because it is too early to decide if the seeds we sowed are producing (or will produce) the desired fruits. So, in section 5, we try to evaluate the new roles within the constructivism paradigm, especially the apprenticeship paradigm described by Jacques Tardif. The teacher and student roles defined in this paradigm are compared with those defined in our immersion system. Some problems are reported and possible improvements are drafted.

We finish the paper with related work and a conclusion.

2 General description

2.1 Immersion principles

We structured SE activities around three main areas : software project management activities, specific software development activities and software development support activities. This division is the reference framework for the university (in a diploma-awarding perspective), for the pedagogical team and the students, and finally for the professional branch which will hire these young graduates.

Teaching these various activities is quite difficult following the teaching paradigm. Hence the idea to tackle these activities within an immersion in a real project, with the following specificities:

- the project goes on in the university in a dedicated fitted-out room;
- the ten students are divided into two separate project teams, that we call companies;
- companies will have to produce the same product but with different methods, tools and technologies;
- the project manager driving the project is a university lecturer, formerly a SE professional;
- the target, the software product, is only a pretext for learning software engineering activities.

In order to emulate a standard firm environment, we fitted out a laboratory room with a landscape room for each company (with own individual working post), a common meeting room and an Internet room.

The apprenticeship environment is made of at least four essential elements:

- a set of activities (or tasks) related to the software engineering profession,
- a software development process which organises the set of SE activities,
- a corporate baseline (by courtesy of Thales-IS) which defines good practices and capitalizes the company's know-how,
- a working framework including common installations and tool suites (IBM, Oracle, Rational).

The whole apprenticeship plan of action is guided by the development process, which defines, among others, the role and the schedule of project stages. It reveals clearly three kinds of teaching activities:

- *Organising*. It is a matter of scheduling and elaborating work cards that define, at each stage, the work to be done and preparing pedagogical supplies (book, software, hardware, corporate baseline…) needed to carry out the work.
- *Tutoring*. For each work card, a tutor is available to students who are thus provided with continuous support and assistance.
- *Control*. Work cards constitute the assessment framework because they define form and content for the deliverables to be produced and delivered.

2.2 Apprenticeship and manufacturing card

First, the apprenticeship process strongly relies on apprenticeship cards; then students enrich them for their own software development (manufacturing) process. The card structure is standardized (see as example below). Its main elements are the activity (here requirements capture) tied up to the work; the role to play (here analyst) with students' name; the work description (here a consolidation task); the products (deliverables) to deliver (here a Software Requirements Specification, SRS); the supplied pedagogical resources (here a writing guide and real SRS samples); workload and lead-time information.

<table>
<tr><td>Number : 8</td><td>Date : 11-21-2002</td><td>Origin : Ph. SALIOU</td><td colspan="2">Action</td></tr>
<tr><td>Program : SI2EWP1</td><td colspan="2">APPRENTICESHIP CARD</td><td>Analyst</td><td>L. Delemazure
S. Le Livec</td></tr>
<tr><td colspan="2">Activity : Requirements capture</td><td colspan="3">Name : Requirements consolidation</td></tr>
<tr><td colspan="5">WORK DESCRIPTION</td></tr>
<tr><td colspan="5">This work aims to consolidate in a single document the set of requirements. The purposes of this work are :
To be in accordance with the TEMPO-ILI baseline and the Two-Track Unified Process.
To bring together two requirements : functional and technical.
…
The expected result will be materialized with a Software Requirements Specification document (SRS). This specification is a reference document for the software design.
…
Pedagogical resources can be helpful in order to write the SRS :
Simplified writing guide for the software requirements specification (TEMPO-IGQ347).
SRS Examples
…</td></tr>
</table>

<table>
<tr><td>Products</td><td>Version</td><td>Milestone</td></tr>
<tr><td>Software Requirements Specification (SRS)</td><td>A</td><td>11-29-2002</td></tr>
</table>

<table>
<tr><td colspan="10">WORK IN PROGRESS</td></tr>
<tr><td colspan="5">Estimation</td><td colspan="5">Reality</td></tr>
<tr><td>Start date</td><td>End date</td><td colspan="3">Workload</td><td>Start date</td><td>End date</td><td colspan="3">Used workload</td></tr>
<tr><td>11-25-2002</td><td>12-03-2002</td><td>3,5</td><td>3,5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Date</td><td>Used workload</td><td colspan="8">Deliveries-Observations</td></tr>
<tr><td></td><td></td><td colspan="8"></td></tr>
</table>

Figure 1 : Apprenticeship card

3 The apprenticeship process

The apprenticeship process is guided by an unified software development process :

- It materializes as a sequence of stages with clear and controlled objectives at each stage.
- Each stage includes some work described with work cards that define precisely the work to be done and the apprenticeships to gain and/or the competencies to mobilize.
- Each work card is assigned to one or several students who should take up the job (or the role) inherent to the activity.
- Students are swapped around the roles from one stage to another stage.

For each work card, students can rely on tutor's support and assistance on a daily basis.

3.1 First iteration

The *first tutored apprenticeship iteration* (4 months) lets students acquire knowledge and skills needed for each stage. An incomplete version of the software is built, entirely driven and tutored by the company's tutor. All SE activities are put in practice within a complete software development cycle.

Each apprenticeship card give rise to one or several deliverables. Each deliverable is carefully examined and annotated by tutors, then the tutor feeds back comments to the authors together with improvements to bring about. This assessment and feedback process is iterated (at least twice) until that the deliverable is considered as good enough for its future exploitation (it should arise some problems when the final delivery is not judged as good enough).

Software project management	Coeff.	Apprenticeship card
Software project leading	2	Project set-up Progress report meeting accounting
Software quality programme	1	Quality programme set-up Quality insurance
Software configuration management	2	Software configuration plan elaboration Software configuration management Technical incident management Version management
Software development engineering	**Coeff.**	**Apprenticeship card**
Requirements capture	2	Functional requirements capture Technical requirements capture Requirements consolidation
Technical architecture	2	Technical architecture validation Development framework exploration Generic design Technical prototype
Analysis	2	Requirements analysis Human-computer interface mock-up
Design	2	General design Relational database consolidation Detailed design
Coding – Unit testing	2	Coding – Unit testing
Integration-Qualification	2	Software test plan elaboration Software test dossier elaboration Integration Internal validation Qualification

Software development support	Coeff.	Apprenticeship card
Technical support	2	Means set-up System and networking support Database administration Development technical support
Tools and methods support	2	Analysis environment definition and set-up Design tailoring Development support Software configuration tool mastering
User's documentation	2	Software user's guide writing Software installation and exploitation guide writing
Installation - Deployment	1	Target installation and configuration Software deployment

The array above describes the link of apprenticeship cards (the learning activities) with the SE activities breakdown structure (the competencies curriculum). This set of apprenticeship cards is the reference framework for all the stakeholders (university, teachers, students, professional branch). Each apprenticeship card has an assessment and a mark is given to.

3.2 Second iteration

The *second accompanied application iteration* (2 months) is intended to transform knowledge and skills into competencies. Each company is relatively autonomous in order to complete the project. The expected software product at this end of this iteration corresponds to the whole software product as defined in the contract. The progress of this iteration is similar to those of the first iteration, except that the company's tutor stands back in order to allow the company to stand on one's own two feet. The company's tutor has mainly a supervising and rescuing function.

At the end of the first iteration, students carried out (or saw their team mate at work) different engineering activities, and students used deliverables produced by other students during previous stages. We consider that they have a first "apprenticeship by doing" of the job and also that they know what they are able or not able to perform.

A fixed organisation of the team is set up for the second iteration, structured around roles. One student is acting as project manager while the others are carrying out all the others activities. During the second iteration, students will rely on the apprenticeship process acquired during the first iteration. The company has to transform this process in a production process.

For the second iteration, we did not want to measure individual competencies and performances. We gave three marks for this iteration : a mark given the project itself (and the work done), a mark given a collective viva voce examination, a mark given individual reports on the personal and the work done collectively. The mark given on the project relies on an formative and summative assessment of the essential deliverables of a software project.

Assessment	Coeff.	Deliverables
Viva voce examination	2	
Individual written report	2	
Work	4	Software Requirements Specification Software Analysis Document Software Design Document Software Test Plan Software Test Description Software User's Guide Software Installation and Exploitation Guide Delivered information system (the software product)

4 Roles

4.1 Teacher roles

In order to guarantee the good progress of the training course, preparation work and continuous maintenance is necessary. This work is accomplished by a "*Coordinator*" working all the year long. He/she has to:

- define the new project in which the students will be immersed. He/she has to write requirements, then a response to solicitation including a technical and commercial offer answering the expected needs.
- prepare the logistics necessary for the smooth running of the service: to make an inventory of company's resources and to sort them out, to reset development framework to zero, to forecast needs in hardware of software, to negotiate contracts with software providers, to supply with and receipt new devices, software, books, self-training media, ...
- consolidate and to tailor the apprenticeship repository in order to make it easier to use by the tutors and the students. It could be the integration of new books or self-training supports as well as enriching or updating the TEMPO-ILI repository, for example apprenticeship cards.

The smooth running of the first iteration relies mostly on the company's tutor, who has two functions.

The "*Software manager-Tutor*" is the authentic software manager inside the company, he/she leads the students' team, is in charge of the work progress, and refers to the "Coordinator" as much as necessary. The "Software manager-Tutor" coordinates students' work and adjusts the planning according to real work progress. On a daily basis (at least one hour per day), he/she is the privileged interlocutor for the students as well as other apprenticeship system staff members. He/she prepares and drives the weekly progress report meeting, which is a privileged time to exchange information within the team. Last but not least, the main objective in the first iteration is the apprenticeship: the "Software manager-Tutor" is, first of all, a teacher who wishes to transfer competences to his/her team mate.

The "*Apprenticeship-Tutor*" coordinates and regulates individual and collective students' apprenticeships, assists students on a daily basis, and finally assesses deliverables. For these purposes, he/she relies on the apprenticeship process (see section 3.1) and on apprenticeship cards (see section 2.2). Thanks to this support and assistance, students are able to provide deliverables. The production process is continuously sustained, the "Apprenticeship-Tutor" annotates, corrects, make proposals, reorientates. Generally, two assessment iterations are necessary in order to guarantee a satisfactory result, in all case sufficient to carry on the project.

The tasks and the workload of the company's tutor are still important in the second iteration; he/she has now three functions.

The "*Regulator-Tutor*" can accompany individually each student. TEMPO defines a regulator as: "The regulator is an expert outside the project whose experience corresponds to the current project in order to give impartial advice on functional and technical features. He/she is working as a peer who can help the software manager or the team mate." So, the "Regulator-Tutor" has mainly a consolidation activity working on documents and deliverables provided at each Manufacturing Card, but it is also used as an assessment activity.

The "*Facilitator-Tutor*" is in charge of the project logistics, but mainly sustains the student acting as the important role of project manager. It is a daily meeting (from 10 minutes from 1 hour) browsing current aspects of the projects.

The "*Programme manager-Tutor*" arbitrates conflicts, regulates workload, indeed may give orders in case of production locking. As seen in the definition above, the "Regulator-Tutor" has no decision power on the team. The role play needs a dedicated hierarchical role in order to solve the problems which could arise. In the TEMPO repository, the immediate superior of the project manager is the programme manager. "The programme manager acts on behalf of the unit (the firm) and the customer to ensure contractual commitments (cost, lead-times and performance) are met. [15]". This hierarchical authority is entrusted to the company's tutor and allow him/her to ensure commitments but also to substitute for the project manager for any technical, functional, organisational aspects.

4.2 Student roles

The first role is called "*a citizen*". Each student lives with their team mates during 6 months, 5 days a week, 8 hours a day. The respect of others, of their work, of their own working place and of the common infrastructure is fundamental when working in a team. Unlike what happened during previous years, the student must realize that the respect for the environment and a few rules (working hours, computer security, deadlines) is not enforced by the institution but accepted by each student. A few students were not able to impose this discipline on themselves, but "it is discipline first which transforms animality in humanity" (I. Kant, [6]).

The main role is called "*a builder*". The student is in turn architect, project manager, manufacturer, inventor, artist. Sometimes he/she will be providing others with products or services, sometimes he/she will be using the other students' work. He/she must understand that his/her own work takes place within a structured set and that the success of each piece is necessary to the success of the whole project itself. The understanding of long term issues should always be kept in mind and regular and sustained efforts are essential. It breaks away from previous attitudes where efforts are mainly motivated by the examination deadlines.

Beside this building activity, the apprentice engineer must sometimes transform him/herself into "*an explorer*". Students cannot always find their way in the maze of pedagogical resources provided (manuals, tutorials, white papers) or in the explanations that they can get from tutors. So there is nothing to help them through the work they have to do. The student generally feels very uncomfortable and this situation is aimed at pushing him/her to deepen existing knowledge, to discover new skills, to invent personal solutions. A few students liked this exploration/invention role so much that the tutor had to lead them back to the hard realities of the builder's life ...

Each of these three previous roles bring us back to the question of teamwork and hence to the definition of the role "*a team member*". Students, until now engaged in a rather individualistic learning process (although they are used to negotiating mutual services) must be aware of the fact that nothing can be done without others or more exactly, that they need the others to do everything. It is not possible to describe the attitudes that each team member will have, develop or discover in others. We think that, in a team, each personal quality or skill is useful to the whole and that diversity is guarantee of success. True cooperation is before all complementary rather than community [3].

5 Examining some problems in the light of the learning paradigm

Let us examine some problems we met the second year in the light of constructivism. Constructivism can be summed up with two fundamental statements [4] :

- learning is defined as an active process for knowledge building rather than a knowledge acquisition process;
- teaching is essentially aimed at helping students in this process rather than transmitting knowledge.

Among practices belonging to the constructivist stream (and cognitive psychology), D. Dwyer [5] and J. Tardif [14] define a learning paradigm, in opposition with the main teaching paradigm. The learning paradigm provides a framework which allows the school to constitute a learners' community for the pupils as well as the teachers and the other staff members.

5.1 Roles relationships

5.1.1 Teachers roles

Tardif's roles	**Apprenticeship by immersion teacher roles**
-1- creators of pedagogical environments	coordinator
-2- interdependent, open-minded, critical professionals	all roles
-3- development instigators	software manager, apprenticeship, regulator, facilitator
-4- mediators between knowledge and students	software manager, apprenticeship, regulator, facilitator
-5- coaches	all tutoring roles
-6- collaborators for the students' success of a whole school	coordinator

Table 1 : Teacher roles relationships

J. Tardif defines teachers' roles as creators of pedagogical environments; interdependent, open-minded, critical professionals; development instigators; mediators between knowledge and students; coaches; collaborators for the students' success of a whole school. Relying on exhaustive definitions of these roles given in [14] p. 59-70, the table above establishes the relationships between these roles and the different kinds of teachers roles described in section 4.1.

Let us examine how Tardif's roles are played in our immersion system.

The second role is obviously essential because the apprenticeship by immersion system comes from the professional world. The two tutors exchange daily their information, questions, doubts and the possible solutions. It works fine.

The first and sixth roles are nearly devoted to the coordinator. He/she is responsible for the immersion system and for putting it in practice.

The fifth role – coaches – is the heart of individual and collective apprenticeship. All kinds of tutoring roles are participating.

The third and fourth roles are shared nearly between all kind of tutoring roles.

Mapping Tardif's roles and our roles does not work. There are two main functions in our immersion system : coordinator which is supervising the system and company's tutor which is playing most of Tardif's roles.

5.1.2 Student roles

J. Tardif defines students' roles as investigators; co-operators sometimes experts; clarifying actors; strategic users of available resources. Relying on exhaustive definitions of these roles given in [14] p. 70-74, the table below establishes the relationships between these roles and the different kinds of students roles described in section 4.2.

Tardif's roles	**Apprenticeship by immersion students roles**
-1- investigators	"an explorer"
-2- co-operators sometimes experts	"a team member"
-3- clarifying actors	-
-4- strategic users of available resources	"a builder"
-	"a citizen"

Table 2 : Student roles relationships

None of Tardif's roles includes "a citizen" role. From the learning paradigm point of view, defined for one school, this role does not exist probably because the teacher stays in centre of the class and enforces the discipline.

Investigators and "an explorer", co-operators sometimes experts and "a team member", strategic users of available resources and "a builder" have very similar definitions. It is not surprising because we integrated in the design of our immersion system many models of constructivism.

Our immersion system did not emphasize on the clarifying role and its associated techniques (peer/tutors questioning, checking reformulation and comprehension). However, this kind of clarifying activities is the basis of four apprenticeship tasks. This role may be enforced in the next version of the system.

5.2 Weak points of the system

The main problems which jeopardize the system are pictured in the figure below, linked with the roles involved.

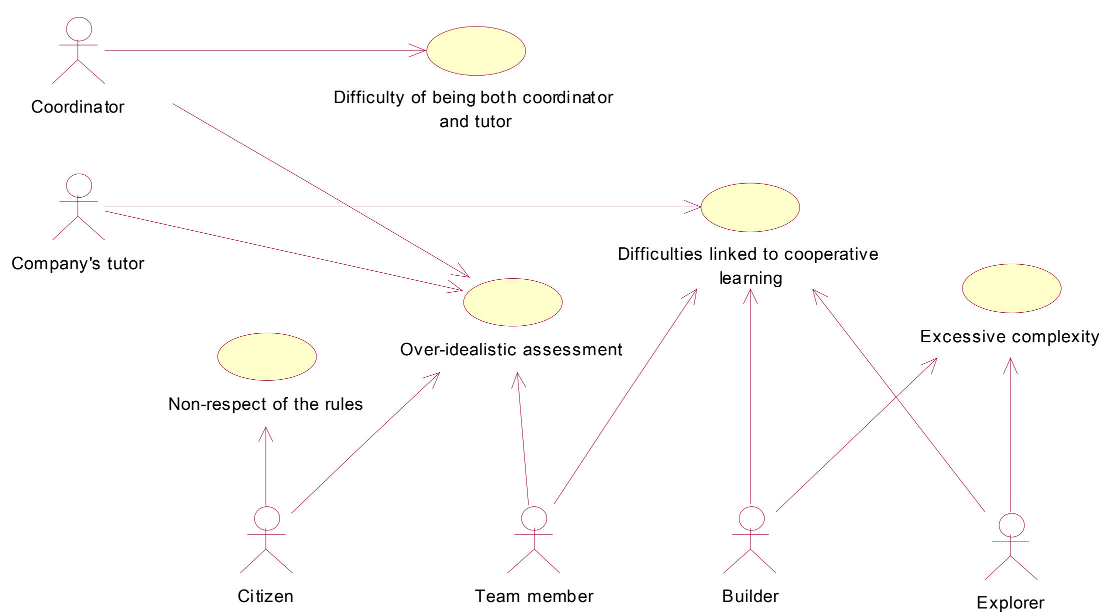


Figure 2 : Relationships between roles and main problems

Each problem is briefly described and possible solutions are drafted. We are aware that these solutions could diverge from the constructivist approach but they are essentially pragmatic.

5.2.1 Difficulty of being both coordinator and tutor

The current system relies on the two authors, each managing a company. The second author also assumes the role of coordinator. It is hard to supervise the system – preparing, coordinating, controlling and accompanying the other company's tutor – while tutoring a company at the same time. Supervising a company's tutor can be compared to a form of teacher tutoring : it requires that activities are well-defined, structured and organized and that events are anticipated. The coordinator has to adjust the general framework according to real work progress. It consumed time and efforts and made it difficult for the coordinator to share the everyday concerns of his own company. Students did not seem to notice it but it caused a lot of inconvenience for the coordinator.

Ideally, the coordinator should not be simultaneously a company's tutor. But the lack of teachers makes it impossible. Hence our ambitious system has to be slightly revised and the interdependence between companies should be diminished by increasing the autonomy and relative freedom of the company's tutor.

5.2.2 Difficulties linked to cooperative learning

Our education system uses a cooperative learning model. The class is divided in teams, each team member builds a competency within a group of 2 or 3 (rarely alone). Each group owns a piece of the puzzle and students are strongly bound together because of the collective results required.

During the first year, we motivated all the students for shifting from compartmentalized knowledge acquisition and sanction-assessment to the process of personal and social construction of SE knowledge intended to be used in a professional environment. We fired them with enthusiasm for this new kind of education. So, we were mistaken in believing that each student would agree with the immersion principles : constructing long-term competencies in SE while being the main actor of his/her education. During the second year, some students moved with difficulty (indeed could not move) from previous attitudes to the requirements of the problem-based and project-based learning (Université de Sherbrooke reported the same difficulty for some students). This could be due to a lack of involvement of students who prefer supporting roles rather than leading roles or it may come from the difficulty to accept tutor's feedback as an essential building element rather than a criticism. The learning process is blocked : what could be done with students who refuse this approach ? This stalemate (mainly for "a builder" attitude), even for a single student, can involve the whole team due to group phenomena. The big role play will then become very difficult for all actors.

We do not have any real solution to this problem. Improving the recruiting process aims to minimize the risk : cooperative learning principles will be emphasized as well as the required attitudes; individual recruitment techniques may be useful.

5.2.3 Over-idealistic assessment

Our assessment process relies on work cards. Cards are essential elements in the tutor(s)-student(s) relationship. The objectives of the card are to describe the work to be done as well as the pedagogical resources supporting apprenticeship. Resulting products should be considered as good enough for their future exploitation. This is a formative assessment of competencies which diagnoses and regulates apprenticeships. Summative assessment is accomplished by giving a mark to each product. We consider that product evaluation is appropriate to judge knowledge and skills acquisition independently from the learning framework.

Assessment has a strong influence on the students' motivation for learning. So it seems important to us to break away from the traditional evaluation process. We privilege collective assessments and we do not communicate any mark to students during the whole year in order to focus on the formative assessment. Selected students graduated from a 4-year technological education system, we assume that everyone will succeed in a traditional system and we wish to offer a transition year between the university and the professional world.

During the first year, this assessment system has been a determining factor in the cooperative learning dynamics. Students quickly understood that learning was intended to reuse competencies in order to diagnose, explain and solve problems rather than restitute knowledge during examinations. During the second year, some students did not play "a team member" role and took advantage of the collective assessment system to have a quiet year, relying on other team members' efforts.

We do not want to fundamentally modify our assessment system. It belongs to the « authentic assessment » stream : this considers moments and contexts where students learn as the privileged place to gather information on assessment itself. Nevertheless, it should be essential to impose sanctions to the students who are insufficiently involved in their apprenticeships :

- *the first iteration, "Tutored apprenticeship", will not change;*
- *the second iteration, "Accompanied application", will aim to enforce the student's autonomy and to individualize summative assessment. Students should keep in mind that knowledge and skills acquired during the first iteration will be put into practice but will also include greater emphasis on individual performance.*

5.2.4 Excessive complexity

Confronting students with complexity is one major goal of the system. This leads to learning situations which are intentionally complex and which some students will not assume. Students could be paralysed with a problem they are not used to solving and could accept no responsibility for this failure and will blame someone else (the education system, tutors and so on).

We must be able to include just the right amount of technological complexity. We agree with Monash teachers who are circumspect about the complexity of using industrial CASE environments [10]. Students can get stuck trying to master commercial tools, rather than learning appropriate abstractions, developing and applying well-suited principles and processes.

Complexity is an essential principle of our education system. We will stress the need for adopting "a builder" and "an explorer" attitudes during the recruitment as well as during the year. Technological complexity should be reduced. Our goal is to come back to initial objectives, i.e. acquire strong competencies in software engineering without getting lost in the complexities of a technological environment.

5.2.5 Non-respect of the rules

This education system is intended for graduate students and relies on students' self-management including the respect of elementary rules such as assiduity, punctuality, deadlines. The necessity of "a citizen" role arose only the second year due to the attitude of one student. Although it happened only once, not respecting the rules is detrimental to the company and hence to the other teams. Our cooperative learning relies on, among other things, the "learning together" idea. Students have to organise their work, to assign tasks, to dispatch responsibilities and to help one another, that is difficult when somebody does not respect the rules.

Next year, we will set up safety and control measures. The students who will not follow the rules repeatedly will be sent back to a traditional system.

6 Related work

The Department of Electrical and Computer Engineering at the Université de Sherbrooke has totally redesigned its electrical engineering and computer engineering programs. Based on recent research advances in cognitive science as applied to student learning, these curricula have led to new instructional models. The programs were built on a competency-based framework, following an original learning approach that combines problem-based and project-based learning (PBL). PBL is the principal mode of knowledge acquisition. Each problem is formulated so that the solving process leads students to discover what of their existing knowledge can be used, what they need to learn, and what skills are required to manage the situation effectively. Competencies are evaluated in terms of behaviours that can be demonstrated and observed in a professional context [7].

Besides formal courses, any curriculum will include software projects. B. Meyer advocates the long-term project as an essential technique, which students should develop over more than a standard quarter or semester – typically over the course of a year. It should be a group project that includes aspects of analysis, design and implementation. And it should involve the reuse, understanding, modification, and extension of existing software [9].

Meyer pointed out that a group of enthusiastic teachers at Monash University, under the direction of Christine Mingins, has been doing exactly that over the past few years (1996-1999). The Monash solution takes place in the second year of an undergraduate program, after that students have already completed two semesters of introductory programming in C++. Monash objectives are : understand the importance of software engineering, OO design as a software engineering method, motivation, experience a large-scale software engineering project, use an industrial strength CASE environment. For some topics, teachers teach the ideas first; for other topics, however, teachers let the students follow an experimental approach. Mingins and al. believe they have achieved a balance between the conflicting requirements of dealing with the complexities of 'real-world' software engineering based on large projects with the need to establish a firm personal software process which students can use as a basis for reflection and further professional development [10].

7 Conclusion

The education given in the software engineering apprenticeship by immersion system relies on the following principles :

- to be centred on the competencies to be developed and on the fruitful apprenticeship situations, rather than be content with the teaching of knowledge, subject by subject.
- to develop an active and cooperative pedagogy based on the project and the role play: students' immersion in a 6-month project imitating as closely as possible a project in a firm.
- to work in a team, to communicate about the work done, to cooperate with colleagues.

- to elaborate and maintain an apprenticeship by immersion repository.

The first year, there was great enthusiasm coming from students and the two tutors as well. This dynamics helped to solve most of problems.

The second year was rather disappointing. Some of the phenomena we expected did not happen and part of the previous system did not work. The role definitions as stated in section 4 did not allow us to diagnose all problems but the classification of Jacques Tardif let us discover some roles which were played incorrectly or missing, either by tutors or students. We have now to enhance the system in order to prevent these possible failures and improve the role play.

As a conclusion, we can say that if the immersion system is exciting and innovative, on the other hand the system is fragile if both teachers and students are unable to play the roles required. In addition to these first conclusions, the professional insertion and career evolution of students need to be observed over several years in order to evaluate the real benefits of this system.

8 References

[1] Computing Curricula, Computer Science Volume, chapter 10, IEEE and ACM, 2001

[2] Computing Curricula, Computer Science Volume, chapter 11, IEEE and ACM, 2001

[3] Dameron S., 2002, La dynamique relationnelle au sein d'équipe de conception , Le travail humain, Vol. 65, n°4, Oct-Déc 2002, pp 339-361.

[4] T. M. Duffy, D. J. Cunningham, Constructivism : Implications for the design and delivery of instruction, *In* Handbook of Research for Educational Communications and Technology, MacMillan 1996

[5] D. Dwyer, Apple Classrooms of Tomorrow : What we have learned, *In* Educational Leadership, vol. 54, num. 7, 1994

[6] Emmanuel Kant, Réflexions sur l'éducation, Introduction, Vrin, 1998

[7] G. Lachiver, D. Dalle, N. Boutin, R. Thibault, J.M. Dirand and all, Redesign of Electrical and Computer Engineering Programs at Université de Sherbrooke, *In* Proceedings, Canadian Conference on Engineering Education, August 2001, Victoria.

[8] Timothy C. Lethbridge, What knowledge is important to a software professional ?, IEEE Computer, May 2000

[9] Bertrand Meyer, Software Engineering in the Academy, IEEE Computer, May 2001

[10] C. Mingins and al., How we teach software engineering, JOOP, Feb 1999

[11] Gilda Pour, Martin L. Griss, Michael Lutz, The Push to Make Software Engineering Respectable, IEEE Computer, May 2000

[12] Vincent Ribaud, Philippe Saliou, Software Engineering Apprenticeship by Immersion, International Workshop on Patterns in Teaching Software Development, ECOOP 2003, University of Darmstadt, Germany, 2003

[13] Progress of the Engineering Education Coalitions, SRI International, May 2000

[14] Jacques Tardif, Intégrer les nouvelles technologies de l'information – Quel cadre pédagogique ?, ESF, 1998

[15] Thales Information System Glossary, Thales Information System, 1997

CREATING BUSINESS FLIGHT SIMULATORS FOR EDUCATION

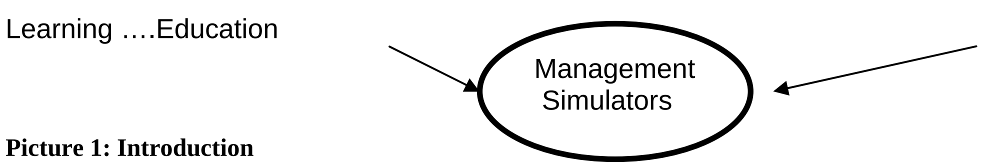
Stanislava Mildeová[1]

The paper is going to present outcomes of a project[2]*, whose main purpose was to produce a simulator that would help students understand dynamic relations mainly in a company. The goal was not to offer a 100% real-life simulation, but to stress the main known characteristics and behaviour formulas. The created simulators are a suitable tool both for the knowledge gaining about company working and for new strategy testing and evaluation. There will be presented newly created managerial simulators, whose theoretic ground is the methodology of system dynamics and system thinking.*

The author will summarize her own findings, how to conduct simulations on system dynamics models and how to represent the outputs in a form of a user-friendly interface, i.e. how to create business flight simulators, in which the user can experiment with the model in a compressed time and space and enrich his or her own mental model of the problem situation. Consequently, problems will be discussed and communicated practical experience that arose in the stage of creation of the user interface, by creation of scenarios and case studies.

1 Introduction

Today's lifestyle requires learning to be offered in an enjoyable form. Consequently, more and more *simulators* (and games) are being developed for *educational purposes*. The paper follows this tendency (see Picture 1).



Picture 1: Introduction

[1] Department of Systems Analysis, Faculty of Informatics and Statistics, Prague University of Economics, e-mail: mildeova@vse.cz

[2] The paper is support by Internal Grant Agency of Prague University of Economics with grant "The support of managerial decision by business flight simulators" number IGA 21/03.

2 Understanding of dynamic relations

Scientific publications and practical experience show, that managers´ *system thinking* and *understanding of dynamic relations* are not sufficiently evolved and that the traditional ways of managerial training do not fulfil the requirements set by *the complexity of social systems* defined within the new paradigm.

There are several reasons for this. On the one hand, it is the evolutional development of our brain, because understanding of *complex dynamic actions* with *feedbacks* and *delays* was not necessary for survival until the industrial revolution, which we think is also the main reason why we are not able to interpret the complex dynamic actions correctly.

On the other hand, there still exists certain influence of conventionality and *the current paradigm of perception of reality* – mainly *the linearization* and *tendency to omit feedbacks and delays* (these influences are describe as "bounded rationality"). *Limited information* (ambiguity, antagonism, lack of clarity) and *the defensive behaviour of complex social systems* also play a significant role.

There are lots of problems and obvious solutions that do not work, occurring in families, companies, governmental institutions, society and between individual states.

The only effective approach to find and apply the correct solutions is to reveal the behaviour patterns (the feedback structure) from which we can infer the solution. It is obvious that we can not consider any solution to be the correct one unless we stick with the systemic procedures, which respect our limitations and important characteristics of the social systems – *detailed and dynamic complexity*, *feedback structures*, *nonlinearity*, *impact of delays* and their *stochastic character*.

One of the tools - *business flight simulators*- will be discussed in this abstract, whose theoretic ground is *the methodology of system dynamics* and *system thinking*.

2.1 Methodology of System Dynamics

As indicated, the main theoretic ground is *the methodology of system dynamics*.

System Dynamics deals with *systems' behavior in time*, as it can be concluded. It is perceived as a *practically oriented discipline*, which can help in solving problems with a *limitation of people's mental models*.

The core of system dynamics methodology is *explicit modeling*. It is definitely interesting for us that the largest IS producers SAP (the German system SAP is often implement in big Czech companies) includes software for system dynamics modeling as a part of the SAP Strategic Enterprise Management. (The practical use of tools for system dynamics is limited mainly because of the level of integration with other IS).

3 Definition of Business flight simulators

There probably does not exist a widely used, fixed particular *definition of a simulator* and it is becoming more specific parallel to their development. We indeed recognize a simulator as a useful *tool for simulations of functioning of the real systems for educational purposes* and for estimations of a future development. One very important factor, supporting the usage of managerial simulators, are *savings of costs and time*, when compared to decisions made executed in a real system.

During *the process of models' transformation into simulators* we benefit from the fact, that business flight simulators make it possible to learn how the system (the aggregate) behaves, based only on changes of its part. The user gets a comprehensive view of *a structure of simulated system* and is also able to *experiment* with different approaches (*strategies*) and bets their *reflection on model behaviour* in time.

In addition, we are taking advantage of the fact that it is possible to simulate not only the *real systems* (which are extensively used for pilot training for instance), but also *the soft ones*.

3.1 The structure of created simulators

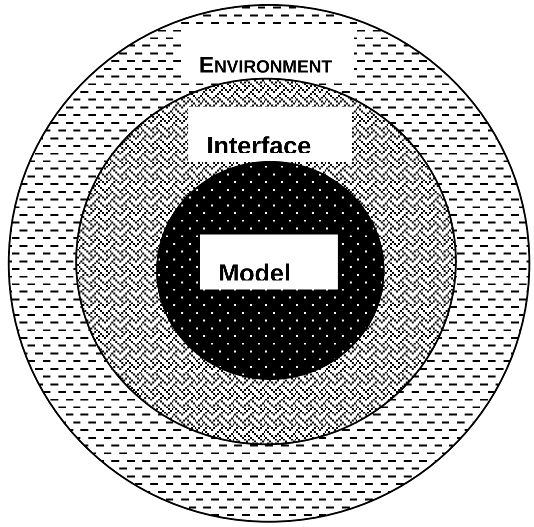
The structure of our business flight simulators consists of three parts. It is *a system dynamics model* that constitutes the manager simulator core, *user interface* and *simulation environment*, represented by *case studies* and *different scenarios* (see Picture 2).

In addition to the simulation model, students were given a "story", i.e. case study that defines both external and internal firm surroundings and the basic rules.

By this way, the simulation enables user to trace particular decisions impacts on the whole firm.

3.2 The symbolics

Appropriate *tools for creation of system dynamic models* as *stock and flow diagrams* or *causal loops* allow us, as opposed to the language, to describe the system behaviour including circular feedback structures.

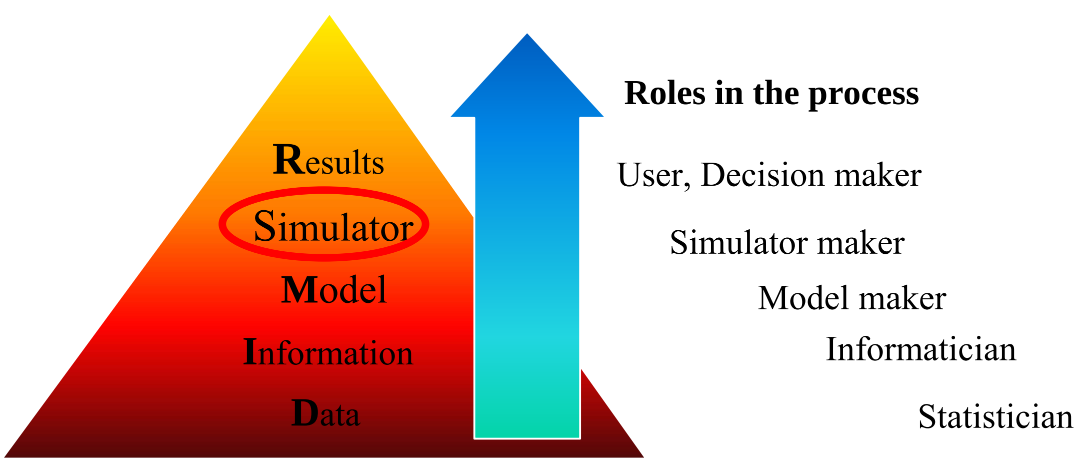


Picture 2: The structure

Moreover, we can't forget *system archetypes* – generic feedback structures that are often repeated, like „Limits to Growth", „Shifting the Burden", „Tragedy of the Commons".

They are usually *graphical tools*. (Our students invent graphical tools that are why there is no urgent need for mathematical background to be able to understand the model.

Anyway **t**his *description* is important for *the completion of our mental models*, for *communication and verification of mental models between various participants* – model makers, clients – managers and others. We can see it in *work process with simulators* and in *particular roles* in it. (See Picture 3.)



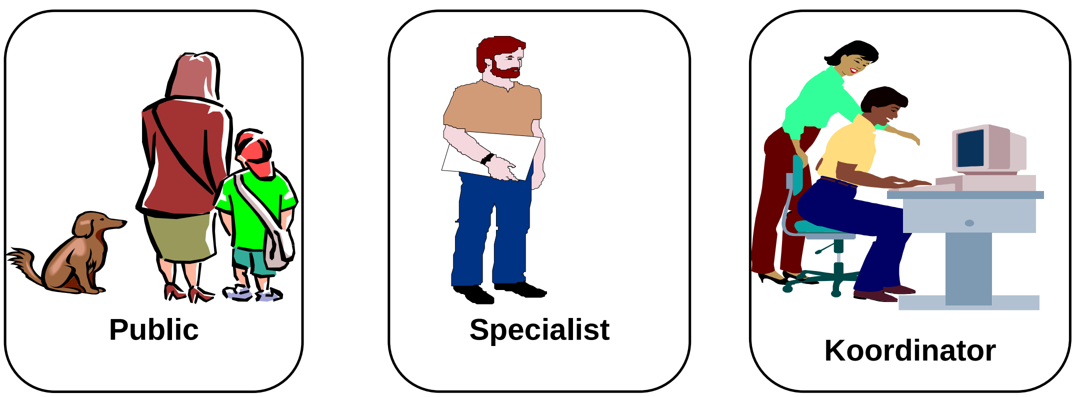
Picture 3: Work process

Obviously, *the quality of the model* is decisive for the whole manager simulator (let us repeat, that the model does not take all the real system's aspects into account, it works only with those which have a remarkable impact on the system behaviour).

3.3 User-interface design requirements

The user interface is the element of user and simulator interaction. Its design can be very divers. Its creator has to respect the way of using the simulator. For teaching purposes, it is important to have a clear and understandable interface, on the other hand, more advanced users will appreciate more information displayed on the screen.

Prime question that every maker of the user-interface of arbitrary model has to raise is: "For whom will the manager computer simulator be designed? Who will be its user? Will he need a training manager? " (See Picture 4).



Picture 4: The user

Training manager and withal coordinator is important for some extensive manager computer simulators, especially those of *multi-user versions*. He/she should be familiar with the simulation model proper very carefully, as well as the work with the front-end.

Surely, there will be difference between the interface for stock exchange computer simulator made by the specialists (for brokers) and those made for the needs of teaching (for university students). Each of the two above mentioned groups search different *entries*, and *swiftness* to be acquainted with the interface is certainly higher for the specialists. Similar issue arises when the task to determine *the computer simulator control mode* and to choose *the number of model parameters* to be influenced by means of the user-interface during the simulation. On that account, a number of diverse user-interfaces can be designed for one manager computer simulator.

3.4 A scenario selection

Another interesting feature is *the work with scenario*. *Scenario* is a *fictitious situation* that fits particular model and which the manager tries to solve best. Several different scenario versions can be composed for one particular model.

Primary thoughts concerning the creation of the user-interface were directed with the aim at as versatile as possible interface, which is capable of simple modification as to the use of multiple scenarios (or the editing of scenario within the manager computer simulator).

Versatility condition was crucial. Perspectives of computer simulator progress can be seen - we claim - within the realization scope of scenarios, which emerge during tuition. As a singly restrictive qualification hindering in new scenarios creation, given variables to alter within the interface of a model are considered.

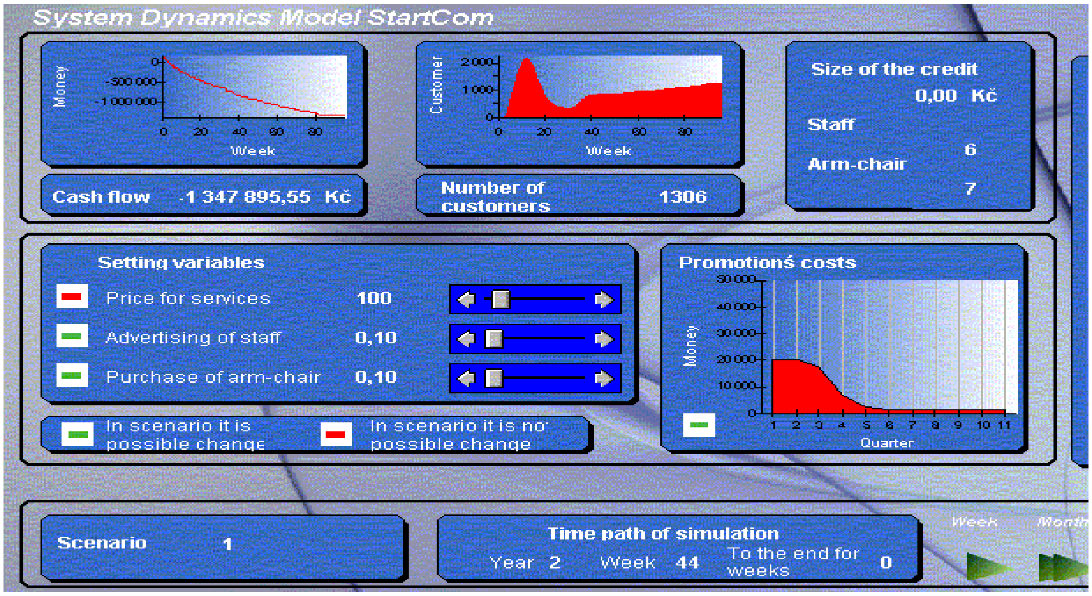
4 Simulator StartCom and Simulator DealSale

Two commercial products from *Proverbs Company* have been used for the creation of simulators - *DealSale* and *StartCom models*.

The *Model StartCom* is *a dynamic simulation model* (belongs to the category of *soft models*) which strives to model the course of the first years if entrepreneurship.

According to *the user preferences*, it is possible to modify the model with different scenarios and interfaces to fit *the concrete type of business*. The main quality of the model is represented by its *clarity* and its *focus* on the most important parts of *business activity*.

The model offers to its user not only the opportunity to try *decision making methods* and learn about *principles of strategic thinking* practically, but it also acquaints the user with *the principles of system dynamics*, methods of work and supporting software (see Picture 5).



Picture 5: A part of the working window

The *Model DealSale* is *a dynamic simulation model* of a wholesale company with a dealer-selling network.

At an acceptable level of simplification, this model offers the possibility to *simulate the strategy choice* and other section of decision making with *emphasis on dynamic relations* within first years of company life cycle. A *user-friendly interface* allows understanding and simulating of various strategies and their consequences. One of the main advantages of this model is the use of *Balanced Scorecard* as a mediator between the strategy choice and implementation.

The structure of the model points out the key areas of decision making while keeping a global view on *the management strategy process*. By this, the main goal of the simulation is achieved: the development and practical use of *managerial thinking* while retaining the so important *global management view*.

5 IS/IT for the simulator development

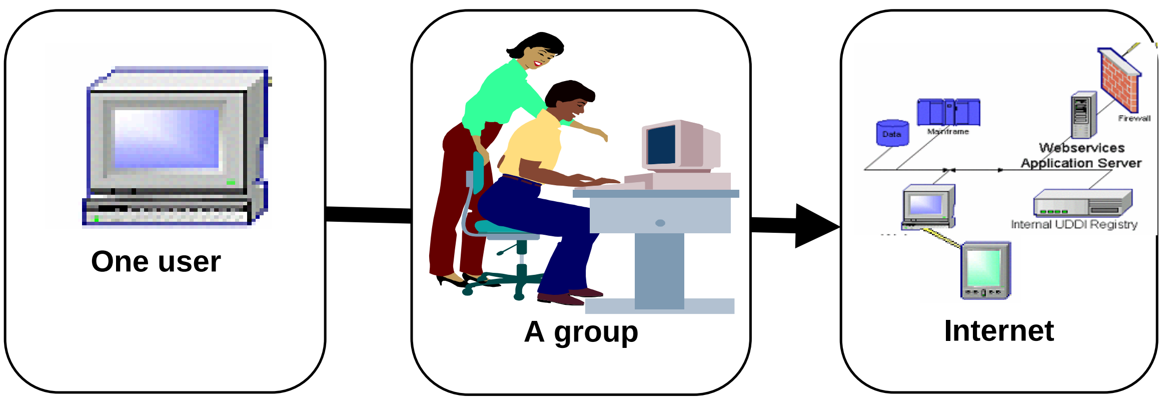
We use *Powersim Constructor* for our *simulator development*. Powersim is a modern piece of *simulation software*, which allows its users to develop complex simulators, based on *system dynamics*.

The main features of the software Powersim are *visual-graphical interactive environment* for creation of a simulator, *full coverage of needs of system dynamics*, in the form of feedbacks and delay functions, *creation of a simulator in teams*, *multi-user group simulation*, *availability for 1 PC*, *LAN and Internet environment*, *connectivity* to MS Excel, Lotus and other applications.

(We use this feature of Powersim, which allows using input data or outputs of simulation in the widely spread office applications as MS Excel, so that the user can work with the data afterwards).

Further, the interface maker shall respect *the way of the computer simulator usage* (see Picture 6). He/she has to know whether it is intended for *one user* or *user group*, whether it runs on *single machines*, *local networks*, or *via Internet*. (Members of the target user group of our managerial computer simulators are university students, which was the main criterion of model creation and simulators are then designed for single user on one machine only).

He/she chooses *means of technical design proper* accordingly, using optional built-in tools of model design software, office packages tools, HTML, or some programming language.



Picture 6: A way of the simulator usage

Design of the front-end varies widely from first manager computer simulators in plain text mode to today's *multimedia interface*. Recently, computer simulators makers try to approximate the standard graphics with *the web presentation making*. Use of the graphical environment and control elements arrangement, with which the user is familiar of other program applications, makes for quicker insight of the user into the particular simulated problem.

6 A graphical interface

Due to final *graphical interface* in *Powersim software*, end-user cannot possess knowledge of the program proper and the making of the model, which is strong advantage for the end-user. As a default, *graphical control elements*, *graphs*, *circle-type* and *bar indices* are available, which serve for *controlling the simulation conditions*, i.e. *model parameters* and *structure* (see Picture 6). Model interface can be accompanied with *multimedia* devices to animate the course of the simulation.

High-quality graphical interface creation was not a simple business from the point of view of time consuming work, in particular. Graphical adjustments of the interface and testing occupied most time. Available version of *Powersim 2.5d* is a powerful tool for creating models but hard work with graphical objects is needed within the user-interface: impossibility of grouping them, and fishy picture insertion. Little scenario support during the graphical interface creation, impossibility of graphical item visualization dependent on the chosen variables are further drawbacks. Hang-up them Impossibility of automatic initialization of simulation after reading initial model-contained file is another drawback. However, the real-time version eliminates this. Most of the mentioned remarks are resolved in new versions.

Powersim Studio 2001 and *2003* comprise particular mode of presentation designed for user interface working and improve the work with the graphical items of the interface.

However, we made many remarks we consider *Powersim* and the work with it very pleasant. Who has at least mediocre knowledge of computers grasps the program quickly and can create his/her own models. Superior user-interface creation demands, however, lengthy work with the program.

7 The process of the simulation environment creation

By creation of the user interface, there was used one interesting feature of Powersim – *ability to interconnect two or more models*. In such case, the user interface contains only *information about the proper link* between models.

The model remains hidden for the end-user due to this solution, and he/she only operates with the user-interface. Moreover, the original model stays untouched as a favourable consequence of the solution. Whichever the original model modification may be, it necessitates high-quality documentation creation, and thus the model conservation is questionable. Many user-interfaces can be designed for one model and these ones are, therefore, comparable, since we obtain in principle comparable results due to the same manager computer simulator core.

As *the technical aspect* of the matter is concerned, *model variables connection* realizes through "*chains*". *Scenarios selection mode* through auxiliary variable, containing *the scenario number*, realizes within this phase, too. This scenario number determines *the model initialisation* concerning the decision of which *scenario variables* are fixed and which ones the user can alter during the *simulation process*. Auxiliary variables designed for information display are not contained primarily in the model.

Progress of operations when *designing the interface* was as follows:

1. Simple version design of the interface for creative designers of the management computer simulator,
2. Analysis of the manager computer simulator scenario,
3. Graphical interface design proper,
4. Interface testing,
5. Debugging and incorporation of test phase reminders.

Ad 1. *Simplified version of the interface* was designed the makers could *test computer simulator proper*. Versions of scenarios were made with this interface according to which students forge ahead during their work with the computer simulator. To know the model contained in the manager computer simulator, as its core is crucial for the work with this interface.

Ad 2. *Parameters of the model* based on *the scenarios* were chosen to be comprised within the user interface. This is one of the most important phases of the interface design.

Improper choice can *shift the understanding* of *the simulation out* of the desirable course, and the user focuses on unsubstantial parts of the problem and thus corrupting *the holistic view of the system*.

Ad 3. One *working window system* for *the graphical interface* was designed. *Graphical items* are arranged to sections according to displayed blocks of information in this window. There is *information section* (it displays important simulation output), *control-button section* (it displays further windows), *system regulators section* (it influences simulation behaviour), and *time-development control section* (simulation initialisation, sequencing). *Graphs* are used to facilitate understanding the *input* and *output* of the simulation.

Ad 4. Within this phase, end-user interface was tested. Bugs were searched and recommendations for interface changes were proposed.

Ad 5. User-interface corrections according to the testers' reminders were incorporated.

8 Experiences from the teaching process

Experiments made on a system dynamics basis in so called „*management flight simulators*"(other synonyms are „*micro worlds*", „*virtual laboratories*", "*interactive learning environments*" ") can in fact help us in evaluating and analysing the impacts of individual decisions, they can serve as a medium of *gathering*, *spreading* and *extending of knowledge* or improving user's skills.

Although other methods may lead to understanding of behaviour patterns too, according to our experience from the teaching process, we can express the hypothesis that using these simulators and the system dynamics models enhances the process of *understanding the complexity of social systems* and facilitates the decision making process.

The results of the applications such tools in developed countries (e.g. Massachusetts Institute of Technology, University of Bergen, Universität Mannheim, London School of Economics, University of Klagenfurt, University of Palermo, etc.) are so favourable, that it is purposeful to think about possible extension of their use here in our conditions.

The experiences from teaching the students at various universities (Worcester Polytechnic Institute or University of Bergen) also confirm extraordinary results in the area of *sustainable development* taught by using the system dynamics models, which can be used for analysis, evaluation of the recent development and for *prediction of the possible quality changes in the environment*. When searching for effective solutions of the lingering issues, the system dynamics models are of great help.

On the basis of our experiences from the teaching process in our courses on the Faculty of Informatics and Statistics, Prague University of Economics, we can state that the use of business flight simulators, respectively software products, which allow the creation of simulators, improve *systemic thinking* and *understanding of dynamic relations*.

It appears that the manager simulators can serve in the educational process as a useful tool for *examining complex systems*; they can apply in experiments that aim to develop knowledge.

Students may see such business flight simulators as a “*micro world*” or a “*virtual laboratory*”, which helps them solve real decision-making situations, clarify principles, that are essential to rational decision-making, retrospectively analyse decisions and isolate the causes of the success or failure.

9 Business flight simulators in economic practise

The paper informs not only about the importance of business flight simulators for the pedagogical process, but about behaviour of how business flight simulators could help in solving *complex managerial problems*, based on particular simulators created on the basis of on the basis of system dynamics models – in particular, with respect to gathering of new and *integration and communication of existing knowledge* in the form of an active interaction between users and the managerial simulator, what problems are probable to happen and what are the conditions for their successful utilization.

On the level of a complex social system is a company, system dynamics models or simulators should lead most of all to an *increase in performance*, but they can also play a very positive role in *sustainable development* of companies – as such models are known.

According to their usual long-run orientation, the simulation system dynamics models are often used for various purposes – *testing of the decision-making strategies* and policies in organisations (profit, non-profit organisations, public institutions, etc.) and society, they also function as a tool for understanding and implementing of the sustainable development, as a common platform for sharing of mental models and knowledge in various professions, as a tool for applying principles of so called “*learning organisations*” or as a tool supporting method of organisational strategic management *Balanced Scorecard*.

In Czech Republic, such tools are unappreciated for now, which is principally caused by lack of sound experience and knowledge. Even though the first steps have been made both in the company domain and in the state and public institutions.

10 Conclusions

The author thinks that system dynamics as practically oriented discipline can help us with the desired shift in reasoning (so called “metanoia“– perception of reality and things around us not as of individual and separate but rather interacting and interdependent). So described simulators were constructed according to principles of system dynamics.

In the paper the question of methodics and creation of simulation models is eluded. It concentrates on models´ transformation on simulators and on the importance of simulator application in education and economics.

It is expected, that with spreading of new e-learning methods and cost saving activities, also usage of managerial simulators will be widespread. We are sure that their extensive use will be supported by sufficient amount of specialized simulation applications, as here mentioned Powersim.

Managerial simulators were presented as tools that can serve as an intermediate stage between theoretical part of education and an experience gained by practice. It has been stressed that students may see such simulators as a "micro world" or a "virtual laboratory", which helps them solve real decision-making situations, clarify principles, that are essential to rational decision-making, retrospectively analyse decisions and isolate the causes of the success or failure.

The paper shows the part of the simulator "The environment for simulations" as a file that significantly increases its value. As a part of this environment author shows also case scenarios of simulation development by various settings of the simulator.

The user interface was discussed as the element of user and simulator interaction, whose design can be very diverse. It points out, that the simulator creators have to respect the way of using the simulator and that for teaching purposes, it is important to have a clear and understandable interface.

Information and Knowledge Services for SMEs

BUSINESS INFORMATION AND KNOWLEDGE SERVICES FOR SMEs

Kornélia Pupáková, Anton Lavrin, Miroslav Zelko

Effective human interaction with information systems supported by information and communication technologies depends on the access methods, suitability and form of content. *Decision support systems assisting the business advisors must integrate their* knowledge *with traditional business advisory sources in a suitable way.*

This paper briefly summarizes the progress, needs and issues, which faces the development of such a advisory services to SMEs.

A Business advisor (BA) is an access point and support for problem owners in, a complex domain of discourse. The advisor has procedures for problem solving, but their knowledge *is often hard to access. They utilize* knowledge *from the wealth of information, rules and heuristics concerning the subtle inter-relationship of sub-elements in each of the business key areas. The business advisor is a repository of complex information gained through business experience, received information, and observational learning gained through advisory practice.*

If the value of existing business support networks is to be maintained by extension of practice then the Business Advisor must recruit coverage of marketing, tailing, procurement, supply-chains, and other emerging topics. Advisors must understand the consequences of transformation to a digital economy for traditional business advisory concepts and knowledge *elements. This implies extension and reinterpretation of standard business practice, and includes critical new topics such as cross-border regulatory and taxation issues. The key is to ensure desired impact in the Advisor*-SME *relationship through an interactive portal that would include support and advises for SMEs's managers in any of the business area. This interactive portal providing such a support and advisory services would be, of course, continuously updated and improved with new branches and data serving the needs of today's SME managers so they would be able to receive all the newest help advises for successful and efficient business managing.*

1 Introduction

As electronic business practices become more important part of business, the risk of exclusion from electronic supply chains, networks, and customer-facing practices is increasing for small and medium sized enterprises (SMEs). Many SMEs are dependent on local support networks of services practice including bodies such as Regional Development Agencies (RDAs), Chambers of Commerce, and Enterprise Agencies whose collective 'front line' is the business information and knowledge services. Our examination shows that business advisors possess a wide range of skills in advising on traditional business practice, but feel challenged by lack of awareness, understanding and expertise necessary to advise on aspects of e-business for investment and operational planning, human resource issues, and extended business process.

For example, the project USHER, supported by the 5FP CEC ’IST’ programme, sets out to develop a ’support package’ aimed at advisors and designed to provide awareness, training and on-tap information in forms defined by advisors as suitable for enhancement of competence in new ways of business (e-business). There are also several Leonardo da Vinci projects, like TRIMAR (TRaining in Internet MARketing, a complete web based advisory and training system for Internet containing solutions to technical, strategic and managerial marketing issues) or TRICTSME (Training and Advice in Information and Communication Technologies for SMEs with an outcome called WITS – Web based interactive learning and advisory tool for the use of ICTs in SMEs (e-business orientation), providing the SMEs managers with understanding of the technology implementation, an interactive advisory about e-business development and adequate training needs / knowledge, an interactive communication system based on system’s own knowledge base), which base on the support and advisory of the knowledge base of the managers in SMEs in various areas of business.

On the other hand, there is a big divergence and lack of integration in the area of information content and advisory support for the SMEs. That is the main objective of proposed or presented services provided for the managers of SMEs.

2 Lack of knowledge management and resources

SME sector is known as an important part of the national economics in each country. However its performance is the subject of concern in many countries of the world. The majority of these enterprises **are lack of knowledge management and resources** for effective performance management to keep track, analyze and introduce regular change into business processes, update technologies, systematically increase skills of managements and personnel, identify new trends and customer requirements in time, adapt the infrastructure, run continuous improvement in quality and efficiency of production addressing competitiveness and globalization issues in timely way. Managers of most companies started their business having some idea but with none of a relevant information and knowledge management, training courses in performance management and business intelligence. Many of them do not know how to make plans in cost budgeting, production, quality monitoring, prepare key business decisions, establish and monitor their enterprises by performance management system, etc. Essentially such a development becomes their life experiment in survival with large uncontrollable losses and mistakes caused by incorrect assumptions and information.

Most of such SMEs have a lack of external support in addressing of these issues by regional governments, banks, providers of new technologies including large ICT suppliers. The reason of the last group is usually because of little interest to the customers with limited resources, low margins for the services with considerable variety of diverse customization requirements. In addition, a general unwillingness of most family-controlled SMEs, which frustrates their development, is to disclose any financial information to outsiders, such as consultants.

There are lots of business associations in each country, but only few are well placed so they would be able to serve the SMEs because of the domination of larger firms and lack of resources. There must be a general consensus. But the information and knowledge skills base is too limited to be able to support the significant improvements in the competitiveness of SMEs. Moreover, vocational training is wholly divorced from the industry needs. [4,5]

The suppliers in many countries are generally stuck at the lowest value added nodes on the manufacturing supply chain due to the lack of service quality and knowledge management. ICT applications tailored to the SMEs's industrial segment needs are very rare, and the majority of SMEs remain offline or under-investing in ICT.

When a SME decide to start-up with the globalization and the fast progress in technology, it is mostly left alone in this fight for survival, because of the increased demand for high quality if products and harsh competitiveness, growing gap in skills of locally available human resources and its availability for the multinational corporations, the capacity and readiness to introduce innovations. In the area of e-business, the increasing need for higher qualifications of the personnel and learning/adapting of innovations, the SME management faces steadily increasing gap between the feasible rate of their own progress compared to the major international producers and national corporations with appropriate resources to be able to meet the world of change and innovation.

In spite of the impressive range of government sponsored SME initiatives in most of the countries, there is a **lack of reliable information on SMEs performance**. This hampers government programs to set targets and measure results of its interventions. On top of this, SME government programs are often competing and overlapping each other. Furthermore, SMEs normally cannot access the Board of Investment incentives because of the high investment threshold requirements.

As a summary of this part could be an explanation to the lack of shared and coordinated vision.

This is due to following factors:

- The broad diversity in the sector, in terms of businesses and productive segments
- Lack of correct, relevant and update information are limitedPoor communications within the sector, due again the diversity but also to the low levels of organization, in overall terms and by activitiesPoor organization leads to weakened agility/ability to communicate within the sector and externally (fear to share information or knowledge).

There is also no creative policy and regulatory framework that could be used for stimulating of the process of development in this sector. There are management problems within the sector, at the level of both individual entrepreneurs and support programs:

- Today's BIS (Business Information Services) do not place a priority on producing teaching, training and advisory materials usable for business administration and management development and improvement in SMEs are mainly commercially orientated, which considerably limits the possibilities of improving the overall business sustainable development.
- Another factor is that there is rarely any specific material for different segments of production.
- This is reinforced by inconsistencies in the methodologies employed in business training and development as well.
- SMEs prefer to innovate in their productive processes (technically) more than adequate improvement in their management methods and administrative techniques

3 Concept of Integrated Business Information, Advisory and Development Services (IBIFADS)

Essential **business information sources** are supported by ICT and currently used by multinational and large corporate enterprises, and **not** by SMEs. To gain market shares or to survive in this environment, SMEs are equally challenged to take advantage of **ICT-driven** business process related to information, knowledge, advisory and services. Compared to large enterprises, SMEs only recently began to realize the **commercial value** of externally validated business information sources. So far, they relied on information circulated among known business partners / associations, neighbors or friends. This has created a rising demand for an external access to validated **Integrated Business Information, Advisory and Development Services (IBIFADS)** accessible at appropriate costs.

IBIFADS is a kind of a Market and Business Development Service that presents information, knowledge, advisory and interpretations to individual or institutional clients in response to the market and business-related issue. IBIFADS creates market transparency on business opportunities and other BDS and contributes to rational decision making for entrepreneurial and development gains. To create adequate IBIFADS, raw data, information and knowledge and to be able to provide advisories are retrieved from different sources, processed and tailored to commercial information products considering demand and ensure access to appropriate marketplace. IBIFADS address number of client groups, between them SMEs (stakeholders of IBIFADS see fig. 1):

- Private Enterprises (including SMEs) for strategic business planning and development
- Market places and market services providers or owners
- Suppliers of BDS (financial, advisory, research and development, training, engineering etc.) for improved targeting of services
- Public, government and communal authorities to develop policies and identify, create and support programs for regional economic development.
- Utility/Subscription Computing (UC) to provide charge-by-use practices enabling SMEs to increase profitability, increase infrastructure reliability, protect crucial information assets, hosting services, and focus on their core business.
- Information knowledge and best practices (publish and subscribe services architecture)

- Business Process Outsourcing (BPO) to delegate ICT-intensive business services to an external provider, who owns, administers, develops and manages it according to a defined set of metrics.
- Agencies and funds responsible for national and international programs/projects to target technological, technical and financial assistance in the area of market and business promotion (including networks of an innovative project)

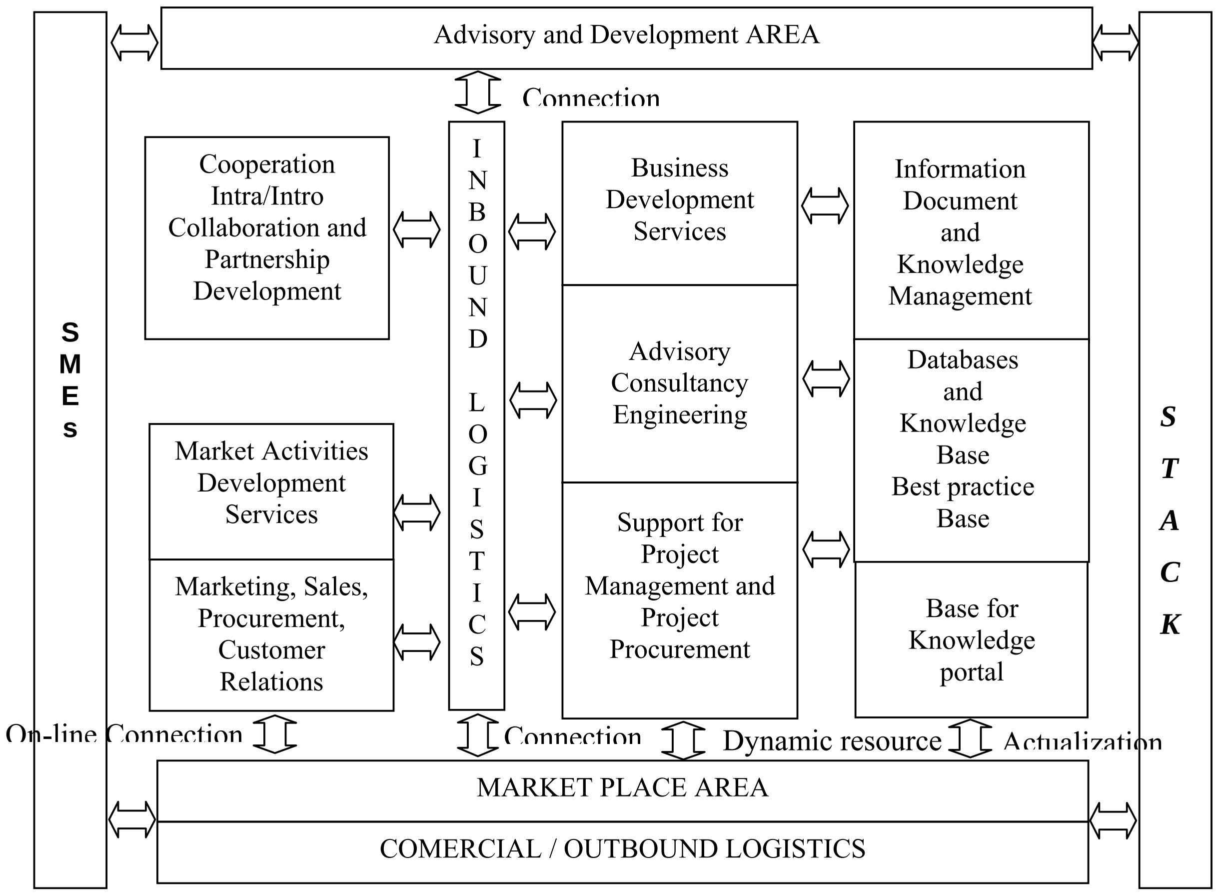


Figure 1: System Structure for IBIFADS

The significance of the use of ICTs for Integrated Business Information, Advisory and Development Services (IBIFADS) is the selection and establishment of accessible and state-of-the-art ICT infrastructure, which is made the way it would be able to achieve adequate features and objectives of IBIFADSs as well as the chosen technological tools for database and knowledge base management, information processing and interactive communication in a complex promotional venture.

The most important element in the communication between the bases is the connection between the market place and stakeholders. It is always influenced by each other and this feedback is of a great importance while providing advisory services to SMEs in businesses.

But to be able to provide such services, it is important to have a connection to knowledge, which is mostly missed by the managers of SMEs. The information and knowledge management are close to document and content management, what should be somewhere in the background while thinking about providing supporting and advise services to SMEs.

The above showed and mentioned concept of IBIFADS environment carries out the possibility for creation and development of virtual service arrangement in accordance to dedicated SMEs needs.

4 Harness the power of knowledge

SMEs are now forming cross-functional virtual teams with geographically dispersed members. These tams need to work collaboratively in real time, regardless of time differences and cannot affords to be dependent upon manual systems to provide the vital information they need to make key business decisions. However, many companies are discovering that their business critical information is held in many different file formats and in widely dispersed database. This information such as engineering and manufacturing drawings, plant operation and maintenance procedures, safety and quality related documents, web content and audit trails can often be difficult to access, distribute and revise – this represents a huge barrier to management efficiency and impacts the overall profitability of the organization.

Success for these SMEs lies in increasing the effectiveness of their valuable business asset – information knowledge – throughout its lifecycle and harnessing it for the future use. Content Lifecycle Management (see the Figure 2 [4]) is a solution that could enable SMEs dramatically improve their business performance through better management of their content throughout its lifecycle – from the initial conceptual project through the operation, management of historical records, knowledge management and re-use content for the future projects.

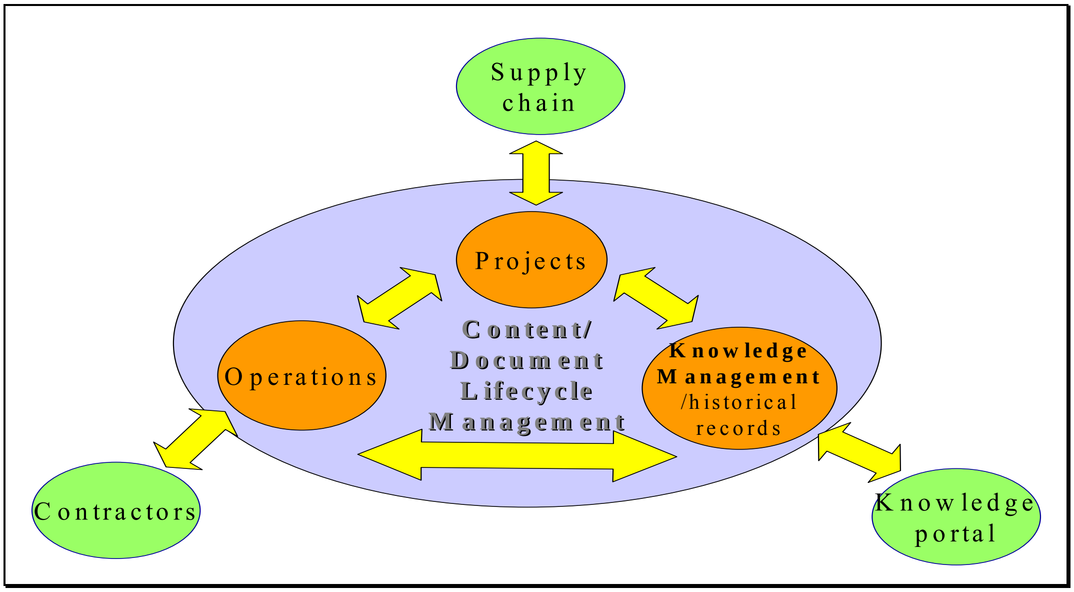


Figure 2: Content Lifecycle Management

Such a solution could be supported by IBIFADS by putting SMEs in control of its information, regardless of its origin and providing secure and direct access to it Both internally across he distributed enterprise and externally with the supply chain. By providing access to relevant information and knowledge sources, it helps SMEs to shorten their project schedules and reduce costs by enhancing collaboration between all project members. This improved information, knowledge management and distribution results in:

- Minimised project delays and safety risks
- Improved co-ordination between dispersed team participants
- Increased productivity leading to faster project completion
- Reduced project overhead costs
- Shorter time to market

Electronic records management (classification/retention/disposition) could enables SMEs to manage and share historical information through knowledge portals helping them to:

- Enhance efficiency by leveraging their knowledge for re-use
- Reduce costs associated with information/records management administration
- Adopt consistent information and knowledge management for both paper based and electronic information (e-mail, web pages, …)

- Minimise expensive office space occupied by huge amount of documentation and archived records
- Improve storage, retention and disposal security

Integrated process management save times, reduce costs, increase operational efficiency and productivity, improve overall return on investment (ROI), ensures regulatory compliance with procedures (ISO), enables collaborative working and gives visibility and control of progress.

5 Content Management

The first step that should be done is the identification of business goals and strategies that will be achieved by implementing a Document and Content Management System. These must also reflect the long-term strategies and directions of SME business.

This should be followed be identification of stakeholders requirements. All of them must be involved in this process. (see Figure 3 [8])

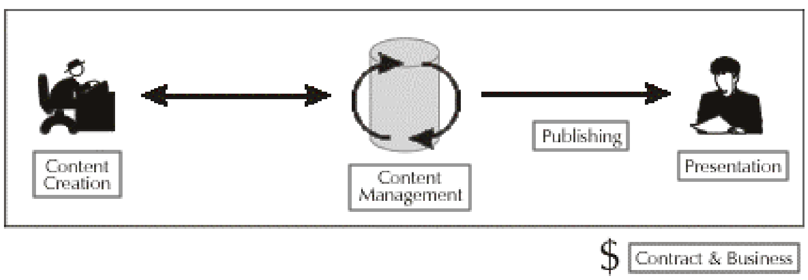


Figure 3 Identification of stakeholders requirements

A Content Management System (CMS) is typically only one of a number of systems used to present information on the intranet and extranet. An enterprise-wide CMS will only be successful if it can be cleanly integrated with existing business systems within SMEs. The most important part of a CMS is the content itself.

The single most important activity is to identify your business goals and requirements. This process must involve all relevant stakeholders. Only once you have a full list of requirements are you in a position to create an adequate helping system that supports the decisions of SME managers.

Spending time on these initial phases reduces the business risks inherent in purchasing a CMS. The project is also likely to be more successful (it will do what the users need), and development efforts will be reduced (goals are clear).

An important aim in this part is to answer the question: where is the knowledge in a content management system (CMS)? In doing so, light will be shed upon the long-term value of a CMS in capturing organizational knowledge, and the role a CMS has to play an important role in knowledge strategy.

Interestingly, the knowledge is not in the content itself. Instead, it's in the processes and practices that surround a content management system. By recognizing the importance of these supporting activities, the greatest benefits can be gained from implementing the CMS, and the goals of the broader knowledge strategy can be met.

The knowledge in a content management system is not the words on the page. Instead, the knowledge is gained via the processes and opportunities used to capture organizational knowledge.

As ever, it is the people aspects, not technology, that are the source of the knowledge. The CMS then serves as an effective enabler within the organization for knowledge management activities.

6 Content Management System (CMS) Solution

Content is at the core of SMEs business. This is why we have seen the best of breed solution - content management applications. Such a solutions provides an efficient, cost-effective, and powerful way to create and manage SMEs information for Internet portals, Web applications, intranets and extranets. These solutions help increase the success of online initiatives by delivering the right information, to the right recipients, in real-time, while also helping to decrease costs through fast and efficient deployments and cost-effective management by business users. Businesses and especially SMEs typically store information in disparate, heavily silted repositories, making access and integration difficult at best. The content management model avoids the pitfalls of discrete content repositories; effectively creating a virtual repository that allows information and data to remain in its native application, which increase IBIFADS “Base” performance. Structured Web content can reside on dedicated servers, and unstructured content from enterprise applications like databases, ERP software and CRM systems, can be dynamically collected and deployed wherever needed. CMS provides applications, workflows, and templates to manage content, sites, content types and objects, and deploy and deliver information.

CMS enables SMEs users to manage virtually all of their electronic assets and delivery applications through one interface. Users can share assets and collaborate on various tasks, using e-mail, familiar desktop applications and Web-based applications.

One of the core reasons why companies from SMEs sector should invest in a CMS is to get better results from their online initiatives. CMS create an effective online environment by streamlining and facilitating the online production process, a good CMS can make online offerings run smoother, serve customers better improving (ROI). Until now, the tools to handle critical content were priced out of reach of small and medium size businesses. Large firms, with access to very costly CMS solutions, have known for years that online content production is easier with the right tools. CMS in the framework of IBIFADS brings the flexibility and features of those costly solutions to small and medium size businesses, at a fraction of the price.

A comprehensive CMS empowers content participants to update sites more quickly, bringing customers what matters to them sooner. The goal of content is to action. Refreshing a web content often is the best way to keep customers coming back, drive brand loyalty, and to realize the maximum return on your online investment. Behind the scenes, the CMS lets managers set up workflow and approval processes to regulate levels of publishing permissions. Throughout the content life cycle, only reviewed and approved content is published live. Approvals and permissions are particularly critical when corporate identity and branding are at stake. With permissions established, only authorized people can push the "publish" button.

The needs of SMEs in different industry sectors are sometimes wildly different. However, when delivering information to customers and sharing information with partner organizations, a common set of issues often arises. These include:

- Must be easy to create and maintain content in different information spaces
- Want a secure environment in which to move content from early drafts to publication
- Must respond to changing understanding of customer needs by modifying the existing information architecture, without losing content
- Support intranet, internet and multiple extranet information spaces
- Be easy to use for new staff members
- Must be affordable to allow for a return on investment (ROI)
- Responsive and effective product support
- Help bind together disparate existing online information and services

How should such a SMEs solution for CMS appeared? Let us outline a features needed for CMS solution strategy:

- Deliver 80% of the functionality for 20% of the price
- Powerful and flexible third generation website software core platform with powerful role based security permissions system
- Iterative prototyping delivery so that a working site is available almost immediately
- Build and secure different information spaces:
  - internet for general public
  - extranets for partner organizations, trusted customers
  - intranet for staff
- Provide easy to use content authoring and maintenance responsibilities through a Web interface to staff
- Content creation and management - provides many basic content types, with hierarchical topics to build the site's information architecture, and user ratings to quickly establish which content needs improvement
- Collaborative knowledge creation and management, highly scalable and efficient
- Build new custom content types and components to allow for expansion of the solution as needs change in future
- Use highly effective search engine – it results to help people find the right information fast

7 Conclusion

To the above-mentioned description of Integrated Business Information, Advisory and Development Services, probably the most important part of the whole system is the process of actualization of information and knowledge among the market place area on one hand and Information Documents, Databases and Knowledge management coordinated by the requirements and needs set by the stakeholders. In this case we can talk about distribution customization of documents within the development area. It creates standard tools and policies for communication and knowledge exchange among the participants – several stakeholders who are in the real life the managers of SMEs.

So, when delivering solution or services to SMEs and sharing information with partner organizations, the following and common set of issues often arises. These includes:

1. **Information Supply Chain** – clustering and networking of SMEs, CRM and SCM solutions
2. **Content Lifecycle Management -** increasing the effectiveness of SMEs throughout its lifecycle and dramatically improve their business performance through its lifecycle and better management of their content.
3. **Document and Content Management System** - reflecting the long-term strategies and directions of SME business.
4. **E-Commerce environment** – effecting collaborative content/knowledge creation and management on such a services-oriented deliveries.
5. **Knowledge management -** increasing the effectiveness of SMEs valuable business asset – information knowledge

8 References

[1] Clifton Burton, Information and Communications Technologies: Are They the Key to Viable Business Development Service for MSMEs? MICRO ENTERPRISE BEST PRACTICES Development Alternative, Inc., 1999

[2] Doucek, P. , Education for Information Society, In.: IDIMT-2003, ISBN 3-85487-493-6, (2003)

[3] Drucker, P., Managing in a time a great change, *Butterworth-Heineman* (1998)

[4] R. Heeks, R. Duncombe, Information, Technology and Small Enterprise , A handbook for Enterprise Support Agencies in Developing Countries, IDPM, University of Manchester, UK, 2001

[5] Jackson, Ivan F., Information Systems – The Customer Service Focus, *MACMILLAN Press* (1998)

[6] New Economy, New Rules, New Leaders, Business 2.0, *Future Publishing*, Issue 8/2000

[7] Strategy and the Internet, Harvard Business Review, March 2001

[8] http://crm.insightexec.com/cgi-bin/kasbrowse.cgi?action=detail&id=20030

ADVISORY COMPETENCE IN VIRTUAL ORGANIZATION

Jan Klas[1]

In this article competence model of virtual organization is introduced and discussion is than concentrated on advisory competence in virtual organizations. Competence model of virtual organization allows thinking about virtual organization as a whole and also about its member organizations as about set of competencies, which are present in organizations.

1 Introduction

Organizations play important role in life of mankind. During times, same as mankind, organizations evolved. Some organizational forms are lasting till today, some disappeared in flow of time and some forms are emerging. Virtual organization belongs to the group of the last named, however some features of virtual organizations can be traced back to the history.

2 Concept of virtual organization

The word „organization“ originates in ancient Greek word „organon“, which means instrument, method or tool helping in individual's living, making or performing.

In literature one can find the term „virtual organization“ in different meanings. Virtual organization is often understood as or referred to:

- Perfect organization
- Organization heavily using ICT
- Organization based on virtual teams
- Imaginary organization
- Networked organization with huge amounts of ad-hoc connections

[1] Department of System Analysis, Faculty of Informatics and Statistics, University of Economics, Prague, Czech Republic, email: klas@vse.cz

All these „definitions“ refer to features of virtual organization. Basically, they are not necessary for organization to have them, but in virtual organization they are often present. Virtual organizations are usually willing to be perfect, they are aiming for excellence. It is so because of this will and because of their nature that they are often heavily dependent on intensive use of information and communication technologies.

And because they are based on cooperation and are often dispersed in geographical and/or time manner, they are employing techniques of virtual teaming. Virtual teams sometimes appear and sometimes disappear – this can be referred to as an imaginary organization. And temporality plays important role in virtual organizations – organizations partnering at this moment do not have to partner in next moment.

That means that virtual organizations characteristics are:

- Virtual organization is organization of organizations
- The intention for virtual organizing is concentration of skills, capacities, resources in very flexible way
- Virtual organizations have usually network structure (connections among organization are considered to be ad-hoc)

Or one can restate these points that virtual organization is network of organizations cooperating together without promising to be cooperators forever.

When organizations accepts this paradigm and starts to behave in this manner, wide space of possibilities opens for such organization. Virtual organization is a concept that has implications for single organizations (members or possible members) of organizational networks and for networks of organizations.

3 Issues of virtual organization

However this powerful concept has several difficult issues for organization-thinkers thinking in traditional way. Among the most important of these issues belong:

- Cooperation (often with competitors)
- Temporality
- Flexibility
- Trust

- Quick connection disbanding
- Security

In virtual organizations there are organizations *cooperating* or integrating with their partners. That means also knowledge sharing and sometimes secrets uncovering. However these partners can be often organization's competitors. When cooperating, partners are educating themselves each other (intentionally or not intentionally), that means organization in VO is likely to get into situation when it will educate its competitor and will be educated by its competitor.

Temporality is also important feature. Virtual organizations are often being set up for utilizing single opportunity, single project and then they are disbanded. However they can also last for long time and grow into strategic alliances.

Flexibility is adjoining to temporality. Virtual organizations are usually open structures which allow flexible reaction – intensification of cooperation or fast ending of cooperation.

Thanks to temporality and flexibility, *trust* among partners in virtual organization is necessary. It so because there is usually lack of time and resources to formalize relationships, so cooperation is often based on word of mouth, hand shake or very simple written agreements.

Quick connection disbanding is also very important when utilizing single opportunity, because staying tied to partner is not good when organization has to fast act or react.

Security is inherent feature of above mentioned areas. When cooperating with your competitors, in short time manner and you need to disband connections fast, organizations have to keep their security issues in mind. E.g. it is not ideal option when disbanding cooperation and competitor has still access to organization's information systems.

From this partial list of virtual organization issues (from the view point of single member organization) it seems, that being virtual organized is not easy. Well, it is not easy, but many organizations successfully managed to do so. For further virtual organizing, competence model of virtual organization might be helpful.

4 Competence model of virtual organization

What are the basic points of model of virtual organization in order the virtual organization to be successful? In my opinion such a model must reflect both virtual organization as a whole and single member organization. Such model has to be flexible and must leave enough space for organizations to adding own qualities however must provide framework for thinking.

In my opinion later described competence model of virtual organization satisfies all these requirements.

In this model I understand organization as set of competencies. This approach is omitting some attributes of organization however it reflects current paradigm knowledge being the most important production factor in advanced economies (with decreasing role of other production factors, such as land...).

Treating organization as set of competencies provides framework for rethinking the organization, which enables organizations qualitative jump forward.

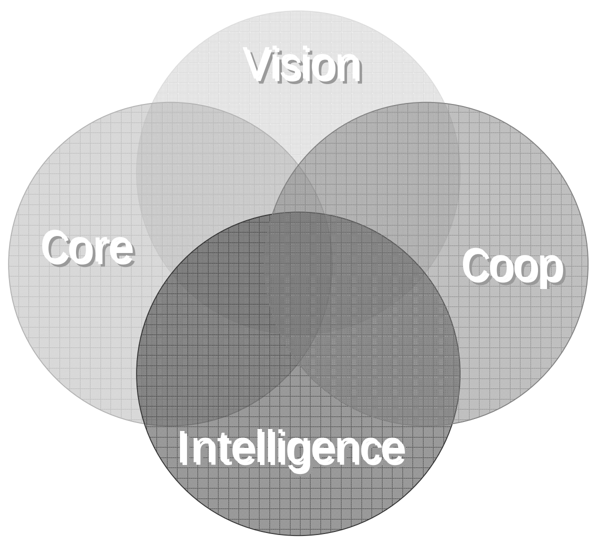


Image 1 Competence model of VO

According this framework, competencies of organization are grouped into four groups. First group relates to vision, second group to core competencies, third group to cooperational competencies and the fourth group relates to intelligence competence. Although competencies are divided into groups, they are mutually interconnected and interdependent.

4.1 Vision competence

The task of vision competencies is to define sense of organization and basic scope of organization. That means producing vision of organization functioning, what would be key core competencies and segments served and mission definition. This is later the basis for setting organization values, which have important influence on organization's formal and informal systems (not only formal/informal information systems, but on organization's culture, relationship to stakeholder, etc.). To say it short and clear, the task of vision competencies is to make organization doing the right things (effectiveness).

4.2 Core competence

Vision competencies defined the area of the firm and the key core competencies. Task of this set of competencies is to reach mastery and excellence in organizations' core competencies. Reflecting statement that vision competencies are to make organization doing the right things, core competencies are to make organization doing the right things right (efficiency). Regarding to mastery and excellence, often organizations are satisfied with not excelling, but doing "well enough".

4.3 Cooperational competence

As no human organization exists in vacuum, organization has to cooperate. Cooperation could be external (with partners outside organizations, like other organizations or customers) and also can be internal (with partners inside organizations, like employees).

Cooperational competence includes the art of partner choosing, relationship management (also relationship cancellation), team leading, cluster management, etc.

4.4 Intelligence competence

As vision competence showed the basic way, core competencies implemented with help of the others via cooperational competence, intelligence competence is to show reflection.

Intelligence competence includes orientation in environment, work with information, the art of asking the right question, dealing with external advices, etc.

4.5 Mixed competencies

As stated before, above mentioned sets of competencies are interconnected and interdependent. Every competence influences the other ones and every competence is dependent on the others. Excellence in one set of competencies could easily prove not to be enough for successful organization, because of the low level of the other competencies. In fact, even one set of competencies not on at least satisfactory level can inhibit results of the other areas.

5 Advisory competence

As mentioned above, advisory competence is member of wider group of competencies called intelligence competence. Advisory competence deals with issues regarding to knowledge transfer from outside of organization and issues regarding to advisory process. Advisory competence comprises of several important parts, which include following issues:

- Substance of knowledge
- Asking the right question
- Dealing with advisors
- Dealing with given advices

5.1 Substance of knowledge

Basic issue of knowledge transfer is related to substance of knowledge. At this point opinions differ. The question hidden in this issue are:

- Is knowledge objective or subjective? That means - can it be transferred[2]?
- If yes, could the knowledge be given (transferred) as a whole, or is it caused with the nature of knowledge to be given in pieces[3]?
- Or is knowledge strictly subjective and couldn't be transferred at all? Is it possible to facilitate process, in which "receiver" of knowledge organically builds its internal knowledge through process of guided learning?

This underlying issue of substance of knowledge influences process of external advising and also process of dealing with advisors. Usually in reality organizations and people in them have their opinions on this issue or neglect this issue at all (which is also sort of opinion).

5.2 Asking the right questions

Asking the right questions is in my opinion important part in daily life of organizations[4]. Organization often spent huge amount of time and resources solving a problem, but not finding the solution, or finding unsuitable outcomes.

---

[2] Transferred in the meaning "given from outside".
[3] Many thanks to my tutor ing. A. Rosicky for introducing concept of pieces of knowledge to me.

Based on performed experiment, key point is to ask the right question. The problem is that the right question is not always obvious. The question asked also depends on organization, group and individual values and interpretation contexts (which are related to vision competence of organization).

Proper definition of problem could be also of important help in this issue. In SMEs with their preference of short time results there often happens that issues are being solved without proper background analysis.

5.3 Dealing with advisors

When having problem defined and the question stated, it is necessary to make advisors understand the question. It is so because both parties have usually different interpretation frameworks.

Another important point is to enable advisors gather necessary information (so they have a chance to give good advice). Often happens, mainly thanks to information barriers, nature of communication and different interpretation frameworks that advisors are not provided with full and precise information. On the other hand, it is advisor's task to make the client to provide such information, however in praxis advisor's efforts are often limited with people, time and financial dimension.

5.4 Dealing with advices

Advice, as a form of external knowledge, should be carefully verificated, before its integration into organization. Advices are too often based on unspecified and untold assumptions, so blind acceptance of advice could have unwished crucial outcomes.

Another problem is responsibility for results based on given/accepted advice. This responsibility can be divided into responsibility of advisor and responsibility of organization. Advisor very often takes no responsibility for the advice and the organization being advised doesn't't take responsible approach, but uses advice as excuse for acting that way, because it was advised to the organization, by external authority (understand "advisor").

So the main issues when dealing with advices are transferability of knowledge, suitability of knowledge for organization (its value system) and responsibility for the advice or result.

---

[4] Many thanks to prof. G. Chroust from Linz University for his remark to my contribution at IDIMT 2003, which let me to think deeper about the problem of asking the right questions. It is not as easy as it looks on the first sight.

5.5 Specifics of advisory competence in virtual organization

Above mentioned three key issues of advisory competence are often much more interesting in virtual organization. It is so because in virtual organizations there is quite common horizontal or vertical cooperation or integration (and often both (horizontal and vertical)). That means, that important role in advisory process is often being played by organizations competitors, organizations customers (or even suppliers of organizations customers[5]), who have important impact on final form of organization's processes.

Although the goal of virtual organization is to reach positive cooperation, virtual organizations are in their nature often temporary, so former positive cooperation can suddenly change into negative one. And this makes the advisory process even more risky, probable gains are much higher, as are also potential loses.

Virtual organizations comprise of more member organizations. Improving processes in virtual organizational usually means improving processes running via more than one organization or affecting internal organization process from the viewpoint of external partners. That means advisory process becomes more completed:

1. Except of traditional external advisors, there appear member organizations of virtual organization in role of advisors (or self-advisors).
2. Having partners, customers, suppliers, competitors, and third party subject influencing processes of organization includes also important security risk, which becomes even more actual, when network of virtual organization disbands.
3. Each member organization has at least a little bit different interpretation context and value systems, so given advice should be in order with these systems in all influenced organizations and virtual organization as a whole.

If organizations are aware of these risks, they can change them into positive risks which could result into providing new qualities for organizations. However for traditional self-sufficient organizations' thinkers this could be nightmare.

---

[5] For details about cooperation among different suppliers of customers see e.g. [5].

6 Conclusion

Virtual organization is very powerful concept with interesting applications in praxis. In this contribution concept of virtual together with competence based model of virtual organization were introduced. This model consists of four sets of competencies (vision, core, cooperational and intelligence competence). Main advantage of this model (except of dealing with competencies) lies in providing framework for rethinking the organization and is applicable both to virtual organization as a whole and to every single member organization.

Discussed issue in this contribution was advisory competence of organization. Organization should play active role in its advisory process. Key points there are: being aware of nature of knowledge, asking the right question, proper dealing with advisors and not blind acceptance of external advices. In virtual organization, there are usually members of advisory process also organization's competitors and customers, which make the process even more risky, both in positive and negative way.

To shortly conclude, advisory competence in virtual organizations is in comparison with traditional organizations enriched with inter- and extra- organizational collaboration aspects.

7 Literature

[1] CUMMINGS, S.; THANEM,T..: The ghost in the organism. Cited at http://articles.findarticles.com/p/articles/mi_m4339/is_5_23/ai_97822733/print as on 19.5.2004.

[2] GIBSON, R. [ed.]: Rethinking the future: rethinking business, principles, competition, control & complexity, leadership, markets and the world. Nicholas Brealey, 1998. ISBN 1-8578-8108-7.

[3] FRANKE, U.: The Concept of Virtual Web Organisations and its Implications on Changing Market Conditions. Electronic Journal of Organizational Virtualness. 2001, Vol. 3, No. 4. ISSN 1422-9331.

[4] HANDY, C.: The age of unreason. Arrow, 1995. ISBN 0-09-954831-3.

[5] HAMMER, M.: Agenda 21. Management Press, 2002. ISBN 80-7261-074-0. (The Agenda. What Every Business Must to Dominate the Decade)

[6] HEDBERG, B.; DAHLGREN, G.; HANSSON, J.; OLVE, N.-G.: Virtual Organizations and Beyond. John Willey & Sons, 1997. ISBN 0-471-97493-5.

[7] MORGAN, G.: Images of Organization, second edition. Sage Publications. 1996. ISBN 0-7619-0632-0.

[8] VODÁČEK, L.; VODÁČKOVÁ, O.: Strategické aliance se zahraničními partnery. Management Press. 2002. ISBN 80-7261-058-9. (Strategic alliances with foreign partners)

Software Quality Metrics Design Support with UML

Shahid Nazir Bhatti[1]

The widespread use of information services will only be accepted by users if their quality is of acceptable level. It is therefore of high interest to be able to estimate, or even measure the quality of a system under construction. UML is by now a de-factor standard for modelling systems to be build. This paper indicates how UML diagrams are related to software quality metrics as described in ISO/IEC 9126 and similar quality standards. The paper discusses relevant quality metrics, analyses sources of errors and related them to the UML diagrams used in software engineering.

The paper discusses the sub-attributes of the attribute 'Functionality in more detail and relates the to the relevant UML diagrams.

1 Introduction

The increasing demand for software and the proliferation of its, bringing it into contact with more and more people creates a major demand for high quality software and as a consequence for skilled software engineers, managers and quality specialists and appropriate tools and methods. Quality is gaining more and more importance in the software world, especially in view of component oriented development. This work discusses software quality support with the use of UML. The application of software metrics has proven to be an effective technique for improving the software quality and productivity. UML is widely accepted as the standard for representing the various software artifacts generated a software development processes. Applying the principles of quality to the software process the term 'quality system' is used internationally to describe a comprehensive process which ensures and demonstrates the quality of the products and services it produces because quality is a journey which has milestones rather than a destination.

It has to be noticed that software organizations invest some how 80% their development resources regarding issues related to their 'products quality' [4], quality related issues are discussed latter in section 2, because managing a quality is more than just implementing a quality system consisting of a set of techniques that meet ISO/IEC standards 9126. It is creation of a quality culture that

[1] Kepler University Linz, snb@sea.uni-linz.ac.at

permeates the entire organization. Now in this regard ISO (the International Organization for Standardization) and IEC (International Electrotechnical Commission) define standards for the world-wide standardization. Issues related to the Quality Assurance. ISO/IEC 9126 defines a hierarchy of software quality metrics. On the highest level they are: Functionality, Reliability, Usability, Efficiency, Maintainability and Portability [5] [6]. The important aspect is while working with the quality issues/testing to propose the graphical support using UML to these software quality metrics [3]. UML diagrams support here is to provide these (ISO/IEC standard 9126) software quality metrics with growing needs regarding engineering and reengineering of processes for software system, quality control activities such as inspection and testing to detect errors and satisfy these ISO/IEC 9126 standards regarding software quality metrics.

2 Software quality issues

2.1 Quality

'The totality of features and characteristics of a product or service to that bear on its ability to meet stated or implied requirements'. Quality is critical for survival and success, the market for software is increasingly a global one and no organization will succeed in that market unless they not produces quality products and services. If any one does not do so then that organization may not even survive [8]. It is estimated that software organizations invest some how large amount of their development resources and energies towards the issues related to there 'quality' of there products [2] [10].

2.2 Why system fails

When a system fails, the failure may be the result of any of several reasons as indicated in the figure: 1, and can be accumulated in the following manners:

- The specification may be wrong or have missing requirements. The specification may not state exactly what the customer wants or needs.
- The specifications may contain a requirement that is too complicated to implement, given the prescribed hardware and software scenarios.
- The system design may contain a fault. Perhaps the database and query-language designs make it impossible to authorize users.

- The program design may contain a fault. The component descriptions may contain as access control algorithm that does not handle this case correctly.
- The program code may be wrong. It may implement the algorithm improperly or incompletely.

Faults can be inserted in a requirement, design, or code component, or in the documentation, at any point during maintenance. Figure 1 illustrates the likely causes of faults in each development activity. Although we would like to find and correct faults as early as possible, system testing acknowledges that faults may still be present after integration testing.

A ‘baseline audit’ can be carried out to measure current practice against the requirements of the ISO/IEC 9126 standards, the audit in fact examines the organization’s activities under various software quality metrics, software quality metrics framework defines a ‘software quality metric’ as a quantitative measure of an attribute that describe the quality of a software product or process. Test procedures should be enough to exercise system functions to every one’s satisfaction: user, customer, and developer. If the tests are incomplete, fault remains undetected, the testing is not a process carried out after implementation because complete and early testing can help not only to detect fault quickly, also it is easier and cheaper to fix these faults [8] [10].

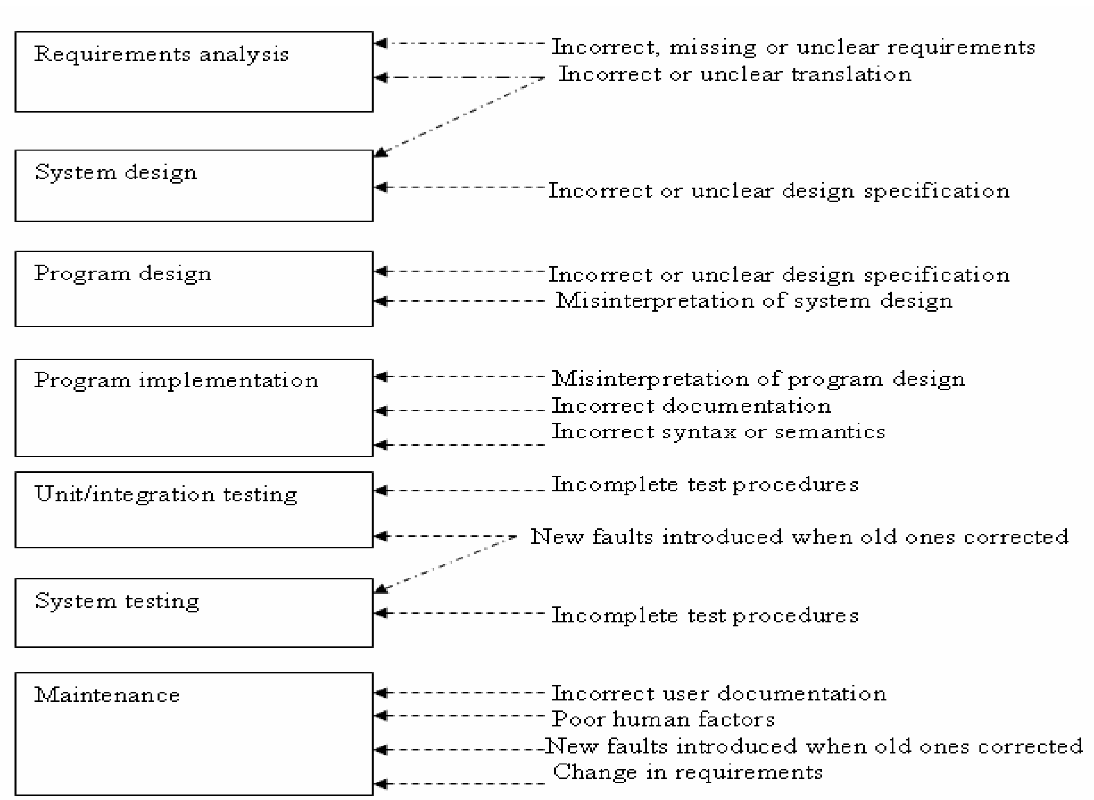


Figure 1: Causes of faults during development [10]

3 Software quality metrics

The application of software metrics has proven to be an effective technique for estimating, assessing and improving software quality and productivity i.e. the initiation of a software metrics program will provide assistance to assessing, monitoring and identifying improvement actions for achieving quality goals regarding ISO/IEC 9126 Standard [9] [5]. Software metrics are of interest for several reasons [9]:

- Quantitative measures can be used as indicators of a software product or development process. These indicators, such as size, product, quality, process quality etc, are of interest to software development mangers, developers, and users.
- The software metrics may indicate suggestions for improving the software development process.

Regarding the requirements for software’s quality issues, the software quality metrics framework introduces categories of metrics that extends through the phases of software development life cycle which are independent of methodologies. The framework is designed to address the wide range of quality characteristics for the software products and processes i.e. as shown in the figure: 2, the following frame work enables better description of software quality aspects and its importance [9].

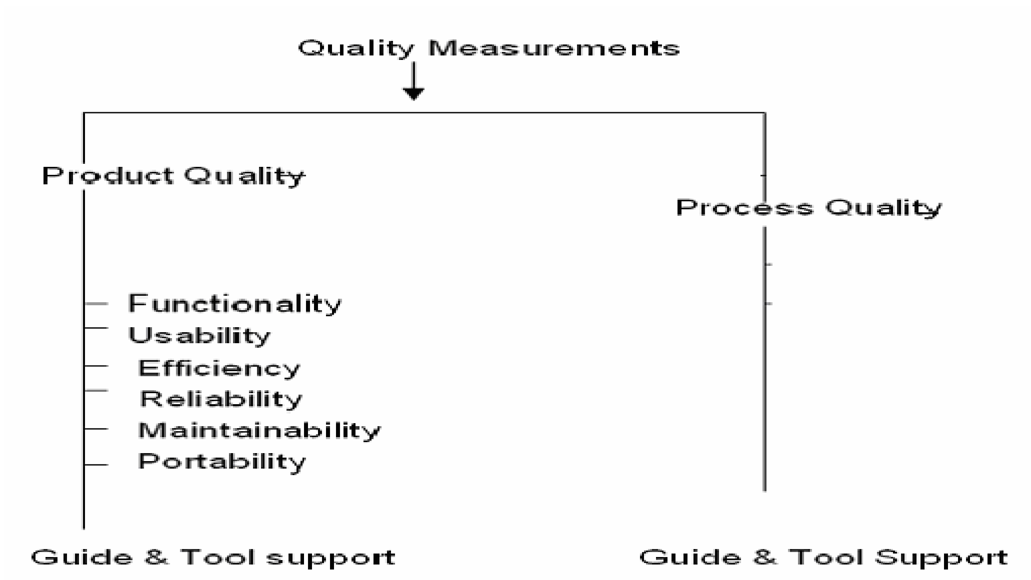


Figure 2: Software Quality Metrics Framework [9]

3.1 Software Quality Metrics derived from ISO/IEC 9126

The International Technical Report for ISO/IEC 9126[2] provides a suggested set of software quality metrics (external, internal and quality in use metrics) to be used with the ISO/IEC 9126 Quality model. Using UML we can only evaluate external measures!

The user of these technical reports may modify the metrics defined, and/or may also use metrics not listed. When using a modified or a new metric not identified in these International Technical Reports, the user should specify how the metrics relate to the ISO/IEC 9126-1 quality model or any other substitute quality model that is being used.

The user of these International Technical Reports should select the quality characteristics and sub-characteristics to be evaluated, from ISO/IEC 9126, identify the appropriate direct and indirect measures to be applied, identify the relevant metrics and then interpret the measurement and then interpret the measurement result in an object manner. The user of these Internal Technical Reports also may select product quality evaluation processes during the software life cycle from the ISO/IEC 14598 series of standards. These give methods for measurement, assessment and evaluation; particularly those responsible for software product evaluation as shown in the figure 3. Also from the diagram (figure 2) it is clear that the internal metrics having a relation strong as possible with the target external metrics so that they can b used to predict the values of the external metrics [5] [6] [8].

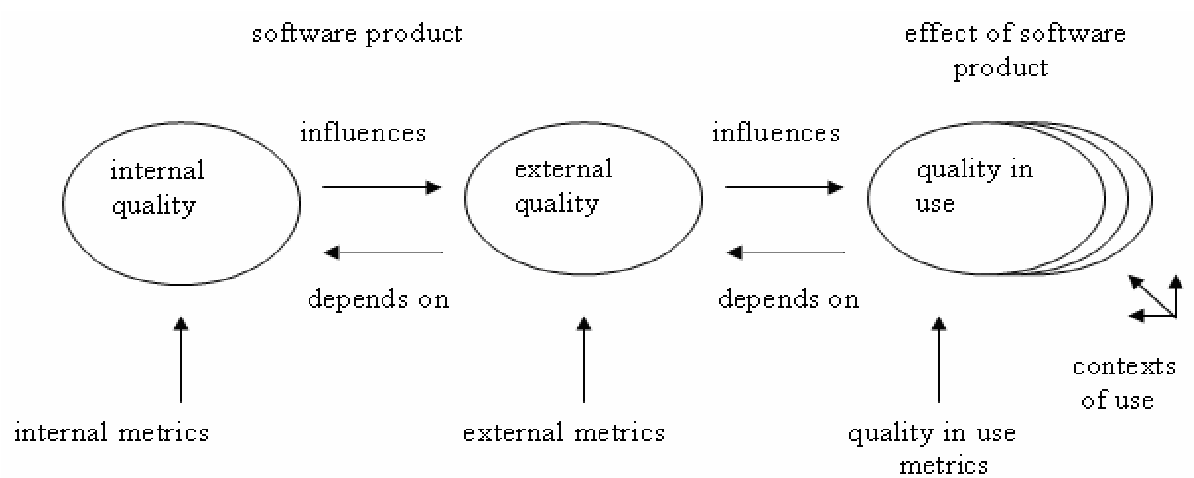


Figure 3: Relationship between types of metrics [5] [6]

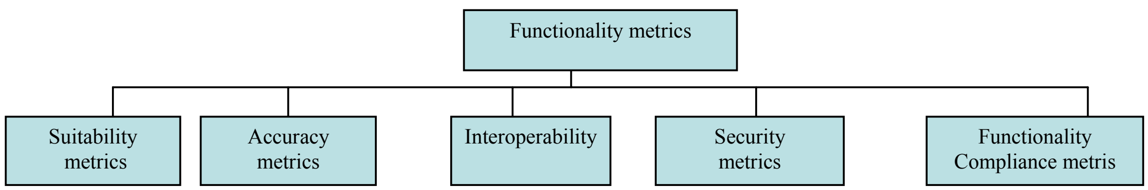
[2] In ISO/IEC 9126, 9126-1, 9126-2, 9126-3, 9126-4, other ISO/ IEC standards in this regard used here are 14589-1, 25020.

3.2 Functionality metrics

Obviously the functionality of a proposed system is of key interest to its users. Thus being able to measure the fulfilment of the functional requirements is an important step towards quality assessment of a system.

An external functionality metric should be able to measure an attribute such as behaviour of a system containing the software. The behaviour of the system may be observed from the following perspective [5] [6]:

- Differences between the actual executed results and the quality requirements specification,
- Functional inadequacy detected during real user operation which is not stated but is implied as a requirement in the specification.



Suitability metrics: an external suitability metric should be able to measure an attribute such as the occurrence of an unsatisfied operation during testing and user operation of the system.

Accuracy metrics: an external accuracy metric should be able to measure an attribute such as frequency of users encountering the occurrence of inaccurate matters.

Interoperability metrics: an external interoperability metric should be able to measure an attribute such as the number of functions or occurrences of less communicativeness involving data and commands, which is transferred easily between the software product and other systems, other software products, or equipment which are connected.

Security metrics: an external security metric should be able to measure an attribute such as number of functions with, or occurrences of security problems like data, operations & secure output information etc.

Functionality Compliance metrics: an external functionality compliance metric should be able to measure and attribute such as the number of functions with, or occurrences of, compliances problems, which is software product failing to adhere to standards, conventions, contracts or other regularity problems.

4 UML heuristics with software quality metrics

UML is used as the first characteristic to be subjected to software quality metrics, we may speak of. 'Quality with UML' (QWUML). The objective is to efficiently design and deploy the software systems that meet customers' requirements; the efficiency which can be measured using QWUML is in terms of cost, quality and lead time.

The dynamic view is depicted with the use cases, list of activities/interactions and the states and there a change by the sequence diagrams, finally the static view is depicted with the class diagram.

If we go with the details of the external metrics from the ISO/IEC 9126 which are listed below, these metrics are indicators that relate to high level size, product and development process quality indicators that are of interest to the software development and maintenance activity. Now when looking for the graphical support for these software quality metrics by virtue of UML, in the [3] Craig Larman, 'Applying UML and Patterns', requirements are categorized according to the FURPS+ model [3] a useful mnemonic. The requirements are categorized and the functional and non functional support is provided to these software metrics, as by graphical illustration of these software metrics by effective use of UML enhance their worth regarding the software quality, performance, and productivity using the ISO/IEC 9126. In the following comparison in the Table 1 given below we show the relation of the ISO/IEC 9126 external metrics and the UML support for these software metrics in this regard.

ISO/IEC 9126, External metrics	**UML heuristics for software metrics**
Functionality metrics	Functional
Reliability metrics	Reliability
Usability metrics	Usability
Efficiency metrics	Efficiency
Maintainability metrics	Supportability
Portability metrics	

Table 1: ISO/IEC 9126 External metrics and UML support for the metrics

While working with the requirement categorization and functional and non functional design aspects of the software products, the following results can be achieved while working with the UML in regard with these ISO/IEC 9126 external metrics. Some requirements are called quality attributes [BCK98] (or "-ilities") of a system [3]. These include usability, reliability, and so forth. Note that these refer to the qualities of the system, not that these attributes are necessarily of high quality (the word is overloaded in English). For example, the quality of support-ability might deliberately be chosen to be low if the product is not intended to serve a long-term purpose.

They are two view points in this regard for the external software quality metrics which are

1. Observable at execution (functionality, usability, reliability, performance ...)
2. Not observable at execution (supportability, testability ...) [3]

UML heuristics regarding the external software metrics in this regard can be enlisted as follows:

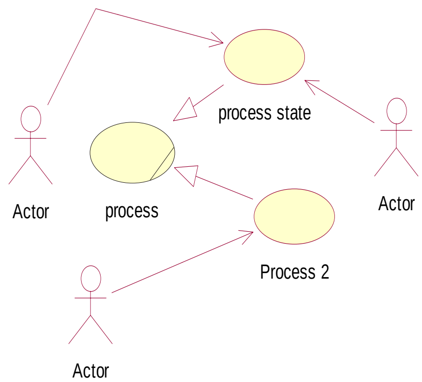
- • Functional—features, capabilities, security.
- • Usability—human factors, help, documentation.
- • Reliability—frequency of failure, recoverability, predictability.
- • Efficiency—response times, throughput, accuracy, availability, resource usage.
- • Supportability—adaptability, maintainability, internationalization,

4.1 Using UML artifacts to identify handle software quality metrics (ISO/IEC 9126)

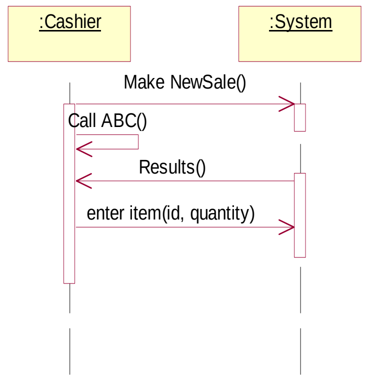
In ISO/IEC Standards (external metrics) the following metric [3]i.e. '<u>Functionality metrics'</u> is the basic consideration for this work. This work also comprises working with the following ISO/IEC Standards i.e. ISO/IEC 25020, ISO/IEC 14589-1, ISO/IEC 9126-1, ISO/IEC 9126-2, ISO/IEC 9126-3, ISO/IEC and 9126-4 [5] [6] [9] .

Although there are several UML diagrams, only the following three diagrams Use case diagram, Class diagrams and especially Sequence diagrams selected due to the nature of the selected software metrics, although there can be a assumption that the Collaboration diagram can also be used when it comes to the dynamic nature of these software quality metrics. Due to the almost similar support for the dynamic structure from Sequence diagram and Collaboration diagram, I there fore use case diagram, class diagram and sequence diagram to meet the static and dynamic aspects of these software quality metrics regarding QWUML. The graphical representation of the just mentioned three diagrams is show bellow using 'Rational Rose'.

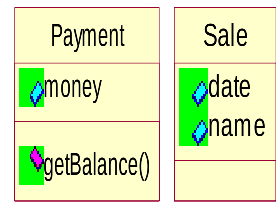
[3] The other external metrics in this regard are Reliability, Usability, Maintainability, Efficiency, & Portability.



a: Use case diagram



b: Sequence diagram



c: Class diagrams

In software metrics design the graphical support (using UML) is provided for these software quality metrics, so that the final design for these software quality metrics is more reusable, understandable and modifiable. Functionality metrics & Reliability metrics from ISO/IEC Standards 9126 and there corresponding support using UML can be attained using following scenarios given below the table 2. Here in this table the UML support to these software metrics is show, that by use of these three UML diagrams (i.e. use case, sequence, class) the sub metrics of the Functionality metrics can be supported by the effective use of these ascribed UML diagrams [3] [4].

[4]**Functionality metrics**	**Use case Diagram support**	**Sequence Diagram support**	**Class Diagram support**
Suitability metrics	Yes: (Are all functions needed by the user covered)	Yes	(yes)
Accuracy metrics	Yes: (With all the required parameters)	Yes	Yes: (All objects detail)
Interoperability metrics	—	Yes	—
Security metrics	(Yes)	Yes	Yes
Functionality Compliance Metris	Yes: (are all functions explicitly asked for user covered in this aspect)	Yes: (are all functions explicitly asked for user covered in this aspect)	Yes

Table 2: Functionality metrics support using UML

Similarly the Reliability metric from ISO/IEC 9126 and the sub metrics of Reliability metric can also be supported by the use of UML diagrams. Using these aspects with the software metrics, the quality of the software products can be enhanced by these graphical design patterns. These useful

[4] In the table metrics support by UML is 'yes' can be supported, '-' can not be supported, '(yes)' can be and cant be

software quality metrics design scenarios are helpful for the enhance representation of the software quality metrics regarding the names, abstracts, identification and responsibilities.

As compared to the traditional approaches (i.e. with out graphical support) toward organising software quality, the QWUML approach is to introduce the concept of all the members responsible for quality and thus distribute the functions and identifying the respective responsibilities. The way it contribute toward software quality is

- Quality activities which attempt to identify and remove errors. This strategy (QWUML) minimizes the functionality & reliability errors being committed.
- The software design methodologies following this scenario and there association with the tools which make it highly unlikely that certain types of software error will be committed by removing many of the traditional steps [5]in this regard.

5 Conclusion

Increasing demand for software and the modest improvement in software productivity required effective techniques for improving the software quality and productivity. Now with this (QWUML) concept where these software quality metrics for ISO/IEC 9126 have (graphical) UML diagrams support. The working and precision of these software quality metrics (Functionality metrics, Reliability metrics) can be effectively supported regarding quality issues. Because ‘quality’ is the key determinant of success regarding software products, no one can longer rely on the functionality, productivity of the products with out quality to these ISO/IEC 9126 software quality metrics.

6 References

[1] Bruce Powel Douglass, Real-Time UML, 2nd Edition, Addison Wesley, 2000.

[2] Cem Kaner, , Jack Falk , & Hung Q. Nguyen, Testing Computer Software, 2nd Edition, Wiley, John & Sons, Inc, 1999.

[3] Craig Larman, Applying UML and Patterns, Prentice Hall, Inc, 2000.

[4] Ivar Jacobson, Grady Booch, James Rumbaugh, The Unified Software development process, Addison Wesley, Inc.

[5] ISO/IEC TR 9126: Software engineering –Product quality, 19-12-2000.

[6] ISO/IEC TR 9126-2: Software Software engineering –Product quality – Part 2: External metrics, 19-12-2000.

[7] John A Mcdermid, Software Engineer’s Reference Book, Butterworth-Heinemann, 1991.

[5] Regarding software quality

[8] Joe Sander, Eugene Currean, Software Quality, Addison Wesley, 1994.

[9] K. H. Möller, D. J. Paulish, Software Metrics, Chapman & Hall Computing, 1993.

[10] Shari Lawrence Pfleeger, Software Engineering Theory & Practice, Prentice Hall, Inc, 2001.

[11] Tom Gilb, Dorothy Graham, Software Inspection, Addison Wesley, 1993.

Authors