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IDIMT-2005
13th Interdisciplinary Information Management Talks

This annual workshop provides an interdisciplinary forum for exchanging concepts and visions in the area of information management, knowledge management, business engineering, information technology, system theory, and related topics. The increasing importance of information as a vital resource both for organisations and for the individual requires considering these topics in an interdisciplinary and holistic way from various standpoints: sociological, technological, commercial and educational. The international setting of IDIMT, especially the cooperation of technical and economic research institutes and the bringing together of researchers with different economical and historical background, guarantees a multifaceted view on these topics.

The main focus of the conference will be the future of today's information society bringing together and affiliating today's innovations, advantages, problems, and risks of information technology on the one side, and the innovations, trends, problems, and risks in business engineering and business management on the other side.

This year's conference focuses on following topics:

- European Integration: Viribus Unitis
- Cooperative Information Environments
- Creative Thinking and Decision-Making Analysis
- Application Development beyond the Methodology Revolution
- Digital Business Ecosystems for SMEs
- The Impact of Information and Communication Technology on Society's Paradigms

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Welcome to IDIMT 2005!

A hearty welcome to the 13th IDIMT-conference. For the third time we meet in Budweis and are really enjoying an excellent environment for exchanging our thoughts and ideas. A lovely old town with a wonderful market place, many friendly people, excellent restaurants offering delicious food, and last but not least the famous Czech beer are inspiring our discussions and invite us to stay.

Started in 1993 as a small conference between Czech and Austrian scientists in the little village of Kobuva Hut in the Bohemian Forest the conference improved constantly over the years. Year by year the originally small kernel of scientists is extending with new faces and bringing in fresh ideas and a 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 unique and 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 were able to accept 21 papers and again the reviewer had a lot of work to do in reviewing and selecting the papers from the submitted ones.

Progress is a sequence of small steps, often triggered by adversary conditions and obstacles. The annual IDIMT conferences are an excellent example for that. This year, again, there is something new to be proud of: The J. Kepler University Linz has renewed and vitalized a cooperation agreement with the University of South Bohemia in Budweis. Our IDIMT Conferences will be part of this partnership agreement. This will give us a chance to incorporate our colleagues from Budweis.

Seal of the University of South Bohemia in Budweis

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 interdisciplinary 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 without 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 the winter semester has not been started yet and allows university members to attend the conference before the start of the lectures.
2. This year we start the conference on Wednesday with an opening session followed by a combined dinner in the evening enjoying Czech cuisine. The main conference runs on two full days, i.e. Thursday and Friday. Early Friday afternoon the conference closes and allows participants to travel home comfortably.
3. This year again we keep the well-proved structure of 9 sessions. Every session will be opened with the presentation of the session keynote paper followed by short presentations of the position papers. The new opening session on Wednesday evening gives us more time for the fruitful and always time-constrained plenary discussions after each session.

The main focus of this year's conference will be the future of today's information society bringing together and affiliating today's innovations, advantages, problems, and risks of information technology on the one side, and the innovations, trends, problems, and risks in business engineering and business management on the other side. This year's session topics are:

- European Integration: Viribus Unitis
  Keynote Speaker: Dr. Petr Doucek, Session Organizer: Dr. Michael Sonntag
- Cooperative Information Environments
  Keynote Speaker: Konrad Klöckner, Session Organizer: Prof. Tom Gross
- Creative Thinking and Decision-Making Analysis
  Keynote Speakers: Vesna Čančer and Prof. Matjaž Mulej,
  Session Organizer: Martin Kejkula
- Application Development beyond the Methodology Revolution
  Keynote Speaker: Prof. Maria Raffai, Session Organizer: Norbert Seyff
- Digital Business Ecosystems for SMEs
  Keynote Speaker: Prof. Anton Lavrin, Session Organizer: Jan Klas
- The Impact of Information and Communication Technology on Society's Paradigms
  Keynote Speaker: Prof. Gerhard Chroust, Session Organizer: Christoph Hoyer

The preparation and realization of IDIMT-2005 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,
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- 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 its 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,
- special thanks go to Dr. Dr. Christian Hofer who chaired the IDIMT conference for several years and established the sound basis on which we build, and
- all other unnamed persons contributing to the success of this conference.

Christoph Hoyer

Gerhard Chroust

July 2005

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European Integration:
Viribus Unitis

EUROPEAN INTEGRATION

VIRIBUS UNITIS – BACK TO IDEAS OF THE „K & K" TRADITIONS IN NEW DIMENSIONS

Petr Doucek[1]

The European Council held in Lisbon on 23rd and 24th March 2000 set the ambitious objective for Europe to become the most competitive and dynamic economy in the world. It recognized an urgent need for Europe to quickly exploit the opportunities of the new economy [Dou_02] and in particular the Internet

The Lisbon Extraordinary Summit – Conclusions – March 2000

Development of contemporary society, by some authors characterized as turbulent or chaotic, is sharp connected to information systems and information and communication technology (IS/ICT). Roots of data production and processing are hidden in the dark of history of human genus and permanent integration features could be visible in each historical époque. Another guide through mans history is data and its collection. Process of permanent integration during human genus existence is visible in the whole history. Several aspects of nowadays European integration process – with especial accent to finance sector and education - is presented here.

1. Short historical overview

History of Europe is forever jointed with history of wars, fights, power, suffering, ideas, and ideology and for the absolute majority of the population with glory and luxury. All these aspects of European life were supported with data and information. Both are curling through the history of the human like a gold clue. They documented existing stands and drew visions of better pictures in the future.

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History of human as a biological genus is closely associated to data and information processing. Starting from the period when the human brain distinguished enough human genus from the world of animals and its development allows human beings to compose abstract terms, to work with these structures and communicate using them with another similar persons begun history of informatics. Abstract terms were saved into data and data structures, in order to be interpreted as information by another individual. People worked with different types of data, data mediums and technologies for working out data in several period of human history. Contemporary boom of information systems and information and communication technologies (IS/ICT) is only resultant of former started processes in the deep darkness of human history. Briefly overview of historical steps in integration process is shown further in this contribution. Basic criterion for distinguishing historical periods were used way how the majority of added value was produced in this era. There were identified following periods according to this criterion:

- detachment human as a genus,
- hunting,
- agricultural,
- industrial,
- information.

There were different main bearers of data collection and processing for each period and main ways how data and information were transmitted and archived in the society.

Massive improvement of IS/ICT into nowadays society is only consequence of the former started processes. IS/ICT became instrument and tool for managing our complicated and complex world. Several aspects of complexity of actually world and impacts of IS/ICT improvement are mentioned in this article. Social changes in current society are mainly pushed by two main factors - globalization processes and IS/ICT improvement. Those cause essential changes of the society and practically of all its social processes. Changes in perception of traditional values and growing rate of value systems unification of particular population groups, depending on the participation of their members in using IS/ICT and generally in acceptation of globalization processes, are natural consequences of those phenomena.

Tendency or better said tendencies to integration are own properties of the human civilization. They are visible practically in all areas of human activities. Essential base for integration is co-operation in our period, war or occupation of a territory by military power in the past. History of integration in Europe was represented by different nations and its leaders in the past. Starting from period of the ancient Greeks and Romans a lot of famous persons started to prove to integrate world or Europe (Alexander of Macedonia, G.I. Caesar and others), then came the period of the holy realm of Rome with usually in Germany settled Rome emperors – but middle age integration or better said attempts for integration were realized by holy realm of Rome by Papas using catholic (exactly said Rome catholic) religion as an integration tool for all settlements on old continent. Very interesting attempt for integration in Europe was started by the Czech King Jiří Poděbradský in 15th century. He sent ambassadors to all important European emperors in order to prepare and to sign agreement of European cooperation and integration. Perhaps was this act inspired by slowly arising danger of Turkey expansion policy on Middle East and Balkan half island.

After ending middle age period were further ideas of integration based on national principles. One nation streamed to be a leader in the region or in the Europe. Very popular toll for realizing the leaders ambitions were military power or ideology in this period. This tendency remains until our days – exactly said until the end of the 20th century. About in the middle of this century – during strong cold war – it appeared new approach to integration ideas. Innovation was hidden in combining ideological and economical principles. Ideological dimension were represented in the "East" and in the "West" by different political base – **market** economy in the contradiction (confrontation) to **socialistic** economy, but with unifying idea – the future platform for integration must be economy and cooperation in business. "Times they are changing…." and ideological dimensions disappeared. The already running process of European integration represents new dimension of thinking – to build up a society based on common optional co-operation without using military or ideological tools for enforcement of ideas. Only principles of market will be the base for competition with respect to human rights and sustainable development of the whole society. Potential risks of these ideas are in conflicts between individual's interests and interests of the whole society. I hope that sport and the economy will be the last battlefields where people will fight in the future.

1.1. Chronology of Modern European Integration [Sch_04]

History of "western" integration process is described in following rows:

July 1952	European Coal and Steel Community (ECSC) is established by Belgium, Germany, France, Italy, Luxembourg and the Netherlands.

January 1958	The same six countries establish the European Economic Community (EEC) and the European Atomic Energy Community (Euratom).
January 1973	Denmark, Ireland and the United Kingdom join the three European Communities.
January 1981	Greece joins the three European Communities.
January 1986	Spain and Portugal join the three European Communities.
February 1986	The Single European Act is adopted.
November 1993	The Treaty on European Union (Maastricht Treaty), which was signed in February 1992, enters into force. It establishes the European Union with a three-pillar structure: • the three European Communities; • the common foreign and security policy, and • justice and home affairs/police and judicial cooperation in criminal matters.
January 1995	Austria, Finland and Sweden join the European Union.
May 1999	The Treaty of Amsterdam, which was signed in June 1997, enters into force; it amends both the Treaty establishing the European Community and the Treaty on European Union.
February 2003	The Treaties are further amended by the Treaty of Nice, which was signed in 2001, to pave the way for an enlarged European Union.
2003	The Convention on the future of Europe draws up a draft Treaty establishing a Constitution for Europe.
May 2004	The Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia join the European Union, bringing the total number of Member States to 25.
June 2004	The EU Member States agree on a Treaty establishing a Constitution for Europe.
June 2005	Crashing the idea of Constitution for Europe.

European Union now numbers 25 Member States, with the most recent addition of ten central and eastern European and Mediterranean countries on 1 May 2004. Although these new Member States will only join the euro area at a later stage, i.e. when they fulfill the necessary conditions for adopting the euro, they are committed to the objectives of EMU (European Economic and Monetary

Union). Their respective NCBs (National Central Banks) became ex officio members of the ESCB on the same day and will prepare themselves for their eventual integration into the Euro system.

Let us try to find out integration features in two selected areas – in finance and in education. The difference between this are it seems to be very large, but the practice changes usually applied models and prepares completely new relations and consequences. The area of finance will be investigated on general macro level, education and its integration process from micro level with source of author's private experience.

2. From Another Cask - From the Cask of Finance

Typical area, where the integration process is running very quick, is the financial sector. The Bible for integration is so called Basel agreements. There are given main characteristics of local nation economies that must be absolutely fulfilled in order to accept to include local economy into the community of the whole Europe. Main representative of national banking is National Central Bank (NCB). Central banking in Europe always used to be tantamount to issuing and managing national currencies: a national currency became an indispensable ingredient of national sovereignty; national banknotes, which occupied an increasingly important role in the circulation of money and eventually replaced par-value gold and silver coins as legal tender, communicated national cultures and symbols. Concurrently with the increasing role of banknotes as a means of payment in modern economic life, their issuers, the central banks, grew in importance and the conduct of monetary policy became an essential part of a nation's economic politics.

2.1. Monetary Integration

Against this historical background, the realization of European Economic and Monetary Union (EMU) at the end of the 20th century was unique in that it introduced a new monetary regime with a single currency for a large part of Europe. The twelve Member States of the EU that have so far adopted the euro represent two-thirds of the EU's total population and the extension of the euro area to other EU Member States is expected in due course. The transfer of monetary policy to the Community level has required substantial changes to the European central banking framework. The establishment of a new supranational monetary organization, the ECB, and the integration of NCBs into a European central banking system, the ESCB (European System of Central Banks), and its sub-set, the Euro system, are representative of the supranationalisation of European central banking. To date, no other policy area of the European Community has reached the same depth of integration as the single monetary and exchange rate policy. Nowhere else has the Community developed its own identity more convincingly than in the euro and the ECB. The ECB is also the embodiment of modern central banking: the overriding objective of its monetary policy is price stability; it is independent within a clear and precise mandate; and it is fully accountable to the citizens and their elected representatives for the execution of this mandate. These features are not necessarily the result of purely European developments; they are in line with the worldwide trend. However, almost nowhere are these features spelled out so clearly and firmly than in the organic law of the ECB, the Statute of the ESCB and of the ECB. Their embodiment in the EC Treaty, with quasi-constitutional status, underlines their importance in the new monetary regime of Europe. The codification of central bank law in the EC Treaty and the Statute of the ESCB is likely to serve as a benchmark for central bank law outside the EU: Switzerland, for example, has recently revised its National Bank Act along the lines of the Statute of the ESCB.

2.2. Steps Towards European Monetary Integration

Europe's "founding fathers", who negotiated the Treaties of Rome in the 1950s, did not dwell on the idea of a common currency. To start with, the initial aims of the European Economic Community (EEC) were largely limited to realizing a customs union and a common agricultural market, which was not perceived to require integration in the monetary field. Moreover, at the time, all the EEC countries were part of a reasonably well-functioning international monetary system (the Bretton Woods system). Within this system, exchange rates were fixed but adjustable and remained relatively stable until the mid-1960s, both within the EEC and globally. The idea of a common currency for the EEC Member States was first launched in the European Commission's Memorandum of 24 October 1962 (the Marjolin Memorandum). In its Memorandum, the Commission called for the customs union to lead on to an economic union by the end of the 1960s with irrevocably fixed exchange rates between the Member States' currencies. However, since the Breton Woods system was ensuring widespread exchange rate stability, the Member States considered that intra-EEC exchange rate stability could be secured without the need for new institutional arrangements at the Community level. Thus, no follow-up action was taken on the Memorandum, except that a Committee of Governors of the central banks of the Member States of the EEC (the Committee of Governors) was established in 1964. The Committee of Governors complemented the Monetary Committee provided for by Article 105 of the EEC Treaty. Initially the Committee of Governors had a very limited mandate, but over the years it gradually gained in importance to become the focus of monetary cooperation among the Community central banks. In this capacity, the Committee developed and managed the framework for monetary cooperation that was subsequently established at the Community level. The Committee's work would also prove instrumental in the final move to EMU. By the end of the 1960s, the international environment had changed significantly. The Bretton Woods system was showing signs of increasing strain as a result of US balance of payments policy. The EEC Member States increasingly differed on economic policy priorities. Greater price and cost divergences between them led to several exchange rate and balance of payments crises, which in turn threatened to disrupt the customs union and the common agricultural market, which had been functioning quite successfully up to then. In 1969 the European Commission submitted a plan (the Barre Plan) to create a distinct monetary identity in the Community. On the basis of this plan, the Heads of State or Government, meeting in The Hague, called on the Council of Ministers to draw up a plan for the realization in stages of an economic and monetary union. This work was done by a group of experts, chaired by Pierre Werner, the Prime Minister of Luxembourg. The resulting Werner Report, which was published in 1970, proposed to create economic and monetary union in several stages by 1980. [ECB_xx]

2.3. The Road to the Euro Unique Currency [Sch_04]

Short overview of the monetary integration history is presented in following rows:

1962	The European Commission makes its first proposal (Marjolin Memorandum) for economic and monetary union.
May 1964	A Committee of Governors of the central banks of the Member States of the European Economic Community (EEC) is formed to institutionalize the cooperation among EEC central banks.
1971	The Werner Report sets out a plan to realize an economic and monetary union in the Community by 1980.
April 1972	A system (the "snake") for the progressive narrowing of the margins of fluctuation between the currencies of the Member States of the European Economic Community is established.
April 1973	The European Monetary Cooperation Fund (EMCF) is set up to ensure the proper operation of the snake.
March 1979	The European Monetary System (EMS) is created. February 1986 The Single European Act (SEA) is signed.

June 1988	The European Council mandates a committee of experts under the chairmanship of Jacques Delors (the “Delors Committee”) to make proposals for the realization of EMU.
May 1989	The “Delors Report” is submitted to the European Council.
June 1989	The European Council agrees on the realization of EMU in three stages.
July 1990	Stage One of EMU begins.
December 1990	An Intergovernmental Conference to prepare for Stages Two and Three of EMU is launched.
February 1992	The Treaty on European Union (the “Maastricht Treaty”) is signed. October 1993 Frankfurt am Main is chosen as the seat of the EMI and of the ECB and a President of the EMI is nominated.
November 1993	The Treaty on European Union enters into force.
December 1993	Alexandre Lamfalussy is appointed as President of the EMI, to be established on 1 January 1994.
January 1994	Stage Two of EMU begins and the EMI is established.
December 1995	The Madrid European Council decides on the name of the single currency and sets out the scenario for its adoption and the cash changeover.
December 1996	The EMI presents specimen euro banknotes to the European Council.
June 1997	The European Council agrees on the Stability and Growth Pact.
May 1998	Belgium, Germany, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland are considered to fulfil the necessary conditions for the adoption of the euro as their single currency; the Members of the Executive Board of the ECB are appointed.
June 1998	The ECB and the ESCB are established.
October 1998	The ECB announces the strategy and the operational framework for the single monetary policy it will conduct from 1 January 1999.
January 1999	Stage Three of EMU begins; the euro becomes the single currency of the euro area; conversion rates are fixed irrevocably for the former national currencies of the participating Member States; a single monetary policy is conducted for the euro area.

Actually economic integration is focused on integration new Members Countries into EURO currency system according to Basel II agreement. The Basel II agreement contents criteria for access of new countries (exactly said economics of these countries) into zone of the unique European currency.

2.4. The Czech Banking Sector

How does the Czech banking Sector look? Short overview of main characteristics of the Czech banking sector:

- total of 35 banks (9 of which are branches),
- total banking assets - approx. 100 billions USD,
- three large banks dominate the sector (approx. 58% of total banking assets),
- expanding range of products and services: esp. detail business, SME lending,
- capital adequacy around 14%,
- sector is mostly controlled by foreign entities.

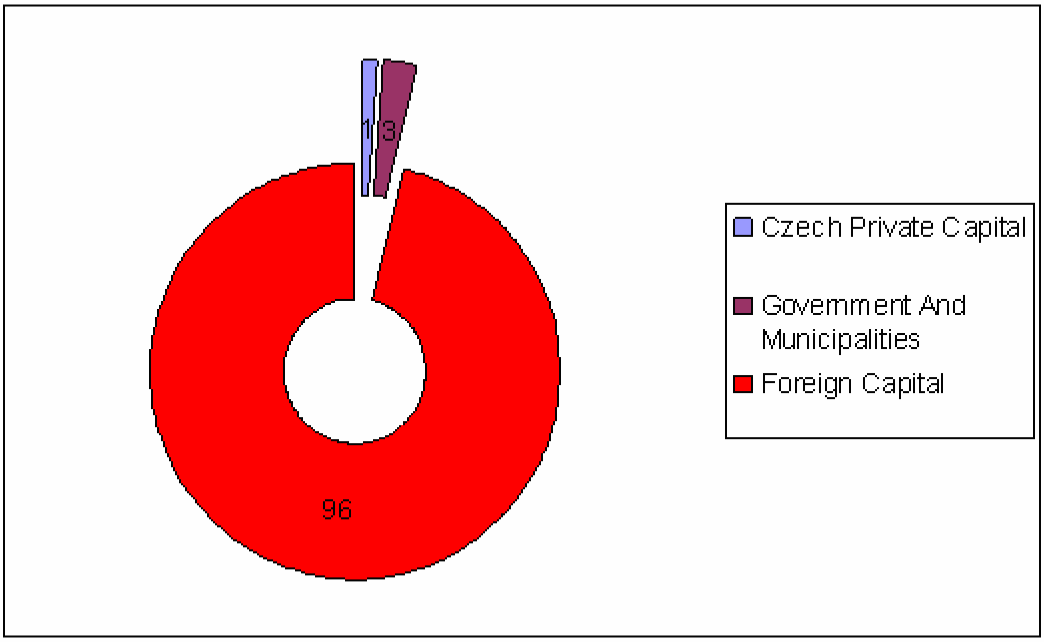

Figure 1 - Who Controls Czech Banks?

Banks and ECB are not only financial institutions in the old significance and sense but also it became also donators for scientific, research and development work.

2.5. Financial Sector as Research "Institution"

The goal of economic research at the ECB is to provide a strong conceptual and empirical basis for policy-making and to better communicate policy to the markets and the public. High-quality research is essential to ensure that the ECB is well equipped to cope with the unprecedented challenges associated with conducting a single monetary policy for a group of sovereign countries. The most important task of economic research within the Euro system is to increase knowledge of the functioning of the euro area economy and, more specifically, to provide models, tools and analyses relevant to the conduct of monetary policy and the fulfillment of other tasks of the Euro system.

[Mar_04]

Financial institutions are contemporary not only cold stone companies they became also sponsors of scientific and research work - example of the ECB.

Five years after the establishment of the European Central Bank (ECB) on 1 June 1998 its Executive Board decided to request an independent external evaluation of its economic research [Mar_04]. Such timing seems appropriate for a first assessment of the strengths and weaknesses of the research activities carried out by the various ECB business areas. For the purpose of the evaluation research is defined as the set of activities leasing to economic analysis which strives to be up to academic standards, i.e. up to the standard of leading-edge scientific journals. According to the Terms of Reference, the goal of economic research at the ECB is to provide a strong conceptual and empirical basis for policy-making and better communication of policy to the outside. The primary objective is to increase knowledge of the functioning of the euro area economy and, more specifically, to provide high-quality models, tools and analyze relevant to the conduct of monetary policy and the fulfillment of the other tasks and functions of the ECB. The secondary objectives include harnessing its value in creating a stimulating intellectual environment to attract and retain top professionals and, more generally, to maintain and develop the human capital of the staff.

Main topics of the research are:

- monetary policy,
- economics,
- monetary policy improvement into economics and trends reactions,
- econometrics modeling.

There are several ways to measure the quantity of research produced at the ECB, but the most natural starting point is to count working papers and publications in scientific journals. The working paper series aims at disseminating research by ECB staff, visiting scholars and participants in ECB conferences and workshops. The papers constitute work in progress that is circulated externally to stimulate discussion and critical comments before they are submitted for publication in academic journals and books. The number of ECB working papers has followed an upward trend.

Table 1 - Number of Published Papers in the Frame of the ECB Research Activities [ECB_xx]

Year	Number of Papers
2001	73
2002	88
2003	97

To separate the contributions of the different Directorates and that of outsiders ECB allocated the authorship of each paper proportionally to the number of co-authors. According to this accounting, 24% of the working papers published in the last three years were produced by DG Research, 20% by DG Economics, 4% by staff in other business areas, and 52% by outsiders (of which about 1/3 were co-author ships with ECB staff).

By this way banks (not only commercial ones) and financial institutions support and influence research, scientific and educational work in their countries.

3. At Last But not At Least – Education

Nowadays is running completely fundamental reorganization of the whole education system in the Europe. I do not know if you have the same feeling, but according to my experience especially universities have lost their extraordinary positions in local region. Higher education, in the contradiction to the basic education, has got universal character. Not only in the dimension of information and knowledge, but also in the aspect of the place where it is realized. It does represent general trend that especially universities, are under increasing competition. Students could be thought as well in Prague, as well in Bratislava, as well in Vienna with almost the same results. The quality of education is no more depending on the place, where the University is located, but on the personal resources – on teachers, that are involved into the education process. Future quality of the education on certain university depends on international contacts and of course …… on actual conditions – especially technical, financial and for some specializations also on technological. All these above mentioned facts lead to integration process. Because responsible managers for the future at universities have to find out on one hand well educated, skilled and flexible experts for performing the education process and on the other hand they have to evoke an interest by perspective students. For both categories must not be borders their limits – with all consequences as language ability, different culture awareness, flexibility, fast reaction on problems, structural a systematic approach to problem solving and decision-making process etc.

3.1. Business Informatics – Common Curriculum

About one year ago (March 2004) started under the name BIN-Net: Business Informatics, Network in Common Europe, 28545-IC-1-2003-1-AT-ERASMUS-PROGUC-1 common project among 10 cooperation universities in 8 countries. The responsible partner for this project is University of Vienna namely professor Dimitris Karagiannis and following countries take part in this project (in alphabetic order): Czech Republic - University of Economics, Prague, Hungary – University of West Hungary, Sopron, Ireland – Dublin City University, Poland – Wroclaw University of Economics and Gdansk University of Technology, Portugal – School of Technology of Setúbal, Romania – University “Lucian Blaga” Sibiu and University Politehnika of Bucharest, Slovak Republic- Comenius University of Bratislava. Main Idea of this project is to develop common university curriculum for master study program in informatics – especially in Business Informatics for all participants. It is not so easy to prepare courses and content of common study in eight different legal systems. Legal systems are one of the most important barriers on the way to co-operate not only in the area of education. Convergation of legal systems is important challenge on the pilgrimage to integrated Europe – and not only in education. We have directives on the European Council, but lower level of legal norms is represented by regional valid acts, directions and laws. Our main selected problems in common curriculum preparing are following facts:

- actual different status of the master degree education level in different countries (Portugal – 4 years bachelor and additional 2 years, Ireland 4 years bachelor stage and 1 year master, others 3 year bachelor plus 2 years master) – realization of Bologna declaration model in the reality,
- different credit donation of the mater thesis work on different universities (example – University of Economics, Prague -6 credits, University of Vienna – 30 credits),
- to unique different rules for examination, especially for final examination of the study program,

- to harmonize criteria for evaluation of final master thesis work,
- what kind of education certificate will be issued (Diploma) and technical aspects of it's issue,
- different content of courses with the same name on different universities – it is based on different terminology and on different research and knowledge back ground.

On the following picture is for the first time published general proposed schema of courses in the common Business Informatics curriculum.

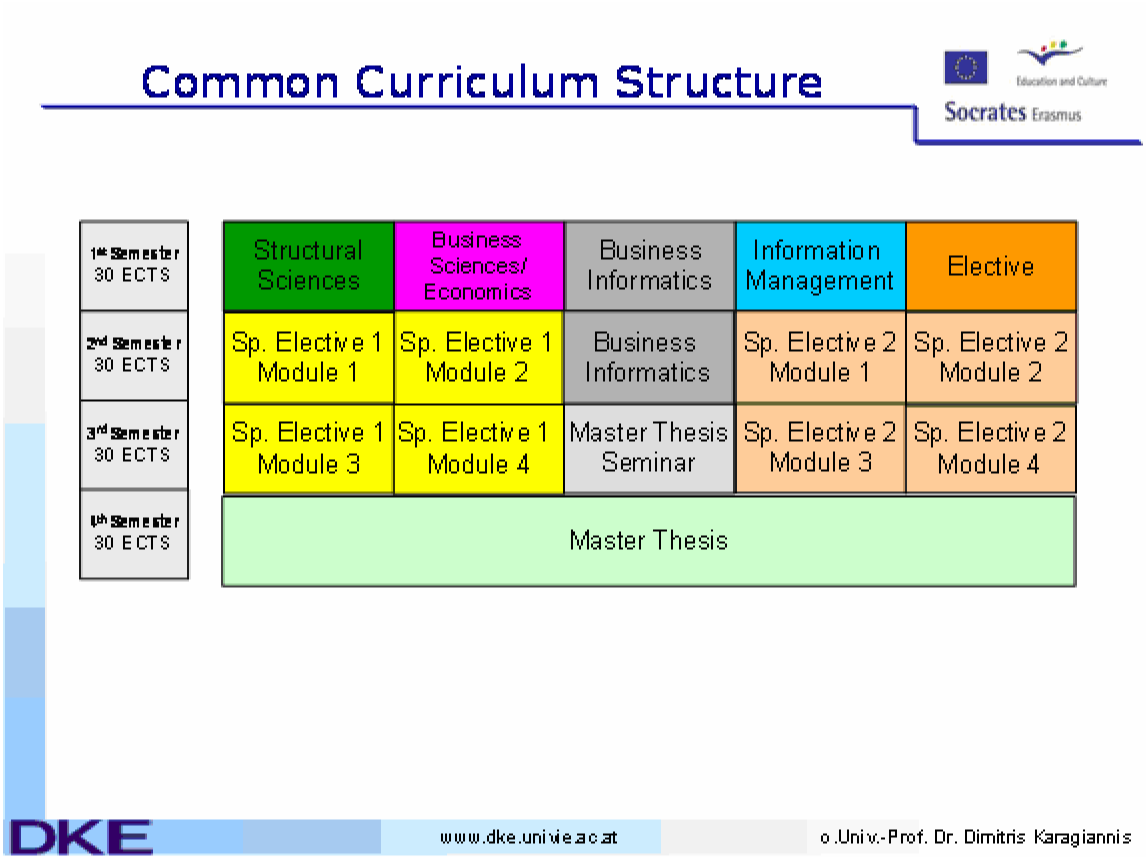

Figure 2 - Schema of the Common Business Informatics Curriculum

Each row of this scheme represents one semester of the Business Informatics master study program. Because students have to fill requirements in this study program on different universities and in different conditions, the structure of the whole program is split into modules. Each module has its own syllabus. Syllabus represents a consensus of ideas all participant universities what could be presented in this course, what minimum of information will get a student. Syllabus is like a general umbrella for various courses. For example requirements on module "Structural science" could be fulfilled by partial different courses on different universities in different states. Each „umbrella" could be realized by a little different courses in and according to specific conditions on certain university. This approach supports the right and correct competition between universities on several fields of scientific, research and development work.

By this way designed curriculum offers opportunity for a large scale of mobility of academic staff as well as of students. This process of convergation will be accelerated by using modern “lingua franca” – English - for teaching selected courses at all universities. Main idea of this project is not to **unique** education at all participating universities but to **realize common visions** regarding:

- level of education,
- general concept of education – main streams, specializations, profile, type of courses etc. and by this way to supply to the market economy by it required type of managers and experts,
- conditions for european mobility students at all levels of study (bachelor, master and Ph.D.) as well as a mobility academic staff.. By this way to remove barriers of the existing information society as fear of new technologies, process, approaches, habits, nations and persons that are entering very assertive into everyday life of the European Community.

New competitive advantage for students that will study according to this curriculum is European join diploma. This diploma is a new element on the education market. There are regularly issued diplomas by each HEI (Higher Education Institution) up to this time. Difference of a join diploma in a comparison to classical ones that is issued by one institution (the member of the consortium of HEIs) and the validity of it is general for all participant institutions (EU member countries) as it will be issued by each HEI of the consortium. It does represent that diploma issued in for example in Austria will be valid **without special nostrification process** in another states of the EU, where is located other or others members of the consortium – for example in Ireland, Portugal etc. This tendency in academic degrees was formulated at the conference of european ministers responsible for higher education in Bergen in May 2005 [Ber_05]. This idea is relative new and it does mean that is not, thanks to the different legal systems in EU countries, full worked out. There are only common ideas how to legalize this joint diploma but a lot of work must be realized to achieve the final goal.

To this Bergen conference were welcomed former U.S.S.R countries Armenia, Azerbaijan, Georgia, Moldova and Ukraine as new participating countries in the Bologna process. To these countries could be focused. The project goal – to prepare Business Informatics common study program – is in the phase of defining and improvement of the content of each “umbrella“. Contemporary with the process of preparing of umbrellas is running the process issuing study certificates – Diplomas.

4. Conclusions

Integration process contents a variety reduction inside and contemporary complexity intensifying [CHA_67]. Let us integrate but do not remove variety from our life. Integrate but not unique. There are visible tidings from the dark history. Our old continent was important player on the playground of the human existence in last two thousand years thanks to the variety. There were different leading nations as – Greeks, Romans, Portuguese, Spanish, Englishmen, Frenchmen, Germans, etc. - in the Europe in the past years. Nowadays has been appeared completely new situation – there is arising a chance for Europeans – internal cultural different “nation” - but they have to collaborate one to each other and all together. If they miss their (Better said if we miss our) opportunity, the place of the Europe will be on the margin of world’s activities in the future. It is our challenge to save hope for our continent and to push reality ahead.

5. After Conclusions - For Discussion

Following themes and topics were suggested for discussing and for presentations at this session:

- **information technology** – a transfer of the same technologies applied in the EU into different conditions and cultural habits in the rest countries of the Europe and the world (developing countries and countries of the former U.S.S.R.); common development of new technologies, using metrics in IS/ICT,
- **business models** – applying classical and new business models developed in founder-member countries of EU into new-member countries,
- **business without borders** – e - commerce activities, it’s realization and limits in common economic space,
- **finance and financial services** – EU became an organic space for development, advertising and improvement of banking and other financial services for all citizens of the EU with a respect to specific features of each country and population’s habits,

- **rebuilding and rethinking of public administration** – public administrations at all levels has challenge to exploit new technologies to make information for the whole population in the EU accessible as possible,
- **IS/ICT security models** and secure behavior in integrated European information society - what is the real situation concerning IS/ICT security realization and author rights violations using IS/ICT,
- **education process** – content and procedures; what is the essence of education process; is unification a right progress in this activity; Does the variability of the European education system represent a real advantage in comparison to the American one?
- **human and cultural aspects** - changes accelerated by integration process.

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SMALL IS BEAUTIFUL – NOT FOR EUROPEAN COMMISSION!

Critical Remarks on the Framework 6 Programme

Gerhard Chroust [1], Erwin Schoitsch [2],
Günther Zoffmann [3], Wolfgang Zuser [4]

In many instances European researchers and members of small enterprises (SMEs) do not get the feeling to be adequately considered by the European Commission (EC). This holds to a large extent for participation in the EC's research programs, especially the 6th Framework Programme. This paper presents some issues which make it difficult for small companies (SMEs) or small university institutes to participate or especially coordinate a research project under the 6th Framework programme.

1. Background

The recent votes on the constitution have drastically shown that individuals do not get the feeling to be adequately considered by the central administration of the European Union Commission (EC). The same sentiment share researchers in small university institutes and practitioners in small enterprises (SMEs) considering participation in an FP6 programme. From the information available on the 7th Framework Programme this situation seems to become even worse, introducing even more imbalance between large and small potential submitters of research projects.

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Having successfully coordinated and finished a rather large Framework 6 Project on component based software development (OOSPICE, 2000-2003 [10] [14] [15]) and having participated in the large ESPITI-project (1995-1996 [1] [2] [3] [9] [12] [11]) and the smaller SPIRE-Project (1997-1998 [4] [13]) one wonders whether the EC still means to support and encourage small enterprises, and for that, small university institutes, to participate in framework research projects. A recent Press release [16] deplores that the EC is seemingly ignoring the predicaments of the SMEs with respect to participating in European research.

Even assuming that this is not done on purpose, the facts listed below definitely show that the EC's decision makers of the Framework Programme framework programs show a considerable lack of understanding and sensitivity with respect to the position and stakes of SMEs and small university institutes when participating in Framework projects. It seems that the SMEs are falling into oblivion by the architects of FP6 and FP7, in contrast to earlier programs (FP4 and FP5) as the projects ESPITI and SPIRE have shown. In the sequel we will demonstrate by examples the adverse conditions and predicaments under which SMEs have to take part in the Framework Programs.

2. Examples of disadvantages for SMEs

If a SME takes part in an FP6 project (or even dares to venture into coordinating such a project) it will soon find out most of the problems listed below.

Writing a proposal: The amount of work to write a proposal is enormous. It starts with wading through heaps of documents describing in often horrendous legal language what the EC expects. There are clauses and sub clauses, not even following a consistent pattern. These texts also contain some essential keywords the EC wants to read in the submitted proposal, whether they convey a true achievement of the proposed project or just some lip service is of secondary importance. But forgetting them can be a killer for the submitted project. Equally difficult is the understanding of some of the legal statements, typically the Intellectual Property regulations rules are extremely difficult to understand - especially for people not having English as their native tongue. The same hold for the rules for cost models, try to understand exactly what eligible costs are what are not. Or the famous category of 'Other Costs'.

Selective opening of Calls and strict deadlines: Does the Commission really think that splitting an idea and a program's vision into many different calls helps Science or only the EC? The effect is that a topic on which one works will be 'massaged' into the next call, if one missed the 'most fitting call' by perhaps one month. This definitely does not contribute to scientific honesty. Large companies have probably a better portfolio of projects to be submitted in answer to a call. What is worse, there are very strict deadlines. If something goes wrong, e.g. a partner takes too long to get his partnership agreement signed by his distant superior (the 'signatory') then the window of opportunity is over. Every scientist knows that often when putting together a proposal and discussing with the partners, new and better ideas spring up. Either you ignore them for the project or you miss the deadline and there will be no other similar call...

Why are there high lower levels for project budgets? Currently it is not really possible to define a small project of international European context, with high class partners, due to rather high minimum project sums.

Inflexibility of contracts: Real research work cannot guarantee the outcome and much less the effective direction of the project. This means that over the course of project partners might leave, new partners might be invited to join the project. Changing partners is a pain in th4 next. There is easily one person month administrative effort for such an event. Even if a partner is only a suborganisation of a larger institution which is in tot bought by some other organisation, all contracts have to be rewritten, signed in original by the signatories again, who are some often distant vice presidents or the like, have changed etc.

Ignore diversity: Despite the beautiful slogan 'unity in diversity' the EC rather prefers 'unity in monotony': Despite different programs and different structures of individual university institu- tes, the EC allows only one cost model (AC or FC) for all institutes of a university: is this the famous diversity?

Is networking and mobility really scientific research? The EC promotes Networks of Excellence, having 100+ scientists - but it pays almost exclusively travel money. Do they really think that this promotes science and competition against the USA?

Big is NOT beautiful: The EU goes more and more for LARGE projects, both with respect to number of participating scientists and the size of the budget - hoping to reduce the administrative burden. But a small university institute cannot afford to coordinate such a monster! It is not the prime purpose of a university institute to be an administrator! This means that these large networks (NOE) will more and more be usurped by large business (SIEMENS, Telecoms, etc.) which then keep the small university institutes as their work horses.

Discretionary power of the EC and the project officer: One cannot always wait until an EU decisi on is made - and often the EC reserved the right to change the rules during the course of the project - only at the end one finds out that some costs are not reimbursed. The 'big players' definitely' have advantages. They a professional staff writing and admonishing several projects a year - so they know. Secondly if there is some misunderstanding with respect to some cost, a big company can easily accommodate the loss - not a small institute or a SME.

Invisibility of additional personal efforts: Academic staff at the Universities usually contributes a significant amount of personal effort to projects. Since most Universities have to adopt the additional cost model, this effort is not even visible, let alone reimbursed at all in financial terms. The rule of the EC is that only staff explicitly hired for the project can be reimbursed. Knowing university customs the added work for the permanent staff is additional work beyond the official 40-hour week.

Value added tax: VAT is not reimbursed by the EC. While the national tax is usually refunded by ones own government, non-national VAT is left to be carried by the SME. From experience the non-national VAT can be considerable, both when buying tools and software in abroad or paying for hotels and meals.

Unproportional costs: Lately the EC has started to request audit certificates from partners, irrespective of the amount they will receive. At least in Austria such certificates are not cheap: 1000 e is not extraordinary, and if you have a 10.000 e share of a project - you are probably already in the red.

Hourly rates and monthly pay: The EC insists that they pay only those hours actually worked on the project, the famous ’hourly rate’. A longer duration of absence (e.g. 5 weeks of vacation taken in sequence) means that the actual hours of work drop dramatically for this period and the hourly rate (based on the constant monthly salary) increases considerably. If there are no hours worked in a period the hourly rate would be infinity! Recalculating and reimbursing on the basis of effectively worked hours, while the contractor has to pay in equal monthly is either senseless or asks to ’play games’ with the monthly rate. Both are neither in the interest of the project nor the EC. A simple calculation (based on 6 month reporting periods) shows that if an employee takes (Austrian social regulations) all 5 weeks of vacation in July and a few extra days at Christmas, then the factor for the hourly rate would drop between the first and the second six month by some 28%. One wonders why nobody in the administrative staff ever recognized this problem.

Hourly rates and illness: Most (all?) project employees have to get a legally valid contract, which usually is paid on a monthly basis. It covers holidays, vacation and sickness. Given current social security in Europe this means that the monthly pay is due even in case of severe and long-lasting illness. With the EC’s concept of only paying actually worked hours, this means that this will essentially come for the pocket of the poor institute having erroneously hired somebody who fell ill: rather inhumane position of the EC and a real danger for SMEs - not for a large enterprise!

Insufficient financial support at project end: The terms of payment under FP6 are such, that at the end of a project some 20% to 25% of the budget spent by each partner is retained by the EC, often for several years. The is due to two facts: the EC retains 15% as a guarantee sum until all checks are done. Additionally the reimbursement of the last cost statement takes also several month. A small university institute or a small company cannot finance this gap on its own; the interests alone could be a financial killer! This means that SMEs get at a disadvantages in comparison to large enterprises like SIEMENS, NOKIA, Telecoms etc. For them it is no problem to wait for 25% of a project which is small compared to their total budget.

3. Lessons learnt with respect to SMEs

From the authors's participation in many successful and unsuccessful project applications several observations with respect to SMEs can be made [5] [6]:

- SMEs can only be 'lured' into a improvement project only by a strong 'umbrella-organisation' which [7] [8] [11] shields them from practically all administrative overhead [5].
- Typically the effort to submit a proposed should be near to zero due to the limited chance that the proposal will be accepted and the hard deadlines for submissions, which very often then to be sacrificed in favour of some customer-oriented effort.
- SMEs must be induced to "see the project through" despite of urgent fire-fighting needs at the customer front. In the SPIRE project this was achieved by handing most of the cash refund only at the successful project end and also paying consultants to help the SME. These persons also acted as a 'whip' to make the SME continue.
- SMEs want a clear cut road map of how to proceed. This road map should also have a high fragmentation robustness. Interrupting the project in favour of some urgent customer related work should allow for an easy to do, orderly return to the project.
- SME-oriented project set-ups must be able to deal with 'person fragments', small slots of time a employee of an SME can devote to the project

4. Summary

The observations above are in definite contrast to the paper ideals of the EC - nearer to the citizen¨and should rather be labelled nearer to the Board of Directors"(something which surely contributed to the French and Dutch vote and some disillusion in Europe.

So what we see is that central administration in the EC seems to move further and further away from the SMEs and the small university institutes, providing a good hunting ground for the large players like SIEMENS, Telecoms, etc. Assuming this is not done on purpose one start wondering what the economic and practical understanding of the architects for these 'big' (not 'great') programs is.

It has to be admitted, that there is a definite need for large European projects bringing (forcing?) large European industrial players to work together. Not involving the SMEs at the same time - in our eyes- jeopardizes a true European dimension. We need some grass root European dimension. The large players, NOKIA, SIEMENS, Telecoms, etc., do not need the European dimension - they are already European in their one setup, they perhaps need European coercion to work together!).

Thus the question remains: Do we want a Europe of all enterprises or just the Europe of a few large ones? And all the nice words about SMEs are just a lip service?

The obvious answer should be: we do need both. This, however, implies probably two different types of support and funding instruments ('diversity in unity'!). An appropriate set-up for attracting SMEs might need more thinking, creativity and willingness to go unusual ways by the EC and its funding organisations. If the current scheme will be perpetuated with its weaknesses the scientist will (and already have) adapted to these conditions, but - how much frustration and empty kilometers is the cost of not catering for the real need of the SMEs and the small enterprises.

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Cooperative Information Environments

COOPERATIVE INFORMATION ENVIRONMENTS

Building Blocks for Next Generation Cooperation Systems

Konrad Klöckner [1]

The key aspects of the rapid evolution of information and the new potentials for communication between people in the last decade were the increased availability of computer networks and the trend towards teamwork. One of the main domains of Applied Informatics in the field of Distributed Systems is computer support for teamwork. 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. This paper presents an overview on next generation of collaborative environments. We introduce some basic ideas of ubiquitous computing. After this we give some examples how RFID techniques are helping to build those ubiquitous computing environments. We show how to build collaborative virtual environments and finally report on the design of toolbar support for collaborative web-based communities.

1. Next Generation Collaborative Environments for Mobile Work

The emerging new technologies and their diffusion will significantly influence the lifestyle as well as the work capability. The future work life will be characterised by mobility which requires sustainability from individual, economic and social perspectives. In order to provide true mobility of work places innovations in different areas are demanded. This research will address these areas such as the future vision of mobile work, the enabling technologies roadmap and the technology

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trends and visions. The results will provide us with a deep understanding of the nature of mobile work and its enablers (MOSAIC, [12]).

Unless the rise of teleworking, most of the work today is still carried out in fixed locations and during fixed time periods. The more information-intensive, the better chances for work being carried out on a distance or mobile, and in collaboration with others. Decreasing cost of communication has stimulated the development towards decentralisation and networked organisations to a considerable degree. Mobile technologies are providing a new generation of possibilities. But practical bottlenecks are many, and further innovation towards mobile workplaces requires new ways of working and new ways of decentralised organising, new collaborative and information sharing behavior of the worker, but also new styles of coordination, leadership, motivation and trust-building, and even new regulations at the societal level. Therefore the actual work setting will be the result of a balance between forces operating at different levels: the work requirements, the worker needs, organisational factors, industry developments, societal policies, and technological opportunities and bottlenecks.

Empirica [5] developed a useful categorisation of five types of mobile work as they are currently found in practice:

- *On-site movers* carry out work requiring movement around a certain site. Examples are workers in different places inside an office or on campus, security agents watching sites, and hospital doctors visiting patients.
- *Yo-yos* are occasionally working away from a fixed location, in temporary workplaces. Examples are work on business trips (in meetings), field work (e.g. interviews); working during travelling; working on emergency service, working on customer premises (mobile engineering and maintenance).
- *Pendulums* include alternate working at two different fixed locations such as the office and at home. This form would cover the classical forms of telework.
- *Nomads* refer to people who constantly are working at changing fixed locations, moving from one location to the other. Examples are: field sales forces, but also managers changing frequently to different locations.
- *Carriers* are working on the move transporting goods or people. Examples of carriers are train conductors and deliverymen. Emphasis in this typology is on the individual worker,

whereas mobile and multi-site group work will be an important model for the near future. The yo-yo and the nomad type would be the forms most related to that.

Taking an extensive list of criteria that was developed by Empirica for the purpose of distinguishing between basic types of mobile work and combining these criteria into two central ones, the number of work locations and the frequency of changing location, we now get the simplified portfolio of mobile work as presented in Figure 1.

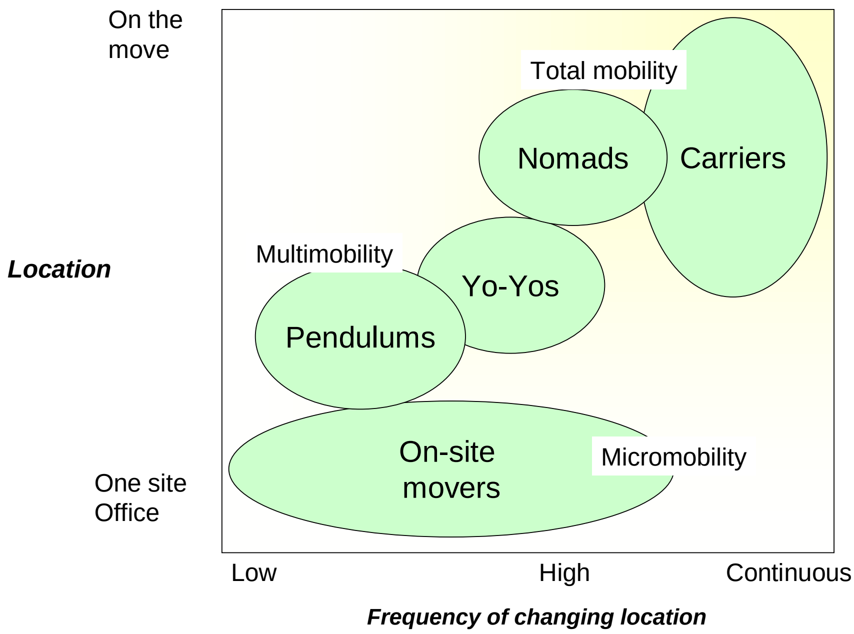

Figure 1 - Characteristics of mobile work [5]

In manufacturing sectors such as **electronics and automotive**, shorter product life-cycle require new capabilities to deal with a situation of faster product development and rapid switching between product families.

The **aerospace industry** to a growing extent is organised as a distributed virtual organisation, which has complex characteristics compared to other sectors.

For the **building and construction industry**, mobile technologies can play a crucial role in order to increase communication among workers, organize work more efficiently and reduce process cost. Finally, in a service-oriented sector such as **healthcare sector** it is experienced pressure for change from the inside (continuing innovation expanding the available methods and tools, increasing organisational complexity) and the outside (increasing demand for citizen empowerment, need for cost reduction, evolving implications of demographic changes like ageing).

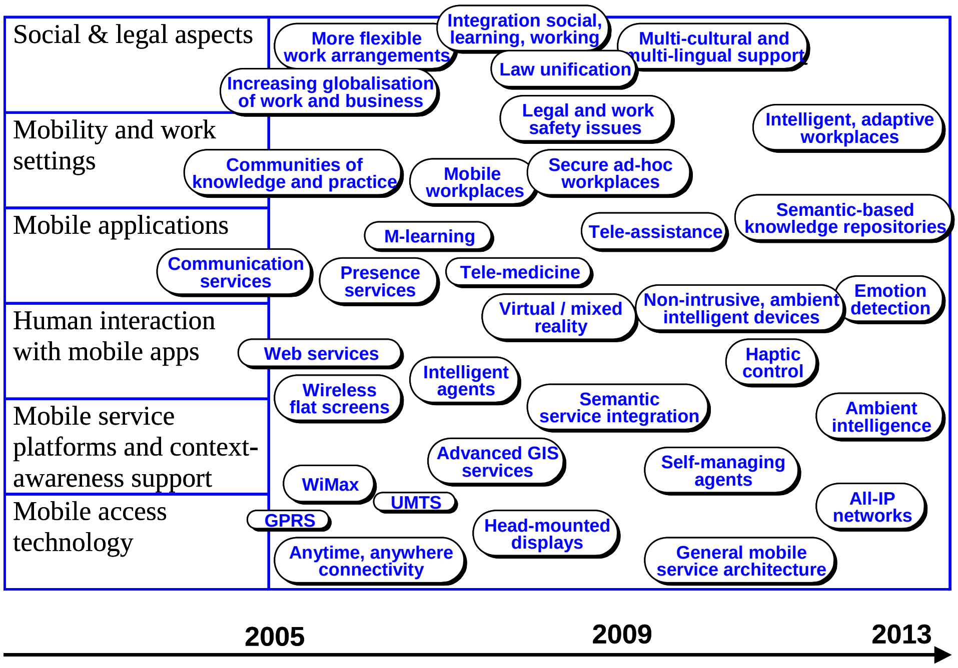

Figure 2 - Initial roadmap for mobile work (MOSAIC, 2004, [5])

Mosaic is an IST funded Scenario and a Roadmap project funded by the IST in the 6th framework program under the Strategic Objective of 'Applications and Services for Mobile workers and Users'. Mosaic is projecting Visions for sustainable Socio-technical Innovation for Mobile Work in Europe (Figure 2).

Key objective of the MOSAIC project is to accelerate innovation in Mobile Worker Support Environments. Mobility at work place is one of the most demanding features for professionals.

2. Ubiquitous Computing

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it. … Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence." (Mark Weiser, [8])

A few years ago in an interview, Mark Weiser, the intellectual father of ubiquitous or pervasive computing—the omnipresent computer—said: "Why shouldn't we obtain digital information from our environment, from things that are familiar to us? I truly believe that soon our clocks, furniture and chairs will all talk with one another over the Internet. The big problem is that today everything still runs through the PC, through this narrow channel between monitor, keyboard and mouse. That's unnatural."

Weiser, who worked as chief technologist at Xerox's Palo Alto Research Center (PARC) in the early 1990s, wanted to be surrounded by "things that think"—as Nicholas Negroponte, one of the guiding intellectual forces at the Massachusetts Institute of Technology, once put it. Equipped with microchips, these "things" were supposed to communicate with one another wirelessly. Microchips were to be put in clothing, book covers, light switches, pacemakers, conveyor belts, and just about anything else of value. But Weiser, who died in 1999, made one suggestion that made his "thinking things" scenario particularly elegant: "The best technology," he said, "is invisible." In the case of wireless communication, we are not very far from achieving Weiser's goal. Technologies such as Bluetooth, DECT, wireless LAN and, for greater distances, second and third generation GSM, GPRS, UMTS mobile networks are already here. The Internet is also well on its way to becoming a ubiquitous communications medium. Thanks to the TCP, IP, HTTP and HTML Internet standards, users are able to communicate with one another wherever they are. An example from telemedicine makes the problem clear. In the future, it is expected that a range of sensors in a "body area network" will record parameters such as blood pressure, respiration and heart rate. As researchers picture it, the data would first be stored in a hospital, retirement home or private home via radio, then processed and transmitted to a control station, doctor or provider through the fixed-line network or via satellite. But all of this presupposes reliable, real-time data transfers [11].

An additional challenge is the variety of terminals that are designed only for certain applications and have thus far been able to interact with one another to only a very limited degree. These range from sensors to cell phones, organizers and multimedia computers.

- Today's networks do not provide optimal support for applications. For example, when a user loads a video sequence onto his or her cell phone, the image dimensions should be adjusted automatically. Today they are not.
- Today's information highways lack intelligent traffic control systems that are able to circumvent bottlenecks and guarantee fast data transfer.
- Today's networks are heterogeneous and operate in isolation. This leads to different billing systems and a lack of transparency, among other things.

Figure 3 - The world of Ubiquitous Computing [11]

Ubiquitous computing would, in principle, make it possible to create detailed pictures of each person's interests, affinities and weaknesses. Today, "IT monitoring" can provide only snapshots of what we do, where we go and what we buy. But in a world of ubiquitous computing, the picture could be far more complete. The distinction between online and offline would fade to insignificance. Could people opt out of the ubiquitous network? How can abuse be prevented? How can effective identification and authentication be achieved without compromising privacy? According to Sokol, providers, manufacturers and service companies will have to overcome these challenges together over the next few years.

Whether or not and to what degree those new technologies may be integrated into our everyday life is quite hard to estimate. As we have already seen, there are some areas like in cars or in museums with its virtual guides some ideas have gone into practice. For other areas we have only research projects and a few prototypes [4]. The acceptance by end users is depending on a lot of conditions like simplicity of use, the price for devices, its reliability and their functionality – only to name a few. Some very few will become accepted and will be used by the majority of the people, like mobiles are widely accepted today. Many others won’t leave the status of a prototype.

3. RFID Technology

Radio frequency identification (RFID) is the short term for a technology similar in theory to bar code identification. With RFID, the electromagnetic or electrostatic coupling in the RF portion of the electromagnetic spectrum is used to transmit signals. An RFID system consists of an antenna and a transceiver, which read the radio frequency and transfer the information to a processing device, and a transponder, or tag, which is an integrated circuit containing the RF circuitry and information to be transmitted [9].

Figure 4 - The RFID antenna (Photo: Metro Group [9])

RFID systems can be used just about anywhere, from clothing tags to pet tags to food -- anywhere that a unique identification system is needed. The tag can carry information as simple as a pet owners name and address or the cleaning instruction on a sweater to as complex as instructions on how to assemble a car. Some auto manufacturers use RFID systems to move cars through an assembly line. At each successive stage of production, the RFID tag tells the computers what the next step of automated assembly is.

A method for uniquely identifying an object is using a tag or module that carries a unique ID number or code. Identification can be made using wireless (RF, or radio-wave) connection, meaning no line-of-sight or physical contact is needed. There are many different ways to achieve RFID and many applications including pet ID, identification of parts on an assembly line, tracking goods in manufacturing or retail settings, etc.

Currently, most material tracking systems employ two-dimensional barcodes that must be close to and within the "line of sight" of the barcode reader. This requires manual scanning or a conveyor-like process to position the barcode and scanner. Barcodes can run the risk of getting wet or scratched due to mishandling or a harsh environment, which often prevents accurate reading by the scanner. Manual intervention is labor intensive, costly, and error-prone. In addition, scheduled scanning or manual methods cannot ensure the inventory remains up-to-date, due to oversights, errors, and internal shrinkage.

Two examples show some interesting application areas for RFID support:

- Management of inventory of automobiles in new and used car dealerships and in rental car lots,
- Patients/doctors management in a hospital environment.

With RFID solutions, inventory can be updated in real time without product movement, scanning or human involvement. An RFID automated system allows inventory status to be determined, and shipping & receiving documents to be generated automatically. The system could also trigger automatic orders for products that are low in inventory.

- Benefits of using RFID systems:
- Provides total asset visibility
- Gives full inventory history
- Allows reduced inventory-stocking levels
- Facilitates "Just-in-Time" deliveries
- Provides full process control for products in the facility
- Shortens cross docking time
- Speeds up sort/pick rate
- Reduces shelf space
- Provides higher-level security
- Reduces errors

RFID technology provides a hands-free access control solution with many advantages over traditional access control badges and systems. With conventional systems, such as bar code, magnetic stripe, and proximity readers, user must handle the badge and place it close to (7-30 centimeters), or make physical contact with the reader. ActiveWave's unique RFID access control technology allows the user to enjoy complete hands free access control. RFID access badges can be read up to 5 meters from the RFID reader, which usually eliminates the need to handle the badge or walk very close to the reader. This freedom is particularly important to handicapped workers, when carrying packages, and during inclement weather.

To make installation simple, many RFID readers can connect to the access control computer through wireless communications. This eliminates the need for long wiring runs and allows a reader to be easily re-positioned or moved as needs change. The RFID access control system can report any unauthorized access and issue an alert to the host software. In addition, it can be used to trigger cameras and video recorders in order to capture unauthorized or authorized access in real-time.

Radio Frequency IDentification technology provides the means to track any object, any time, anywhere. A major consequence of this technology is that the existing Information Technology systems, applications and processes have to be retrofitted to have RFID-awareness. Many new systems and applications have to be developed while the technology and standards are still emerging. These will be driven by dynamic business processes and therefore have to be agile, and easy to modify and use by a business user.

4. From Virtual Reality to Collaborative Virtual Environments (CVEs)

In augmented reality the computer provides additional information, that enhances or augments the real world. The user can interact with the real world in a natural way, with the AR-system providing information and assistance. Therefore, AR enhances reality by superimposing information on it rather then completely replacing it. The information can be inserted in a context-dependent way, i.e. derived appropriately from the visualized object. Among others, AR could therefore act as a substitute for the traditional assembly manual [10], for example by inserting assembly instructions into the field of view of a person per-forming an assembly task (see figure 5).

Figure 5 - Inserting assembly instructions into the field of view [10]

Collaborative Virtual Environments (CVEs) extend the capabilities of virtual reality to a new dimension. CVEs are computer-based worlds that can enhance and expand our ability to communicate with others and collaborate on the creation and exploration of data. They are a complement to existing tools that support human-human collaboration. Many computer-based tools for communication and collaboration (such as email) focus on the passage and sharing of content and assume a baton-passing, cooperative model of human-human interaction, that is, individual content creation, manipulation and editing, with asynchronous content exchange and mark-up. Where synchronous communication is supported, tools tend to target the data to be shared (distributed whiteboards) or give primary focus to the human-human communication itself (chat spaces). In all cases, the presence of people along with the data is very limited (e.g. static images, shared telepointers). By contrast CVEs focus on putting interactive, dynamic representations of data and people into virtual landscapes and offer rich mechanisms for navigation, exploration and communication. CVEs can be graphical or textual. They can be task-specific - supporting a focused set of actions over carefully rendered data sets - or can be task-independent - offering editable spaces wherein objects and data are created, modified and acted upon by their inhabitants. CVEs can be entirely computer-based, or can be include elements of the physical world, forming "augmented" or "mixed-reality" spaces. Thus, CVEs have been designed and developed that can support exploration, communication and collaboration between people who are physically remote but co-present in an entirely computer-generated world. CVEs also exist that allow people who are physically co-present to share views of metadata, people and objects that are projected into the physical world.

A *multiscale Collaborative Virtual Environment* (mCVE) is a virtual world in which multiple users can independently resize themselves to work together on different sized aspects of very large and complicated structures. Interactions among users in an mCVE differ in many ways from those in traditional collaborative virtual environments. In this paper we explore collaboration related issues affected by multiscale, such as social presence, perception of proximity, and cross-scale information sharing. We also report results of an experiment with our mCVE prototype system, which show the impact of multiscale capabilities on social interactions.

Collaborative virtual environments (CVEs) have become an emerging tool in supporting research, training, education, and community activities. Many CVE systems are designed for the purpose of using VR technologies to enhance our real world experiences. While many virtual environments

(VEs) are designed to simulate reality, it is often valuable to consider how VEs can go beyond reality. Many constraints of everyday physics do not exist in VEs.

An mCVE could be a prominent tool, for example, in the support of cross-scale collaboration in scientific research, where increasing complexity requires collaborations among scientists from a variety of fields. The traditional research focuses of individual disciplines are often on different length scales, so cross scale collaboration may be needed in cross-disciplinary research. For example, the analysis of metal cracks may need collaboration among people from engineering, materials science, and chemistry. Their expertise with different length scales can help investigate

problems ranging from the mechanical properties of materials at macroscopic scales (e.g., stress), to those of material structures at a scale of thousands of atomic diameters, to chemical bonds at

atomic scales. An mCVE can bring people in different areas together and allows them to work together in a common environmental context, thus making cross-scale collaborations easier. One could envisage that such an mCVE approach will increase efficiency in collaborative research and enable researchers to think in new ways.

5. Virtual Communities and the FIT Community Toolbar

Supporting teams and communities on the internet needs a cooperative management of informations. A variety of toolbars integrated in various web browsers give only little support for solving the problem of learning from the experience and knowledge of other users in order to avoid double work and staying informed about activities of other users.

Teams and communities on the internet need virtual meeting places for continuous development of business and information processes. Today the interaction of people is not so much the result of the closeness to each other than the common tasks, goals, and interests of people. Online communities represent a social network of people with a common interest needing common information. Users want to exchange experiences and get in touch with others so that everybody can profit from each other’s knowledge. New effective ways of producing common knowledge, sharing information and coordinating activities are required to make communication and cooperation in distributed working and interest groups possible.

Teamwork today is no more only working face-to-face. Cooperating via Cyberspace in teams and communities with the help of technical tools like email, web conferences and virtual offices make it possible: the scriptwriter produces in London, the web designer works in Dusseldorf, the internet queries run in Paris, the programming is done in Prague coordinated by their chief from Luxembourg – and they all are integrating their tasks via a common web portal.

The internet sector demonstrates how division of labour may look like in the future. You find virtual teams nearly in every branch and size. Polls ands surveys show it: nearly 20 % of the executives in industry and commerce are working permanently in virtual teams. Nearly 50 % are working in virtual teams only short-term or in selected projects. This shows a teamwork related study of the Akademie für Führungskräfte der Wirtschaft[1] in Bad Harzburg [6]. 376 executives from different branches and company sizes gave their opinion on virtual teams, their understanding of the term, their role in the team and what a good team is all about. Virtual teams and communities seem to be a prerequisite for a long-term business success and the Web is its platform. Portal systems like business and customer portals represent a rich environment that offers interesting information, discussion forums etc. Increasingly a lot of companies are providing so-called toolbars that integrate as a symbol list into the web browser. The advantage of toolbars is that users are able to directly access the information without being forced to visit dedicated web pages.

But recent research shows that the establishment and the operation of virtual teams and communities in the internet are not adequately supported up to now, although the potential for this class of web applications is growing continuously [2]. Supporting teams and communities on the internet needs a cooperative group and information management. A variety of portals and toolbars give only little support for solving the problem of learning from the experience and knowledge of other users in order to avoid double work and staying informed about activities of other users [7]. One of the main tasks that has to be solved in an online community is to support social interaction in any kind of those workgroups. In our paper we are focussing on toolbars and their functionality.

We analysed the existing internet toolbars regarding their field of application, their benefit and their usability for cooperative knowledge work. One of our sources for investigation was ‘ZDNet UK’ [13] with more than 400 internet toolbars. We had a closer look at 35 toolbars and evaluated their application domain. What we found was that the predominant number of toolbars are limited to an individual search and the opening of specific or comprehensive application domains. A technically developed global functionality for the support of mutual knowledge work is hardly found in those systems. You may identify essentially six groups of internet toolbars:

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[1] Academy for Executives in Economy

The most often we found toolbars that support a **global web search.** To enter a query you just type in a few descriptive words to receive a list of relevant web pages. For a global web search toolbars like for *Google*, *web.de* and *Ask Jeeves* offer sophisticated functions for an individual opening and assessment/weighting of web content. The query returns web pages that contain all the words in the query. Refining or narrowing the search means adding more words to the search terms already entered. A new query will return a smaller subset of the pages already found for the original "too-broad" query.

For **opening of literature and media** as well as procurement of goods you find toolbars for systems like *A9 (Amazon)*, *Alexa* and *WWWinkazon.* The user is backed with adequate functions in order to provide a survey of relevant books, CDs, DVDs etc.

A comfortable support for **purchasing and auctions** is offered by toolbars for systems like *guenstiger.de*, *Dash bar*, *active shoppe*r and certainly *Ebay*.

Toolbars for **yellow page systems** like *Dogpile* and *Plusbar* help i.e. to find the right company, address and phone number, unfortunately at the moment still mainly for US use.

In order to adequately **tailor web interfaces** toolbars like *quickres*, *tb creator* und *add button* offer help.

Finally you find toolbar support for domain specific **dedicated inquiries** like for political/economical news, weather, travel etc. that give a rapid answer to individual concerns.

Web toolbars for:	
global web search	**55 %**
opening of literature and media	**10 %**
purchasing and auctions	**15 %**
yellow page systems	**2 %**
web interface tailoring	**3 %**
dedicated inquiries	**15 %**

Figure 6 - Application domains for Web toolbars

The investigated systems are restricted to "work alone", at the most giving "+" and "-" ratings to selected web pages for all users – not restricted to a selected group or specific team. The formation of teams, communities or groups of interest and the efficient cooperation among them is not or only rudimentarily offered or supported.

With the FIT-Community Toolbar [1,3] portal systems become virtual meeting places that facilitate and enhance new and existing forms of social interaction in virtual teams and communities. This is possible, because the Community Toolbar provides functions to build self-organized communities, to acquire and manage common knowledge collaboratively, to exchange experiences and to get in touch with each other. All these functions make the effective knowledge cooperation and efficient collaboration in online communities possible.

The most important meeting place of our online communities is the common link collection of web pages. It contains web pages that provide interesting information for the community. If community members find relevant information in the web, they add the webpage to the common link collection of the community. Whenever a community member visits one of the collected web pages, the Community Toolbar offers community information and functions in the context of the current information. The Community Toolbar indicates the common member rating of the webpage, it highlights annotations of community members in the webpage, the user is notified of other online users, all visitors can get in touch with each others and discuss in the context of the common information. To facilitate the search for relevant information in the web, the Community Toolbar flags those web search results that may be interesting in the context of communities.

Figure 7 - Community Toolbar integrated in IE

The Community Toolbar is integrated as a toolbar in the web browser. Whenever a user visits a webpage, it adapts its content according to the current visited webpage. The Community Toolbar proofs if the visited webpage is contained in a link collection of the user's communities. All functions to communicate and cooperate in the community are available by buttons, menus, list items etc.

To ensure the liveliness and expansion of communities we support self-organized communities; users invite new members, extend and modify the common information. We support two categories of communities: public and moderated communities. In public communities all community members are allowed to invite new members, but the membership can only be terminated by the users themselves. In moderated communities only a designated member, the so-called moderator, has the right to invite new members. Additionally, moderators are permitted to des-invite members. Basically, only authorized users are allowed to extend and change the common community information, so that is always comprehensible who is responsible for the information.

In order to make social interaction in online communities possible we integrate different communication and cooperation functions in the Community Toolbar. Tools like email, chat, discussion, etc. enable users to react spontaneously on events and to get in touch with others. To keep the users informed on the ongoing activity in communities, we integrated functions for group awareness. The Community Toolbar captures the presence and activity of users in their community context. It notifies of awareness information like who is currently online in a community, what happens and what happened while a user was absent. The availability of these communication, cooperation, and awareness functions depends on the user's current working context. If the user's working context changes, also the available functions change.

The evaluation we performed pointed out that the Community Toolbar is a useful collection of functions that supports the efficient cooperation in different working contexts. Not all users need all functions, but the result of the evaluation confirmed that the Community Toolbar with its collection of functions satisfies the users needs.

6. Conclusions

Cooperative information environments often combine aspects from cooperative systems with those from multimedia and Web-based systems as well as from mobile systems. 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. In this paper we investigated some basic building blocks for the next generation cooperation systems like collaboration environments for mobile work, ubiquitous computing, RFID components, CVEs and communities.

Apart from studying the potential for technical improvement, it is required to study the social aspects of communities. Of particular interest is the relationship between real world social relations and those in the electronic media. It is necessary to watch what consequences the growing participation in the Internet in the near future has for real world communities and the post-modern society, in addition to the consequences this has on the individual processes of constituting a personality for oneself, and on personal relationships. This should be studied under the aspects of sociology, psychology and anthropology in addition to the field of computer science. Implications for the development of future systems are to be considered.

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SUPPORTING COLLABORATION WITH USER ORIENTED PROCESS VISUALISATION

Dian Tan [1]

In the globally operating automotive industry a multitude of different organisational units have to be attuned to one another. This implies that persons from different cultural, professional and organisational backgrounds need to cooperate. To support a successful cooperation and possibly make use of the synergies available it is mandatory to agree on common processes. To come to this agreement, and also to support further cooperation, it is necessary that all persons involved have a common understanding of the process. The user oriented visualisation of the processes helps to built up this common understanding and acts as a basis for communication.

1. The Automotive Industry as Cooperative Information Environment

The automotive industry is one of the most globally operating industrial branches [5]. Different organisational units have to be attuned to one another, mergers take place and suppliers need to be integrated. Since these units and partners are dispersed all over the world this means that persons from different cultural backgrounds work together on a product or in a project. Due to the need for cooperation beyond department and organisational borders the co-workers do also have different professional and organisational backgrounds. These differences imply an increased amount of project management, structuring and coordination of the cooperation to attune all parties involved. It also implies that, if coordinated properly, the variety of cultures and perspectives can lead to a more fruitful cooperation. To support a successful cooperation and possibly make use of the synergies available a variety of factors has to be considered.

First of all there are the cultural differences due to the ethnical or country cultures. These express not only in language, but also in different styles of interaction, ways of discussing and cooperating. Since these differences base on implicitly learned behaviour styles and social norms they often cause serious misunderstandings in intercultural cooperation. People are usually not aware that they

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follow culture specific behaviour patterns, which often leads them to judging behaviour that differs from their own style as unfriendly and uncooperative. These differences have been discussed in detail e.g. in Hofstede [2] or Trompenaars [6].

Second there are different organisational cultures. Each operational unit has its own history and culture and has developed its own corporate identity over the time. This includes the way the employees interact with each other as well as leading styles and business processes. Within an operational unit the people share a common sense of how things ought to be handled and they follow their own work routines which are usually not written but learned by experience. Especially when mergers took place, organisational politics are also an issue.

Additionally the persons working together come from different professional backgrounds. According to their education people are experts in their field. This interdisciplinary cooperation between these specialists lets new problems emerge: the professions do not share the same vocabulary; the same words are often used to express different meanings. Not even work specific terms are consistently used in the same way in all professions. Even the way to look at a problem is influenced by experience and previous knowledge. The differences in experience and expertise hamper an effective communication and cooperation.

All these differences have an important impact on the collaboration. According to their background people have a different understanding and expectation of work routines, proceedings in certain situations and processes. Since these misunderstandings hinder effective cooperation it is worth an effort to clarify the situation. The first step is to make people aware of the differences and their origin. Being sensitised for different cultural behaviour and work styles helps to improve cooperation and to be considerate of one another. But still the cooperation will not be sufficiently supported if the different organisational units do not follow the same business processes.

2. Process Visualisation to Support Collaboration

For successful cooperation between the different partners it is mandatory to agree on common processes. To come to this agreement, but also to support the further cooperation, it is necessary that all persons involved have a common understanding of the process. The visualisation of the processes helps to enhance this common understanding and so improves the collaboration between the different partners. Especially tasks that involve interaction of different persons are difficult to handle without this common understanding. The visualisation also acts as a basis for communication. It contributes to ensuring that everyone understands the process in the same way, talks about the same things and uses the same terms. The process visualisation is also helpful for each person individually to understand how his own activities fit in the whole process. The visualisation can be used to introduce new colleagues to their duties or to look up information about seldom occurring incidents. Process visualisation is further helpful in the actual process of defining the business processes. It helps the persons involved to comprehend the process detailed so far and to detect mistakes. In this way the process representation supports also the further definition of the process.

3. User Oriented Process Visualisation

In a lot of organisations the processes are not clearly and understandably defined. Sometimes the processes are defined and represented in process models or diagrams like ARIS (see e.g. http://www.ids-scheer.com/, [3]). But these models are not always available for the people actually involved in the process, but are often solely used for controlling or management purposes. And even if the process models are available to the process owners the commonly used models for process representation are usually not easily understandable for inexperienced users. A certain amount of previous knowledge about the way such models are built up and are to be interpreted is assumed. But since the processes include information mandatory for the users for the completion of their tasks they must be understood by every person involved, regardless of the person's specific background.

The differences in cultural habits, reading and writing direction and experiences influence the way a process visualisation is interpreted. Furthermore not all users need the same information out of the process representations and the user groups use the process representations for different purposes. Therefore it is particularly important to react to the special requirements of every group involved.

User oriented process visualisation regards the cultural, professional and organisational background of the user. It addresses every user or user group that is involved in the process. This could be by using individually adapted models or by supplying a common model suitable for all user groups in the same way. According to the requirements only those information are displayed that the user actually needs. The process should be comprehensible without any previous knowledge about processes or process representations in general. The visualisation forms used until now do not consider these aspects. To interpret e.g. the often used ARIS models the user needs to have some knowledge about which icons and forms represent what kind of information. Figure 1 shows an example of an ARIS model. This model represents the process of personnel selection in an organisation. Certain modelling conventions are defined by the organisational corporate identity guidelines, but it mostly follows the established and commonly used conventions.

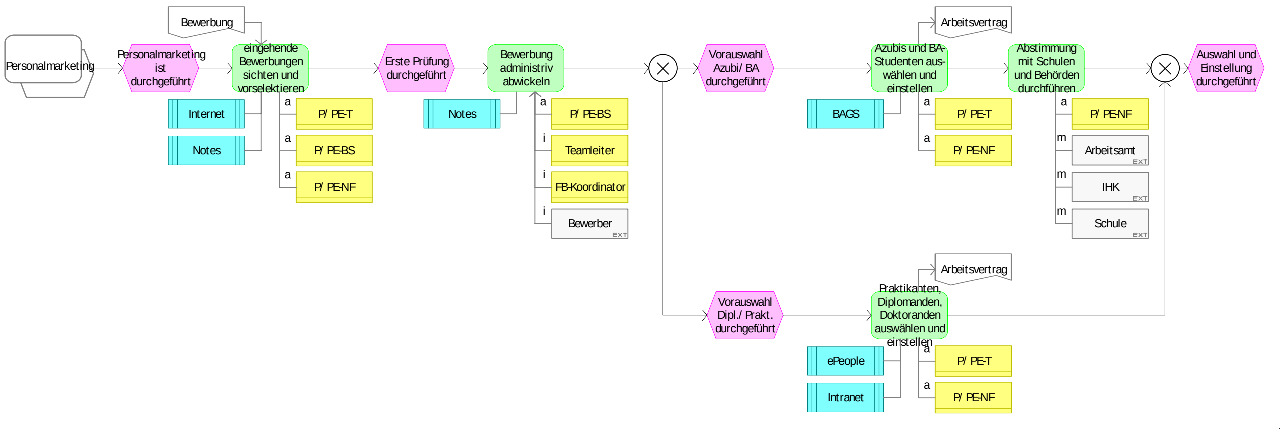

Figure 1 - Example of an ARIS Model

The user oriented process visualisation helps to reduce the complexity of the process, enhances the process comprehension and so promotes transparency and compliance with the process. Relevant information can quickly be found, the user is enabled to work more effectively. Misinterpretations and misunderstandings are avoided. The most important advantage of user oriented process visualisation is that every user is enabled to interpret the processes correctly, work with it and communicate about it, regardless of background and experience.

We surveyed the requirements of users in a project that aimed at developing new software to be commonly used for a special prevalent business process in the commercial vehicle division of the DaimlerChrysler AG. Since this division has a number of operational units dispersed all over the world it is well suitable to represent the target group of our research. We talked to representatives from Germany, Japan and the United States. They differed not only in their cultural but also in their functional and professional background and in their familiarity with the relevant processes. We completed the analysis of the requirements with observations in the actual work surrounding and we joined work meetings in which the process definition was being discussed.

It clearly turned out that users want a process visualisation that displays only the details they just need for their special purpose. The users want to be provided only with the information in detail that is relevant for them in their current situation. But they as well want to obtain an overview over the whole process. An often uttered wish was that the level of detail should be adaptable to the current needs. The ideal representation would present a process overview first and then give the users the possibility to retrieve the information they need in detail on demand. Zoom and search functionality within the process representation was clearly demanded. The process representation should provide a self explaining navigation structure, e.g. by adopting navigation concepts used by well known text processing programmes. The process information should be clearly arranged. Preferably it should be in every user's native language. Most users would prefer an interactive representation they could use on their computer, but the possibility to print out the process as a whole in one picture should still be given. The process visualisation should nonetheless be kept as simple as it possibly could.

4. Possible Concepts for User Oriented Process Visualisation

To support the commercial vehicle division with an apt form of process visualisation we started developing different concepts for the visualisation of their business process.

One way to represent the processes is to use a narrative style. By telling a story the user is gaining tangible information that she can easily utilise. The idea behind this approach is to promote the direct use of the information in every day work. A narrative process representation can e.g. be implemented by using a scenario based method. Scenarios were first used as a future oriented design method, as a means for generating relevant information about an uncertain future. Developing scenarios a vision was created and enabled persons to educe further steps. Schultz describes scenarios as a "term usually used to describe an image of the future deliberately crafted for planning or foresight purposes. … It should describe how changes created the particular future present out of the past, and offer a vivid, provocative, accessible picture of how the future present differs from today" [4]. The scenario method can be transferred to the representation of processes. Since a to-be-process is being designed in the project which the persons will have to follow as soon as the software is ready, we are also concerned with a future oriented situation. To describe the process content as a scenario means to choose a concrete example on which the process is explained. This further implies that possibly only one path through the process is described - the most often used path or another path following certain criteria that matter to the user.

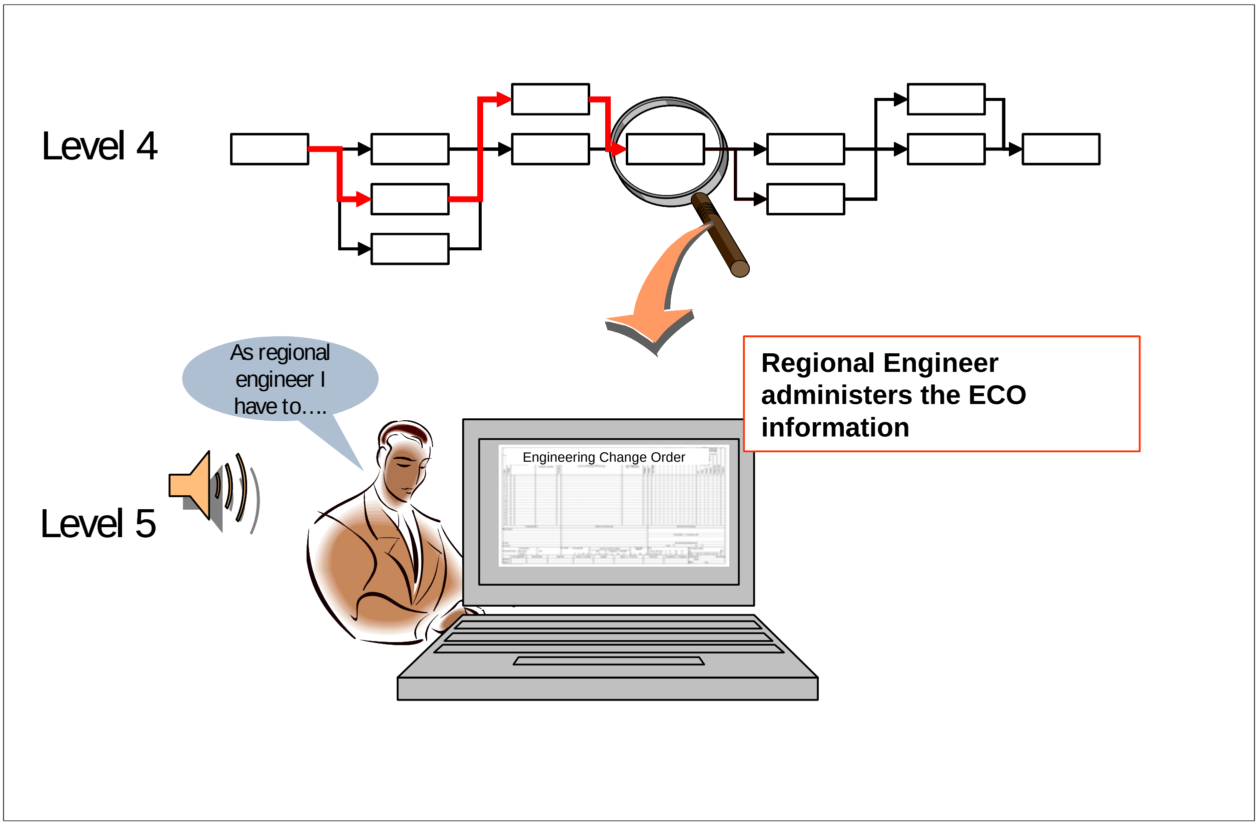

Figure 2 - Scenario based process visualisation

Our idea of the scenario based visualisation is to start with an established form of process representation on a higher level, say level 4. This representation is being done in our application project in any case for the experts who do the process detailing. Based on this model a scenario is developed. Figure 2 shows how we form the scenario using a number of different media to address the users' different senses. Different scenarios can be supplied that are concerned with the different situations or target groups. These specific scenarios make the scenario based visualisation easily adaptable to the different user groups and application purposes. The specific scenarios can then be combined to gain information about the whole process. Interactive navigation facilitates the orientation and usage of the scenario based visualisation.

Still the scenario based visualisation does not fulfil the requirements for a general, ideally printable overview of the process. To provide this overview another approach has to be found. One possibility is to adopt a concept well known to the user and transfer it to display the process information. One example for a metaphor like this is the Tube Map by Burkhard and Meier [1], see Figure 3. The Tube Map resembles the well known picture of the net of tube lines that follow different routes through a city. Here the concept is used as a metaphor to communicate the more difficult to grasp topic of project organisation. The coloured lines resemble persons or groups of persons instead of tube lines, the "stations" are the project milestones. There are milestones relevant for only one group and others that impact all the groups involved in the depicted project. The time line is represented from left to right. All "tube lines" end in the same point when the project goal is reached.

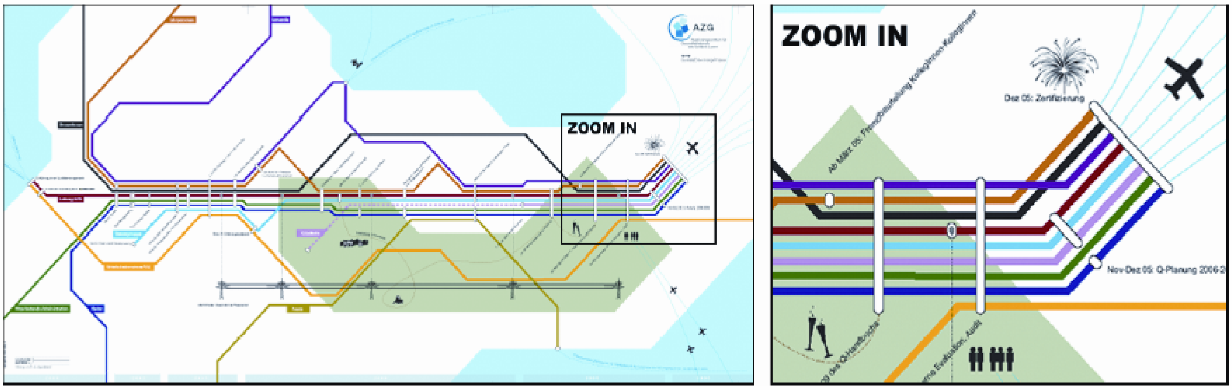

Figure 3 - Tube Map by Burkhard and Meier as example for metaphor use

The Tube Map metaphor can not easily be used to represent a process as complex as the one we are concerned with in our project. A lot more dimensions have to be displayed in this process like persons involved and their interaction, input and output systems and, most challenging, the splits and joints. In the moment we are evaluating different metaphors for their transferability to our process. Ideas that could suit this purpose are the metaphor of a board game or of a detailed city map.

Further concepts to visualise business processes are to be developed. We will then identify the most promising visualisation forms. These will be realised and evaluated in a multicultural, multi-organisational and interdisciplinary cooperative environment.

5. Conclusions

We have documented the need for a user oriented process visualisation and the benefits of its use. Especially in an industrial branch that requires the interaction of a multitude of disciplines and cultures, like the automotive industry, a comprehensible visualisation of the processes can have important effects on the collaboration. To improve the collaboration it is mandatory to be responsive to the individual users' needs and backgrounds. We developed and assessed different concepts for the user oriented visualisation of processes.

We believe that it is most helpful for the users to offer them a process representation that provides an overview of the whole process as well as a closer look at the information needed in detail. We therefore decided to combine appropriate forms of process visualisation to fulfil these requirements. After the assessment of the visualisation concepts is completed we will decide which of these concepts will be best suited for each of the requirements given. We will then work out the best possible combination and implement it for further use in the project. If it proves suitable in this environment it will be considered to establish the user oriented process visualisation in every division of the company.

6. References

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ENHANCING COLLABORATION THROUGH NOTIFICATIONS

Michael Sonntag [1]

Asynchronous communication on web platforms is currently difficult, as it requires regular visits and checks, whether new messages have been posted, and finding out, whether these are of interest or not. This is a special problem for collaboration in E-Learning, where the focus is mainly on such asynchronous interaction modes, and class sizes are large, but communication should still take place speedily. One possibility to achieve this are notifications for users when "interesting" things happen. Methods for performing these notifications are discussed in the paper, as well as how to reduce the work for configuring them: pre-configuration as well as transfer from similar objects. The implementation of basic notifications in a learning platform is described, as well as a new transfer method through a personalized RSS feed, and a first implementation for automatically adding new notifications.

1. Motivation

Online E-Learning platforms usually contain facilities for asynchronous communication, typically in the form of discussion forums. While this is a useful feature, sometimes it can also lead to problems. E.g. in large courses discussions might be lively, with lots of new messages, so it can be difficult to identify those, which might be of interest to individual learners. Similar problems exist for coaches, but to an even larger degree, as usually the ratio students/teacher is increased compared to conventional courses. For them important are for example questions, which have not been answered after some time (e.g. by tutors or other students) or those pertaining to certain topics. Another difficulty can be group results: When one participant updated some content, the other should be informed about this new status to avoid conflicts and speed up his/her reaction to these modifications. With regard to coaches this is important e.g. for uploads of results to be inspected or corrected. Unlike [8] (notifications used in a workflow of authoring E-learning content), we focus

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on the actual holding of the course, where usually no structured interaction exists. There communication happens rather spontaneously and information on its reason can hardly be predicted or derived for future notifications.

Such difficulties can be reduced through introducing various kinds of notifications, i.e. "active" messages to inform members of the platform of certain actions within it. These notifications can be classified into three kinds:

1. Passive notifications: These are informational content, which is just presented unobtrusively to the user. If interested in it, he/she can follow it to receive more detailed information. Examples for this are small icons (see e.g. [4]) or awareness information to be observed peripherally ([1]). Drawbacks of this scheme are, that only a very limited amount of information can be presented to avoid cluttering the "main" information and taking up valuable screen space. In addition, no proof (or guarantee) is possible, that the user actually observed and/or noticed the information.
2. Semi-active notifications: These are notifications presented actively to the user while being online in the learning platform. Examples are interstitials (webpages presented in-between; when clicking on a link, a webpage is inserted before presenting the actual page) or very obtrusive information (automatically opened windows, playing sounds, etc.). Another example is the BSCW event monitor [5], which must be explicitly started and monitored. Advantageous of this form is that partly presentation to the user can be proved, and that it is closer in time (nearly synchronous) than plain passive notifications. A drawback is their interference with actions of users and their similarity to advertisement forms widely detested. They can be useful, but whether to use them or other kinds of notifications must be decided upon carefully to avoid user annoyance.
3. Active notifications: These are notifications, which can be at least sent and (possibly) received even when users are not logged into the learning platform. Examples are E-Mails or SMS. Although RSS is intended for public use, through a slight modification (encoding user identifications into the base URL) this can also be used for notifications. Advantages are again the proof of sending/delivery, the immediateness even when offline, and the integration into other common services. Drawbacks can be additional costs or that these services usually require "outside" help. So even though the platform itself might be working, problems can exist somewhere else (e.g. mail server offline; SMS received on the mobile phone but unnoticed; unread E-Mails; …), preventing delivery.

2. Impact of notifications

Notifications can improve collaboration/cooperation between learners and teachers (and within those groups) in two main areas. The first is to speed up interaction through hints when interesting (depending on the person) things happen, instead of waiting until they are "manually" discovered. The second is added interaction through avoiding lost updates or orphan messages.

2.1. Collaboration between learners

Collaboration between learners improves when "empty" time is avoided, i.e. through accelerating the (asynchronous) communication. Through this shortened response time, questions are answered when they are pressing and not when already partly forgotten, solved by the student him-/herself, etc. Nevertheless, because of the high number of posts in absolute measurement, a filtering stage must be introduced: Not for every new message a notification to each participant should be generated. Therefore, interests of students must be identified and matched with the message content. Only if reasonable overlap exists, the participant should be informed. This applies not only to questions but also to messages in general, so discussions arise more easily and are performed with more interactions and faster.

Another area is shared creation of work products (e.g. seminar papers). Although learning platforms usually provide only limited support compared to groupware, this is still important. Here often not the upload/change of a document is important (but useful for speed up), but rather the opposite: Actions, which did not happen within a certain timeframe.

2.2. Cooperation between teachers

Especially in larger courses (or when several teachers jointly hold a course, like in seminars), cooperation is important but can grow difficult. One example is task sharing with regard to student questions: Who is responsible for answering certain questions? This can be difficult if there are many questions (assigning them), or if there are very few questions (no regular visits so they might go unnoticed for some time). Here retractable notifications (e.g. when it is no longer applicable as someone else has already answered the question) could be useful. However, not all notification methods allow this (e.g. E-Mail, SMS or alert windows cannot be retracted, while notifications through RSS or icons could be removed). Here notifications must be especially tied to intelligent systems as otherwise the configuration will be quite difficult. Intelligent agents can e.g. decide whom of several coaches to notify based upon their explicitly configured (or implicitly derived) interests/areas of responsibility.

2.3. Interaction between learners and teachers

Improvements are possible e.g. when learning material is updated or added: the system can check whether the learner has already seen this element/part. If not, there is no need for a notification (except perhaps that something possibly interesting was added, to be determined similar to messages), but if this part has already been viewed, it should perhaps be revisited. The same applies to tasks or assignments, which, when changed by the teacher, must be communicated rapidly to the students. Practical examples in CS courses are e.g. new versions of libraries to be used or generally additional hints/clarifications of tasks. Interaction can also be increased similar to between students through notifications on unanswered questions. Desirable would also be a verification of student's answers of questions or even direct automatic answers as in [7] , but this is currently not possible: The system would have to understand both question and answer semantically, not only as data or its syntax (through natural language processing).

3. Automatic generation of notifications

Configuring notifications can be difficult: E.g. for each forum or folder a separate configuration is needed, although these might be rather similar (but not necessarily identical). "General" notifications in the sense of applying to multiple objects (e.g. all forums within the system or of a certain course) are not that useful, as they are either very complicated (specific objects should perhaps again be treated differently), or the rate of "false", i.e. unwanted, notifications could be quite high. One approach to ameliorate this problem is automatic generation of notifications. The following approaches can be identified:

- Pre-configuration: When creating objects, matching notifications can be generated automatically. Care must be taken that these depend only on the specific object and its (default or adapted) configuration, but not on any external elements like interests or preferences of the creator or its intended use. An example is automatically creating a notification for a forum for when the first answer to an own message (this is probably interesting for every user) or new messages containing keywords of interest are posted. For the latter the actual content is different for each user, but generally postings with such interesting keywords will always be important for all users. A drawback of this approach is, that only rather general notifications can be generated in this way.

- Transferal: Existing notifications from similar objects are transferred to newly created ones. Dependent on the information available these could also be adapted simultaneously (e.g. exchanging the teacher from the source course with the one of the target course if this data is available). This allows generating notifications that are more complicated: manually configured/adapted ones can be included. Even when "wrong" notifications are transferred (e.g. with keywords applicable only to the source course), these will usually not be triggered. In some cases difficulties can occur, e.g. when a user is in a special role for the source object (like responsible author for documents or moderator for forums), and not for the target. Such notifications will not apply to other elements, unless the role also applies to them. However, such rules are often not made explicit or detectable. If there is for example a group named "forum moderator", how can the system detect its semantics (like a notification on every single message to approve or reject it) if this is not configured explicitly? Generally, erroneous configurations will mostly remain untriggered, but can still serve as starting points for manual modifications to adapt them to their new location.
- Derivation: Based on intelligent subsystems rules could also be created fully automatically. One example would be that when a user's interests have been ascertained with a specific certainty, appropriate notification rules are added or modified, e.g. adding keywords to existing rules or introducing new ones. Another approach could be transferring manually created new rules to similar existing objects. In this category cooperation between users can serve not as the target but rather the source: Notifications can also be derived from other users (e.g. those with similar notifications, interests, browsing habits or groups). This is however a difficult area and depends largely on the intelligence of the base system.

An important aspect for the acceptance of automatic generation of notifications by users is information: When new notifications are generated: what are they and why were they created. This provides feedback to users helping them understand the system and allows suggesting changes or improvements. Additionally it could be used for an adaptation cycle with explicit feedback, as otherwise only modifications or removal of auto-generated notifications can serve as implicit input, which is much less reliable.

4. Implementing notifications: WeLearn

Notifications have been added to the web based learning platform WeLearn [9]. These can be configured manually, but also initial support for automatic generation exists (see below).

4.1. Kinds of notifications

Notifications can be split into two separate groups. The first group are notifications of a general nature, which are not connected to any specific object, but rather pertain to the platform as a whole. In this group currently only notifications on logins/password changes are implemented. A notification can be sent to the user when the password has not been changed for some time. This can be defined either by a number of logins or as a time span since the last change. It can be configured automatically for each user upon creation of an account. While the fact of its triggering might be of interest to the administrator or course manager, it was decided that only the user him-/herself will be notified because of privacy reasons: It is not possible to configure such notifications for other persons, although this could be implemented easily. Obviously, there is no guarantee of enforcement, as users can instead of changing their password just as easily delete this notification and not receive any notices in future, but this too is on purpose.

The second group of notifications are associated with various objects within the learning platform. Currently two types of object are supported, although enlargement is planned for the future. A common problem is monitoring uploads to folders, especially where students have to hand in exercises, or within the workspace of a smaller group creating a shared result. A notification can be sent either when an object was uploaded (for workgroups), regardless of who uploaded it or what type of object it is, or when an object was uploaded and there are now X objects of different users within this folder. The last is intended for folders where students hand in exercises. Usually they can upload them several times (the last one is actually rated), so a distinction between the total number of objects and the number of objects from different users is necessary. Coaches can use this to be notified when all (or a specific part) of students have uploaded their results. Another possible, but not yet implemented, notification could be the upload of an object by a specific user or group: this could be interesting for students, e.g. to be notified of new (or new versions) of documents added/replaced by coaches.

The second object type supported is forums, which are especially important for cooperation. While their asynchronicity should not be removed (the goal is not a structured kind of chat), interaction should be sped up. Notifications are supported for the following events: The first reply to a posting authored by the creator of the notification. This avoids e.g. the problem of continuously looking for answers to a question posted. If a forum is very interesting, a notification on every new message is then possible. As only forums can be selected and not sub elements like individual messages, this always applies to the whole forum. A more personal option is specifying several keywords of interest. When one of those appears within a new message, the user is notified. As users probably cannot exactly foresee such words, regular expressions can be used. If the extension of the learning platform through the agent system is available, an additional option can be selected. The agent system identifies keywords of interest from the user's actions, and these can be included in the keywords [6]. In this way adaptation trough the agents is possible and the notification is enhanced dynamically. Another option is triggering a notification when a message is posted, which seems to contain a question. Currently only basic textual analysis takes place, but enhancement through an algorithm performing actual grammar parsing is possible. This should help teachers find postings, that should be replied to, as mere comments or answers need less attention. The last notification in based on a message being posted by a certain person or group. This can serve both learners (e.g. hint on posts by coaches) and teachers (close supervision of persons requiring special attention).

A third group of notifications is theoretically possible, which are related to several platform objects. This could be a hierarchy (all objects within/below a container) or a freely defined set. However, configuration of such notifications would be very complicated and useful applications could not be found yet.

4.2. The notification subsystem

Notifications within the system are based on events, which are triggered through various actions. These can be logged, but are sent also to the notification subsystem. Within the notification subsystem these events are added to a rules engine containing both the general rules for notifications as well as all notifications configured by users. Based on this information the rules engine fires rules if appropriate (see ***Figure 1***). Information on fired rules is stored for later presentation on the personal page or through RSS within the rule base. After all matching rules have fired the event is removed from the system. Otherwise the large number of events would dramatically increase information within the engine. Therefore, notifications requiring persistent information store it within the engine explicitly (internal data). An example for this is information on when users last changed their passwords, so their expiration can be calculated.

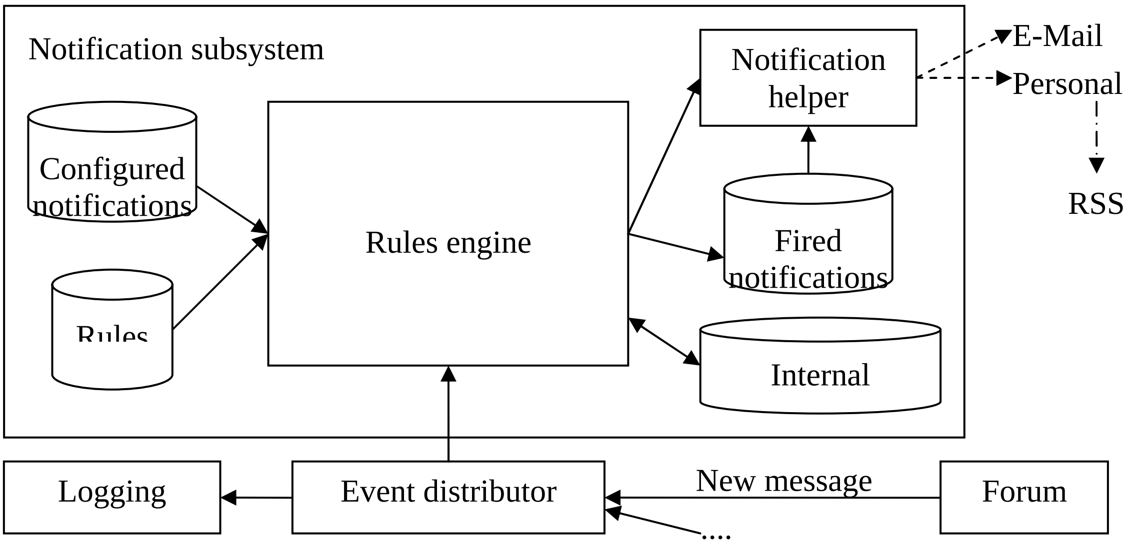

Figure 1 - The notification subsystem

Each notification can be delivered using several mechanisms (see below), which can be configured separately for each notification: Some might be deemed very important (→E-Mail, SMS), while others are not that urgent and are only shown on the personal page. The actual "transfer" is done through a helper, which either assumes the role of an active (in case of E-Mail, or SMS employing public webpages) or a passive (personal page and RSS: extracts information on fired notifications from the rules engine and formats it appropriately) component.

A peculiarity of the rules engine used (DROOLS, [3]) is, that no new rules can be introduced at runtime: All rules must be configured at its creation. To circumvent this problem, notifications are not rules, but themselves (persistent) input objects. Rules possess usually two inputs: a notifications object and an event. An (abbreviated, e.g. imports omitted) listing of a sample rule is shown in ***Listing 1*** (as rules are configured in XML files, '&' and '<' must be escaped through character references). The example contains five conditions, before creating a holder for the fired notification and actually sending it. The first two conditions verify that the user the notification belongs to is not disabled or blocked and that the event was generated by the forum to be monitored by this notification. The third element checks the type, that it is actually a "first reply" notification. The next verifies whether it is a reply to an own posting: The owner (=creator) of the parent message (if one exists), must also be the owner of the current notification. The last condition verifies that this is the only child of the parent message, i.e. the first reply.

```
<rule name="ForumNotifications: First reply to own posting">
    <parameter identifier="notification">
        <java:class>ForumNotifications</java:class>
    </parameter>
    <parameter identifier="event">
        <java:class>ForumCreateMessageAction</java:class>
    </parameter>

    <java:condition>Notification.isUserActive(notification.getOwner())</java:condition>
    <java:condition>notification.getMonitoredObject().getMonitoredObjectOID().
            equals(event.getTargetObjectId())</java:condition>
    <java:condition>notification.getForumData().getType().equals(
            ForumNotifications.NotificationCode.FIRST_REPLY)</java:condition>
    <java:condition> DiscussionForumHelper.getParent(event.getMessageOID())!=null
            &amp;&amp; DiscussionForumHelper.getParent(event.getMessageOID()).
            getOwner().getOid().equals(notification.getOwner())</java:condition>
    <java:condition>DiscussionForumHelper.getParent(event.getMessageOID())!=null
            &amp;&amp; DiscussionForumHelper.getParent(event.getMessageOID()).
            getChildren().size()&lt;=1</java:condition>

    <java:consequence>
        FiredNotificationData fnd=new FiredNotificationData(notification.getOwner(),
            notification,event);
        NotificationsObject.getInstance().fireNotification(fnd);
    </java:consequence>
```

Listing 1 - Exemplary rule: First reply to own posting

This approach of integrating the notification framework directly into the learning platform instead of moving it into the agent system, while improving performance, has also an important drawback: Timed notifications are not possible. As a servlet can be removed if unused, there is no guarantee that it will continually execute. Notifications like "Notify me if there has been no answer to a forum question after 1 week" are therefore not possible. One way to circumvent this is using other events as triggers, which can be seen at the example of changing the password. Theoretically, a user should be notified e.g. exactly three weeks after last changing the password. In the implementation this happens on the first login after three weeks, with the login being the initiating event. This makes no difference for notifications on the personal page, but if E-Mail is selected or the RSS feed monitored, these will also only be triggered upon the next login. This could be extended to arbitrary events (whenever an event comes in, the current time is checked and rules fired if overdue). Another possibility could be adding an external actor (e.g. the agent system), which either regularly "pings" the learning platform (so that an integrated scheduler will be active and is not deactivated through the servlet container), or directly serves as a store and initiator of timed events.

4.3. Notification delivery

For actual transport, E-Mail, SMS employing public websites, RSS and in-system presentation are available. To enable E-Mail notifications, an E-Mail server must be configured for the system and the user in question must have configured an E-Mail address. Only one attempt of delivery is made: errors are logged, but delivery is not retried later. To make sure a notification is not lost therefore the internal presentation should be selected in addition to E-Mail notification.

For in-system presentation, only passive notification is possible, partly depending on the actually implemented rules: None of them is that urgent to warrant semi-active delivery. For each user there is a personal page showing dynamic information for him/her. If the agent system is present, this contains the last position (e.g. facilitating easy continuing at the place left off) within learning material or forums, a brief history of such positions, and information on keywords of interest. Notifications add to this page through a list of all fired notification instances, for which this delivery method was selected. These elements can be removed separately or all at once. Each element provides information on when and which notification fired (through the title and the description), as well as the object it pertains to. So when a new message is posted which triggers a notification for whatever reason, the information contains a link directly to this message (otherwise it might be quite difficult to find it). Reading and answering it is therefore simple and straightforward.

An active notification supported is through a personalized RSS feed. RSS is usually public and intended for general news items, as it is referenced just through an URL. In our implementation the URL is created specifically for each user, incorporating the login name and password of the user. This method allows integrating notifications into any RSS reader, so notifications are presented similarly as current news items. This kind of delivery cannot be selected separately from others; it is bound to the internal presentation on the personal page. It simply mirrors this information to external readers. For security reasons, the password is integrated into the URL only after employing a one-way hash function, so deriving the password from it is impossible. This is important, as the communication link is not encrypted and does not employ additional access control, e.g. through HTTP passwords. Therefore, everyone who can achieve knowledge of the URL can view the notifications of another person. While this is certainly an information leak, we do not think it is very dangerous. It is especially not possible to access any actual content (e.g. messages or documents), as within RSS notifications no links to the content exist (instead of a link to a message, only its title is shown). The intended procedure is then logging into the platform and navigating to the specific message via the (identical) personal page. As the link also contains the password, it is not possible to calculate the URL for other persons, as would e.g. be the case if only the username were encoded. The only possibility of attack is therefore observing the link in some way.,

5. Implementation of automatic new notifications

While adding new notifications is not complicated, it can get tiresome, especially for coaches assigned to several courses. Therefore, automatic addition of new notifications is integrated into the system. Now only a single class of notifications is supported: notifications pertaining to forums. The initiating event is the creation of a new forum. Automatic configuration supports pre-configuration and transferal. For pre-configuration the example presented above, first reply to own posting, is used. Transferal tries to port all existing notifications of a single or several "comparable" forum(s).

Finding a comparable forum is based on the following algorithm: If a sibling forum exists (i.e. within the same folder), this is used. The next step are descendants of the parent container, i.e. forums within folders, that are siblings of the forum to find a similar one for. If still no forum was found, the search continues recursively up to the top of the system hierarchy. It moves up one step, looks within this container and then searches all descendants in BFS order. If there is more than one forum at a level, only notifications common to all forums are transferred. For a single comparable forum, all notifications are copied exactly. A peculiarity of this algorithm is, that not necessarily the nearest forum in terms of distance of steps is chosen for comparison. I.e. the grand-grand-child of a sibling folder is preferable to a forum within the parent folder. This is based on the assumption that courses (and therefore also the object hierarchy in the system) are based on a hierarchical model. This mirrors the basic principle of the learning platform, which is similar to a file system: objects can contain other objects or "leaves" (e.g. a forum or a document). While links do exist, these are rather rare and exceptions to the general principle. Therefore a course will usually be modeled as a folder with all pertaining elements being contained within. Because of this organization, preferably moving down and only up if there is no other possibility finds forums "closer" from a didactical point of view, but possibly rather more remote in the hierarchy than others in terms of navigational steps.

To avoid user confusion about new notifications appearing seemingly at random, each automatic configuration of a new notification rule also produces a new notification itself (on the personal page only) about this fact. Through this mechanism users are notified about the new notification, receive a brief description, and can easily (through a link) modify or delete it if desired.

One limitation of automatic notification generation is the initiating event: As notifications must be configured for many users, the access rights at this moment are very important. While new notifications might be useful for the creator of the forum (e.g. the administrator or the coach), they should also be created for others, namely students. This provides some difficulty in WeLearn, as there is no explicit notion of a "course". Therefore notifications are created for all users having at least the right to read the forum. If, however, subsequently access rights are modified, this is not taken into account. It might therefore happen that users receive new notification rules for forums, which they later are unable to access. Similarly, users receiving access at another point in time will have to configure such notifications manually. This problem could be solved through integrating access right changes as events too, which later on remove automatically created notifications or add new ones. This could also be generalized so notifications, which never can fire (e.g. access was revoked), are deleted, even when created manually. But this idea also possesses some difficulties, e.g. wrong assignment of rights, which are quickly repaired, would lead to notifications disappearing or being modified (if recreated with different parameters). These would be very difficult for users to understand. Adding notifications upon access right changes is much less of a problem, as these will just not be triggered then (but still fill up the list of notifications).

Another approach to ameliorate this problem could be avoiding an implicit event as initiator for generating notifications. E.g. a coach would create a forum, configure it, and, if everything is complete, start (e.g. through the properties page) generation of notifications. This could also happen in the form of a wizard, allowing to specify additional properties, e.g. groups this forum applies to (removing the need to derive this information from the access rights), or kinds of notifications to add. But this would first require additional interaction through the teacher (which as the general idea should be obviated), and second put the teacher in the position to configure notifications for learners. While this is no inherent problem, psychologically it might not be desirable by both teachers (implicitly prescribing actions based on these notifications) and learners (patronizing by the teacher). Also, even small errors in the configurations would be attributed to the coach instead of the system otherwise. So while this is certainly a possibility, it seems worse than integrating changes in rights as triggers for modifications to notifications.

In some cases this problem is much less severe: E.g. adding notifications on password expiry can be easily configured upon creation of a new user. No difficulties arise as these apply only to this user (and not others as in case of forums) and moreover do not change over time (like access rights). If undesirable, the user can modify or delete them. However, one optimization could be of interest: If the user is disabled (e.g. at the end of a course), all notifications remain active. Therefore new notifications will accumulate, although they cannot be read any more (apart from RSS; could be a potential problem). This is however a general problem and was solved through adding a related check to all rules.

6. Conclusions

Notifications on interesting events can be performed in several ways, but selection of the transfer method is important to avoid annoying users. While presentation within a system is easy, it suffers from the drawback of being easily overlooked and possible only, when users are online. On the other hand, sending E-Mails gets easily classified as Spam. Fine-grained and diverse possibilities to decide on the notification method are therefore important. A new method was added through a personalized RSS feed. Additionally, automatic configuration of notifications is very conservative, favoring online over offline configuration (minimum of methods of comparable forums used).

While notifications can improve cooperation, a problem factor is, that configuration is usually rather complicated, so they are created rather rarely and therefore are of little influence. Either only few categories or possibilities exist, but then notifications are not very helpful, or configuring them gets difficult and is avoided then. An important aspect is therefore easing or replacing this task, which we attempt through various forms of auto-configuration. Some notifications can be preconfigured (e.g. the first reply to own postings, which is especially helpful for communication through speeding up replies), but most must be adapted to the individual users interests and preferences. This is especially helpful for coaches in contrast to learners, as these will be involved in more areas. While personalization commonly targets the learner [2], this is therefore an aspect more important to teachers. The approach currently used is transferring notifications from similar locations, which will be extended in the future to new types of notifications.

7. Acknowledgment

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EXTENDING SHAREPOINT TECHNOLOGIES TOWARDS PROJECT MANAGEMENT CAPABILITIES

Wido Wirsam [1]

Modern groupware systems serve as universal information sharing platforms by providing manifold capabilities for customization and extension of their core functionalities. In this paper we introduce a set of extension modules that were developed in the context of the 'Distribution networks Relationship Management' (DRM) project[2] *to support distribution networks of industrial small and medium sized enterprises (SMEs) in terms of project management and advanced group awareness mechanisms. These interoperable modules tackle the specific requirements of SMEs particularly with regard to ease of use and flexibility. Our software development bases upon the collaboration platform product 'Windows Sharepoint Services' by Microsoft [5]. Thereby we also exemplarily demonstrate the general flexibility of enhancing this particular groupware system by custom functionality.*

1. Introduction: Project management needs for distribution networks of SME

Industrial SMEs that act in a global market often have a highly dispersed network of people, who act as distributors for the respective company. Those distributors can have a variety of different types of affiliations with the company. They may be employed in the company, they may be external partners that work exclusively for one company, they may represent different enterprises or they may be completely independent freelancers. This diversity of distribution networks is typical for industrial SMEs in contrary to large enterprises.

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[2] This project is carried out from Feb. 2004 until Aug. 2005. It is partly founded by the European Commission through IST no. SME-2003-1-508101.

The main challenges that we face in this environment are:

- That the dispersed network of distributors is neither locally nor organisationally directly connected to the company's headquarters.
- The high communication and collaboration needs of the outlined target group.
- The fine grained user access restrictions necessary due to the nature of the heterogeneous kind of the distribution networks.

Taking into account these requirements of industrial SMEs, we identified the following factors of major importance, when effectively supporting these companies with customised groupware solutions:

- The generally low budget available for acquisition, implementation and training activities of users in the companies.
- Integration with existent software products (i.e. CRM and Office software).
- Easy and flexible ways to adapt the groupware system according to the respective needs of the companies to guarantee an ease of use and thereby a good acceptance of the system.

The way of establishing a groupware system that suits the requirements of the outlined target group differs fundamentally from the approach that would be suitable for big enterprises. One of the specific requirements is the heterogeneous kind of user groups in terms of affiliation with the companies' headquarter, level of technological literacy and loyalty. Another aspect is the companies' lower impact on distributed salespeople, suppliers and partners to change their communication behaviours and technological infrastructure used. Those challenges are closely related to the problems targeted by the research field of concurrent enterprises (CE) as defined by the CE-NET consortium.

The CE-NET consortium has examined the state of the art of KM for CE and identified the most important fields of research for the future in this application area. In CE-Roadmap Nr 3 they state that *"The focus in Knowledge Management has slightly shifted from the emphasis of making knowledge explicit towards facilitating individual and organisational relationships and supporting knowledge flows between individuals and organisations."* They identified the lack of connectivity in actual software systems and propose to close the gaps of missing standardised interfaces [1].

2. Description of the 'Project Management Suite' – a set of universal collaborative software modules

With the term 'Project Management Suite' we designate a set of adoptable and reusable software modules – so called 'Web Parts' that may be integrated in any cooperation solution product based on MS Sharepoint Technology. In this chapter we introduce these specialised add-ons and demonstrate their functionality by showing the adaptation and practical use in an example implementation done in the context of the DRM project. Details about the DRM project, achieved results as well as about the current state can be accessed online [2].

2.1. Windows Sharepoint Services as underlying cooperation platform

The DRM consortium agreed on implementing the DRM solutions based on the same publicly available collaboration platform. Such a platform has the advantage to cover a variety of features needed. The most important ones are:

- Web based client server architecture which allows remote access with only a web browser and no additional software installed.
- Integrated mechanisms for security, access control, data encryption and personalisation.
- Well defined interface specifications for the connection to external information sources.

The reasons for choosing Microsoft Sharepoint technology are:

- Penetration of the market due to the wide distribution of Microsoft Servers that support Sharepoint Technology.
- Seamless integration in Microsoft Office Products that are widely spread in the target group.

2.2. Basic structure of the DRM knowledge management problem

This paper concentrates on the motivation and realisation of a set of enhancements for project management capabilities supporting distribution networks of industrial SMEs. This is just one aspect targeted by the DRM project. A deeper explanation of all applications related to the support of distribution networks that is done by the DRM consortium would go beyond the scope of this paper. You can find more information about generally supporting distribution networks of SMEs with knowledge management tools in [6].

The information that is managed by the Project Management Suite is structured based on projects. Each project is represented by a ‘Sharepoint site’. User access mechanisms are defined on a ‘per site level’. This means that all members associated with a project can access the specific site. Depending on the role the user incorporates, there may be different access restrictions like read only access or the ability to contribute to the site content.

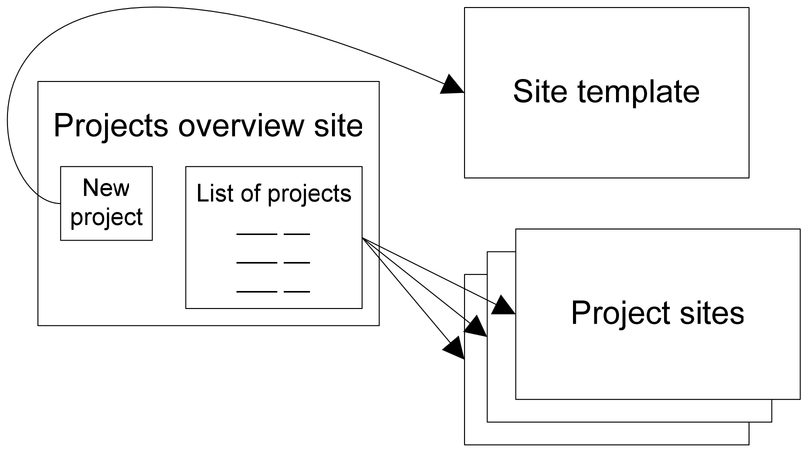


Figure 1 - structure of DRM project management

One root site represents the entry point of all users to their projects. This site enumerates all accessible projects for the current user and allows him or her to navigate to one specific project or instantiate a new one, if the user has the appropriate rights. Newly created project sites are based upon a ‘site template’. This guarantees that all sites of a kind have certain common properties. This is important to enable a meaningful processing of the contained information like searching for projects fulfilling certain criteria or sorting and filtering based on project related contents.

As a result we have a very simple jet universal hierarchical structure that the project management functionality of the Project Management Suite relies on. Figure shows this structure. Figure shows an example of a project site derived from a site template and populated with some project details.

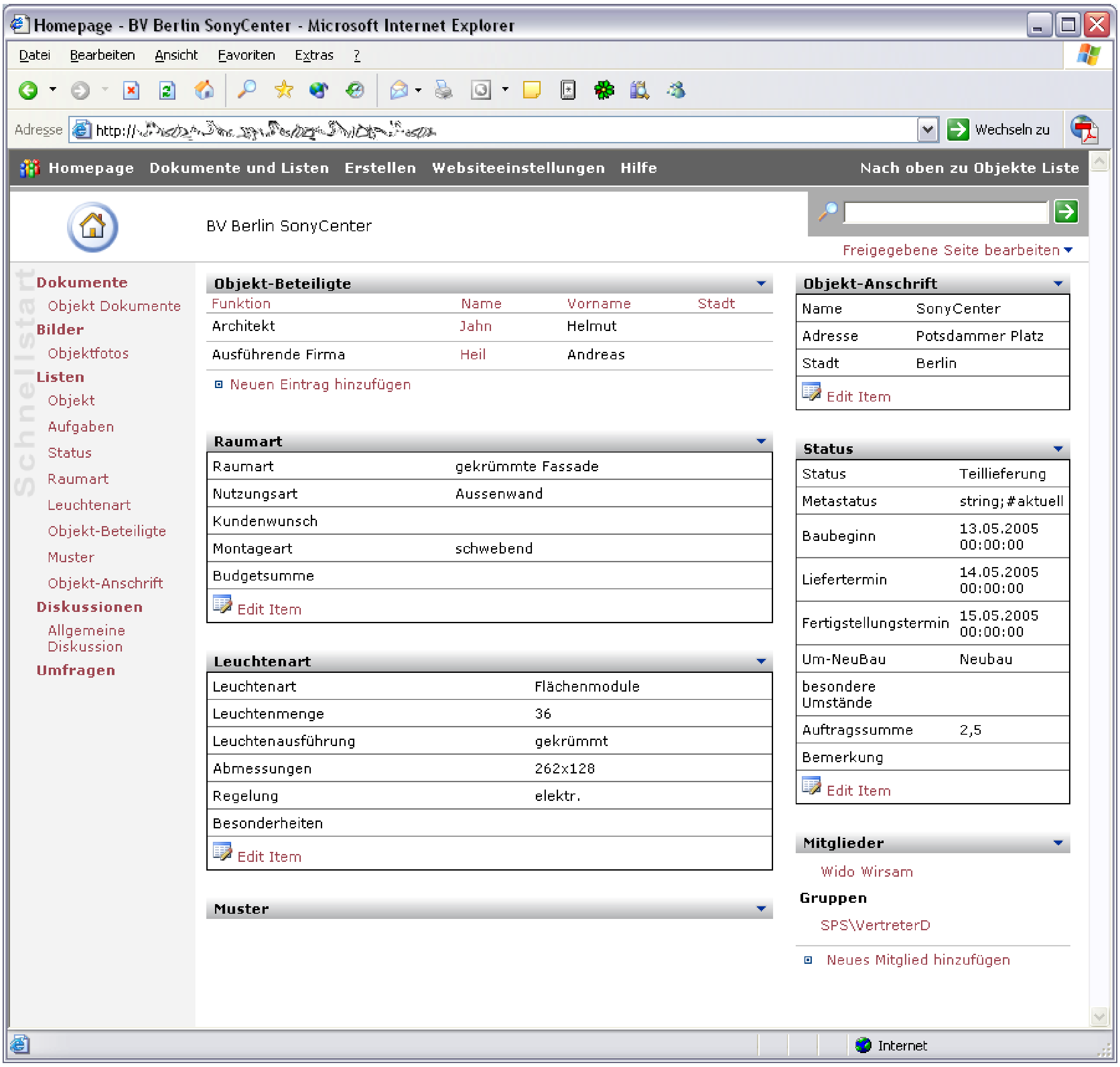


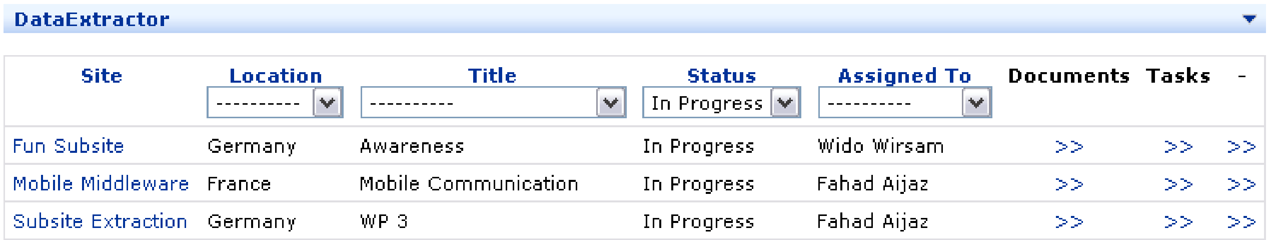
Figure 2 - Screenshot of an example project site

2.3. Project management extensions added to the core Sharepoint functionality

Even though Sharepoint Services support this kind of sites hierarchies, functionalities for a comfortable and user friendly navigation and creation of this kind of structures are missing. The DRM development team created interoperable software pieces that close this gap. Those components that can be deployed to any Sharepoint based solution are called ‘Web Parts’. Those Web Parts are predefined functional units that have their own user interface and may be placed on any Sharepoint based web site. In the following sections we describe the design and functionality of the Web Parts facilitating project management that were developed as a part of the DRM project.

2.3.1. Displaying and navigating project sites

The main purpose of the ‘Data Extractor’ Web Part is to provide the user with a comprehensive view of all projects he or she can access. Because this view can become cumbersome when the number of entries grows, the Web Part is capable of sorting and filtering the enclosed entries. Furthermore it delivers several shortcut links to certain configurable views of the project site of interest. Figure shows a list of projects accessible to a specific user. This list is filtered to show only projects with the status field set to ‘In Progress’


DataExtractor

Site	Location	Title	Status	Assigned To	Documents	Tasks	-
	----------	----------	In Progress	----------			
Fun Subsite	Germany	Awareness	In Progress	Wido Wirsam	>>	>>	>>
Mobile Middleware	France	Mobile Communication	In Progress	Fahad Aijaz	>>	>>	>>
Subsite Extraction	Germany	WP 3	In Progress	Fahad Aijaz	>>	>>	>>

Figure 3 - Web Part to browse, sort and filter accessible project sites

2.3.2. Creating new project sites

The process of creating a new project site by using the standard mechanisms as provided by the Sharepoint platform is perceived as too cumbersome by the majority of the target user group’s members. The way to create a new site based on an existing template, as it is designated by the Sharepoint system, provides some pitfalls for the disregardful user and additionally requires some basic web technology knowledge. To overcome this, the ‘Subsite Creator’ Web Part was designed to enable the user to automatically create a site based on a template, fill the parameters needed and assign access rights to the authorised user groups. Figure shows a screenshot of this Web Part. In the first step the user specifies the users and/or groups of users that shall have access to the newly created project workspace. In the second step the user specifies the template, that defines the basic kind of the new site as well as the title before he or she finally creates the new project site.

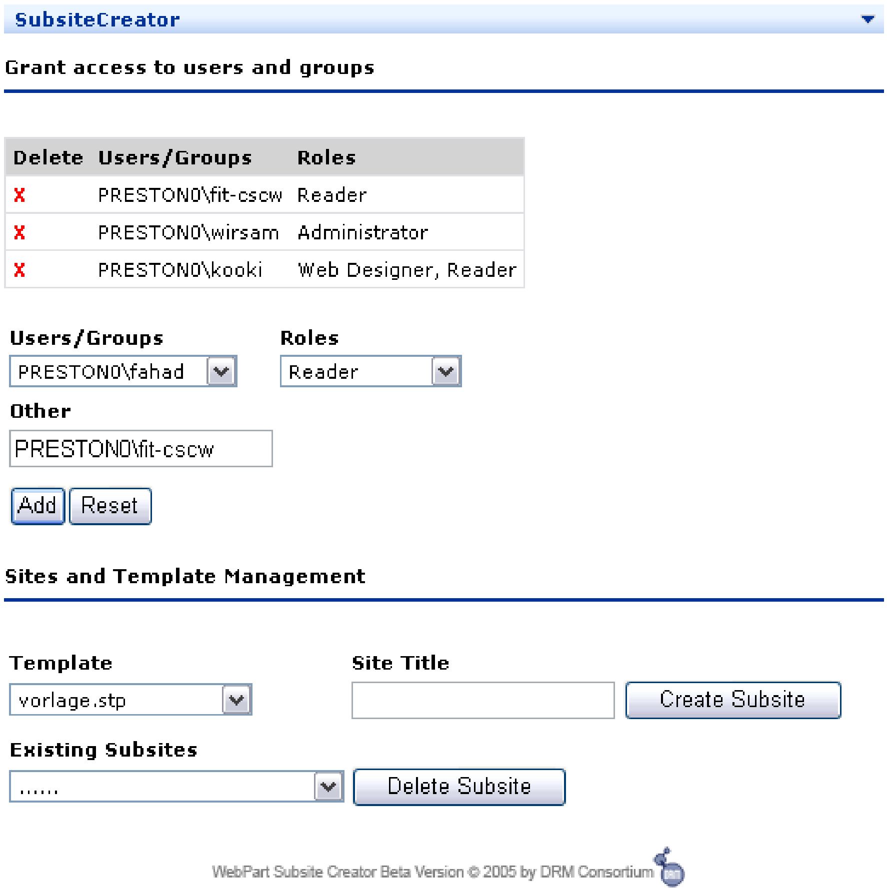


Figure 4 - Web Part providing project sites creation capabilities

2.3.3. Contextualised uploading of documents into the projects workspaces

The 'document uploader' Web Part enables the user to upload documents to the right place and to specify the required parameters directly from the projects overview site, without having to navigate to the respective document library on the respective project site.

2.3.4. Advanced group awareness functionality for activities performed on documents

All previous Sharepoint enhancements which the 'Project Management Suite' consists of have the common purpose to support the user in creating, accessing and filtering project related information. Although the following extension can be utilised very well in this context, its field of application is more general. It lends itself to be integrated in every collaboration scenario based on Sharepoint technologies where a big number of documents are handled and many document libraries are distributed over several workspaces. In this very common scenario it quickly becomes hard for the information worker to overview the current state of changes, versions and occurrence of new documents of his or her interest immediately. Therefore we created a Sharepoint Web Part to facilitate this very task. The user is provided with the possibility to specify, which document libraries are of actual interest in the current context and then can quickly browse the latest activities performed by all users on the selected information sources. The so called ‘Document Libraries Awareness Web Part’ provides three views: the first lets the user choose which document libraries are of interest to him or her. The second provides the user with a textual tabular representation of the recent events on the documents in the libraries and the third view displays the images of the people who have caused the recent events on the documents. As an additional visual representation of the age of the corresponding event, the user’s images fade out over time according to the age of the user’s last event. The visualisation of this third view follows a concept introduced by Gross et al. [4] in the context of the CYCLADES [3] project. Figure shows s screenshot of two views of the described Web Part.

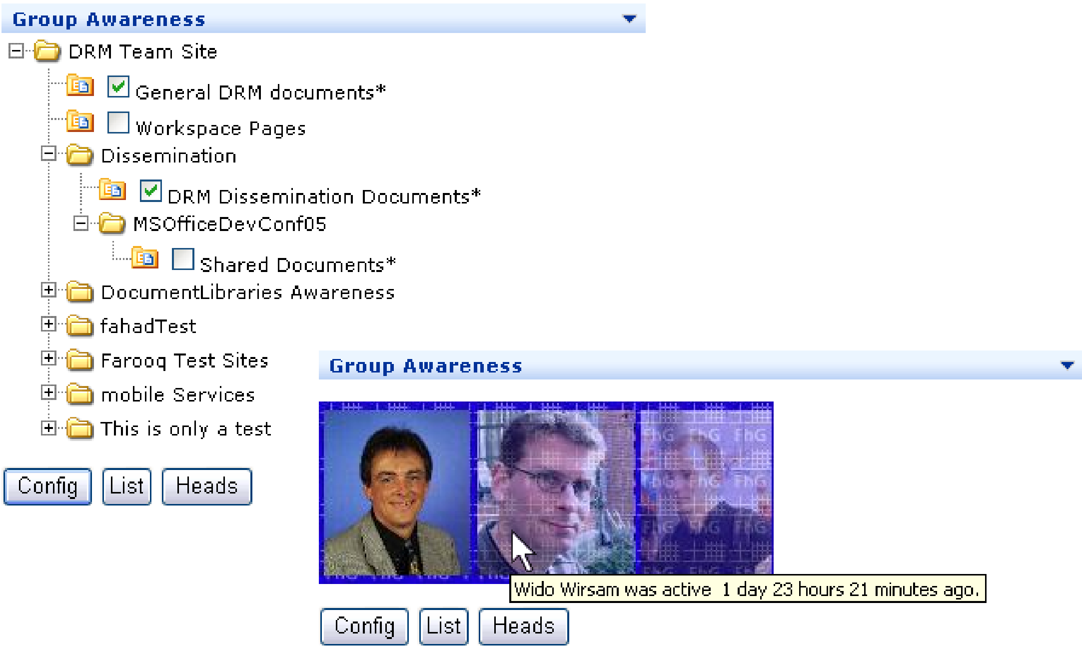


Figure 5 - Document libraries Awareness Web Part in Configuration and Peoples’ images mode

3. Conclusion and outlook

In this paper we presented reusable software components that can be integrated in any Sharepoint server installation to facilitate the project management related activities of groups of co-workers. These so called Web Parts are installed as a showcase implementation in one company participating in the DRM project and will be evaluated in the upcoming project phase. After the evaluation phase this set modules delivering extended groupware functionality will be made commercially available to the public by the associated exploitation partners within the DRM consortium.

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SUPPORTING VIRTUAL COMMUNITIES IN MOBILE VIDEOBLOGS WITH FRAMEDROPS

Tom Gross[1]

In this paper the concept and implementation of FrameDrops, a system supporting the creation and maintenance of as well as the browsing in shared multimedia archives in virtual communities, are presented. FrameDrops is a novel, mobile and location-based, VideoBlogging-System allowing users to create videos and take pictures on the go, and to send them with comment and location information to the FrameDrops server. The FrameDrops server automatically adds the data, manages them, and provides them to interested users in a homogeneous, interactive Web-interface.

1. Introduction

In general, virtual communities consist of users who have similar interests and seamlessly connect over distance in order to exchange information amongst each other or to jointly collect information [10, 17]. Systems supporting virtual communities should, accordingly, fulfil the following requirements: they should bridge geographic distance among users; they should support informal and formal communication among users; and they should provide for persistent data storage of mid to long periods of time [3, 4, 7, 12].

Besides traditional, often Web-based systems [17], recently more and more Weblogs are used to support virtual communities. Weblogs are digital diaries that can be produces and read with Web browsers [13]. Most Weblog systems provide integrated tools for creating new text entries and for sending them to Web-based Weblog servers. These servers then store the entries and present Web pages with both overviews in reverse chronological order, so that the most recent entries are on top; and the individual entries [8]. With PhotoBlogs users cannot only create text, but also picture entries. They are often used for picture documentaries (e.g., BabyBlogs, or TravelBlogs) [13]. VideoBlogs additionally allow users to produce video entries [6].

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Early Weblog systems were primarily developed for bringing diaries online. Newer Weblog systems aim to support communities of users who jointly collect and manage information on the Web. Nardi and others [14] published a study on the motivation and behaviour of users of Weblogs and discovered several reasons for using Weblogs: to update others on activities and whereabouts, (e.g., on trips); to express opinions on current topics (e.g., on politics, or on technology); to seek other's opinions and feedback (e.g., on personal thoughts, or on poems); to think by writing (e.g., on their personal circumstances); and to release emotional tension (e.g., on painful experiences). Several of these forums have characteristics that are similar to virtual communities.

In this paper the concept and implementation of FrameDrops is presented. FrameDrops is a system supporting the construction and maintenance of shared multimedia archives in virtual communities. It is a mobile VideoBlog allowing users to capture videos and pictures on the go with modern mobile phones, and to send these data with a comment and with information on the current geographical position to a FrameDrops server. FrameDrops servers automatically insert the data in a repository, and present this repository on homogeneous interactive Web pages. Compared to similar systems, FrameDrops offers several innovative features and novel combinations of features:

- Capturing and commenting as well as uploading videos and pictures is very simple and can be done with standard mobile phones and standard applications available on mobile phones—thereby fostering universal access for contributing to virtual communities.
- Sending videos, pictures, and comments to a VideoBlog server and creating a video base, which can be consulted by interested users anytime and anyplace, entails greater flexibility for readers than with an information push approach such as with email exchange.
- Capturing the position, where the videos and pictures are taken, and automatically positioning them allows to store valuable context information, which can be used to structure entries according to their location of origin and to foster encounters of users who are at close locations.

Because of these reasons VideoBlogs in general, and the mobile VideoBlog FrameDrops in particular are elegant tools for virtual communities. They provide a steadily growing base of entries, and through the geo-referencing of the entries they support flexible interaction among users not only in the online world, but also in the real world.

In this paper FrameDrops' concepts for creating mobile video, picture, and text entries as well as for browsing and viewing individual entries are presented. The user interface as well the implementation are described. Related work is discussed. And, some conclusions are drawn.

2. FrameDrops

FrameDrops combines three innovative concepts from net-centric media: joint online publishing in Weblogs, video and photo capturing on the mobile phone, and automatic positioning of authors and their entries.

2.1. Concept

FrameDrops supports users in creating and maintaining shared Web-based archives of video, picture, and text, as well as in later browsing through the archives. Users can capture videos and pictures on the go, annotate them, and send them to a shared FrameDrops server. The server processes the incoming data and automatically produces a new entry in the shared FrameDrops Weblog. All entries can later be retrieved and viewed with a standard Web browser. Subsequently the approach of FrameDrops is presented.

2.1.1. Mobile Blogging

FrameDrops allows users to create and insert entries in a simply manner and without knowledge of the underlying technology and transfer mechanisms. Being a mobile Weblog, it can be used anyplace and anytime. Additionally, FrameDrops' Web interface facilitates later changes—this is particularly convenient for entering or altering large amounts of text.

2.1.2. Automatic Positioning of Entries

FrameDrops can automatically position entries via GPS, and put entries in a geographical as well as chronological context. This coupling of the users' coordinates in the real world fosters a stronger connection between the online world and the real world, and between online and real communities. For instance, FrameDrops stimulates real-world encounters of users who have so far only met online by providing real-time information on their current positions. This is a novel way of bridging the gap between communities in the real and in the virtual world, which has been emphasised by several authors [e.g., 17].

2.1.3. Mobile Phones as Means for Media Production

Mobile phones of the third generation feature all means that are needed to create and publish moving images. FrameDrops uses the following: an integrated camera can be used to capture videos and pictures; an email application can be used to exchange the captured data; a Web browser can be used to retrieve entries later; and an integrated GPS receiver can be used to detect the user's current position. So far, the production of media was possible, but caused a lot of effort: the users manually had to capture pictures and video, transfer them to a computer, edit the data on the computer, and upload the data to a server.

2.1.4. Shared Information Base

Many users share Weblogs because they perceive exchanging the data via personal emails and attachments as intrusive and feel obliged to reply [14]. FrameDrops supports the joint creation of shared information bases, which stimulates users to add entries, but does not enforce them to do so. The entries are available online and users can annotate them, or attach greetings and hints, and links to related information.

2.1.5. Browsing Entries

FrameDrops provides an easy and intuitive Web interface to the information base and its individual entries. The interface is based on a Flash client that seamlessly integrates the individual entries into overview pages showing comments and static picture frames of the videos. The Flash client is lightweight and provides simply interaction for viewing the video entries.

2.2. User Interface

Creating and publishing new entries with FrameDrops is easy and straight-forward: users capture a picture or video, create a new email and write a comment in the email's body, and send this email with the attached picture or video to the FrameDrops server.

Figure shows an example screenshot of the FrameDrops overview of entries. The design of this overview page is based on two requirements: the interaction of the user with the system should be as simple as possible and neglect unimportant details, and no new software should be needed.

On the overview page the user can see a list of the most recent entries in reverse chronological order. An integrated calendar provides a navigation interface to earlier entries. For each entry the overview page shows the date and time of creation, a title, and a short description. Additionally, a picture shows a little preview, and an overlaid icon informs about the type of the entry (e.g., video, picture, or text entries). In a schematic map the locations of the individual entries are visualised as little blue dots. Hovering the mouse over a blue dot fades in the title of the respective entry.

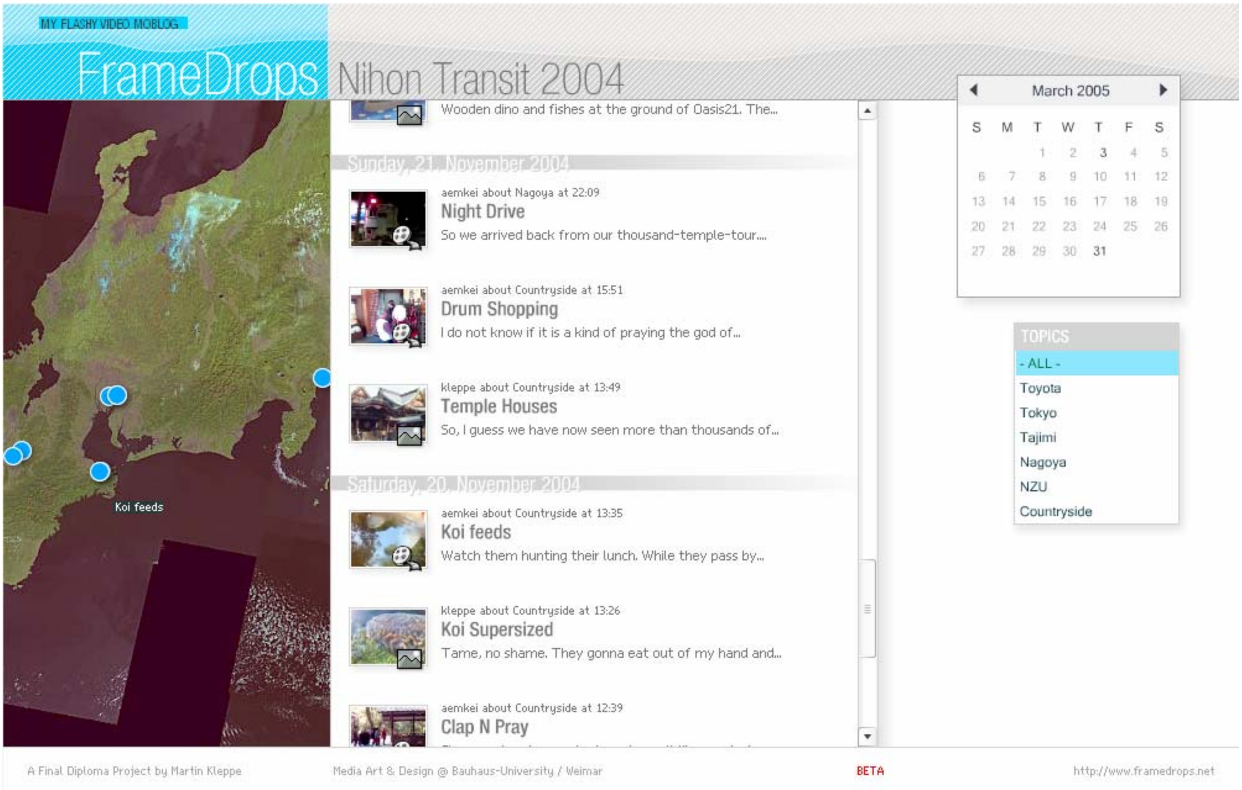

Figure 1 - FrameDrops overview of entries.

When the user clicks on one of the entries, the other entries fade out, and the complete information on the respective entry is shown (cf. Figure). All elements of the entry smoothly fade in. The video is integrated in the interface. The video controls for starting, stopping the video, for moving backwards or forwards in the video, and for changing the volume only fade in when the user hovers the mouse over the image of the video. On the bottom of the page the user can see information on the creation date and time as well as a globe icon, the latter allows users to move back to the schematic map and shows the position of the active entry.

Figure 2 - FrameDrops view of an individual video entry.

2.3. Implementation

The FrameDrops software architecture consists of a central server, of standard applications on the mobile phone, and of a Web browser with a Flash plugin.

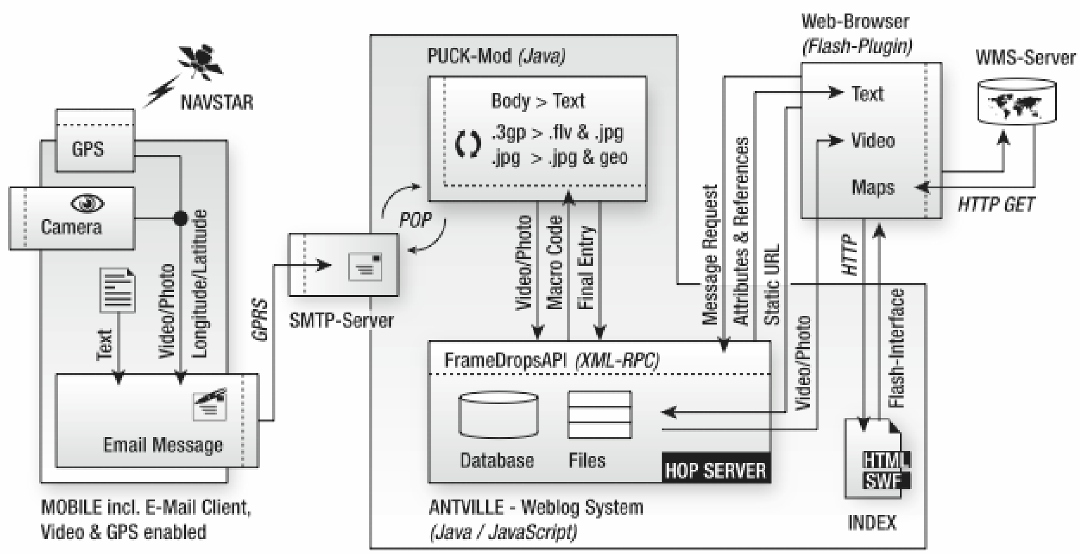

Figure 3 - FrameDrops software architecture.

Figure shows the FrameDrops software architecture and the flow of information through the architecture. It is described below.

2.3.1. Creating Entries

In order to create video or picture entries in FrameDrops the user needs a mobile phone with a picture or video camera, GPRS [5], and GPS [19]—this technology is available in mobile phones such as the Motorola A845, or the Motorola E1000. The user takes a video or picture, and stores it on the mobile phone. The GPS module automatically writes position information into metadata. Then, the user sends an email with the video or picture in the email attachment and the description in the email body via GPRS to the FrameDrops server.

2.3.2. Conversion at the Server

The FrameDrops server is based on the Antville Weblog system [2] and extends it with functionality and interfaces for publishing video entries from mobile phones. The Antville Weblog system provides the Helma Object Publisher server, which stores the descriptions of the entries as well as the metadata in a database, and the videos and pictures as files on the hard disk.

The processing and conversion of the FrameDrops server works as follows: at the FrameDrops server a standard SMTP server receives and stores incoming emails. The PUCK module of Antville periodically contacts the SMTP server and checks for new email and analyses the sender of the email. Emails from unauthorised users are deleted. The remaining emails are parsed: incoming video attachments are converted from the standard 3GPP format of the 3rd Generation Partnership Project [1] to the Flash video format (FLV) of Macromedia and a picture frame (JPG) is produced; and incoming pictures are already in JPG format and are simply adapted in scale. The metadata [15] of incoming pictures provide valuable information on the creation date and time, on the picture dimensions, on positions, on the camera used, and so forth and are extracted. The video and picture files are then sent to the Antville Weblog system via XML-RPC [20]. Antville returns a macrocode. Finally, the server generates the description by combining information from the body of the email, the extracted position information, and the macrocode and sends it the Antville server.

2.3.3. Content Presentation and Browsing

FrameDrops presents its overview and individual entries in a Web page with an embedded Flash object (SWF). This Flash object manages the whole communication with the FrameDrops server via XML-RPC. Upon request, pictures and videos are loaded in JPG and Flash format respectively. Since most Web browsers currently feature a Flash plugin in their standard distribution, the user does not need to make any installation.

The Flash object also manages the positioning of the entries in maps. For positioning the entries in the respective maps, the free maps from the WMS Global Mosaic Server [15] are used, which allow a positioning precision of 15 meters. All entries are geo-referenced and contain information on the longitude and latitude of their creation position. Entries from devices without a positioning feature are added without geo-reference. The Flash object then overlays all geo-referenced entries on top of the respective map.

Flash offers several advantages for the seamless presentation of text, pictures, and videos: the design is more aesthetically pleasing than pure HTML; content can be transmitted upon request; videos can be seamlessly integrated; and the whole positioning and layout information is loaded in the Web browser only once, this reduces transmission overhead.

3. Related Work

Only recently some systems and prototypes have been developed, which offer similar functionality—either concerning the data formats or concerning the positioning of the authors and entries.

Flickr [11] is currently the most comprehensive platform for private photo collections. Besides online forms and stand-alone tools for uploading pictures, Flickr also offers features for publishing pictures from mobile phones. Transferable code fragments allow users to include photos into any other Web page or PhotoBlog. Users can specify tags for photos, which are then used to as categories and keywords for search requests. The external module *Mappr* [18] can analyse these tags, extract position information, and position the photos in online maps. However, this positioning only works in major U.S. cities. And, due to the large number of photos, the positions are hardly distinct. Like FrameDrops on a whole Flickr in combination with Mappr facilitate the creation of Weblog entries on the move. Yet, FrameDrops also supports video and text entries, and works around the globe.

TokyoPicturesque [16] also supports the positioning of photos. Users of GPS enabled mobile phones can send an email with their picture to a server, which inserts the photos into a map of Tokyo, Japan. Later, users can see a satellite picture with overlaid dots of the positions of the photos in a Web browser. Hovering the mouse over a dot fades the respective picture in. Similar to FrameDrops TokyoPicturesque allows users to create and upload photos on the move. These photos can also be positioned. However, FrameDrops also supports text and video entries.

Finally, Textamerica.com [9] is a Web site of the American Camera Phone Moblog community, which allows registered users to maintain their personal VideoBlog. Videos, pictures, and text can be uploaded and later commented by other users. Yet, this system does not support positioning.

4. Conclusions

In this paper a mobile VideoBlogging system was presented—especially its concept, user interface, and implementation were described. The FrameDrops system is completely implemented, and has been used in our research group. A systematic user evaluation is currently missing. Still, several users of FrameDrops provided highly positive feedback—particularly concerning its advanced functionality and technology in combination with its easy and straightforward user interaction.

The existing implementation of FrameDrops has its limitations: current mobile phones with GPS extension can write information about the camera's position in the metadata of JPG pictures, but not in videos. Therefore, when capturing a video users also have to take a still picture for capturing the position information. Furthermore, some users pointed out that creating entries on the move is a great feature, but that they miss features for browsing and viewing entries on the move. Finally, FrameDrops only provides one map with all entries of all users of the community; it is not possible to follow an individual user's path.

5. Acknowledgements

The author would like to thank Martin Kleppe for inspiring discussions on the concepts of FrameDrops and for implementing the system.

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Creative Thinking and Decision-Making Analysis

CREATIVE THINKING AND DECISION-MAKING ANALYSIS – REQUISITE FACTORS OF INNOVATION CAPACITY

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Information is a tool of creativity and a result of creative thinking, decision-making and working, in terms of content and impact. All information and communication devices result from creative thinking and decision-making, too. The open issue is: with which methods does one achieve that no unavoidable cost is caused, and no unavoidable or even dangerous oversimplification or over-complexity and over-complications are caused. Hence, the point is in reaching the requisite holism with only requisite effort by applied systems thinking and innovation.

1. Introduction: The Critical Questions Addressed

Modern theory of competitive advantage considers innovations as one of the most important sources of competitive advantages, and national innovation potential as an important factor of a country's success in globalization. Studying the values of the national innovative capacity index (see [30]) can let us report that the advanced European countries like Germany, France and Austria are ranked in the first third, whereas some of new EU member countries (as of May 1st 2004) like Slovenia and Hungary are ranked in the second, and some of them like the Czech Republic in the last third among 28 European countries with available data in 2002 (see [7]). Not only the scientists in developed countries, but also the entrepreneurs and managers in successful firms recognize creativity as a vital ability in achieving excellence [3]. Creation of inventions and innovations, leading to improvements in e.g. quality and quantity of output, needs the *strengthening of the individual and the group thinking in order to define problems, produce and select creative and useful ideas with methods of creative thinking, and to choose and verify possible solutions with decision-making methods, supported with appropriate computer programs*.

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The critical questions addressed, therefore, inclusion of creative thinking methods as a basis of innovation management, and methods for supporting business decision making as inevitable tools in problem solving, especially in the phase of

- Problem definition (to identify, analyse and define problem), and
- Decision-making (to choose and verify possible solutions to the problem).

Creative thinking as a required ability of innovation possibility is discussed. Conditions for creative thinking, together with the techniques of creative thinking (for inventions and innovations) that can be used to make products, processes and services (better), and software for creativity and idea generation are presented.

Effective decision-making and learning in a world of growing complexity requires us to apply Systems/Systemic/Holistic thinking (about diverse Systems/Systemic/Holistic Thinking vs. Un-systemic/Traditional Thinking see [19], [20]), e.g. in the form of tools for systems theory, decision analysis, multi-criteria decision-making methods for solving the problems that can be structured hierarchically or like a network, and tools for risk analysis for verification of the expected value associated with decision alternatives. Although these forms of Systems/Systemic/Holistic thinking are briefly introduced, together with the software for decision-making analysis and applications on practical examples of evaluation, selection and verification of ideas, as well as problem solving and analysis, the emphasis is given on the *multi-criteria decision-making methods* since

- They enable a complex, integrated and logical framework that allows for interaction and interdependence among factors, structured hierarchically or like a network to deal with dependence and feedback, and
- They enable consideration of all dimensions of the so-called sustainable performance: economic, environmental, ethical and social dimension (see [16]).

Systems thinking, management science with the emphasis on decision-making analysis (quantitative and qualitative methods), the modern trade theory, the theory of the firm, computer science, and management concepts (like innovation management, knowledge management) give broader theoretical foundations for practical business applications in the fields like Product (and Service) Design and Development, Strategic Planning, Project Management, Re-engineering, Risk Assessment, Enterprise Portfolio Analysis, Marketing Planning and Strategies, Total Quality Management, Resource Allocation, Vendor Selection, Human Resource Management, and others. There are many innovation techniques [9], but they all depend on creative thinking.

2. Creative Thinking Methods as a Basis of Innovation Management

2.1. Creative Thinking as a Requisite Ability of Innovation Possibility

The life periods that are characterized with the routinised repetition of unchangeable functions are expiring. In innovative society (information society, society of perfect quality, learning society, knowledge-based society, entrepreneurial society, … as their partial characteristics), the successfulness depends on competitiveness, creative thinking and decision-making – of individuals and organizations, from a family to all people. Therefore, creativity is at least as important as professionalism; its use is especially important in creating useful novelties, i.e. for innovating. This paper emphasizes the need for the activation and development of creativity where creative thinking is understood as a specific thought process, which improves one's ability to be creative.

Creativity defined as producing of new ideas [22] can be used as a process to make products, processes and services better and it can be used to create them. It enables improvements in quality and quantity of output. It should be beneficial to career and company [14] and is emerging as one of the few sources of competitive advantage [3].

2.2. Conditions for Creative Thinking

Several options for removing or minimizing creativity blocks can be found in the literature (see [3], [12]): modifications of the environment, behavior, capability, beliefs and/or identity have already proved in practice to be reasonable ways toward solutions to the problem of personal creativity. When designing a creative organization, the necessary synergy can be provided by including the context elements: culture, leadership style and values; structures and systems (meaning: tools and means, in this case); skills and resources (see [3]). Each organization needs to adopt options for eliminating or minimizing organizational blocks to creativity, appropriate to its environment: e.g. with hiring creative leaders, challenging rules and values, adding co-operation by using team development, using creative problem-solving tools and changing the climate. As Albert Einstein has said: creativity consists of breaking the rules, genius consists of persistence, and both of them are based on a never-ending curiosity [28].

Many learning organizations encourage creativity. It is generally known that there is a correlation between conditions for creative thinking, including the climate for innovation, and business success. The characteristics of the climate for creativity vs. the non-creativity climate have been delineated by Pečjak [22]. Pioneering work of Ekvall [8] that has been further refined and validated by Isaksen [15] proved that it is possible to quantify the climate for innovation. One of the most important steps in the quantifying procedure is the definition of the dimensions of this climate (e.g. challenge, freedom, idea time, idea support, trust & openness, playfulness and humor, conflicts, debates, risk-taking; see [23]). Considering our knowledge and experience in the quantifying procedures, it should have its next step in assigning an appropriate type of scale (e.g. ordinal, interval or ratio) and defining the scale values. These steps require knowledge of experts that deal with creativity, innovation, and the quantitative methods in decision analysis. With a joint work, questionnaires can be used in practice to improve the environment for creativity, and therefore for inventions, potential innovations, and innovations.

2.3. Creative Thinking Techniques for Inventions and Innovations

Following the 80/20 formula suggested by Cook [3], creativity is 80 per cent context and 20 per cent technique. Context as the permission/encouragement for creativity has already been delineated in the previous chapter. Techniques as the processes are used to push individual/group thinking beyond the constraints and have their place when an appropriate context has been created.

A wide variety of traditional methods for strengthening individual and group creativity are outlined in literature (see e.g. [3], [11], [12], [22]. In practice it is enough to select the most appropriate one(s) according mainly to their function (and the problems' nature). "Why" technique, mind mapping, fishbone diagrams and wishing are the most known techniques among wide variety of the techniques for *problem/opportunity definition*. This group also includes systems thinking approaches like relevance trees and cognitive mapping. The most known and widely used technique is brainstorming with its variations, applicable mainly for *generating ideas*, and for their evaluation and problems' identification, as well. Nominal group technique, provocations, forced relationships, brain-writing, attribute listing, morphological analysis, synectics, as well as mind mapping and different types of checklists can be used for *generating ideas*. Moreover, attribute listing, morphological analysis and mind mapping can be used for *decomposing*, whereas mind mapping and W technique can be used for *analysis*. Checklists are also known as toolkits for *verifying* and *systematization*. Besides generating ideas, synectics can also be used for *finding solutions*. Idea writing can be used not only for generating, but also for *ranging ideas*. Star rating matrices, the balance sheet method, paired comparison analysis, reverse brainstorming can be (among other purposes) used for *choosing ideas*. For this purpose we can also use already mentioned nominal technique, which can be used for *defining and evaluation of ideas*, too. Balance sheet can also be used *for solution implementation*; for this purpose we can use stakeholder analysis, implementation checklist, critical path analysis and many other techniques, too.

It has been assessed that two thirds of innovations are results of a demand-pull, whereas one third of them is a result of a discovery push (see [22]). Newer theories mention five phases of innovation management theories:

(1) Innovation derived from science (technology push).

(2) Innovation derived from market needs (market pull).

(3) Innovation derived from linkages between actors and markets, such as chain-link theories.

(4) Innovation derived from technological networks, such as “systems of innovation” on a national, regional or international basis, which cause synergies of ideas and information from both internal and external sources.

(5) Innovation derived from social networks, which enable a lot of exchange of information and makes knowledge available very rapidly on a worldwide basis. The point is meeting the need for many kinds of knowledge and their convergence from a variety of actors.

Hence, the theory (5) is closest to (informal) systems thinking. (See: [9], pp. 23-25)

The idea is only the initial stage in its realization. It has to pass the invention, developmental and commercial phases before a product is massively produced.

Therefore, modern internationally advanced methods for strengthening creativity like work simplification, USOMID, 20 keys, ISO 9000, TQM, EQA, Slovenian quality award, re-engineering of business performance, learning enterprise, knowledge management, heartstorm, Total Systems Intervention, project management, and other methods, connected with the innovation acceleration should be used to improve innovation capacity in enterprises, regions, and countries. Further, research and development, unprofessional invention and innovation creation should be used to strengthen the creativity in central invention-innovation activities.

2.4. Software Supportive of Creativity

Numerous software products for creativity can be found on the Internet (see e.g. [21], [27]). They differ in prices, the offer of free-trial versions, applications, potential users (executives, entrepreneurs, journalists, farmers, college professor, writers – one or some of them), approaches, the number of participants (individual, group thinking, or virtual), the possibility of ranking each idea according to the thinkers' criteria, operating systems, forms (graphics, outline), and in the techniques used.

We focus on the tools that could help mainly enterprises in creative thinking and decision-making. Main fields of our interest include Product (and Service) design and development, Strategic Planning, Project Management, Re-engineering, Marketing planning and strategies, Total Quality Management, Business writing, Human Resource Planning. We collected, generalized and edited main purposes of applications, together with software products for creativity, and presented them in Table 1.

Table 1 - Purposes of applications of available software products for creativity

Purposes	Software products
Capturing, generating ideas	Inspiration, BrainStorm, BrainStormer, Idea Generator Plus, Brainstorming Toolbox, Idea Generator Plus, Sirius, Concept Draw MINDMAP®, Grouputer, IDEGEN++
Recording ideas	ACTA Advantage, CK Modeller, Visimap / InfoMap, MicMac, Microsoft Word – Outlining Feature
Visualizing ideas	Axon Idea Processor
Organizing ideas	ACTA Advantage, Axon Idea Processor, Inspiration
Manipulating ideas	CK Modeller
Drawing mind maps	Concept Draw MINDMAP®, MoonLite
Generating alternatives	Microsoft Word – Thesaurus Module
Team working	Grouputer, ThoughtPath
Virtual meetings	CM/1
Moonlighting	MoonLite
Solving problems	Brainstorming Toolbox, Idea Generator Plus, Sirius, Turbo Thought, Genius Handbook, Grouputer, IDEGEN++

Moreover, Brainstorming 1.0.1 is a program for helping frontline employees be more creative, innovative at work; IDEGEN++ is a program for creative problem solving and innovative thinking; The Creativity Machine facilitates a creative production. Some software packages support more functions. For example, Concept Draw MINDMAP® is software for creating Mind Maps ® and diagrams, for facilitating the capturing, editing and presentation of ideas; Grouputer supports brainstorming, problem solving, team building, strategic planning and interactive learning, and ThoughtPath stimulates work teams and inspire break-through ideas.

Besides these functions, the upgrades of ThoughtPath software bring techniques and processes that enhance the user's natural creative abilities. Axon Idea Processor enables that idea processing is concerned with problems and solutions, questions and answers, unknowns and facts. Decision Explorer has applications not only in cognitive mapping, but also in many other areas including group decision support systems and knowledge modeling. By using Innovation Toolbox, a problem solving structure guides users through the different problem-solving processes to ensure that questions are answered and that all ideas are evaluated. By organizing information into hierarchies, TreePad makes an environment for organizing and creating new ideas.

It can be concluded that these computer programs can help decision makers define problems, generate ideas, together with recording and organizing, capturing, manipulating, editing and organizing them, and – to less extent – to solve problems. It can be up to the decision makers to decide if the idea is of value to them, and it may be in their skill to develop the idea into a solution. However, decision-making methods can help to choose and verify possible solutions.

3. Decision-Making Methods: Between Ideas and Innovations

3.1. Tools Supportive of some Systems Theories

The 20th and the 21st centuries bring notable developments to the following tools for systems theory: system dynamics, management cybernetics, soft systems methodology, cognitive mapping, and models, for example viable system model, to mention only these among several systems thinking approaches. They:

- Help understand and handle the increasing complexity (soft systems methodology),
- Enable the study of effective organization, communication and control in social systems (management cybernetics),
- Ease understanding of how organizations work (viable system model), the structure and dynamics of complex systems, the ways in which an organization's performance is related to its internal structure and operating policies, including those of customers, competitors and suppliers and
- Help then to use that understanding to design high leverage policies for success, and

- Help model and simulate system behavior over time (system dynamics).

They are increasingly used to design more successful policies in companies, and – for example system dynamics (see [26]), to public policy settings, too. Namely, its applications include mainly business cycles, corporate growth and stagnation, the diffusion of new technologies, the design of supply chains in business and other organizations, service quality management, project management and product development.

In practice, simulation is used to verify the produced models because of their complexity. Via simulations, understanding of real-world situations can often be radically changed.

There are several software packages designed to support this kind of system thinking modeling. These include e.g. ithink, Powersim, and Vensim (for system dynamics modeling), ViPlan Learning System (for viable system model), Group Explorer (for cognitive mapping).

3.2. Decision Analysis

Decision analysis can be used to determine an optimal strategy when a decision maker is faced with several decision alternatives and an uncertain or risk-filled pattern of future events. It includes decision-making without probabilities, decision-making with probabilities, risk analysis, sensitivity analysis, decision analysis with sample information, etc. (see [1], [5]). Influence diagrams, payoff tables and decision trees could be used to structure a decision problem and describe the relationships among the decisions, the chance events, and the consequences. The concrete applicability of decision analysis can be obtained by the use of a decision tree as a model for decision-making with sample information. Decision trees can be used to analyze more complex problems and to identify an optimal sequence of decisions (each of which could lead to one of several uncertain outcomes), referred to as an optimal decision strategy. They provide a graphical representation of the decision-making process with the emphasis on the sequential nature of decision problems. Decision-making with sample information and using decision trees can gain support from appropriate (and popular) computer programs, for example Tree Plan (that has already been mentioned as software for creativity) or Precision Tree.

Because of the uncertain or risk-filled patterns of future events, decision analysis with the emphasis on risk analysis can be used to provide probabilities for the payoffs associated with a decision alternative. As a result, risk analysis helps the decision maker recognize the difference between the expected value of a decision alternative and the payoff that may actually occur. The risk profile for a decision alternative shows the possible payoffs along with their associated probabilities. Risk aversion, analysis of probabilistic dependencies and of uncertainty as well as sequential decision-making can be supported by, for example, @RISK, Analytica, DEA SolverPro, DecisionPro, DecisionScript, DecisionTools Suite, DPL Professional, Equity, Netica, Optimal Manager, Qualrus, QMS, TreeAge Pro Suite, etc.

A spreadsheet provides a convenient way to perform the basic decision analysis computation; it may be designed for any of the decision analysis approaches mentioned above. We can use one of computer programs that are actually used in enterprises, e.g. Excel.

Representations of available decision analysis packages contain the information provided by the vendors and surveyed by the Operations Research / Management Science (OR/MS) researchers (see [18]). The appropriate information can be easily found on the world's web pages. It includes applications like trade-offs among multiple objectives, analysis of uncertainty, analysis of probabilistic dependencies, risk aversion, sequential decision making, multiple stakeholders, and specific applications for which software is most widely used. Before buying such a decision support package, experts in enterprises can use trial-free versions of computer programs to find out whether a product offers enough possibilities for a convenient preparation of their decisions. However, when using the results in answer and sensitivity reports, decision makers in enterprises must be provided with appropriate knowledge about the basics of the methods used in order to read, interpret and use these results for problem solving. Especially in small and medium sized enterprises where the sphere of action of one employee combines a broader spectrum of working tasks than in large enterprises, the knowledge base and ability to learn of each employed expert is of high importance.

3.3. Multi-Criteria Decision-Making Methods

A group of decision analysis methods that are distinguished by applicability in several social fields, characterized by different levels of the problems that are to be identified, structured and solved (personal, business, economic: micro and macro, political, technical, environmental, ethical, …) is described as multiple criteria decision analysis. Multi-criteria decision-making (also called multiple objective problems) describes the set of approaches where more (than one) criteria are taken into consideration. These approaches can help individuals or groups in researching important complex decision-making problems. They should be used when intuitive decision-making is not enough for several reasons: because of the conflicts between criteria or because of disagreement between decision makers about relevant criteria or their importance and about acceptable alternatives and preferences. Conflicts can appear in individual and group business decision-making, too.

Let us emphasize the main characteristics that distinguish single- from multi-criteria decision-making. The main goal of single-objective decision-making (and optimization) is to find the "best" solution, which corresponds to the minimum or maximum value of a single objective function. Single-objective models require that all design objectives must be measurable in terms of a single fitness function of same units (see [25]). Single-objective approaches put the decision-making burden on analysts since single-objective optimization can detect one optimization solution in a single run, whereas decision makers must express preferences beforehand. When the role of supporting decisions and decision-making (or even decision-taking) is misunderstood, the responsibility for (wrong) decisions is much easier placed on analysts by using single-objective approaches. However, multi-objective approaches allow for one's responsibility for defining problem (goal, criteria and alternatives), its structuring, assigning the criteria's importance and expressing the preferences to alternatives, and even verifying the sensitivity of their judgements to be placed on decision maker.

Although single-objective optimization identifies a single optimal alternative, it can be used within multi-objective framework [6], e.g. so that in the simulations obtained optimal values are included**.**

The results of the multi-criteria decision-making should not be understood as the final ("right") answers in the problem solving process. Multi-criteria analysis cannot be justified within the optimization paradigm frequently adopted in traditional OR/MS (see [2]). The appropriate ("objective") analyses cannot relieve decision makers of the responsibility of making difficult judgements. It is an aid to decision-making, which seeks to integrate objective measurement with value judgement and to manage subjectivity. The last one is evident particularly in the choice of criteria and in determining of their weights. In this work we introduce some of the methods of multi-criteria decision analysis (MCDA) because they have already turned out to be applicable in business practice. To their applicability in solving complex problems contribute the following facts:

- The MCDA methods do not replace intuitive judgement or experience and they do not oppress creative thinking; their role is to complement intuition, and to verify ideas and support problem solving.
- In multi-criteria decision-making we take into account multiple, more or less conflicting criteria, in order to aid decision-making.

- In this type of decision-making process we structure the problem.
- Users can compare different methods and assess their convenience in problem solving. The most useful approaches are conceptually simple, transparent and computer supported.
- The aim of multi-criteria decision-making is to help decision makers learn about the problem, express their judgements about the criteria importance and preferences to alternatives, confront the judgements of other participants, understand the final alternatives' values and use them in the problem solving activities.

The process of multi-criteria decision making can be realized from identification of a problem, through problem structuring – model building, expressing judgements, to the creation and analysis of a plan of activities that can solve a problem. These activities can be, for example, to implement a specific choice, to put forward a recommendation and to monitor performance.

Although approaches to multi-criteria decision-making are distinguished from each other, mainly in the model and in the information required, they have in common problem definition (and within that global goal), determination of acceptable alternatives and criteria that structure the model, and the use of measure for differentiating among criteria and their ranking.

In some environments decision makers are not able to co-operate in their group decision-making, they do not want to search for compromise solutions, they are not prepared to express their judgements consistently or they need ad hoc solution. In such cases they are recommended to express their preferences beforehand. The goals can be included in the models for goal programming. In the available literature, this technique is included in multi-criteria decision-making because it has been developed to handle multiple criteria situations within the general framework of linear programming whereby the objective function is designed to minimize the deviations from goals [4]. In some ways it can be thought of as a heuristic approach to multi-criteria decision-making because it allows decision makers to incorporate his or her or their preference system in dealing with multiple conflicting goals. Goal programming seeks allowable decisions that come as close as possible to achieving specified goals. However, these models should be understood more as a tool in searching for optimum than as a tool in searching for the most preferred solution with respect to different criteria.

One of the most widely applied sets of multi-criteria methods is multi-attribute value (or utility) theory (MAVT or MAUT) (for a detailed description see [2]). From the late 1960's this set of methods has been developed not only by management scientists, mathematicians, psychologists, but also by practitioners in management, economic, environmental and public fields. The need to include different scientific, professional fields in the development of these methods results from the need to manage complexity. It has been improved to SMART (a simplified multi-attribute rating approach) and other approaches (for example SWING, SMARTER). One decade later they developed the Analytic Hierarchy Process (AHP) method that excels by widely applicability, too, and is distinguished by the scales used, the methods used to express judgements about the criteria importance and preferences to alternatives, and the manner of transforming these judgements into numerical vales. A (relatively) holistic approach (as the opposite of a linear and piecemeal approach) is used in this method in which all criteria of the problem are structured in advance in a multilevel hierarchy; it is, in addition, completed with the interaction and dependence of higher-level elements on lower-level elements and relations in the form of feedback structure that looks like a network – the Analytic Network Process (ANP) is the generalization of the AHP to dependence and feedback [24].

The use of the discussed methods would lead to over-complications when decision makers do not need so detailed results as they are obtained with these methods. Namely, some decision problems do not require the alternatives' ranking with respect to their final values; often it is good enough to find out which of them is the most preferred. Therefore the so-called "outranking" approaches that focus on pair-wise comparisons of alternatives, and are thus generally applied to discrete choice problems, have been developed since 1970's. The most widely applied are ELECTRE in more variants and PROMETHEE (for details see [29]). Further, interactive methods as another set of multi-criteria approaches emphasize dialogues with the decision maker, who reacts to the first solution provided by the first computation step by giving extra information about his/her preferences. The dialog must be one of the principal investigation tools. These methods are especially applicable when a complete preference model is not constructed a priori and when alternatives need improvements (for details see [29]). An evolution from search-oriented to learning-oriented methods can be noticed.

Software products for multi-criteria decision-making that have been paid much attention among experts in different practical business fields (because of user capabilities, availability of graphical elicitation techniques, the possibility to transform subjective judgements into objective measures) are as follows:

- HIPRE 3+ and its web-version Web-HIPRE [13]. According to our experience it is especially applicable for the methods based on ordinal and interval scale: SMARTER, SMART, SWING, and for the measurement of alternatives' values with respect to each attribute by value functions, although it supports also the AHP method in the sense of pair-wise comparisons, and direct measurement of alternatives' values;

- Expert Choice [10]. According to our experience it is especially applicable for the AHP method that is based on a ratio scale, although it supports the measurement of alternatives' values with respect to each attribute by value functions and direct method;
- Logical Decisions for Windows [17]. According to our experience it is especially applicable for problems where describing the alternatives is of special value; utility functions do the conversion different levels on each measure into common units; further, AHP or Adjusted AHP can also be used for this purpose; weights can be assessed with Tradeoffs, by direct entry, the SMARTER and the SMART method, weight ratios and the AHP;
- Super Decisions -- the software for decision-making with dependence and feedback -- is the software that goes beyond Expert Choice (as well as the Analytic Network Process goes beyond the Analytic Hierarchy Process), by dealing with the outcome of influences.

4. Concluding Remarks

In attempts to increase the extent to which company strategies and operating practices are oriented toward innovation we emphasize the capacity of dialectical systems thinking as a precondition for requisite holism, and therefore for successful and efficient creating and decision-making. For managers, the understanding of an economic role of creativity and a relationship among central invention-innovations activities, the knowledge about traditional and modern methods supportive of the creativity activating and strengthening, as well as the capacity of understanding and using the selected quantitative methods that support creativity and decision-making, including adequate computer programs, is often necessary. Many learning organizations encourage the use of this knowledge in activating and strengthening creativity and in decision-making, including the use of adequate quantitative methods and computer programs. In this context, the creative thinking techniques, the decision-making methods and adequate computer programs that are given special attention in this paper are necessary (but not sufficient) conditions for innovations.

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THE PRINCIPLES OF SYSTEM DYNAMICS TOWARDS BALANCED SCORECARD IMPLEMENTATION

Stanislava Mildeová

This paper discusses the possibilities of using system dynamics models to solve the problem of innovation management methods in various fields, mainly with respect to practical use of simulations for management decision-making support in a complex world. System dynamics emphasizes explicit modeling, and takes advantage of the involvement of dynamic characteristics including delayed nonlinear feedback activity, which can be used towards Balance Scorecard implementation. SD, used as a common frame for building BSC, is illustrated to implement strategy into regions and above all can be used for creation of a business flight simulator. This simulator of a Balance Scorecard is shown as tool that could support management systems thinking and would help to understand dynamic relations in an organization as a whole.

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1. Complexity of decision-making in management

Innovations, adjustments and changes are the most apt and common characteristics of the situations in which managers must make their decisions. As the complexity of decision-making problems grows, time urgency comes into the fore, the number of unstable and disturbing effects in the competitive environment rises and the risk of wrong decision-making threatens more than ever before. Decision-makers need an efficient way of solving these problem situations.

An effective approach to finding and applying correct solutions is to uncover the behavior patterns from which we can infer the solution. It is obvious that no solution can be the correct one unless we stick with systemic procedures which take our limitations into consideration. In addition, *important characteristics of the complex systems in a company – detailed and dynamic complexity, feedback structures, nonlinearity, impact of delays and their stochastic character – must also be part of an effective solution package* [4].

Thus, an improvement of our ability to solve problems is a necessary presupposition for the ongoing development of cognition. Based on such improvements we can expect plenty of benefits not only in management but also in various areas of human life – from improvements of social problems, increases in performance and sustainable development of companies and society, to applications overlapping the frontiers of different fields, e.g., psychology, sociology, medicine, politics, economics, pedagogy, etc.

Based on our experience, we formulated a hypothesis that *system dynamics models could be an effective means for solving complex problems* [6]. Therefore we have focused mainly on questions like how to use system dynamics models for helpful simulations of entrepreneurial reality and how to contribute to the "building of knowledge" of future and current managers; how to solve specific problems in systems with occurrence of dynamics complexity [12] and what support and environment could encourage creative and systems thinking in managers in an acceptable form [12], [7], [9].

We found system dynamics models and simulators that create an environment in which it is possible to think and invent new ways of solving complex problems [15], [9], [8]. System dynamics simulation models could also help managers understand and outline possible future consequences of their decisions.

On the level of a complex social system such as 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 – they function as a tool for understanding and implementing sustainable development [4].

In the Czech Republic, system dynamics models and methods have been quite unappreciated until now principally because of a lack of sound experience and knowledge. Nevertheless, we can draw on some successful projects as examples in the Ministry of Defense. For example, the personnel model "Libuše" was created for the military of the Czech Republic, and terms of the Phare project were verified using the French system dynamics model of sustainable development under Czech conditions [2]. Models covering areas of financial management, strategy testing, risk management, development of distribution chains, project management, implementation of Balanced Scorecard method were created for some notable Czech firms, including Hartmann-Rico, Precheza, Czech Telecom, and a local branch of T-Mobile [12], [16].

As in developed countries, *system dynamics models are now being used for various purposes, such as testing decision-making strategies and policies in organizations* (profit, non-profit organizations, public institutions, etc.) and society, as a common platform for sharing mental models and knowledge in various professions, *as a tool for applying principles of so-called "learning organizations" or as a tool supporting the Balance Scorecard method of organizational strategic evaluation*.

2. Dynamic Balance Scorecard

There are a myriad of tools and techniques for helping leaders improve managing, in which techniques of Total Quality Management, or Kaizen, can be used.

It has been ascertained, although not substantiated, which concrete technology firms derive benefit from. Of critical importance is to be strong in basic company business undertakings, which outdo competitors, and excel in four prime managerial practices: strategy, operative management, culture and structure.

Strategy, strategy and again strategy. No pilot would admit that he does not have strategy. *One tool which can uncover management production strategy, which converts common basics to the concrete and everyday firm activities, is the Balanced Scorecard.*

The effectiveness of the Balanced Scorecard for the successful operation of the firm increases with number of successful implementations, due in part to the increased understanding of the strategic management systems during life cycle survival firm.

The Balanced Scorecard allows one to see the company in relation to economic forces, which support each other. It allows elect purposes take them apart and delegate middle management. It links the seemingly incompatible: it leads to thinking about the reason and purpose of all activities, and at the same time aids whole organization in seeking the same direction. Its analytical requirements attempt balance, drawing in business activities from all significant sources.

Relations between Balanced Scorecard objectives don't need to be merely direct, linear and without delay. Extending the classical Balanced Scorecard model using the elements in the simulation allows integration with the principles of system dynamics. In this way, the Balanced Scorecard model creates a dynamic simulation of actual strategic processes with the existence of backward structures delays (on *Picture 1* they are designed in gray) *and nonlinear relations among objectives*. It allows better understanding of dependence and verifies the practicability of strategy through models that allow simulation with different variables.

Dynamic BSC isn't an analytical tool; model accuracy isn't a primary focus. The purpose is understanding system structures and resulting behaviour in time, revealing the importance of lock-up and increasing workers responsibility in strategy implementation.

SD methodology will find use either in the creation stage of BSC or at spreading (roll out) to the lower management degree and ensures permanent use.

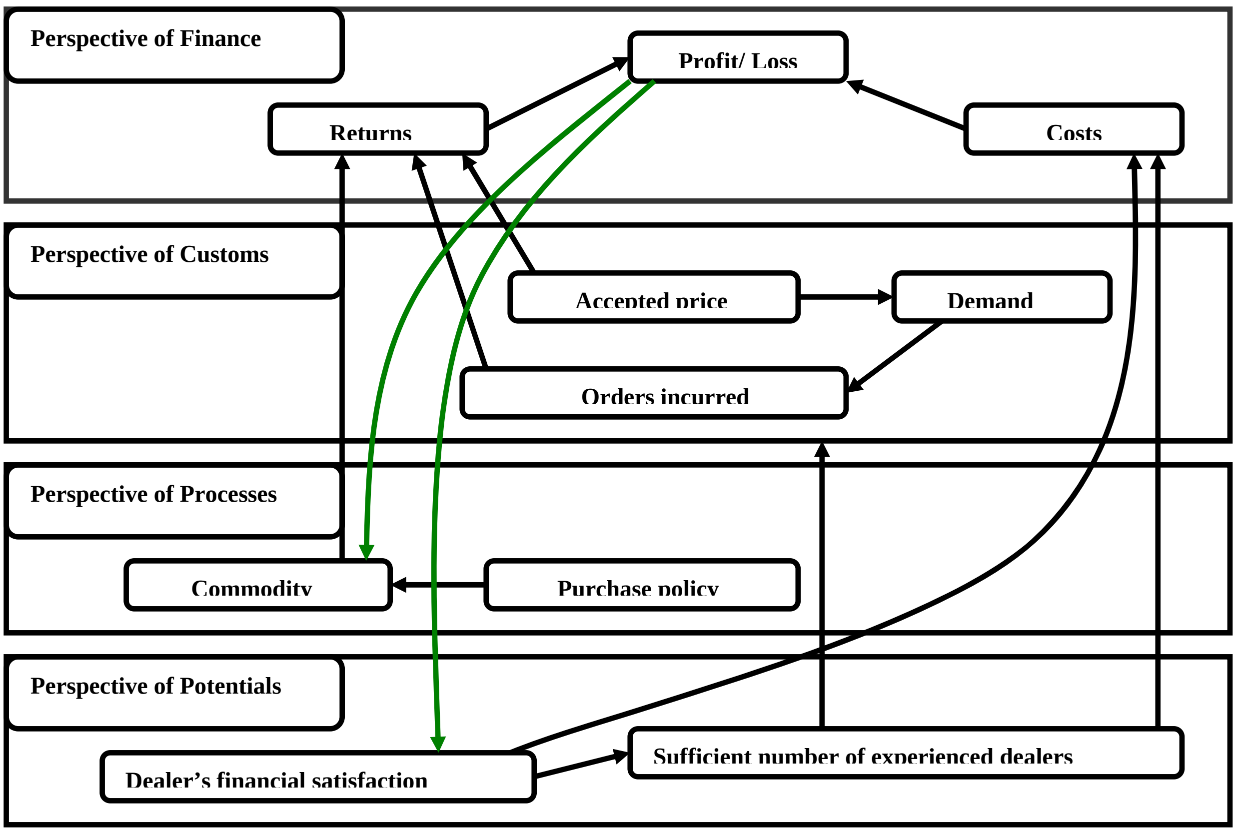

Figure 1 - Chain of causes and consequences

In practice the simulator, which this author further describes, allows easy discovery of strategy and the main determinants of its achievement, as well as with objectives and responsibilities, which are calculated on particular management levels. It is an instrument of communication between workers and a tool for strategic teaching.

Work with dynamic model requires a shift in thinking, as is shown in following text.

3. Introduction to Strategic Management

In this case, our aim was to create a simulator based on system dynamics principles, which would help understand the Balanced Scorecard as a strategic management method [1]. We used the DealSale model from Proverbs, Inc. Company and extended it towards Balanced Scorecard implementation [10]. (The DealSale model is a dynamic simulation model of a wholesale company with a dealer-selling network.)

We applied Powersim Constructor for our simulator development. It is a modern piece of simulation software, whose name arises from the words Powerful Simulation, efficiency and effective simulation, all of which are true of Powersim [3].

The simulator primarily shows a well-arranged diagram of the Balanced Scorecard and a record of all the important indicators of company health according to 4 key perspectives (finance, customers, internal processes and growth). The next level contains windows with settings of all crucial factors, according to the perspective. This makes it possible to make various simulations and investigate the influence and sensitivity of several parameters on Balanced Scorecard indicators.

At an acceptable level of simplification, this simulator offers the possibility to simulate the strategy choice and other aspects of decision making with an emphasis on dynamic relations within the first years of a company’s life. 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 the Balanced Scorecard as a mediator between 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. In doing this, the main goal of the simulation is achieved: i.e., the development and practical use of managerial thinking while retaining the important global management view.

It leads to knowledge that in a system functions backward bindings, and except financial indicators it’s necessary to monitor the other row of indicators. Furthermore, this shows the influence of time, namely that short-term improvement of individual components can lead to a long-term failure of the whole system, unless the connections with uncertain functional parts are considered.

Work on the dynamic Balanced Scorecard simulator places responsibility on user thinking and exigencies in a sense that the future isn’t affected only by immediate options, but also by decisions which were made in the past. In addition, the influence of all decisions changes over time, and the short term effect can be distinguished from the long-term impact.

4. Introduction to city strategy

Connection of SD methodology with method of The Balanced Scorecard is not only useful at the firm level, but it is possible and in other areas. For needs of cities and municipality, Proverbs, Inc. Company used integration methods in city strategy creation.

Complication of strategies in region requires from management the development of possible thinking in dynamic connections, which is not at all supported in by common use of resources. Subsequently, the apparent solutions that result from such decisions produce long-term problems, with irrevocable consequences and ultimate elimination of the problem's causes (problems originating from municipality revenue shortfalls, gypsy ghetto, depopulation in the rural areas).

It is necessary to set tools and techniques on regional level for support thinking and teaching in dynamic connections, based on system thinking.

Way out is present current situation in regions, when in a number of cities and their its municipalities was in passed years cleared up vision, certain city appearance, environment, entrepreneurial structures, living and services. Proceeds number of activities, which supports achievement of vision, but the problem is often nonexistent integration within the strategy.

Activities are fragmented, one is able to limit the other one, and there is no balance among single projects. Next problem is issue of factual the impossibility of vision and strategy presentation to cities population, because they aren't explicitly expressed at all, or on the contrary in practice not providing transparent folders, in noon except author is able to understand them.

Next substantial feature of regional environment is that efficiency is measured only by financial indicator.

In dynamic model are perspectives of Balanced Scorecard connected to the logical, in part hierarchical model with definite terms. During derivation of strategic goals, balanced perspectives lead to balanced system objectives.

Four standard perspective of Balanced Scorecard - financial, customers, internal processes and potentials, which may be conformed to specific conditions of section or a company, which were in our case defined for the needs of region.

Method allows creation of well - arranged strategic map. Strategic map includes graphically expressed troubleshooting topics and mediating view of strategy from four basic perspectives. Quite up is vision of region or cities (e.g. . „„, clean royal seat with advanced care of citizens" etc.) and below it's five basic strategic subjects. If city leaders have idea about vision, direction, it is necessary also to tell, in what way they want to achieve this vision. Next level then includes keywords (e.g. . „„, modified town", „ safeness", „ job opportunities" etc ..) and they are in detail described in four perspectives. These strategic topics are saturated by citizen and client perspectives (e.g. . „„, prevention and safety", „ offer of free time-time activities" etc ..). These activities are necessary to finance and so the perspective of citizens and clients are enriched by this financial perspective. We meet with this these teams, which are connected to ensuring finances for superior perspective.

All activities described till this time are ensured by perspective of internal suit (with subjects like „ preparation of capital investments ", „ Ensuring safety" etc.). Nothing that has been mentioned is not possible to implement without people, their development and appropriate technology. Therefore the perspective teaching is based on strategic map and growth, in which we finds topics such as„ coping with community scheduling", „ maintenance of favorable climate in town hall" and so on For every term there is certain number of measures created, which entrap positive, eventually negative development fruitfulness given to subject.

Cities and eligible regions at the same time will learn how to measure unaffected, so - called soft factors (satisfaction, quality etc.).

Pilot implementation method, which was effected in town Vsetine (legacy) succeeded with the following points:

- city strategy is clearly expressed strategic map,
- it is possible to communicate to citizens with strategy,
- it is clear, which projects strategy supports and which it doesn't,
- every formation has clearly designated purposes,
- every employee knows its share in city strategy implementation and reward for achievement of personal goals,
- establishment of team objectives is supports team tasks solving,
- balance between financial and no financial criteria exists.

Experience with implementation of Balanced Scorecard from industrial companies reflect, that pivotal period is stage after completing first phase project (creation Balanced Scorecard and connection with remuneration system). Here comes the phase of so - called strategic teaching, in which organization penetrates into depth of disabled strategy relations. This phase forms closed loop in teaching, which we edit, innovate and change its imperfect notions dependant on changes of surrounding environment and inner relations in organization. Analogous is it for local town halls, where we support strategic teaching by continuous updating of strategic map, criteria and personal goals, and by which we bring strategy to the everyday life and ensure correct direction.

5. Balanced Scorecard and Multi-Methodology

System point of view for building - up BSC doesn't need to be SD itself. It could be also multi-methodology, which combines and links techniques, method and methodology from same, but also different paradigm of system thinking. Such synthesizing and dialectic methodology, which arose out of combination of two widely used system-based methodologies, from two different paradigm of system thinking – soft systems methodology and system dynamic is SSDM. Application of SSDM is not covered by the development of BSC, and which is not covered by this paper.

6. Conclusions

The fact that systemic dynamics can contribute to the experiments and study of real economical processes and that it can be used for various simulations is acknowledged also in Czech. This signification paper tried to develop a theoretic knowledge and make practical recommendations for the use of system dynamics methods in Czech conditions, especially for decision making support and for improving systemic thinking in problems which are related to complex social systems.

It is discussed dynamically about possibility connection contiguous surfaces methodology system and system strategic drive Balanced Scorecard. Remitted on contribution of dynamic thinking at decision-making, whose reaches could be done on the basis of implementation of Balanced Scorecard in its system dynamic variant.

The author hopes that her practical experience will help in searching for the real possibilities and in identifying the benefits of system dynamics simulators. Furthermore, she hopes to draw attention to their influence in improving of decision-making and learning in firms and in public which need to cope with the dynamic complexity of real world problems.

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USAGE OF TRIZ TOOLS IN EU-PROJECTS TO FOSTER CREATIVITY IN THE INNOVATION PROCESS

Approaches to disseminate the ideas of the TRIZ-Methodology (Theory of Inventive Problem Solving) - Project Examples of the University of Leoben, Austria

Jürgen Jantschgi [1]

Strengthening innovation power in European companies as well as encouraging sustainable development are two of the main future goals of the EU (see Lisbon goals, European Council 2000). Also in Austria there are several initiatives from local and the federal government to foster these two issues (among other things - Funding Programmes "Plant of the Future", "Protec 2002+", "Technofit"). In the last three years the University of Leoben, Austria, was engaged in several projects both on the European and the regional level to encourage companies to learn and practice innovation – and creativity-tools in order to strengthen their creativity potential.

The idea of this paper is to give an over view about these projects and of the core methodology, which plays a central part in all of this projects – ***TRIZ*** *(The Theory of Inventive Problem Solving).*

The Projects, which will be presented, in short are:

- *"SUPPORT" – Training Course in the topic Sustainability and Innovation Tools (TRIZ): Funding Programme Leonardo da Vinci*
- *"European SUPPORT" – Dissemination and Valourization of the training course SUPPORT : Funding Programme Leonardo da Vinci*
- *"SME´s Innotool" – An Innovation-Toolbox for SME´s: Funding Programme 5th Framework EU, SME´s & Innovation*

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- *"Technofit" – A set of regional project to foster the use of methods and tools in the product development process by styrian companies*
- *World Conference "TRIZ Future 2005" (organized by the University ogf Leoben, the European TRIZ Association ETRIA and the Austrian TRIZ association) in November 2005*

1. The Industrial Liaison Department at the University of Leoben

The University of Leoben is the most specialised university among the three technical universities in Austria. It enjoys national as well as international reputation for education and research. Science and research at the University deal with the fields of resource engineering, metallurgy, geosciences, materials science and engineering, and environmental science and engineering. The University of Leoben is located in the province Styria, a region located in the Centre of Austria.

The Industrial Liaison Department is responsible for the technology transfer activities at the University of Leoben (building up partnerships between industry and universities for the purpose of active technology transfer).

One of the substantive areas of work of the Industrial Liaison Department can be found in the consultation for companies on topics of the development of new products, the improvement of processes and environmental considerations. In most cases the subsequent projects are managed by the Industrial Liaison Department and the scientific work is carried out by the responsible department. Beneath these projects the Industrial Liaison Department coordinates several scientific and technical projects and involves departments as "consultants" in these projects.

In 2001 the Industrial Liaison Department has started his interest and work with TRIZ.

The following projects are the major attempts and outcomes of the efforts since 2001 to spread the ideas of TRIZ in Austria (mainly among Austrian companies).

2. TRIZ – Theory of Inventive Problem Solving

The term TRIZ is a Russian acronym for "Theory of Inventive Problem Solving". It has been in use internationally for several years. The theory was developed in the former USSR by the scientist Genrich Altshuller in order to systematically solve technical problems.

As a methodology, TRIZ encompasses a large number of different and partially combined methods and tools, which aim to help the designer solve technical problems. The general procedure (see figure), begins with the systematic analysis of the problem or the system to be improved. This first step allows the focusing on and abstraction of the problem and it in itself often already leads to innovative problem solving. After this, suitable TRIZ-tools are selected. These tools suggest methods of problem solving which have often led to innovative solutions in the past. At this stage, the inventiveness of the designer is called for so that he can apply the standard solutions to his particular problem and thereby develop his own innovative solutions.

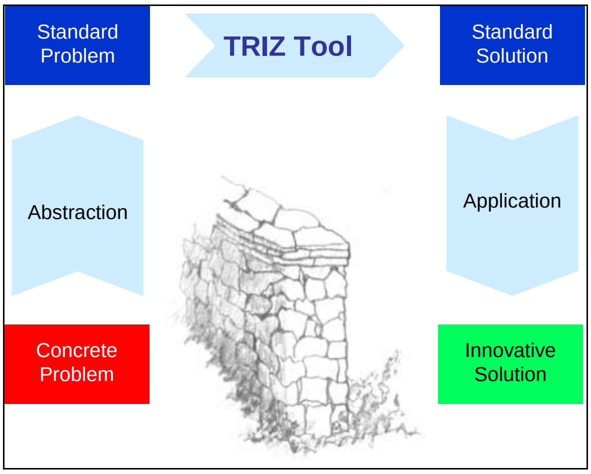

Figure 1 - The TRIZ – Methodology

The basis of the methodology rests on the hypothesis that the path to an invention is based on well-defined rules and regularities. In order to empirically test this hypothesis, Genrich Altshuller analysed and evaluated numerous patents.

He came to the following conclusions:

- The mere systematic description of a problem often leads to innovative problem solving.
- Many problems with very similar content have already be solved in other areas and branches under different names.
- The contradiction is the central element that produces innovations in technical problems.
- The development of technical systems towards an ideal final result follows certain trends of technical evolution.

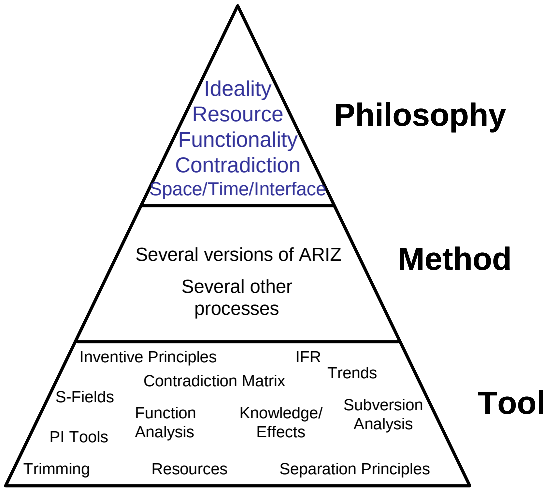

Figure 2 - TRIZ – Philosophy / Method / Tools ?

3. Projects "SUPPORT" & "European SUPPORT"

The training course SUPPORT has been developed in the framework of the European Leonardo da Vinci programme and shows companies different ways to build up an environmentally sound innovation management system. This approach combines "cleaner production" tools with tools of the TRIZ (Theory of Inventive Problem Solving) method which form the main part of the training course. To complete the course programme it has been complemented with tools for the assessment of ideas in respect of their environmental compatibility.

3.1. SUPPORT - Course targets

The most important goals of (the training course) SUPPORT are:

- To highlight the advantages of a methodical approach to innovations
- To convey new tools for problem analysis and idea generation.
- To anchor the ideas concerning sustainabe development
- To arouse interest for creative methods (with emphasis on TRIZ)

The training course mainly deals with the early stages of innovation management – problem analysis, idea generation and idea evaluation. Almost all tools used in the course are taken from the TRIZ (theory of inventive problem solving) method.

The topic "environmental awareness" is elaborated with the help of approved tools that have already been used in various projects coping with „cleaner production" and its commercial benefits for individual enterprises. Another central issue is the impact of a sustainable form of business on the global market.

3.2. SUPPORT - The project partnership

The project SUPPORT, launched at the end of the year 2002, was carried out by a group of 16 partners from 6 different countries. (It started at the end of 2002.) The following project partners were part of the development process: University of Leoben, Austria; Joanneum Research, Graz, Austria; Fa. CREAX, Ieper, Belgium; Fraunhofer Institute IPT, Aachen, Germany; AREA, Triest, Italy; University of Marburg, Slovenia

3.3. SUPPORT – Structure of the training course

SUPPORT currently consists of seven modules:

1. Introduction module: Innovation / creativity & sustainable development
2. Aspects of Cleaner Production for products and processes
3. TRIZ- tools for problem analysis (innovation checklist, ideality, functional analysis)
4. TRIZ- tools for idea generation I (innovative principles and contradictions)
5. TRIZ – tools for idea generation II (S-curves, evolution lines)
6. Tools for idea evaluation
7. Project Management

The modules can either be taken individually (one module a day) or combined to form a whole training course. Modules 1 and 2 explain the importance and the benefit of (that can be expected by) using a methodical approach to “sustainable development” and “creativity” within an innovative process. Modules 3,4 and 5 cope with innovative tools used for the structured analysis of a given task and the methodical formulation of possible solutions. Module 6 introduces a variety of evaluation criteria to facilitate the assessment of the ideas in hand, taking into account the demands of sustainable development. Module 7 gives an overview of approved project management tools, which can be used to successfully put the chosen ideas into practice.

3.4. SUPPORT – Project products

The main products of SUPPORT are:

- Written materials and CD-Rom for the course participants
- Presentation materials for the course trainers and
- Videos (sequences) of the whole project and its individual modules

Figure 3 - Products Projects SUPPORT (CD-Rom, SUPPORT Training Folder)

In addition to that the participants are given other dissemination materials and can consult the project's homepage → www.leonardo-support.com.

3.5. Project "EUROPEAN SUPPORT"

The project EUROPEAN SUPPORT is running also in the framework of the European Leonardo da Vinci programme and aims to disseminate the training course SUPPORT. (It was one out of eight European Leonardo da Vinci projects which were founded in 2004 for further dissemination and valourisation). Project partners in the following new countries are responsible to foster the idea of the SUPPORT materials: Slovenia, Greece (Cyprus), Estonia, Sweden, Romania.

Most of the training materials will be translated by these partners and the training course will be held in all of these new countries. A further aim is to achieve an international certification of the whole training course SUPPORT and to establish an European platform on product development and technology transfer.

4. SME´s INNOTOOL

The project “SMEs innotool” was handed in in the last call of the Fifth Framework programme of the EU, especially in the second horizontal programme “promotion of innovation and encouragement of SME participation (Innovation/SME)”.

4.1. Objectives of the project

The objective is to create a practical, i.e. representative of actual circumstances, optimised toolbox which has been developed with and tested several times by SMEs, which will have multiple benefits from the standpoint of the funding agency by:

- creating the prerequisites for an innovation friendly atmosphere in SMEs,
- strengthening the innovation potential by presenting tools for structured problem analysis, idea generation and idea evaluation,
- imparting the ideas and goals of sustainable development – one of the main economic and social objectives of the European Union
- encouraging the willingness of SMEs to cooperate with other industries and external institutions

The project consortium consists of 18 partner institutions from 6 countries in the European Union (United Kingdom, Sweden, Germany, Austria, Slovenia and Italy).

At the development of the Toolbox the demands of small and medium sized enterprises are specifically dealt with. This means that the implemented tools can be easily used and without long training sessions and that they are also completely independent from different branches.

4.2. Target groups of the Projects

The main target groups are enterprises with (entrepreneurs, who have got) their own production plants and R&D departments. The course is designed to help these companies improve the cooperation between innovative (R&D) and environmental departments (environmental or generic management). Additionally, the course aims at students or potential Start-Ups.

4.3. The Toolbox “SME´s Innotool”

At the development of the Toolbox the demands of small and medium sized enterprises are specifically dealt with. This means that the implemented tools can be easily used and without long training sessions and that they are also completely independent from different branches. The Toolbox is meant to supply an overview-knowledge in useful tools, at the same time an application of the tools by means of included working material will also be possible. In addition, the digital version of the Toolbox shall be completely independent from the operating system and an implementation into the company-own intranet shall also be possible.

The structure of the Toolbox can be described as follows: After access there will be the selection of the language. Then the start page of Toolbox for the user will have the following structure.

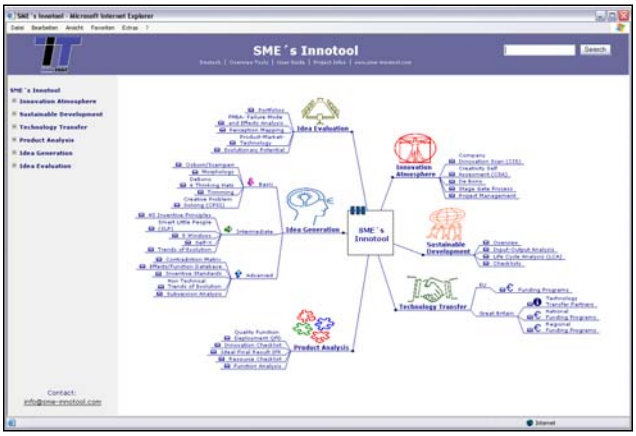

Figure 4 - Toolbox “SME´s Innotool” – Startpage

The Toolbox is subdivided into the main issues Innovation Atmosphere – Sustainable Development – Technology Transfer und Product Development , the issue Product Development is again subdivided into the three fields Analysis – Ideas und Evaluation. On the left side the complete structure of Toolbox will be accessible for the user in a navigation frame in tree structure. The Toolbox has a logically comprehensible structure and can be operated just like a normal website. The available navigation frame resembles the Windows-Explorer and can be easily operated. The separate folders can be opened with a click on “+” or closed with a click on “-“.

For each tool there exists a document overview page. The documents are subdivided into three groups: descriptions / working material / examples

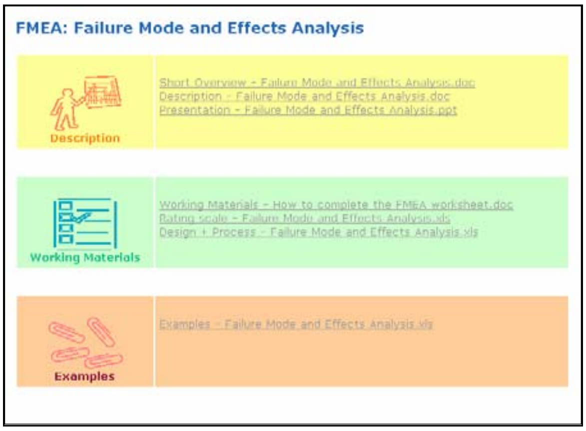

Figure 5 - Toolbox "SME´s Innotool" – Overview Documents

All working documents will be embedded in the toolbox in pdf, doc, xls oder ppt file format. The „Descriptions " are short explanations in Word format and presentations in Power-Point format. The „Working Materials" are more detailed descriptions and auxiliary material to the separate tools and also forms which can be used directly for the use of the tools. The „Examples" facilitate the application of the methods and tools with the help of a demonstrative illustration and processing of already solved problems.

In total about 40 single tools are inside the toolbox, from which nearly the half of them are out of the TRIZ methodology. (The project's homepage → www.sme-innotool.com.)

5. TECHNOFIT-Projects in Styria

The Industrial Liaison Department is coordinating one project , called "STURM", and in parallel is partner in two projects, called " Ideenfabrik & Aktiver Technologietransfer", of the local government which is running under the Art. 10 EFRE programme. The aims of these projects are to support companies in Styria on their way to develop new products or to improve their processes directly and to organize and offer seminars about the topic innovation management.

In 2002 a one-day Conference with the title "Develop Products Successfully" was carried out. The main topics were new methods and tools in the product development process, esp. TRIZ. The interest and the feedback of the participants were that good, that since 2002 this conference has become an annual event, which is financed through this Project.

With the three mentioned projects also a strong cooperation of the technology transfer departments of the three major R&D-Institutions in Styria was started. This approach of cooperation has led to several further common activities in Austria.

6. Final Note “TRIZ Future 2005”

The annual TRIZ-Conference of the European TRIZ Association ETRIA is organized by the University of Leoben. The conference will take place in Graz, the capital city of Styria.

Figure 6 - Logo “TRIZ Future 2005”, Graz, Austria

Information about the conference: www.etria.net

DIALECTICAL NETWORK THINKING – METHODOLOGY SUPPORTIVE OF REQUISITELY HOLISTIC CREATIVITY [1]

Bojan Rosi [2], Matjaž Mulej [3]

Managers have normally to do with networks of co-workers, co-working units and organisations, and have to manage them in a creative way, while making processes as simple as possible and as clear as possible. Network Thinking was established to support solving this problem, so was at the same time Dialectical Systems Theory, and Project Management. All three have strong and weak points, showing up over decades of application. Dialectical Network Thinking is a new synergetic response to their history. It is a new systems theory. We brief it here as a means supportive of creative solving of complex problems of managers.

0. The Selected Problem and Our Viewpoint of Considering it Here

Managers rarely have time to be creative on a requisitely holistic basis, if they have no tools to visualize situations and processes they are supposed to work on and no tools to visualize processes they use. Once they visualize such processes, a lot of networking between parts of processes, units of organization under consideration, and co-operating units show up. The Swiss methodology labelled Network Thinking was invented to support such problem solving three decades ago, and so was the Slovenian methodology labelled Dialectical Systems Theory. They have proved very good, mutually complementary, but not without weak points. So has done Project Management. On the basis of Rosi's experience in railway maintenance and management the Dialectical Network

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Thinking resulted from a synergetic analysis of all three, as a new systems theory. It is aimed at supporting managers' mastering complexity in a creative, and possibly innovative way.

1. Briefly about the Dialectical Network Thinking

The concept of network may apply to any complex feature in the life reality; it is very close to the notion of system[4] consisting of a set of elements and a set of their relations plus relations with their environment (in the case of an open system). (See: Bertalanffy, 1979, p. 139-154; Mulej et al, 2004)

This fact offers the basis for a soft-systemic theory called network thinking (vernetztes Denken, NT, Gomez, Probst, 1987, 1997 etc.), NT is a methodology of holistic problem solving, especially of the ones in management of organizations. Of course, one should apply NT with no limitation to a fictitious holism that results from authors' decision to use a single viewpoint when defining the contents of the »system«. One should neither strive for the Bertalanffian total holism, that cannot be attained[5]. One should rather meet the Mulej-Kajzer law of requisite holism, which offers a middle way between the two extremes. (Mulej, Kajzer, 1998; Rebernik, Mulej, 2000; see: Hindle, 2004; etc.) Thus, one should produce a synergy of NT and the Dialectical Systems Theory (DST) (Mulej, 1974, 1976, 1977, 1979; Mulej et al, 1987, 1992, 1994, 2000; Mulej, Ženko, 2004). These two

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[4] »What is to be defined and described as a system is not a question with an obvious or trivial answer. It will be readily agreed that a galaxy, a dog, a cell and an atom are *real systems*; that is, entities perceived in or inferred from observation, and existing independently of an observer. On the other hand, there are *conceptual systems* such as logic, mathematics (but e.g. also including music) which essentially are symbolic constructs; with *abstracted systems* (science) as a subclass of the latter, i.e. conceptual systems corresponding with reality. However, the distinction is by no means as sharp and clear as it would appear. .. the distinction between »real« objects and systems as given in observation and »conceptual« constructs and systems cannot be drawn in any commonsense way.« (Bertalanffy 1979, p. XXI-XXII)

[5] Elohim (1999) quotes Bertalanffy requiring people to behave as citizens of entire world rather than of single countries and consider the entire biosphere rather than its local parts only; this is a precondition for humankind to survive. – This quotation is close to the Bertalanffy's criticism of reductionism under the name of systems science in footnote 2. »Physics itself tells us that there are no ultimate entities like corpuscles or waves, existing independent of the observer. This leads us to a »perspective« philosophy for which physics, fully acknowledging its achievements in its own and related fields, is not a monopolistic way of knowledge. Against reductionism and theories declaring that reality is »nothing but« (a heap of physical particles, genes, reflexes, drives, or whatever the case may be), we see science as one of the »perspectives« man with his biological, cultural and lingustic endowment and bondage, has created to deal with the universe he is »thrown in,« or rather to which he is adapted owing to evolution and history.« (Bertalanffy, 1979, p. XXII)

sources, Project Management, and Rosi's experience with network style of management in Slovenian railway led Rosi to create Dialectical Network Thinking (DNT) (Rosi, 2004, Mulej being his mentor).

DNT is a new methodology – a new systems theory – leading toward innovation of the problem solving process. DNT:

(1) Requires and supports team work;

(2) Supports requisite holism in the human work on development of OBS;

(3) Supports the organization / OBS structures aimed at innovation and development;

(4) Shows what kind of OBS suits the modern environment and is capable of using the DNT;

(5) Stresses the interdependence of development and structuring of OBS with the development of project management;

(6) Supports change management in OBS;

(7) Makes easier the detection of the need to restructure the OBS;

(8) Supports learning and unlearning in OBS;

(9) Serves as the bottom-line in making of the contemporary organizational culture.

Thus, DNT leads toward more holism and innovation in problem solving, which is a precondition for a more sustained mastering of the modern turbulent business conditions. It can be briefed in Figures 1 and 2 most quickly.

2. Feedback loop of problem-solving activities and the curve of the problem(atiques)'s life cycle

DNT methodology grants its users a new opportunity to tackle, in an original and innovative manner, the problem-solving processes by combining the dialectic system and network thinking and acting. Doing this we also envisaged that the *dialectic network thinking* (and acting) *will take place in creative feedback loops* (typical of DNT). This signifies our awareness that some more or less complex problems will continue to resurface and for that reason we will repeatedly try to detect and resolve them. If we can solve them only partially and not requisitely holistically, we may risk causing the emergence of new problems. They may appear as an interaction of new influential (network of) factors with consequently (more or less) altered characteristics, which we will have to be able to identify and resolve once again and in due time.

For that reason we will "synergetically" permeate the envisaged procedures/steps of the problem-solving activities' circuit with the (known) characteristics from DST and thus add them the needed (determined through our investigation) *dialectical-systemic style*. The latter should enable the requisitely broad and deep level of holism, which is required for quality solutions. The findings brought about by DST namely enable us to approach the mastering of complex problematiques in a both systemic and systematic way. Thus we can more holistically embrace the dialectics of the processes at stake, which are primarily marked by the interdependence and the resulting dynamics of both internal and external causes of their complexity.

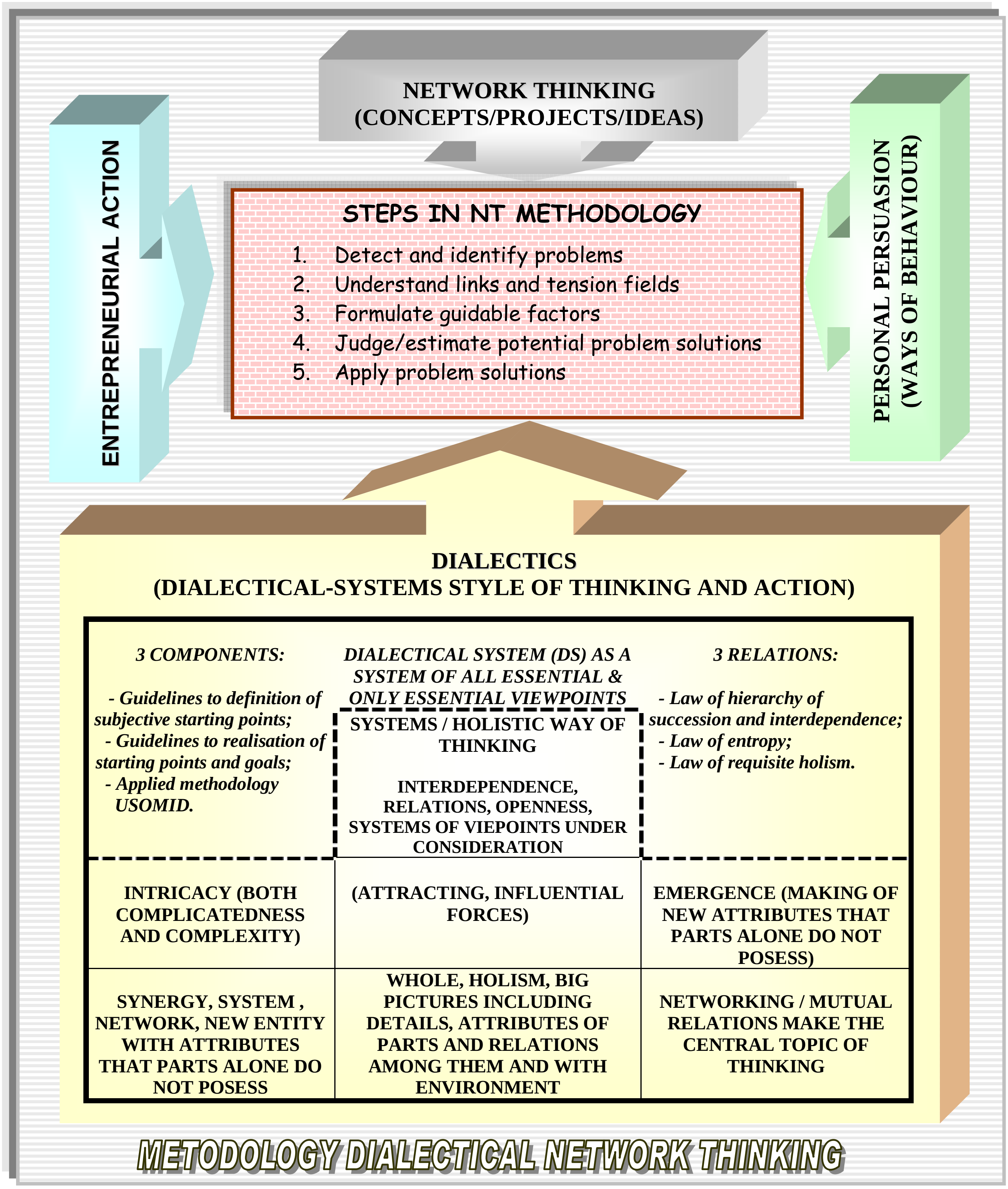


Figure 1 - Synergetic integration of components of DNT metodology

Following figure shows the steps in the complex problem solving procedure according to DNT.

PICTURE OF OBJECTIVE STATE FOLLOWING NT METHODOLOGY

DEFINITION OF STARTING POINTS BY DST, SELECTION OF THE DIALECTICAL SYSTEM OF VIEWPOINTS FOLLOWING DST

PICTURE OF NETWORKING OF VIEWPOINT FOLLOWING NT METHODOLOGY

SELECTION OF SELECTED VIEWPOINTS 1 – N FOLLOWING DST (INCLUDING USOMID CIRCLE METHOD)

PICTURE OF NETWORKING OF ATTRIBUTES 1 - N OF THE OBJECT UNDER CONSIDERATION FOLLOWING NT METHODOLOGY FROM THE SELECTED VIEWPOINTS AND THEIR SYNERGIES

SELECTION OF PERCEIVED NEEDS AND POSSIBILITIES FOLLOWING DST AND THE SELECTED VIEWPOINT 1 – N

PICTURE OF THEIR NETWORKING AND SYNERGIES FOLLOWING NT METHODOLOGY

SELECTION OF PRIORITY NEEDS AND CORRESPONDING POSSIBILITIES

PICTURE OF THEIR NETWORKING AND SYNERGIES FOLLOWING NT METHODOLOGY

SELECTION OF OBJECTIVES FOLLOWING DST

PICTURE OF THEIR NETWORKING AND SYNERGIES FOLLOWING NT METHODOLOGY

SELECTION OF TASKS FOLLOWING DST

PICTURE OF THEIR NETWORKING AND SYNERGIES FOLLOWING NT METHODOLOGY

SELECTION OF THE CHOSEN TASK FOLLOWING DST, 1 – N

PICTURE OF THEIR NETWORKING AND SYNERGIES FOLLOWING NT METHODOLOGY

SELECTION OF THE PROCEDURE FOR SOLVING THE TASKS 1 – N

PICTURE OF THEIR SUCCESSION AND NETWORKING FOLLOWING NT METHODOLOGY

MODELING AND PERFORMANCE OF PROCEDURES FOR TASKS 1 – N FLLOWING PROJECT MANAGEMENT PRINCIPLES

DOUBLE CHECKING HOW HOLISDTICALLY HAS NETWORKING BEEN CONSIDERRED IN PERFORMANCE

COLLECTION OF EXPERIENCES ON JOB PROCEDURES, ESPECIALLY THE CREATIVE ONES, IN PROGRAMOTEQUE

USING THE PROGRAMOTEQUE IN THE LATER ON DNT ACTIVITIES

Figure 2 - Steps in the complex problem solving procedure according to DNT

Due to the ever changing conditions and recurring of new outer / visible appearances of intricate, i.e. complicated and complex problems, these causes must *continuously complement or adapt to values, expertise, knowledge and experience* (= capital of expertise and knowledge) that we have acquired through the use of the DNT in the processes of solving new problems. We may talk of a certain feedback that is typical of cybernetic regulations and may be applied also to the problem solving processes, which are in their simplified form demonstrated in the Figure 3.

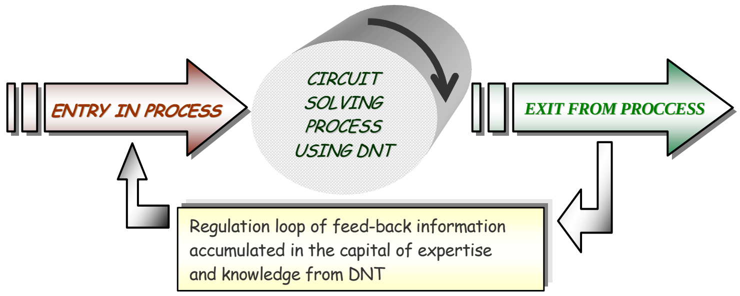


Figure 3 - Circuit and feedbacks in the process of solving complex problems

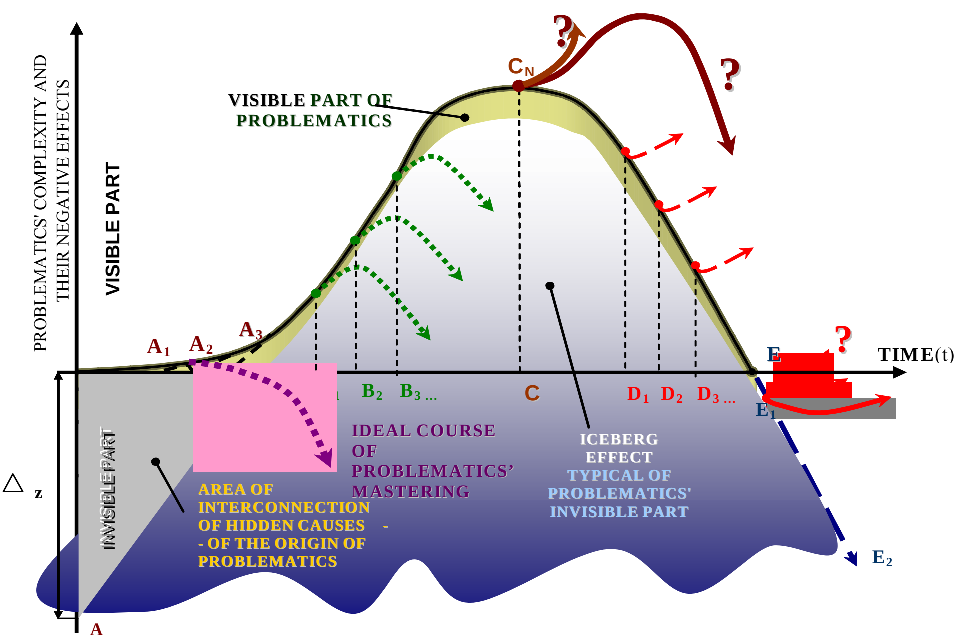
Such regulation, which is a corollary of the use of capital of expertise and knowledge acquired through DNT, enables us to (by means of the feedback) influence, in real time and requisitely holistically, changes in problem solving processes. Briefly, our reactions to changes are prompt and always enriched with new information – i.e. components of capital of expertise and knowledge (following the model of expert systems). Therefore we may with full right expect that the problem solving activities will be better adapted to development stages of complex problems.

Doing this we have to be well aware that the effects of problem(atiques) on their environment, or concretely on OBS, wherein we try to solve and control them, prove to be of diverse nature. This signifies that the effects change in relation to the development stages of problem(atiques) and more or less (negatively) aggressively affect – aggravate the characteristics of OBS. Thus, we have to adapt the complex problem(atiques) in OBS's different life cycle periods to the activity and to process of its requisitely holistic and therefore lasting solution. In Figure 4 we present the life curve of problem(atiques) and critical points, typical of individual periods of emergence or development of problem(atiques):

1. *Area A (source)* – represents the invisible, deeper located part of emerging processes of problem(atiques). Of considerable importance is the "grey area" or the region of intertwining of hidden causes of the origin and source of problems. This area may be of random size and is highly important (Δ_z), since it depends on the problem(atiques)'s complexity. Consequently we are not able, by means of customary methods (mostly one-sided and not systemic) and actions, to grasp it in sufficient depth, which strongly influences the correctness (= quality) of all subsequent activities in problem-solving processes. The point A_2 represents two possibilities, namely: (1) ideal (timely) action whereby negative effects of problem(atiques) do not occur, (2) the problem is fictitious and therefore without any impact. The point A_3, however, is that demarcation point, up to which we may permit

the development of a given problem: this point indicates to us the potential weaknesses within OBS, which we are otherwise unable to discern.

2. *Area B (growth)* – within this area the problem(atique) surfaces and thus becomes visible. In case of incorrect, i.e. un-requisitely holistic measures, its negative effects will grow fast. In the accelerated rise of the problem(atiques)'s curve, e.g. from the point B_1 to B_3 we may, by means of correct solving measures/processes, prevent its further growth and thus eliminate its negative influences increasing the entropy of the OBS.
3. *Area C (maturity)* – within this area the impact of the complex problem(atique) is the most negative. All subsequent action is in most cases belated and leads to the additional increment of negative effects, which finally, in a given (theoretical) point (C_N), unquestionably causes the collapse of the entire OBS, wherein we (incorrectly and in the non-systemic manner) tackle the complex problematique.
4. *Area D (weakening)* – within this area the effects exerted by problem(atique) are diminishing, yet the unstoppable growing influence of the system's entropy, which was brought about by the uncontrolled problematiques, continues to exist nonetheless. Despite this there still remains the danger to instigate, with our belated (mostly panicky and hence very single-sided and in-requisitely holistic) measures, the renewed growth or reactivation of problematiques, this time even more complex and therefore decisively altered.
5. *Area E (appeasement)* – within this area we may expect that the effects of the problem(atique) have faded away and calmed down (E). Of course this calm may prove fictitious and in case of our carelessness and non-systemic approach the problem(atiques) may be once again reactivated and, usually, even reinforced (E_1) (in significantly higher degree). Yet if we were despite the fictitious appeasement requisitely attentive beforehand already and steered problem(atique) to its complete (effectual) appeasement, we might reach the desired point (E_2), where the problem(atique) is truly (and probably also lastingly) resolved.



DESCRIPTION:

	$\triangle_z$	- Divergence in problem(atics)'s detection
ORIGIN	A	- The original incipient point of problem(atics)
	A_1	- The point of detection or the visible start of problem(atics)
	A_2	- The point of ideal action – solution to problem(atics)or problem(atics)turned out to be imaginary
	A_3	- The point, which indicates weaknesses of OBS and where the control of problem(atics)still proves to be fairly simple
GROWTH	$B_{1\text{-}3}$	- Points of potential solutions of the problem(atics)
MATURITY	C	- Critical point of the problem(atics)' maximal impact
	C_N	- The point, where problem(atics) is uncontrollable and certain collapse of OPS
DISSAPEARING	$D_{1\text{-}3}$	- Points, where consequences of negative effects are so great that any action proves meaningless
APPEASEMENT	E	- The point, where problem(atics)become once again invisible/imaginary
	E_1	- The point, where the likelihood of the problem(atics)'s reactivation is (dangerously) large
	E_2	- The point, where there exist no problem(atics) any more – it is completely mastered

Figure 4 - Problem(atique)'s life cycle

On the basis of our findings from the problematique's life cycle curve we have to *continuously adapt our problem-solving activities to problem life-cycles* or to problematiques that emerge from them, i.e. all the way from their coming into being, through their detection and solving, to their (more or less) final resolution. This process of (circular and repetitive, when needed) action process reflects the findings, derived from the rule of the *hierarchy of succession and interdependence*, i.e. that *earlier steps exert greater influence than later ones, the consequences* (direct or indirect); however, *the influences of parallel occurrences also interconnect and intertwine*, since they are more or less *dependent on each other – they are interdependent*. Such *dialectic network feedback loop* comprises process in Fig. 5.

Thus we can by means of DNT methodology more easily comprehend, how problems arise, and how to detect and resolve them. Nevertheless time and again a number of fresh problems may occur. Thus, the circuit is all the time repeatedly turning in the same customary direction, i.e. from the beginning towards new solutions or towards new problems. Therefore the problem solving process cannot be considered a strictly sequential (= linear) one, but moreover as the iterative (= repeating) one. If we find out that the identification of the problematiques has proved insufficient (lacking holism), we may again return to the starting step. At that point, however, our options are fairly open, since it is not obligatory to test all steps anew in their sequential order, but we may opt for the most adequate solution (moving forward or backward within the circuit) for the given (more or less complex) problematic situation.

Step 1: (Emergence of problem(atiques))	1. *How to detect a (potentially) problematic situation?* 2. *How do subjective starting points of problem-solvers, particularly those, which are in synergy through the team-work, affect the detection of a (potentially) problematic situation?* 3. *How to start (correctly, i.e. in a requisitely holistic manner) confronting the process of solving the detected (potentially) problematic situation?* 4. *How does the real problem emerge from the detected (potentially) problematic situation?* 5. *How to identify objectives and tasks as well as procedures for solving the problematic situation?*
Step 2: (Emergence of the integrated whole)	*How does the integrated whole emerge from individual parts of problematic situation the, i.e. complex problematique and what are its characteristics?*
Step 3: (Supporting points)	*Which are the supporting and guiding points for introduction of changes?*
Step 4: (Adequacy of the solution)	*Which indicated alternative solution is the most adequate?*
Step 5: (Application of the solution)	*How to practically apply the (most adequate) solution of problem(atique)?*

Figure 5 - Steps of the problem solving feedback loop

In theory as well as in practice we still face the deeply rooted erroneous assumption that the most crucial part in mastering problems is their solution. Figure 5 demonstrates (of course only in principle) that the earlier phases of the irreversible problem solving process are veritably more important and effectual as well as more influential as the later ones (Duh, Kajzer 2002; Rosi 2004; Rosi, Mulej, 2005).

3. Some conclusions

Contrary to the above findings above problem-solving processes, the major part of the usual human attention is still consecrated to the problem-solving process in its narrow sense, although it represents merely the concluding phase of the entire process and exerts but a limited influence on the final outcome – i.e. the *practical application of the solution of problematique.* Needless to say the advocates of such a narrow view cannot be blamed for lack of knowledge and/or understanding or holism, but most frequently for deliberate superficiality and oversimplification – missing the earlier and thus more influential and decisive phases of this multifarious process. Their approach may also be the most effective way to manipulate people, since doing this we may cover up, who and why has detected and identified the problem, which we now have to (provided we possess the knowledge and will) "merely (in a requisitely holistic way) sort out". DNT shows a more creative way.

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REQUISITE HOLISM OF OWNERS' INFLUENCE ON CREATIVE BUSINESS DECISION-MAKING[1]

Dr. Vojko Potocan [2]

Success of the contemporary enterprises (as business systems – BSs) depends a lot on their external and internal members, especially on interests, behavior and decisions of their owners and managers. Owners make their influence through corporate governance, especially through their BS's managers. They require creative business decision-making (DM) and creative decisions realization. DM must be requisitely holistic, which makes DM face the issue of entanglement of itself and of its topic under consideration as well of its environment. The requisite holism of BS behavior can be supported with creative business DM (BDM) standardization, which can take place on a level between a total one-sidedness and a total holism. And within creative BDM standardization, one can establish both a standardized dialectical system of processes and a standardization of contents of standardized BDM in the BS. Both help the requisite holism.

1. INTRODUCTION

There are cases in the business practice demonstrating with a lot of echo that enterprises (as business systems – BS) do not always meet expectation of their social environments (e.g. Enron, Royal Ahold, etc) [6; 9; 11; 30]. On the other hand, modern BSs also tend to requisitely holistically satisfy legal, market, stakeholders, and environmental requirements in their internal and external environments [61; 58; 54; 7; 1]. What causes these differences?

Owners are the most responsible as long as the Roman law is valid saying that "Ownership is the owner's right of use and abuse". Owners make their influence through corporate governance (CG),

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especially through their management. They require creative of business decision-making and creative decisions realization.

2. CORPORATE GOVERNANCE AND OTHER INFLUENCES ON CREATIVITY IN BUSINESS SYSTEMS

In general CG helps owners direct and control BSs, which they do not manage directly. The CG process and structure specify how results are made and distributed among different BS participants. To do this, CG spells out rules and procedures for decision-making decision on BS affairs. By doing this, CG also provides the structure through which its sets objectives, as well as means to attain BSs objectives and to monitor its performance [40; 41; 55; 28; 32].

Still, functioning of contemporary BSs depends a lot on impact of different other participants (e.g. their external and internal members - persons that directly and/or indirectly participate in their business); it depends on purposes, ways and methods of their participation in BS and on its/their values [15; 10; 3; 29; 5; 12; 57; 59; 47].

A very important group of BS participants are managers. Their management governance influences all others CG members. Their desired business style can receive be support (also) from the appropriate creative business decision-making, making business requisitely holistic and acceptable, i.e. suitable by economic, social, environmental and ethical criteria [45; 46; 47]. Implementation of such principles of business decision-making requires all BS members to requisitely actively participate in entire business process.

3. SUPPORT TO CREATIVE DECISION-MAKING IN BUSINESS SYSTEMS

Along the above lines we consider two basic influences of CG aimed at creative business decision-making of managers [45; 46; 47; 49]:

- Professional and political objectives concerning/called creative BDM should be used as a qualitative basis of CG (in general) and (especially) for management governance. BDM critically impacts existence and development of BSs, because BDM makes the central phase of all BSs management activities. Therefore creative BDM might make the modern general framework of efforts aimed at bettering management governance.

- Many professional and political measures can support creative BDM of managers and about them.

In this framework we understand creative BDM as: 1) a basis for all successful action of BSs in contemporary society (because creativity of BDM enables in principle, requisitely innovative decisions), 2) a basis for BSs to define appropriate (requisitely) holistic business operation and behavior, 3) a basis for completing up contents of the theoretical MG concepts, aimed at enabling (and perhaps assuring) the suitable behavior and action of BSs and all its influential members in BS decision-making process.

4. OWNERS INFLUENCE ON MANAGEMENT OR MANAGEMENT GOVERNANCE

Authors consider notion of management governance (MG) from different viewpoints, apply different methodological approaches, and differ in definitions concerning the relation between “governors” and “executives” [5; 21; 31; 55; 57; 13; 48]. On the most general basis one can perceive the important impact of MG on the BS’s economic and social aspects that result from MG’s encouraging and measuring how BS’s objectives are attained (business success), and from MG’s assuring of responsibility and transparency in making and distribution of business results. Thus, one sees that results of BS working are hence under serious impact of interests, behavior and decisions of their governors and managers.

Because we wish to understand and research the management viewpoint of MG, we use as a basis for research the concept (and the model) of integral management, which defines governance as the owner’s title to decide about the business factors (and related rights and duties).

When we speak about the contents of MG, we must take into account the organizational theory. In terms of contents, the organizational theory defines governance on the basis of the process approach, both from the organizational techniques viewpoint, and from the socio-economic viewpoint. This basis allows us to understand governance as an integral process, as well. It consists of the partial processes of governance, managerial goals definition and execution, and monitoring of their results. Inside the selected dialectical system of essential viewpoints [35; 36; 38] the governance and management system are comprised as both a subsystem and a partial system [8; 22; 42; 46; 47].

Different investigations on MG agree when defining their execution, and differ when delimiting governance and management [21; 56; 18; 24; 28; 1; 9; 11; 32]. On this basis, every BS forms its specific structure of its MG, thus to define relations between (1) governors, (2) management, and (3) execution in line with BS's own purpose and goals of its working.

Why these three groups, first of all? Their role depends a lot on purposes, ways, and methods of their participation in business, their knowledge, their ethics, and company culture resulting, as their synergy, from all influential value systems of stakeholders. In practice, different relations show up between governors and managers, but it is mostly the owners who have the biggest impact over the direct and/or indirect definition of the contents and form of the entire BS working.

Owners try to implement their impact in their BSs differently, including by (1) governing BS's (i.e. determining its long-term working, and by selection of managers, distribution of business results, etc), and (2) by governing BS's management. By the latter the owners try to realize: their own business interests, and their environment's interests inside their own objective and/or subjective responsibility. They do it with different levels of holism [35; 36; 37; 39].

We understand MG in the most general terms, as an entity of the normative and non-normative working (e.g. short-term interest working). The business practice of so far has mostly been based on normativism, which tries as much as possible to define in advance the working and behavior of management and thus to assure their requisitely holistic responsibility. This normativism aims at institutional arrangement of MG and builds the methodological basis for it to work. Cases of un-appropriate working and behavior of governors and managers lead to the conclusion that it is necessary and makes sense to complete up the normative approach in a way allowing for or even assuring more accountability, responsibility and trust-worthiness of all stakeholders.

Business theory and practice know various partial solutions with which authors try to influence single aspects (e.g. economics, environment, ethics, etc) alone, single levels (e.g. politics, strategy, tactics), and single areas of management [2; 21; 31; 12; 23; 13; 11]. This is a fictitious holism, because their emerging synergies are not a considered. Thus, the real results of majority of the known solutions fail to attain the foreseen outcomes; one can add a variety of objective and/or subjective reasons.

It is still an unsolved issue how to make management to for sure: 1) Creatively accept governing solutions of BS owners, 2) Use this acceptance as defined bases of its own work and to upgrade them with innovative solutions in its work, and 3) Really take in account all the important bases that keep making BS working requisitely holistic (i.e. suitable in economic, social, ecological and ethical terms, as a dialectical system of attributes of working and behavior).

We see a possible solution to this dilemma in more creative understanding of (e.g. requisitely holistic, dialectically systemic consideration and implementation) of BDM. With it one can, partially at least, respond to the following issues: 1) Can new ways of working of MG be introduced with implementation of creative BDM standardization, 2) How to help more people requisitely holistically understand of BDM, and 3) How to implement innovative impact over BDM?

5. HOW TO DESIGN "CREATIVE BDM STANDARDIZATION"

5.1. Some Reasons for "(Creative) BDM Standardization"

Standardization of products, spare parts, and process-related procedures of manufacturing and other work, if routine-based, has been applied and beneficial for a long time. Less so has standardization been used in BDM, although it has more influential consequences then routine work. Due to them, DM needs to be requisitely holistic, which makes DM face the issue of entanglement of itself and of its topic under consideration as well as of its environment [42; 43; 44; 47; 49].

On an experience-based and framework level, creative work procedures can be standardized, too. E.g. by programoteque, which has been developed in USOMID methodology [33, and later], and later), which is the applied part of the Dialectical Systems Theory [33, and later]. It has been applied many times and led to many innovations from rationalizing the work processes in production and all other jobs to new products and business programs as well as management style and methods.

In fact DM is a creative work. Considering of both the experiences from the business practice and the theoretical findings, we can, in general, conclude that DM can be standardized on a level, which lies in the interval between the total standardization and the total uniqueness. The level of a possible standardization depends objectively, to the largest extent, on criteria of holism of consideration and entanglement of situation, process and trend at stake. Subjectively, the level of DM standardization depends on one's decision: what to take into consideration.

For this reason, we try to conceptualize standardization in a manner, which will enable us, as much as possible, to requisitely holistically understand and treat the selected phenomenon (feature, environment, system / image about them). The interval of holism of consideration and DM is, on one hand, limited by a total one-sidedness and, on the other hand, by a total holism. What about entanglement, we are trying to conceptualize DM standardization in a way that will make possible a requisitely holistic consideration of the entanglement of the phenomenon under consideration. Realistically, only a certain level of entanglement can be detected and mastered. The level of the consideration of entanglement is somewhere in the interval between the total entanglement and total simplicity. In our research, we used the extremes only to determine which level is the requisite level of holism and entanglement of our operation in reality [42, and later].

In reality, the problem is much more complicated and complex. Namely, complexity and complicatedness have a synergetic impact on the level of entanglement. However, the consideration of these topics exceeds our scope of work here.

The interval of the requisite level of consideration of entanglement is restricted by "requisite simplicity" and by "requisite entanglement". They provide for the consideration of all essential relations of the DM under consideration (its complexity) and of all important components of decision-making (its complicatedness). The requisite holism of consideration results, but not as a totally unified and requisite solution; it is rather a chosen solution [33; 34; 35; 44; 37].

On the basis of a requisite level of entanglement, DM can only be simplified in general terms, not in details. This is usually sufficient for the work to be done. According to such an approach, we can form framework algorithms of DM and operation, which support creativity of the decision-makers, but they neither can nor may substitute decision-makers' creativity, participation and interdisciplinary co-operation [33, and later; 42, and later].

In the real business circumstances, it is logical and reasonable to detect and choose a requisite level of entanglement of consideration of reality. The defining of this level of entanglement of consideration of reality is a creative process which is under synergetic influence of characteristics of both the object under consideration and the decision-makers as well as of the objective / other conditions and preconditions of their work.

5.2. Standardization on a Requisitely Holistic Level as a Case of More Creative Consideration of BDM

On the basis of findings about holism and entanglement of both DM and situation being decided in and about DM, one can define the level of the DM standardization. One can be conclude that one can decide what is the requisite level of standardization on the basis of both the requisite holism of consideration and entanglement of situation in reality. It includes, at least: 1) The selected starting points for the consideration of the DM standardization (subjective and objective starting points for the consideration of DM), 2) The object under consideration (and its interaction with the decision-maker), 3) Subject of DM (and its interaction with the object under consideration) and 4) Synergetic entity of the object under consideration and decision-maker.

According to the above facts, one can say that one can define what is the requisite level of DM standardization from the point of view of both its methods and its contents. The methodological definition of such a level is not disputable. We used it to present the basic starting points of our concept. Our assumptions were confirmed to be right when applied to DM in business process. These cognitions are also confirmed by various standards, usages, classifications, etc. internationally, worldwide, such as ISO etc.

Requisite standardization is best attained by Law of Requisite holism [4; 35; 50]. The Law of requisite holism applies to many other attributes of reality, too, of course [4; 35; 50].

One can, therefore, be concluded that the DM standardization in the BSs, within this framework, includes also the determination of the requisite level of DM standardization in the BSs [52; 12; 16; 13], is logical [25; 14; 19; 53], needed [12; 26; 13; 60; 49]; and rational [12; 14; 19; 17; 20; 53].

Once a part of the DM runs on standardized methods, investigators and / or decision-makers may consider that part as a black box, and therefore may have more time, resources and energy to work on the other parts of the DM. A step closer to (a requisite) holism may result. Also a step closer to understanding and mastering of complexity and complicatedness may result. Thus, by DM standardization on the level of requisite holism the creative and systemic as well as systematic thinking can receive additional support in its striving for more creative thinking of BDM, and action [33, and later; 35, and later].

5.3. Impact over BDM to make it innovative

In the contemporary globalize world an innovation-and-knowledge driven economy is a prevailing fact. It requires the management and BDM to strive at excellence, which is attainable by permanent innovation. To make this change happen, BDM must, in terms of its content, include the innovation potential factors rather then routine-based production running only.

Different authors [50; 53; 13; 27] identified different number (from 20 to 100) factors influencing the BS’s invention / innovation potential. Many of them classified factors in groups such as in Figure 1:

Factor under BS's control	• BS's vision, politics, and strategy – BS governance • BS's management and organization • BS's staff and their knowledge, skills, experience, motivation • BS's culture and climate • BS's research and development linked with marketing as well as other business functions • BS's technology • BS's networking with its business environment • BS's other available resources and capacity to gain them • BS's other attributes such as size, industry, location, export, previous business success
Factor outside BS's control	• Invention & innovation infrastructure, policies and factors outside BS • Markets' attributes • Random events and (good or bad) luck

Figure 1 - Invention and innovation potential factors in overview

BS can influence factors in Figure 1, if allowed or even invited, only. It can be done more directly or less directly. Both action possibility and outcome depends on the BS's absorption capacity, which in turn depends on the network/system of knowledge and values of the influential individuals and bodies in a given BS [39; 51].

6. SOME CONCLUSIONS

Owners are the most influential stakeholders in every BS, followed by managers and executives. All three groups must make, cause, and support creative decisions in a creative way for their BS to be innovative enough to complete in the modern globalize market.

Creative DM standardization can help them face and master entanglement (i.e. complexity and complicatedness) of BS at stake, situation and processes under consideration and influencing then BS directly and / or indirectly.

Many professions, polities, and interest need consideration and mastering as well as many invention and innovation potential factors, all of them making a dialectical system of essential viewpoints and all their interdependences and interactions, creative BDM is a very demanding job.

This attribute requires owners to be very capable of creative co-operation and co-ordination. Otherwise, owners' influence over managers might become one-sided rather than systemic/holistic and dangerous rather than successful.

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Future Trends and Scenarios of Information Technology

FUTURE TRENDS AND SCENARIOS OF INFORMATION TECHNOLOGY

Christian Loesch

We are enjoying the benefits of a period of unprecedented advancement of information technology stimulating similar advancements in many other fields. As for all phenomena of exponential growth the question is not whether, but only when and why this would reach its limits, or more specifically: would it be physics or economics that raises the barrier to further scaling? We will review some of the research efforts could extend and potential post-silicon scenarios. Is there practicality in the research results of such topics as Nanoelectronics, Molecular Computing, Silicon-Photonics, Spintronics and Quantum Computing?

But there are other aspects worth discussing as:

- *The effects of connecting computers increasingly to the physical world around them, creating and networking billions of nodes and devices from keys to sensors, tags, RFIDs etc.*
- *The future role and weight of ethical, security or privacy concerns. How far will the framework of ethics and law interact with these developments and technologies on a planetary scale?*
- *What will be the impact of human factors? Do we need a different, may be more disciplined or more engineer-quality ethics like approach e.g. to software and applications?*
- *Shall we come to a systemic-thinking-type approach to meet these challenges?*

Many are trying to understand the impact of these developments on the future business environment, future products and for their investment priorities. These developments will model the future scientific scenario and economic developments, but also education requirements, social evolution and thus last but not least people's lives.

1. Introduction

Before looking at future trends let us takes stock where we stand today and which developments are already visible on the horizon emerging from the pipeline of research and development. Since many of the physical and technological aspects were covered at IDMT 2004 more room will be given to non-technical and human aspects today.

We will approach the subject by points of view as seen from the public the user, professional societies and of course from current research and development.

A recent CNN survey asking worldwide for the 25 top innovations people think affecting their life resulted in the enumeration shown below:

Table 1 [2]

1. THE INTERNET
2. CELL PHONE
3. PERSONAL COMPUTERS
4. FIBRE OPTICS
5. E-MAIL
6. COMMERCIALIZED GPS
7. PORTABLE COMPUTERS
8. MEMORY STORAGE DISCS
9. CONSUMER LEVEL DIGITAL CAMERA
10. RADIO FREQUENCY ID TAGS
11. MEMS
12. DNA FINGERPRINTING
13. AIR BAGS
14. ATM
15. ADVANCED BATTERIES
16. HYBRID CAR
17. OLEDS
18. DISPLAY PANELS
19. HDTV
20. SPACE SHUTTLE
21. NANOTECHNOLOGY
22. FLASH MEMORY
23. VOICE MAIL
24. HEARING AIDS
25. SHORT RANGE, HF RADIO

This shows the extent Information Technology has left the area of computers and has become an integral part of our lives.

2. Scaling to Nanoscale

The semiconductor industry was driven by a "smaller-cheaper, cheaper-better" synergy model into nanotechnology. Aggressive scaling is an integral part of the semiconductor success story and will be a success story for the next decennium. Silicon technology rather than being replaced is infiltrating many other fields but we are approaching increasingly challenges both scientifically and economically as:

- Lithography
- Interconnection
- Power dissipation
- Cost

The picture below should help to illustrate the scale of things we are entering:

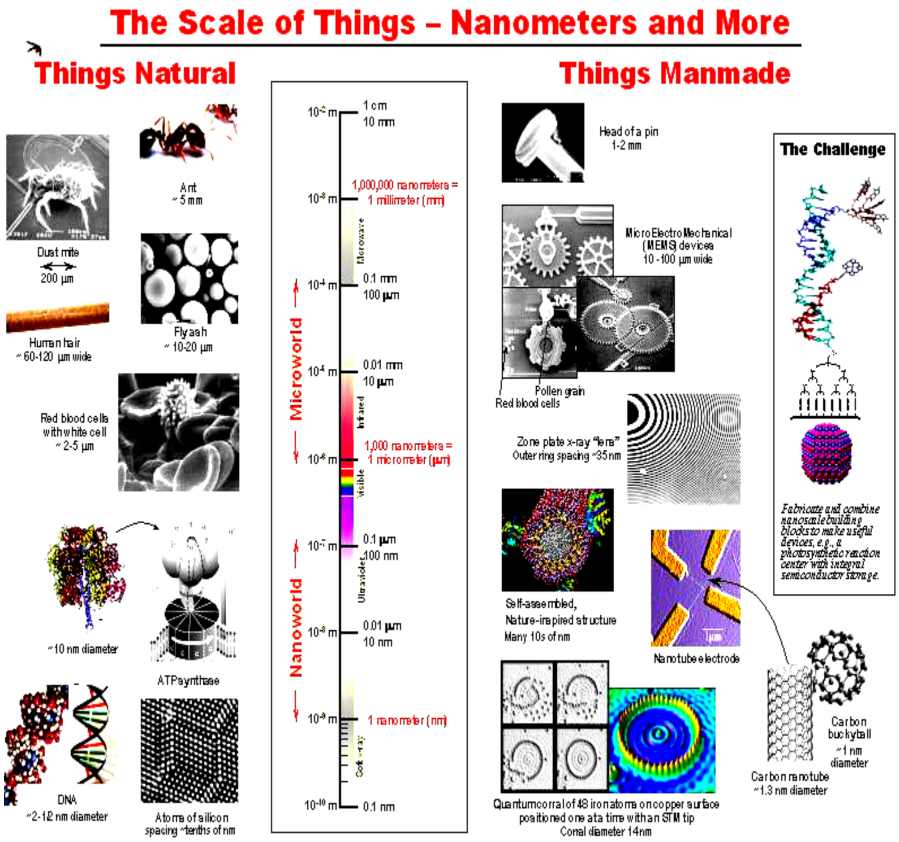

Figure 1

2.1. Limits for Downscaling and Integration

2.1.1. Lithography and Interconnection

Photolithography is a combination of optical, chemical and micro mechanical processes to transfer geometric shapes onto the surface of silicon wafer. This technology is successfully used to producer more than a billion transistors every second.

Optical lithography is the current workhorse of semiconductor industry. Since the minimum feature size is closely related to the wavelength of light, and we are already approaching the short wave edge of conventional optics for further downscaling to sub-100 nm patterns will require costly new X-rays and electron beam based manufacturing technologies.

This explains the efforts to extend the familiar technologies to advanced UV or EUV lithography to its limits and explore alternatives as described later. [18]

As IC's (Integrated circuits) are downscaled total performance of the IC is not automatically guaranteed to improve. Downscaling circuits increases the resistance and capacity of narrow and dense interconnect metal lines. The resistance and capacitance of those wires limit the speed at which the electrons can flow and while most wires are getting shorter, wires are also getting thinner which increases the delay; additionally effects as leakage currents, fluctuation, thickness of films, line edge roughness and dopant distribution are also decreasing performance. So interconnects are becoming more and more of a bottleneck. That applies especially for the connection between the processor and the main memory. A microprocessor running at 3.6 GHz can execute several instructions each time its clock ticks, but the system typically takes about 400 times as long to fetch information from while the main memory the processor is just sitting waiting for each piece of data to come from memory.

Cost reduction measured in cost/bit or cost/microprocessor operation is the biggest driving force for downscaling. Downscaling also opened new fields of applications, attractiveness and added value (as e.g. image processing capacity, portability etc).

2.1.1.1 Cost

Exponentially is not only characterizing desired properties achieved by downscaling but also features as production cost, as the example of lithography (mask set costs) shows.

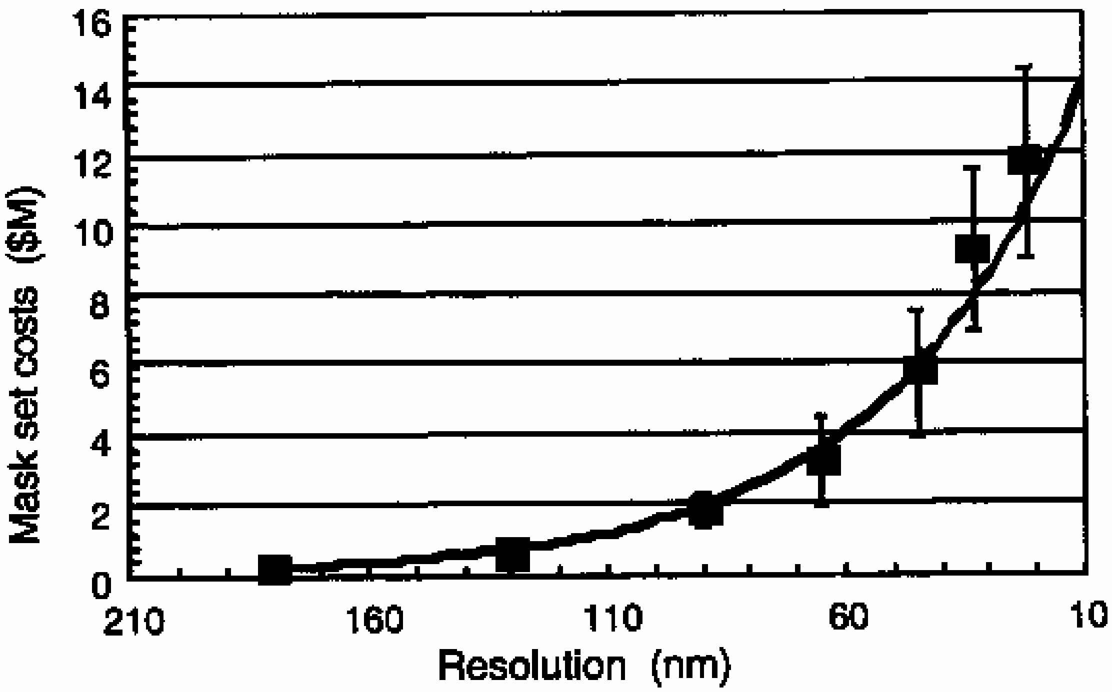

Figure 2 [1]

Another example, is the cost of the tools to produce chips with for the under 100 nm generation costing up to hundred millions of dollars each.

Industry is trying to cope with this by technological, business and structural measures. In reaction to this we see the growth of strategic alliances between competing companies as well as increasing outsourcing and cooperation with universities and research institutions.

2.1.2. Power dissipation

If the current trend in clock frequency and number of transistors per chip would continue power consumption of a high performance microprocessor would reach 1kW/cm2 the near future. To counter this a plethora of developments reaching from new architecture, new devices, special heat sinks, trade offs with performance, multiprocessors, supply voltage adjustments to the duty of the chip are being advanced. [7]

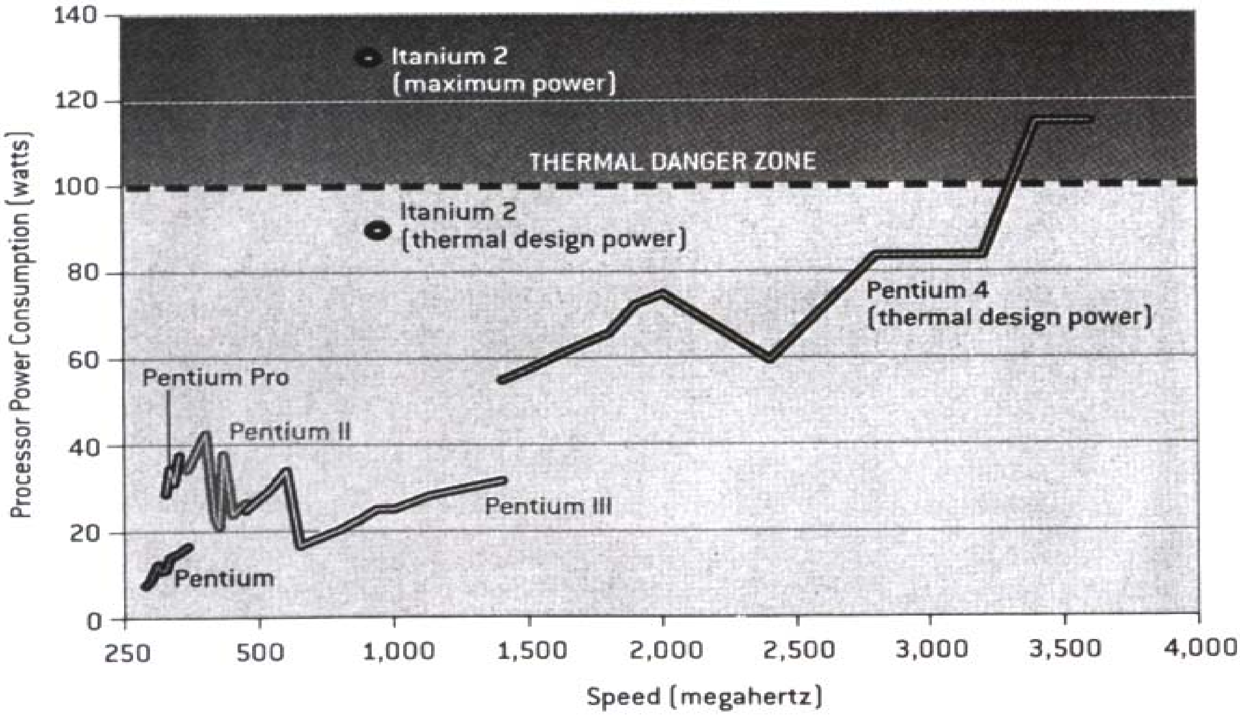

Figure 3 - Source INTEL

2.1.3. Reliability and yield

Higher integration leads to higher sensitivity to defects or particles and more complicated device structures detrimental to reliability. To counter this error correction and fail save structures will have to be increasingly incorporated.

Another approach to improve the IC performance further before the downsizing limit is reached is the integration of different functional chips on the chip as hybrid technology thus reducing parasitic capacitances, saving power and increasing performance.

2.1.4. Architecture and others

The challenges mentioned above have been recognized and the quest for cost efficient solutions has led to a systematic broadening of the research for additional performance into many directions, thus related advances have become significant to the total performance.

- Architecture
- Instruction pipelining
- Multiple instructions per cycle
- MMX (multimedia extensions) and Hyperthreading

This is not just theory, in May last year Intel decided to delay work on its next generation of processors. It meant that the microarchitecture of the central engine of its business and about three quarters of the world's computers have reached the end of its life earlier than planned.

All new Intel micro processors designed for desktop use will not have one but two cores working side-by-side on the same chip (some high end processors already have two or more microprocessors on circuit boards).

Integrating multiple processors into one multicore chip involves more than a dramatic design change. It implies the reduction of their interaction time to fractions of nano seconds. The shift to multicore processing may have significant ramifications how computers are sold, how they are upgraded and how they are programmed.

The first dual core chips will probably work at lower frequencies than the fastest chips we are using today. Assumptions are that from now on 70% of performance gains will come from architecture improvements rather than from additional megahertz. A notebook processor might have eight cores; a program customized for such chips could divide itself into many threats each running simultaneously on different cores. The operating system might turn off some of the cores. Since most of the software has no idea how to exploit a multicore processor, it would take the software community a long time to rework that. A parallel processor deprives the programmer of one of the most valuable tools for debugging: the repeatability. A threaded parallel program is not deterministic. Some applications will not get any boost from multi-core, but several kinds of tasks could run dramatically faster when redesigned for multicore chips. A few special tasks could exploit as many cores, but for general-purpose computing there is a point of diminishing returns, sixteen cores are certainly not much better than eight.

The most worrisome questions for the microprocessor industry may be whether the shift to multi core processors will discourage customers from upgrading to new computers since today's computers are more than fast enough to handle most of the popular software.

Major design changes add uncertainty to apathy as reason that computer owners might postpone an upgrade. It questionable whether customers who buy the first dual core machines and replace much of their software to suit the new architecture will have to repeat the process few years later to take advantage of quad-core machine. Faced with that prospect many users could decide that the new architecture is not worth the hassle.

2.1.5. Summary of challenges and potential solutions

Table 2 [8]

Performance	New device/process technologies
	New materials
	Chip integration
	New architecture, algorithms
Cost	Extension of present technologies
	Cooperations, Alliances, Outsourcing
Power	Trade offs with performance
	New device/process technologies
	New architecture, algorithms
	Cooling technology
Reliability / Yield	New device/process technologies
	Fail-safe design
	Architecture

2.1.6. Memories

The development of memory devices is not paralleling but surpassing the processor scenario.

Promising developments as FRAM (ferromagnetic RAM), MRAM (magnetic RAM) or PRAM (phase change RAM) have entered the research scene enriching already presently researched options as holographic, millipede or organic memories. While the search for next technology materials is on, it is reassuring to know that these developments will be supplemental since conventional memories will remain the key players down to the 30-50 nm technologies for the next future. [4, 11, 13]

Figure 4, below is summing up the potential future development of the downscaling of processors and storage devices and their physical limits

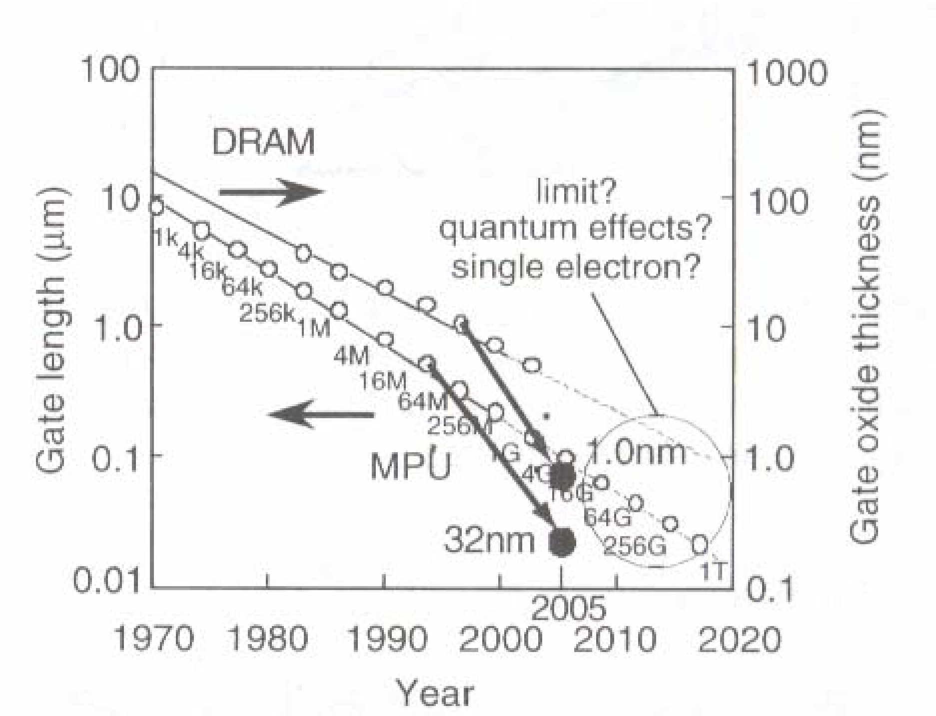

Figure 4 [10]

2.2. Long term future

For the benefit of those who could not attend last years IDIMT conference, a short overview of some potentially supplemental or alternative technologies for the long range is given below.

Table 3

NANOELECTRONICS
MOLECULAR TRANSISTOR
ORGANIC MATERIALS
SPINTRONICS
QUANTUM COMPUTATION

2.2.1. Nanoelectronics

Silicon based electronics has already reached the scope of nanoelectronics and is therefore nanoelectronics. But this does not encompass the full range of potential.

A basic breakthrough was the Buckyball and its derivatives the nanotubes. 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.

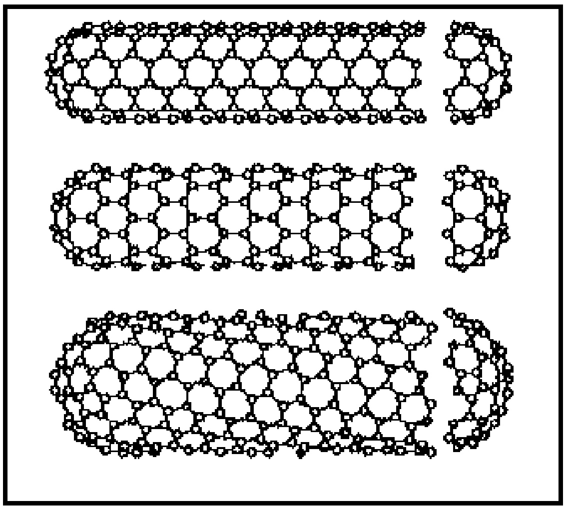

Figure 5 - Different structures of nanotubes, Veld, TU Eindhoven.

Carbon nanotubes have been around since 1991. Their astonishing physical properties as 100 times the strength of steel but only of 1/60 weight, their outstanding 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 their impressive properties that make this field so attractive.

A major problem with nanotubes is still to make them uniformly, reliable and in quantity, since structural differences can result in different properties e.g. make a conductor to a semiconductor. Building molecular and nanoscale devices is the first problem, but interconnecting these devices may be the even greater challenge. [7, 23]

Nanotechnology is not a proprietary IT technology. It also promises also to bring about technical progress in many areas form nanoscale catalysts and filters, coatings, to fuel cells and photovoltaics. Nanotechnology also might enable the development of new drugs, diagnostic tools, and a great variety of other uses.

2.2.2. Molecular Electronics and Organic Material

More than a quarter century ago scientists of Bell Labs suggested the use of molecules for electronics. 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. 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.

The first molecular electronic devices will probably not compete with silicon devices; they are more likely to be sensors, memory devices rather than logic devices. But molecular devices must not only compete with a rapidly advancing silicon technology but as well with host of bi-stable materials systems. Again economy will be the judge; they will only be successful if their manufacturing costs are significantly lower as comparable technologies. This could be achieved if it becomes possible to prepare many copies of the same molecule in parallel or in self-assembly concepts in which the shape of molecules dictates that they will form themselves in regular assemblages. [26]

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

There is another dimension in the future scenario: high carrier-mobility organic thin-film transistors. 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 extremely low cost, as 100 millions transistors in postage stamp size, or as large flexible plastic displays driven by plastic transistors enabling futuristic sounding applications. 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, replacing the clean room fabrication or a “fab-in-a-box” or chemical factory on a chip [15].

2.2.3. 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. The realignment within the molecule serves as reversible switch changing with the internal structure also physical properties.

The history of silicon technology has consistently demonstrated that all these obstacles and showstoppers of the past could be overcome by the ingenuity of researchers and engineers.

The argument that no exponential growth is sustainable forever is certainly true but does not automatically mean that there will be room for molecular devices to take over. Recent demonstrations of research silicon based devices approaching the size of few nm in critical dimensions, seem to leave only costs as true roadblock.

Any new technology has not only to be scientifically appealing but also to meet and excel very challenging yardsticks [22]:

- Intrinsic switching speed > 5 THz
- Power consumption < 6µW per MOP/s
- Reliability > 10^5 hours ~10 ys
- Cost < 0,5 mcents/logic gate < 50 ncents/bit of memory
- Density > than $4x18^8$ logic gates/cm2 and 10^{10} switches/cm²
- Mass production capability (> 1Munits/day)
- Integration of logic, analog, RF, memory etc.

[22]

How could a scenario for a roadmap for realization a molecular electronics look like?

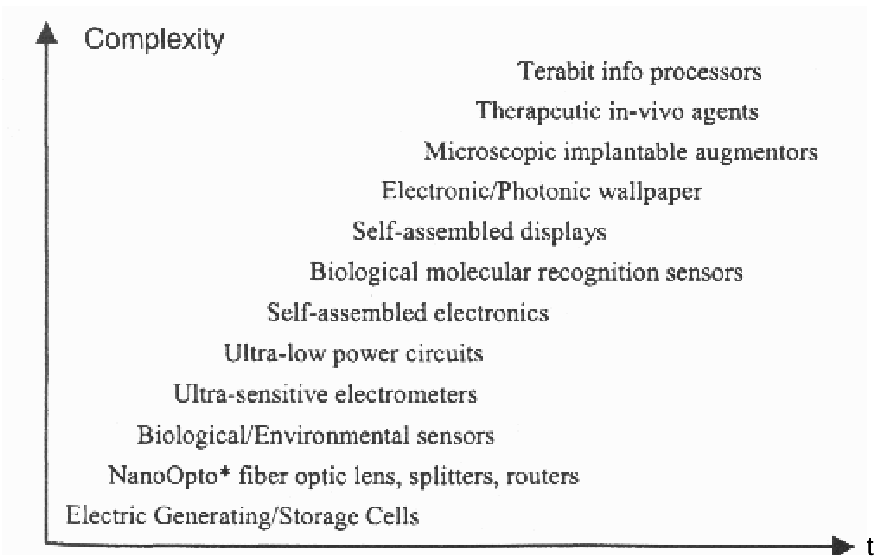

Figure 6 [8]

2.2.4. Spintronics

Spintronics is electronics where it is not the electron charge but the electron spin that carries information.

A spin device would have several advantages over a conventional since flipping spin takes much less energy and can be done much faster then pushing an electron out off a channel.

The research efforts in spin-physics have dramatically increased during the past years. Spin-based electronics offers opportunities for a new generation of devices combining standard microelectronics with spin dependent effects, combining logic, storage and communications on a single chip.

High-capacity disk drives using spintronics effect to read such data with will probably come in few years to the market, increasing storage density by 300%.

2.2.5. Optical computing

Optical computing is attractive because it would solve several problems of silicon based computing, as power dissipation, cross-talk interference, and the marriage of computing and communications. In February 2004 demonstrated a modulator made from common silicon that can process one Gbit/sec making it 50 times faster then previous devices has been demonstrated.

2.2.6. Quantum computing

Quantum computing is often heralded as the ultimate technology bringing about properties unmatched by any other technology. In spite of the expectation that we will see a quantum computer in the next decade is rather low.

But there might be an application within reach: quantum cryptography. In the eighties it has been proposed that as stream of photons could create unbreakable keys. If an eavesdropper attempted to observe the photons that act would alter the key making it thus impossible to steal and the receiver would know a breach was attempted. But last year companies as MigiQ Technologies, NEC QinetiQ Co. announced commercially available cryptographic systems.

3. Information Technology and our Environment

Microprocessors are increasingly playing a major role in the modern life. The use of microprocessors has increasingly perpetrated all kinds of equipment with computers being increasingly inferior in numbers but spearheading the technology. Microprocessors today are both "visible" the ones used to build the different classes of computers, and "invisible" the ones used for controlling and monitoring machine tools, cars, aircraft, consumer electronics etc. and communication equipment.

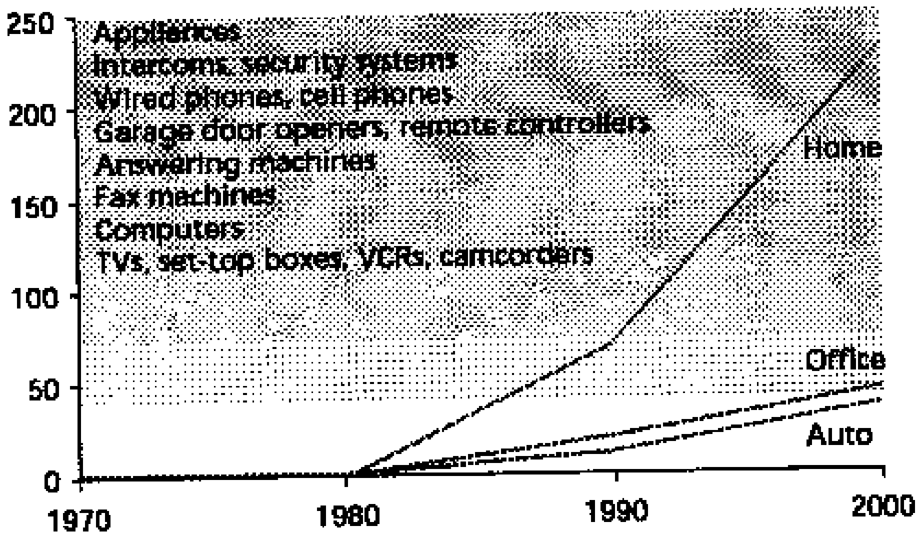

Figure 7 - Micro processing's changing eenvironment [Source: Bell Labs]

The class of invisible microprocessors is already the most important one in terms of the number of microprocessors in use. The home is the largest place of employment for microprocessors. They are gradually changing the relationship we have with these devices but also business structures and priorities attached from component value to infrastructure and business value. We might be at the beginning of this business-culture evolution.

3.1. The "Great Challenge Exercise"

The British Computer Society in a project called Great Challenge Exercise] tried to identify along range perspective and identify major directions challenges for the future. This inquiry resulted into several proposals as perspective for future computer technology and applications as e.g.[11]:

- Scalable global ubiquitous computing systems
- Memories for life: managing information over a human lifetime
- The architecture of brain and mind
- Dependable systems evolution
- Journeys into non-classical computation

3.2. The Networks and Sensor Revolution

The visible face of computing, the ubiquitous PC, is nowadays generally networked. In contrast, embedded computing systems have largely been stand-alone (e.g. tools, brakes of a car), replacing analogue control systems, but are increasingly becoming integrated into a whole.

Sensor networks are emerging as the next technological thrust in the global area ranging from simple video cameras to micro and nano-structures, RFIDs or hyper spectral optical sensors. These sensors are being imbedded in both ad-hoc and static networks that in turn exploit the Internet.

This should be seen in the context of the parallel ongoing developments in Location Technology (GPS II) aiming at a low cost Location Technology and a precision Location Technology both intended to work outside and inside buildings, and will add a plethora of new potential uses and sensitive issues ranging from ethics to legal.

Within the next years these sensors might be shrinking to the size of sand corn will be scattered across farms, industrial parks or battlefields, clothes credit cards as well as attached to containers, train cars, trucks and all kind of merchandize they will become an invisible extension of Internet coupled with distributed or grid computing to handle the enormous data flood with but most traffic flowing from machine to machine.

Autonomous self-aware sensors, capable of gathering information about their physical and digital environment might recognize events, identify threats and take appropriate actions. Intelligent spaces will be created by positioning sensors in the environment, all wirelessly connected and capable of monitoring working conditions and access to restricted parts of the buildings by automatically sensing radio tags in clothing. Medical treatment could be more specific personalized, based on genetic make-up and factors such as age, and even delivered directly to our bodies by wearable devices.

The RFIDs and their rapid evolution their use is expected to multiply by ten within the next five years and – cost is the key – reaching costs of > 5c/chip and later even > 1c/chip.

But also the step from product tracking to people tracking is not far.

What are the essential features of an infrastructure to support such a scenario?

Firstly, an Internet-like enabling global connectivity, by means of wires, radio and satellite communications.

Secondly, each node on the network, either sensor or device, is capable of computation, communication and information processing, as it shrinks in size to the microscale, possibly nanoscale.

Thirdly, the devices could be even become increasingly self-aware, space and location conscious, able to interact with the surrounding environment and exhibiting introspective behavior and control. The size of the network, and the complexity of the interactions within it, demand that they be capable of cooperation, self-organization, self-diagnosis and self-repair.

Finally, trust, privacy, security and dependability must be assured, as the cost of malfunction or breach of contract can be very high.

This will lead to a new dimension of system complexity as the systems become more integrated more numerous, smaller and more deeply embedded. Designing such populous systems, engineers can conquer complexity only by evolving scalable design principles, applicable at each level of population magnitude. The core of this challenge is therefore to abstract engineering design principles, and in parallel try to master the complexity and variety via a more systemic point of view. [11, 24]

Summarizing, this will create Computer Science related challenges or:

- Data and content management
- Connectivity problems for pervasive networks ubiquitous communication
- Trust, privacy, DRM, encryption
- Biometric identification at a more subtle level
- Interface technologies as speech, vision or appearance.
- System level challenges as computational intelligence or contextual awareness
- Education requirements both in quality and priority

Technical prerequisites are needed as:

- Ultra-low power, short-range communication, tiny cellular system
- Displays, ubiquitous flexible reflective displays
- Sensing and control
- Energy supply for autonomic devices [9,11]
- Software engineering

3.3. Function and Emotion

This combination builds upon the assumptions of on ubiquitous computing, a future where progress is not longer driven by ever better performance of existing functionality of the electronic appliances, but envisaging an ambient intelligent world where the digital environment is sensitive and responsive to people, some scientists envisage a world of ”Layers of ambient Intelligence” [9]

The increasing closeness and ubiquitousness will make the emotional dimension increasingly important. Additionally to achieve the necessary public acceptance politics and market participants will emphasize this in future. Designing an effective and appealing user interfaces or putting emphasis on emotional aspects has already become fully in line with marketing. Just remember that a digital camera is for the user not a tool to take pictures but to preserve memories. When computing devices become more and more invisible, it will be more important to find new ways to capture their values in selling experiences rather than products specs.

3.4. Meeting the Requirements for the future

3.4.1. The next 10 % and their requirements.

The future extension is not one-dimensional just improving technological specs at a cheaper price but also extending horizontally the scope of use and users. To extend the reach for those technologies when talking about the next 10 percent it means 10% of the world population, this means 600 million people. These populations are presently not having access to the technologies we have been enjoying since years. Studies show that the need is different being not better performance high technology (except price performance) but applications as

- Health care
- Education and

- Political empowerment and
- Communications

The access might be more appropriate via sharing technologies between users, an approach also used before in Western countries also as form of access to utilities as water supplies or phone boots.

3.4.2. Education requirements

Education requirements are not restricted to developing areas, in parallel to the drive for ease-of-use and more "intelligent" systems there will be an increasing need for the educational system to bring non scientists to a level of understanding appropriate to their involvement in making societal choices.

This should be seen in the context of a global trend just characterized by the fact that the number of engineering students and future engineers in China outnumbers the USA by tenfold not to mention India and Pakistan, while European students seem to shy away from so called "hard science & high threshold "studies.

Since these numbers and quantities can hardly be matched quality seems to be the only way to for Western European to hold one's ground against these developments.

4. Summary

Few technologies other than Information Technology ever had such a lasting impact on economic development and our way of life. Now as additional industries are entering downscaling and nanotechnology, one of the questions will be, if they can repeat the silicon story?
But the impact is not restricted to industrial and economic achievements.
We tried to make brief visit to the field of interaction between man and technology, function and emotion and its future symbiosis, the invisible fields of ambient intelligence and the extension from today's Internet to the "Internet of People and Things."

This interdisciplinary cross-fertilization might change even accelerate future developments building up to a development governed by "law of increasing returns".

Isn't it is a privilege to have the chance to witness and participate in these developments?

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BIOMETRIC SYSTEM AND THEIR USE

Sonja Hof, Michael Leitner [1)]

The last years more and more technical features and technology which seems for us –some years ago- more like science fiction then daily routine were put into practise. New, unconventional technical approaches which were future thinking some years ago have been implemented and integrated in everyday life. Some of them are still in the status of testing and/or have not yet been integrated but others like biometric systems are more and more used. Even legal and political regulations have already been introduced to support acceptance and development within society. Exemplary for different new approaches biometric systems and their use are chosen. Not only because ten years ago it was future thinking using biometric information for identification but also to show that advantages and disadvantages of technology.

1. Biometric Systems

Beginnings in 2006 biometric characteristics for passports are introduced within the European Countries. The EU supports biometric technology like fingerprint, iris or face recognition to a certain degree. Identification methods like this will become more and more important in our daily life. Sooner or later we will be used to these procedures and the experience and comfort and security and biometric identification and authentication methods will become normal. Even though some questions concerning credibleness and data protection arise the legal prerequisite are determined. Why are biometric identification means nowadays so popular and is it possible to improve systems and authentication with these technical means? Are we yet ready to adjust and implement systems which can guarantee correct and not sophisticating identification?

Looking back to the year 1989 when [6] stated that voice recognition is beginning to have significant impact on information systems, comparing this to the actual state of implementation using this voice recognition as technical feature it seems that this kind of biometric system has had not that much success. Even though a lot of the mentioned implementations of that time were launched voice recognition still suffers comparable problems. But looking on different output [8] or

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focusing on different technical approaches, development in this area has never stopped. This is only an example for technical development and how it can change through the years.

At the beginning when biometric systems were future thinking it was unimaginable that feasible technical implementations are put into practise and accepted by the users as enrichment.

Biometrics is the science that tries to fetch human biological features with an automated machine either to authentication or identification [1]. Biometric products should remove the necessity of password or PINs. Typical two-factor authorizations use possession, e.g. smart card, and knowledge, e.g. PIN. Biometric systems try to exchange knowledge with an individual feature, e.g. finger print. Recording of the feature should be comfortable and fast. The most commonly use biometric feature is the finger print. It is well known and in wide spread use in daily police work. In contrast to passwords or pin codes, biometric features are dynamic, i.e. they change over time. This is probably the most challenging property of the biometric system. One has to find a balance between a check which is too strict and generates too many rejections, and a check which is too loose and generates too many false accepts [5].

One of the main issues that should be stressed is the difference between biometric authentication compared to “classic” authentication as e.g. smart cards. For this paper the well known concept of card readers based on biometrics, e.g. card readers with fingerprint authentication is not focus; In this case, the biometric input is not used to authenticate the user to the system, but rather to authenticate his/her smart card. The system does not interact in any way with the biometric characteristics of the actual users, but still authenticates the user with the help of the user’s authentication certificate as present on the card. Seen from this perspective, this solution is not a biometric approach. This paper will focus on biometric approaches that actually use the biometric data to authenticate the system. Another issue with biometric systems is that this approaches are relatively new, there is still currently a set of standardisation efforts going on. Due to the recent political development biometric implementations are booming again. Different approaches like [9] dealing with electronic identity management require a combination of technological, social, economical and application-oriented research, which include also biometrics.

Possible biometric properties that can be used for the authentication of individual persons are listed to show the different approaches and to increase flexibility and security. In this paper, just a subset of different biometric properties is presented. Not the feasibility but rather the spectrum of theoretically possible human properties that can be used in biometric systems. [17]

- Fingerprint. Fingerprint scanners are probably the most commonly used biometric system; as and replace the pin code entry to unlock the card, especially in the area of smartcard readers. Similar systems include hand geometry or palm prints [14] [15].
- Iris. Another static property of individuals are eyes. One can either use pictures of the person's iris or use a retina scanner that scans blood vessels to create an individual data set.
- Face. The human face is also a feature that can be used by biometric systems. Human face recognition by analysing the size and position of different facial features is being pushed for use at several airports to increase security. Another possible approach is to make infrared recordings and analyse the resulting facial thermogram [16].

Figure 1 - Face Recognition [12]

- Voice. A more behavioural individual aspect of humans are their voices. Everybody has a special mode and tone while speaking. Voice recognition tries to analyse these features and use them to identify a person [5].

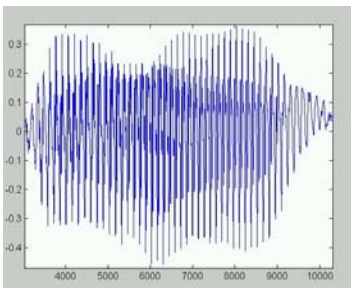

Figure 2 - Biometric Voice based Security System [10]

The individual characteristic of human speech is the result of the shape and size of the appendages of the synthesizing sound. Biometric systems based on speech recognition are based on text or not text focused speech input. Text independent verification verifies the user independent of the phrase. Due to the high variability of individual voices and poor performance [7] speech recognition systems are relatively often used for not high security systems and applications. [2]

- Signature. Another behavioural aspect of a person usable by biometrical analyses is the signature. Not only the form but also the dynamic aspects can be seen as a set of unique features of a person. Other possible movable biometric input could be the rhythm and pattern of a person's walk.

Figure 3 - Signature [11]

- DNA analysis. Now this is a rather more theoretical idea for biometric identification. Imagine a DNA reader that can create a full DNA analysis within seconds from just a few cells of a person's body. Such a device would surely be a match to, e.g. a finger print reader, when comparing the quality of the results.

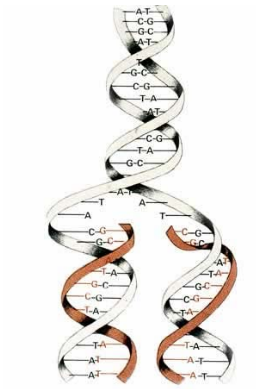

Figure 4 - DNA Molecule

- Hand geometry. This method includes measuring hand shape, lengths and widths of the fingers. Individual anomalies can affect the result of the identification. As hand geometry information may not be invariant over the lifespan special authentication methods are restricted by time and are initialized regularly. [4]

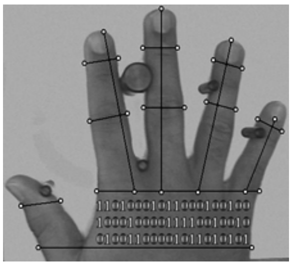

Figure 5 - Hand geometry [13]

- Multi-Biometric Systems. As a final approach to biometric data gathering, one can combine two or more actual biometric analyses and combine their results, i.e. use more than one uni-biometric system. This combination yields better results than each of the combined analyses individually and thereby increases the reliability of the biometric system. [6]

2. Possible Attacks and Disadvantages of Biometric Systems

One of the central issues concerning biometric systems is the need to have some type of central storage that handles the biometric templates of the users. This data storage imposes high security demands, it must be impossible to tamper with the biometric templates, as this would enable fraud.

An attack on the templates can come from two directions:

- A third party could replace a number of biometric templates against other templates which would allow them to manipulate data.
- Even if the risk of the above attack is seen as neglectable, there is one attacker that has a much more direct access to the biometric templates: the government.

Besides attacks on the templates, an attacker has a second – rather destructive – attack approach that does not tamper with the templates, but rather tries to prevent the use of them. Either, he starts the attack before the actual connection starts, or he initiates the attack after the data transmission has started, e.g. using distributed denial of service (DDOS) attack on the servers with the biometric templates. The second approach has two advantages. First, it gives the service provider a very limited time to react. Second, one has to take into account the psychological consequences when a user is denied access based on his biometric template.

After taking a look at a selection of biometric properties, as well as the required infrastructure with its weaknesses, we will now set out a list of criteria that allows us to classify biometric systems.

2.1. Cost.

The cost factor is very important for all systems as the number of participants tends to be very high. Each and every participant needs to spend an initial amount of money for his/her biometric reader. Depending on the recorded biometric characteristic, these costs can be rather large.

2.2. False Reject Rate (FRR)

No biometric system is perfect. One of the problems that can occur are the so called false rejects. A false reject is the situation where a valid user tries to authenticate and is falsely rejected by the system (see Figure 6).

One way such a false reject can happen is due to noise in the recorded biometric data, e.g. a fingerprint with a new scar or a voice altered due to a cold. Noise can also be introduced due to altered environmental conditions, e.g. humidity on a capacity finger print reader or unfavourable illumination for a face recogniser. If this “noisy” data is matched with the stored user templates, the difference can be too big and the authentication fails, i.e. the user is rejected. Another issue with the universal applicability of biometric systems is the possibility that a user is not able to participate, as he/she does not have sufficient biometric properties within the measured domain, e.g. his fingerprints were burnt during a fire.

Final effects that may cause a false reject are time dependent variations either with the individual, e.g. tone of the voice changing over time or an accident that changes the individual’s signature, or a variation due to the reader, e.g. a new version of the reader uses slightly different sensors that yield slightly different measurements.

	False Reject Rate	False Accept Rate
Fingerprint[1]	0.20%	0.20%
Voice[2]	10-20%	2-5%
Face[3]	10%	1%

Figure 6 - FRR and FAR for three example biometric systems

If a biometric device is used as an access control mechanism, a false reject may be acceptable, as it may only require the user to use a different means of authentication, e.g. by calling security, to access the area from which he was excluded by the authentication system

2.3. False Accept Rate (FAR).

The second type of error a biometric system is doomed to make is a so called false accept. In contrast to false rejects, a false accept means that a user is successfully accepted (authenticated) even though he/she should have been rejected. In an e-Voting system there are actually two scenarios where we have to talk about false accepts (see Figure 6).

- An unauthorized user is erroneously accepted. This has two consequences. First, this user is able to give a vote and thereby to possibly change the vote's outcome. Second, as the wrongly authenticated user already gave his vote, the actual user that should be allowed to vote is wrongly rejected yielding the same result as with a false reject.
- An authorized user is confounded with another valid user. With this the short-term effect does not yield a wrong vote count. However, once the other user is trying to make his/her vote, he will be rejected under the assumption that he has already made his/her vote. This again leads to all the consequences of a false reject.
  Another source of false accepts is the uniqueness of the tested biometric recordings. Even with assuming that a finger print is actually unique, a finger print reader will not yield different readings for all users. This stems from the fact that a finger print does not yield the complete finger print as a picture for matching against the stored template, but it actually reduces the input to a predefined feature set of typical characteristics. This introduces a theoretical upper boundary on the number of individuals that a biometric system can distinguish between.

2.4. Spoofing

Another important aspect of a biometric system is its susceptibility to spoofing. Spoofing is the wilful trail to impose a false accept onto the biometric system. This type of attack is especially relevant for behavioural properties, e.g. replay of a voice recording or a blueprint of a signature. However, face recognition as well as the other physical properties are also susceptible to this type of attack.

As an example we will examine an attack on finger print readers. Modern models do not rely solely on the pattern of the applied finger, but also executes a “Life-Check”. [3] describes how members of the CCC try this approach. Their approach is to first get a finger print of the impersonated person using conventional means. This fingerprint is digitally photographed and reworked using graphics software and finally transferred onto a photo layered using acid. This form is then used to make a latex print of the original finger. Due to the very thin layer of latex, it is also possible to trick the “life-check” of the reader.

2.5. Costs of the Biometric Infrastructure

In addition to the costs of the biometric readers, the cost of the biometric infrastructure has to be handled. The infrastructure roughly consists of two parts: enrolment infrastructure and voting infrastructure. The enrolment infrastructure is necessary to collect and maintain a database of the biometric templates of all participants. The voting infrastructure handles the actual e-Voting process, i.e. it must be able to handle authentication requests of all participants within the official voting period; Depending on the used biometric mechanism which may require considerable space as well as computing power. Another aspect of the biometric infrastructure is its high demand on security. It has to maintain the two requirements of a secure system: personalisation and privacy.

2.6. Fail Safety of Biometric Infrastructure

In an access control system, a failure of the system may be acceptable. There will be a way to bypass the system and go back to a manual authentication mechanism, e.g. using human guards and using alternative authentication methods like a paper ID. If used in remote scenarios, a DDOS attack can actually completely disable a biometric infrastructure and thereby denying access to most/all citizens. Scenarios, such as the one described with the DDOS attack are quite common nowadays.

2.7. Acceptance of Biometric Infrastructure

The final factor for a biometric user authentication mechanism is its acceptance with its users. Electronic interaction with systems is mostly a matter of trust. Regardless of its actual security, an electronic system is only as good as its acceptance with its users. Therefore, any introduction of a new system requires a good deal of work to increase its acceptance with the future users. This is especially true with biometric systems [3]. Increasing the acceptance of such systems is probably a slow process.

3. Conclusions

Even though biometric systems are well integrated in various implementations users still have prejudices against biometric information that is stored. Partially this misgiving is comprehensible. Biometric systems are probably one of the most controversial approaches. Nevertheless it is foreseeable that implementations using biometric information are improving and will be used more.

However for large scale usage, several properties of biometric systems have to be improved which includes:

- The false accept rate
- The false reject rate
- Protection against spoofing attacks
- Judicial aspects regarding access to biometric templates

These issues have to be meliorated before large scale biometric systems can be successfully deployed. Exceptions are systems that use biometric measures only as an optional add on in authentication procedures.

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Application Development beyond the Methodology Revolution

APPLICATION DEVELOPMENT BEYOND THE METHODOLOGY REVOLUTION

Maria Raffai [1]

As the basic mission of the software developers is to satisfy the business requirements entirely and efficiently they are forced to use the newest and the most appropriate solutions. In this session I propose to discuss the concepts, methods and the standardized technologies in order to develop interoperable and platform independent applications. The planned topics of this session:

- *application development concepts: model driven approach, abstraction, visualizing, component based design, object.-orientation, reusability*
- *solutions: development methodologies (object oriented methodologies and beyond the RUP), modeling languages (e.g. UML and novelties in UML 2.0, OCL); engineering techniques, role of architectures, importance of middleware*
- *standards: MDA (PIM, PSM), MOF, UML (UEML, iUML, XUML etc.), CWM, middleware standards: CORBA, COM, .NET, XMI/XML*
- *tools: for supporting design, for transforming models, for generating codes, libraries for reusing model elements and components, for creating and publishing design patterns*
- *difficulties and risks: problems that the developers have to face when they give up the experienced methodologies and tools on behalf of using new and yet unknown technologies!*

As I am convinced that a Forum dealing with the above listed topics is a great leap forward in the problem solving process, so I call the attention of the potential participants to discuss the most important themes and opportunities.

1. The Enterprise Centric Computing

At the beginning of the 21st Century the enterprises have to face with the challenge of the increasing system complexity and the strong competition, the information technology has more and more progressive influence, the organizations, the number of the software-intensive business'

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environments and their impact are increasing. These facts force the managers to invest in the computing technology, to use the latest products and solutions of IT and urge the specialists responsible for the application development to create effective, well adaptable and intelligent solutions in order to satisfy the increasing user's demand. The engineers must integrate the existing and the easy changeable newly developed applications, they need to ensure the interoperability of the different software systems running on different platforms.

But it is an enormous challenge! As we know the computer industry is always looking forward to improve the software and even the application development productivity as well as the quality and the longevity of the created products. It seems that the methodology revolution is over, the OMG has elaborated and accepted standards for every aspect of distributed computing from analysis and design through infrastructure until application objects and components defined on every enterprise middleware platform.

As the different packaged applications within the enterprise (the so-called legacy systems) cause overlapping functionality and duplicated information and moreover use multiple resources to solve similar problems, it has become necessary to integrate these separated islands across the enterprise. But there are other aspects as well. The demand for using business-to-business integration adds a new dimension of the complexity. The integration problem must now address not only to the disparate systems and data formats, but also to the differences between the enterprise's systems and the B2B message formats [9]. The interorganization cooperation from the standpoint of the computer systems is fluid, the partnerships undergo continuous change therefore the companies are forced to virtually merge their island systems by extranets.

The enterprise architecture makes possible to design well integrated systems with knitting the preexisting islands together. This is more effective way to satisfy user's requirements, rather than to develop new enterprise applications and/or components. But under the pressure of necessity on reaching low production cost, high quality of enterprise-centric computing, the software industry have to face the more and more increasing challenges. The demand for realizing the increased complexity is shown on the Figure 1.

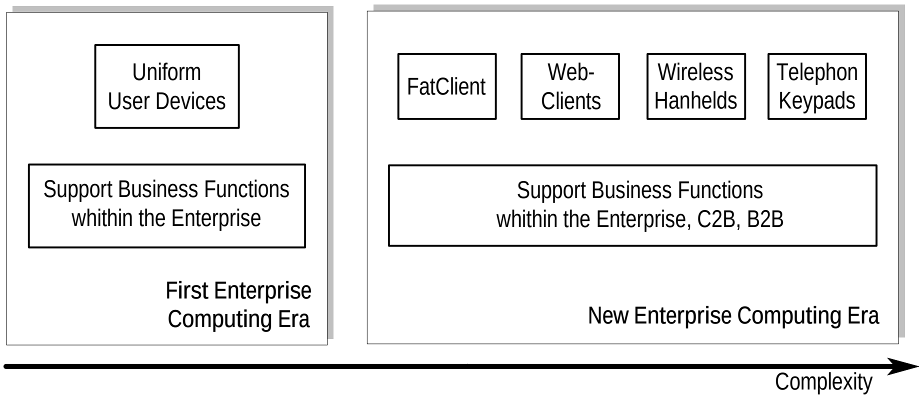


Figure 1 - The pressure for realizing the increased complexity

The software industry has the answer to the social-economic challenges; it has solutions manifesting themselves in different concepts, methodologies, standards and tools. The results of the last year's research and innovation constitute the basis of the enterprise-wide computing, and give possibility to realize the application integration on a standard way [10]. Since the organizational need for the world wide cooperation requires solutions assuring the users on reliability, the specialists are forced to satisfy these demands. The multitier architecture of the computing systems (see Figure 2) is suitable for the enterprise requirements, and together with the most important issues (component-based development, distributed computing systems, middleware that raises both the platform and programming abstraction levels, declarative specification in programming, standard modeling language that helps the unambiguous definitions through the whole development life cycle, separation of the concerns, creation and usage of design patterns etc.) gives the appropriate answer.

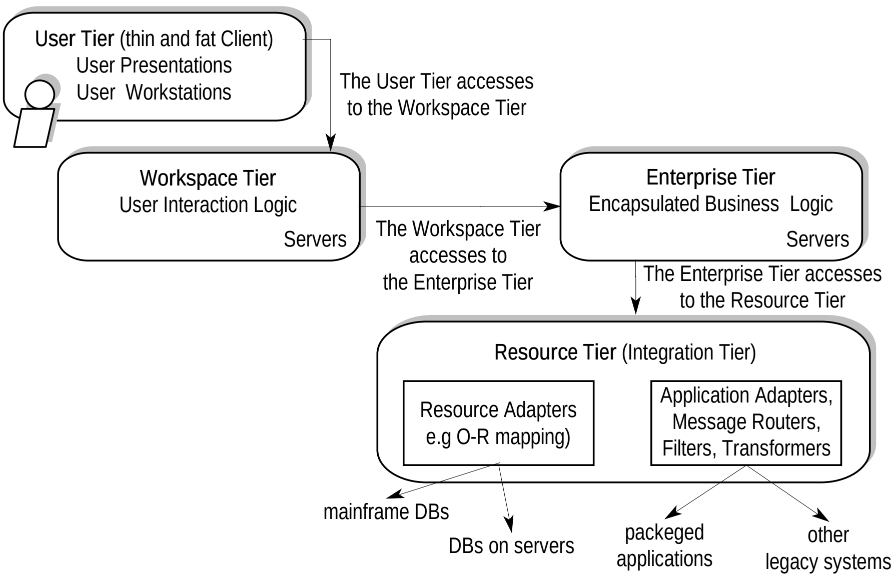


Figure 2 - Multitiered architecture with EAI adapters and message management

2. The Modeling Approach

The modeling paradigm is a proven and well-accepted engineering approach. A good model includes those elements that have broad effect and omits oon those minor elements that are irrelevant to the given level of abstraction. But the reality may be described from different aspects, and these model views are therefore semantically closed abstractions of a system. The *model* is a simplification of the reality, a blueprint of a system. It is the result of an abstraction process, which reflects the general, essential and permanent features from the modeling target's view. It is a formal specification to describe the functionality, the structure, and/or the behavior of the system. Developing a model for an enterprise computing system prior to its construction or renovation is a well-considered abstraction process. Good models are essential for communication among project teams and for assuring architectural soundness. Making effort to implement the complexity of the systems, so does the importance of good modeling techniques. The basic target to build models is to know and understand the structure and the behavior of the system, its components and their relations, and to give a precise description of it [14]. A model may be static or structural emphasizing the components and organization of a system or it may be behavioral, focusing to the functionality and the dynamics of the system. The models can be categorized from different approaches. In order to understand the new concept of the model driven application development methodology we have to study the models and their nature.

2.1. Abstraction Levels

As result of an abstraction process we can create many models for a given system that vary in details and also in the approach. Although all of these models reflect the same system, they represent it on different levels with different accuracy in details and/or from different point of view. It follows that during modeling we create an abstraction which emphasizes the functionality of the system, another one which reflects the static features, and one that expresses the states of the system components. These models are in some cases overlapped and they have always relations to each other. In most cases we distinguish 4 level of abstraction (see Figure 3):

1. The first level of the abstraction is *the business model,* which reflects the main characteristics of the business processes, the elements and their relations. This model is often called *Computational Independent Model* (CIM), because it focuses on the real

processes, the system features and the functionality and the nature of the modeled system.

2. The second level expresses the logical view of the system modeling, the attributes and operations of the objects, the functionality, the behavior, the states and the state transitions. At this stage the designers do not take into consideration what kind of technology will be used in the realization. The model set of this level is called *Platform Independent Model* (PIM). This model may involve the modeling of various business components, their structures, the interfaces and the dependency to other components, meta data and stereotype representations keeping away the technical details. The model is then refined in an iterative process, where all the elements, interactions, interfaces and procedures are identified, reviewed and validated. The PIM (problem domain, business logic, different views of business and analysis model) plays definitive role during the development lifecycle, not only because it is the base of the enterprise-wide integrated application system, but also because it identifies and controls the deployment, maintenance and the software quality assurance.

3. On the third level the conceptual PIM model is transformed considering the platform on which the designed model will be implemented. Therefore the *Platform Specific Model* (PSM) is developed on the basis of the available technology and of the desired services. A PSM may involve various business- and platform-specific technical details in the form of design constraints, patterns, interfaces and deployment descriptors. The Platform Specific Model is a formal specification of a system that assigns the technical details such as CORBA, SOAP, EJB etc. to the PIM model elements.

4. As the final aim of an application development process is to support the business processes by software systems it is necessary to transform the platform specific model to *implementation* components. The writing or generating source code, defining test criteria, creating test cases and carry out testing and evaluating procedures are the last tasks in a software development process where the majority can be automated.

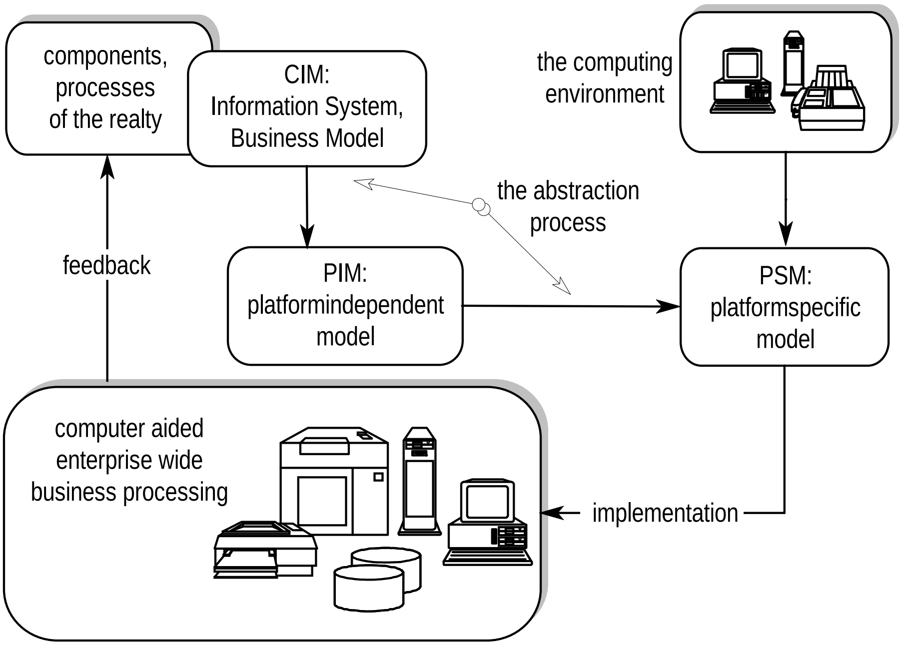


Figure 3 - The abstraction process from realty to the running computing system

2.2. Modeling Languages

The models are always written in a language which might be plain English or another spoken language, a modeling or a programming language etc. The modeling tools help to create technology-neutral designs that are then transformed into specifications. A well-defined language has a well-defined form; this is the *syntax,* and a well-defined meaning and rule for using language elements and symbols. This latter is called *semantics* of the language. Figure 4 shows the relationship between the model, the described system and the language in which the model is represented.

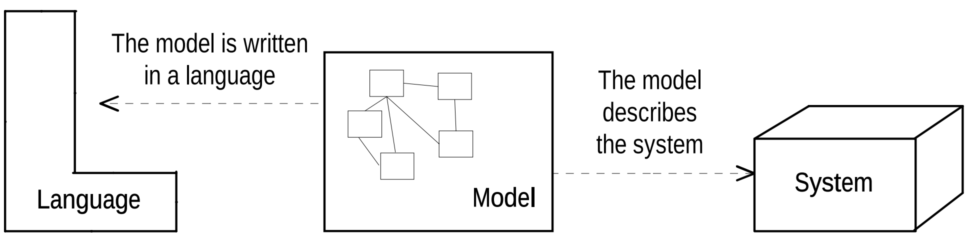


Figure 4 - Models and languages

The Unified Modeling Language is one of the languages supported by the software industry as a standard modeling notation [16]. It is a widely accepted human-readable graphical/textual notation for visualizing and specifying the technology-independent business domain and for mapping the processes. The UML includes (1) *model elements:* fundamental modeling concepts and semantics, (2) *notations:* visual rendering of model elements and (3) *guidelines:* idioms of usage within the trade [2]. The UML was accepted in 1997 as an OMG modeling standard primarily for analyzing and designing software and to be an industry-wide breakthrough for visual modeling (see Figure 5).

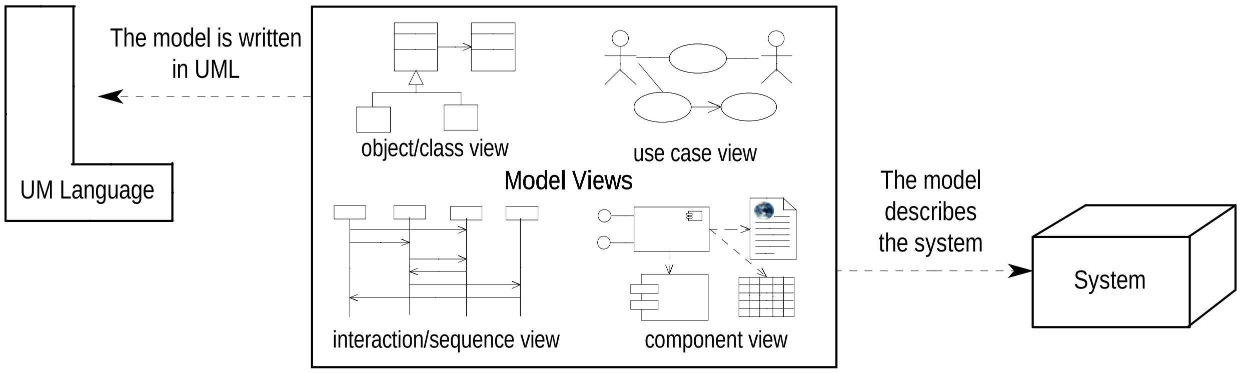


Figure 5 - Different views modeled in UML

The modeling language suited for MDA should offer the following [7]:

- Expressive enough to specify system complexity, which includes both static and dynamic view of the system.
- Generally applicable, but not application specific languages like for example the 4GLs.
- Abstract often-used patterns of lower level constructs into single higher-level constructs.
- Suitable for n-tier application development including three-tier, two-tier and single-tier applications. The actual number of tiers should be of no consequence in the model, but should be adjusted in the settings of the transformation tool.
- Suitable for distributed applications. Transformation tools should take care of building the bridges between various nodes.
- Seamlessness between the model and the implementation.
- Support for managing large models for instance by supporting an aspect-oriented manner of modeling.

2.3. The Automated Model Transformation

During the development lifecycle the models on different abstraction levels are generated from each other. For example the source of the analysis model is the business model, and the design model is generated from the analysis model. In every transformation process there are exact rules that describe how a model in the source language can be transformed into a model in the target language, or better to say how one or more constructs in the source language can be transformed into one or more constructs in the target language. But the source and the target language can of course differ, that means it is not a prescription to write every model in the same language. For example in order to normalize the data structure it is recommended to use the ER modeling language (Entity Relationship), and when the model is at least in 3rd normal form (3NF) then transform to UML class diagram.

The developers need *transformation tools* for model transformation. The tool possess definitions that describe how a model should be transformed. Figure 6 shows the process of the transformation flow using special tools. A transformation tool uses the same definitions and rules for each transformation of any input model. In order to apply these tools in every environment and on every platform independent of the source model we need different subsets in the transformation definition. These subsets are formalized by profiles (see later in the chapter *Architecture)* which define completely new language derived of course from the root, and make possible to convert models into different programming languages such as C#, Java etc.

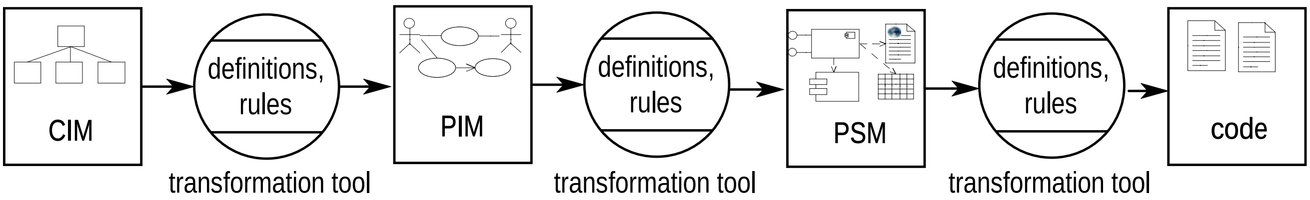


Figure 6 - The model transformation flow

3. The Developing Framework

3.1. The MDA process

Instead of traditional development lifecycle (following waterfall phases) the OMG offers a development framework: the MDA. The Model Driven Architecture is an innovative approach to construct enterprise architecture by abstracting and visualizing business requirements in the form of platform- and implementation technology independent models, separates implementation details from business functions, and gives chance for Rapid Enterprise Integration [17]. Once the interfaces are identified and the implementation technologies are selected, the conceptual design models are transformed into platform specific software architectures [5]. The MDA framework enhances the capability of the software architecture to be flexible, extensible and adaptable to new technologies or standards, and to abstract business application components in the early stages of EAI initiatives. Most importantly, the MDA enables business experts and software engineers to focus on business risks, issues and concerns, ensuring the effective use of existing and evolving technologies. Figure 7 shows the new development process that is recommended to follow if the software engineers want to build portable, platform independent and productive applications.

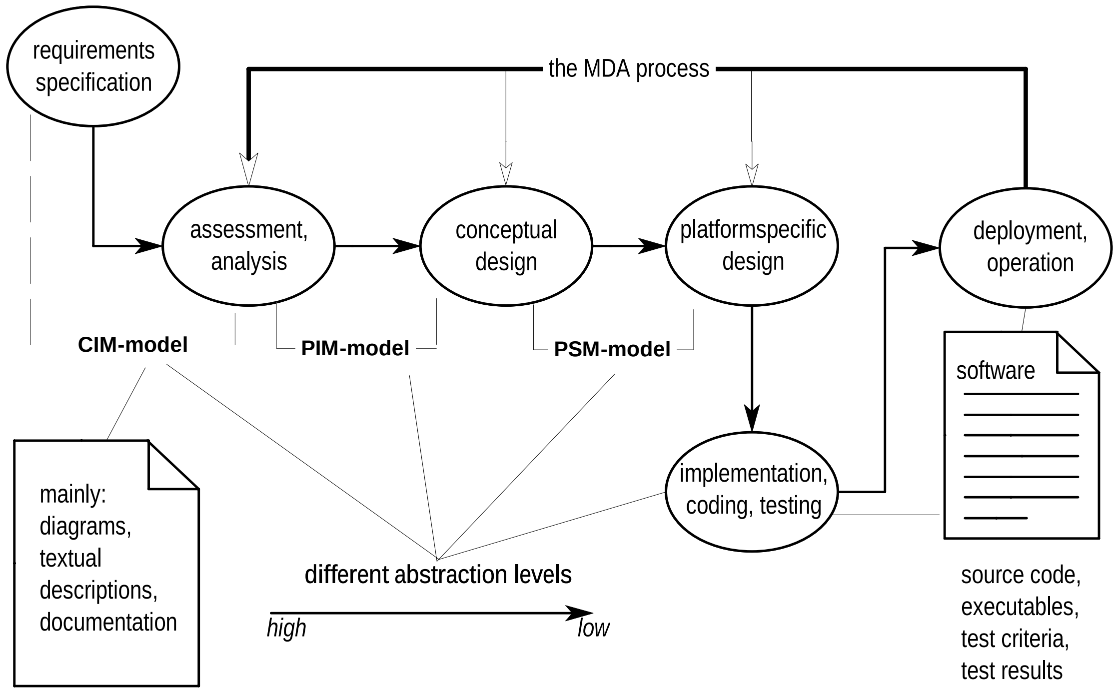


Figure 7 - The MDA development process

3.2. The Architecture

In order to enable the productive use of MDA it is necessary to have a set of related modeling standards. The most important standards related to the framework are mainly defined by OMG, but there are other products that fit also the MDA. The MDA unites the well-established modeling standards with every past, present and future middleware technology to integrate what you have built with what you are building and/or what you are going to build. Rather than focusing on other things, MDA raises the bar and brings portability and interoperability into the application at the model level [19]. As its core is a technology-independent definition of the distributed enterprise computing infrastructure, it includes the concepts of the various architectures on the market. The Figure 8 shows the OMG standards and the non-OMG elements that fit in the MDA framework.

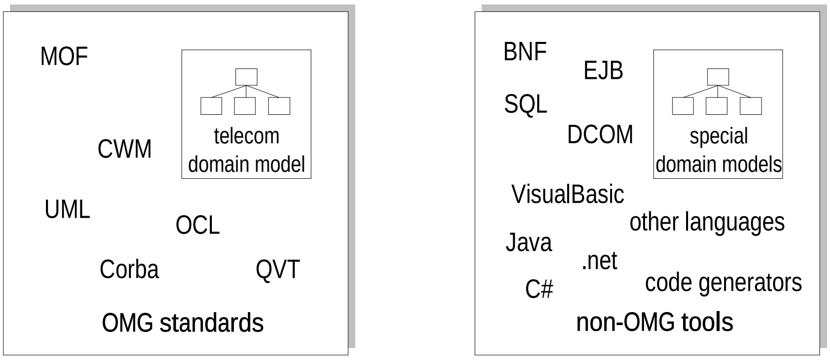


Figure 8 - MDA elements

The modeling languages fulfill the requirements that are suitable for automated interpretation. These languages do not have to be text based and usually they are not, but they have graphical notations and syntax and a special mechanism for defining and specify the abstraction of the system. This mechanism is called *metamodeling*. As the real world has different element, the modeling language also need to define what elements exist, what are their relations and behavior, in other words it defines the element what can be used in the system. Every kind of element that a modeler can use during his or her interpretation is defined by the metamodel of the language (see Figure 9). Because the metamodel is also a model it must be written in a well defined language which is called metalanguage. But there is a difference between a modeling language and the metalanguage because the latter is specialized to describe modeling languages, while the metamodel completely defines the language itself.

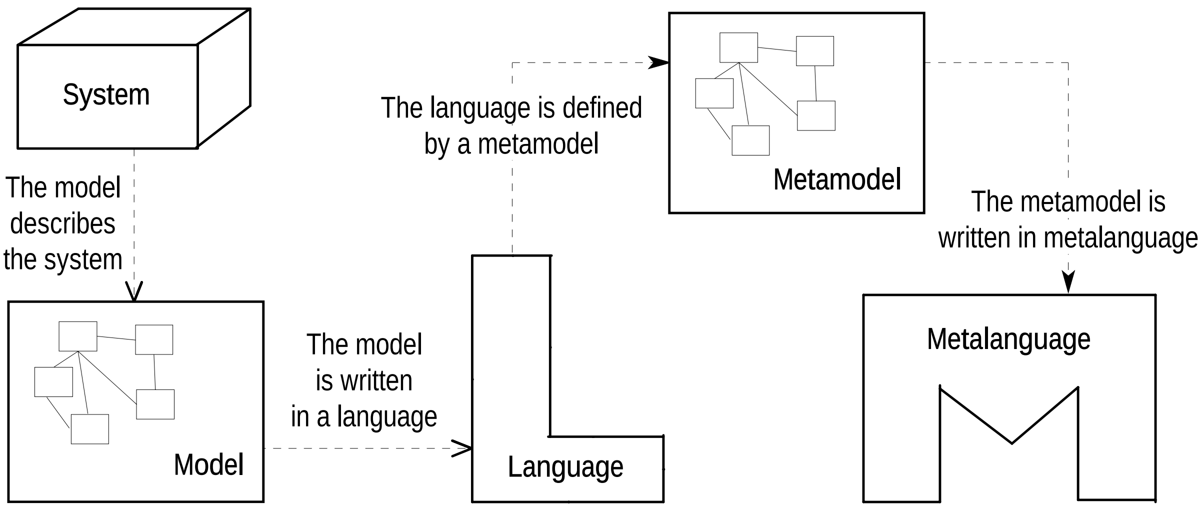
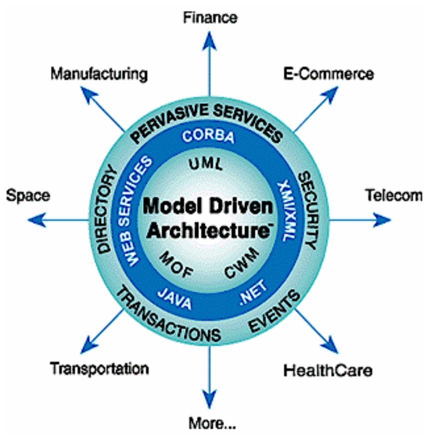


Figure 9 - Models, languages, metamodels and metalanguages

At the highest level of the metamodel architecture is the meta-metamodel layer, where MOF (Meta Object facility) takes place. This layer has information about meta-metadata, that is to say there is the abstract language for defining different kinds of metadata. The MOF is mainly used to define modeling languages but it also provides some additional functionality such as the repository interface for allowing the developers to get information about the models on the M1 information layer consisting of data what the system needs to describe, or the model interchange to define a stream or file based interchange format (XMI) for the M1 models.

The UML modeling language (Unified Modeling Language) and the CWM (Common Warehouse Metamodel) as abstract languages for describing different kinds of models and model views are on the M2 level of the metamodel architecture. The metamodel layer contains data about models, that define their components, structure and semantics. In this context the UML and CWM metamodels are instances of the MOF and they have the same structure as the MOF model. Although both, the CWM and the UML are modeling languages, the CWM was developed specifically for modeling data mining, data warehousing applications and it has a number of metaclasses (for example objectrelational databases) [3]. In order to stress the importance of the UML whithin the MDA the language is extended with profiles. The profile concept is a specialization mechanizm to define languages derived from the UML. In a profile defined language adds additional constraints as a subset to the UML in order to make possible using specialties for the developers. The profile looks like UML because it uses the UML's diagramic notations, stereotypes, tagged values, OCL textual descriptions etc. Some of the profiles are already standardized by OMG, such as CORBA Profile, EDOC Profile (Enterprise Distributed Object Computing) or the Scheduling, Performance and Time Profile. There are also non-OMG standards, for example the UML/EJB Mapping Specification profile which was standardized by Java Community [13], [15].



The architecture of the MDA shows the hiarerchical relation between the standards and the services. The Pervasive Services provide directory, security, distributed event handling, transactionality, persistence and other services required for running applications on any platform through MDA generated bridges. These services are necessary to support distributed computing, both within an enterprise and among many companies over the Internet. In the MDA there are defined four Pervasive Services, the *directory*, the *transaction*, the *security* and the *distributed event* and *notification* services. The *interface definition* describes how the base model is implemented on different middleware platforms, how the implementations are completed, and what the application developer decides to support.

3.3. Supporting Tools

The MDA is implemented by tools and/or suites of tools, that integrate modeling and development into a single environment that carries an application from the PIM through the PSM, and then via code generation to a set of language and configuration files implementing interfaces, bridges to services and facilities and possibly even business functionality. The tools supporting the MDA engineering process vary in many capabilities from the simple code generation to the products providing full scale automation. It is useful to distinguish the following categories [8]:

- The *PIM to PSM tools* transform the high level PIM into one or more PSMs. This type of tool is barely available at the time of writing code, although some of them offer minimal functionality in this area too.
- The *PSM to code transformation tools* are the most well known products, which have built-in transformation definitions and rules to take a predefined type source model and to produce another predefined target.
- The *tools transforming the PIMs to code* unite both the PIM to PSM and PSM to code transformation. This software usually hides the PSM to code transformation process from the user, it seems a direct PIM to code transformation. With this type of tool the source and target language and also the transformation definition are built into the tool that acts as a black box.
- The *tunable transformation tools* should allow for some tuning or parameterization of a transformation definition. This means that there is a possibility to make changes to the tool-specific scripting language in which the transformation definitions are written (there is no standard language yet to write transformation definitions).

- The designers need a *transformation definition tool* for creating and modifying definitions in the case of special situations, while they do not have transformation definition tool off the shelf. The OMG is working already on a standard language for writing transformation definitions (QVT: Query, Views and Transformation). Such tools are not on the market yet.

Beside the above mentioned tools in the MDA process it is needed to have other supporting solutions in which models can be made and changed. Figure 10 shows the functionality of the complete development environment.

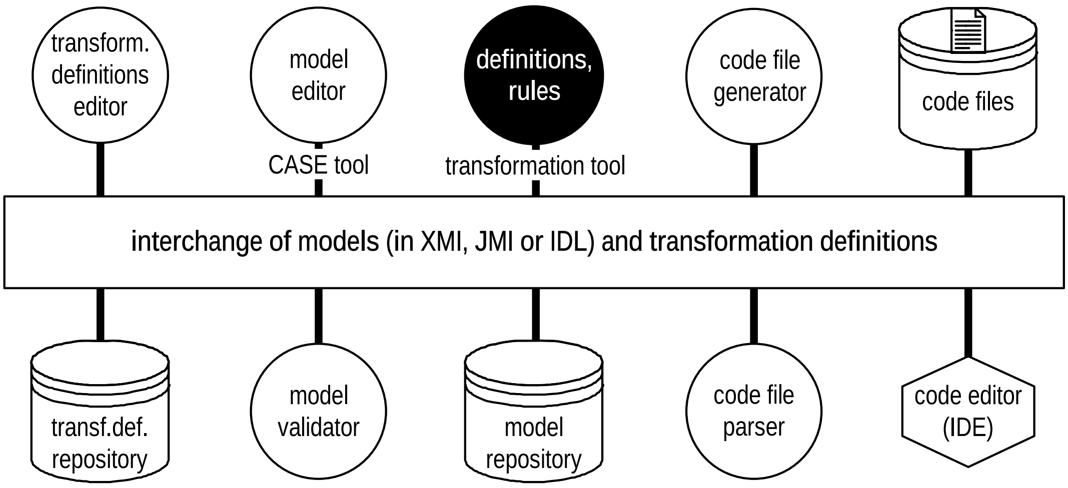


Figure 10 - The functionality in an MDA process environment

Several vendors already provide tools which support integration, including substantial code generation capability. In the last years the tool vendors and service providers have extended their support also to MDA. Codagen Technologies, IBM, InferData, Iona, Hewlett-Packard are only some examples of these companies, and ArcStyler, ARI, iUML, iCCG, ModelMethods are examples of the offered products. While evaluating or selecting most of the existing tools, the developers might also find them useful in automating model transformation or generating skeleton source codes. In most cases, it would be necessary to modify the generated source code or to write the code manually. As the evolved development tools become mature enough, it is anticipated that practitioners will be able to extend the capability of their enterprise architecture to adapt future technologies easily for many years to come.

3.4. Advantages, Benefits

Comparing the MDA to the traditional development process it is apparent that the answer to the challenges of today’s highly networked, constantly changing system environment is to provide an architecture that assures:

- *portability,* increasing the application re-use and reducing the cost and complexity of application development now and in the future;
- *cross-platform interoperability,* using rigorous methods in order to guarantee the standards, based on multiple implementation technologies, implement identical business functions;
- *platform independence,* reducing the time, outlays and complexity associated with re-targeting applications for different platforms;
- *domain specificity,* through domain-specific models that enable rapid implementation of new, industry-specific applications over diverse platforms; and last but not least
- *productivity,* allowing developers, designers, software engineers and system administrators to use languages and concepts they are comfortable with, while making possible seamless communication and integration across the project members.

The functional description of every standard of MDA is technology independent, and the architecture is capable of producing *interoperating implementations on multiple platforms.* This allows defining the *business functionality and behavior* as a PIM, and then to produce PSMs and implementation models on whatever platforms the participants require.

The most important actions suggested by MDA are the following

- the architecture based development process is suitable for managing yesterday's, today's and tomorrow's applications,
- it makes possible to integrate all kinds of applications and facilities across middleware boundaries, and
- the domain facilities defined in the MDA will provide much wider interoperability by always being available on a domain's preferred platform, and on multiple platforms whenever there is a need.

4. Conclusions

The MDA brings a real revolution into the software development process, in other words: the paradigm, the methods and the tools of the development is radically changing. But we have to take into consideration that the possibility of the automated model transformation does not mean the end of writing lines of code! We are now at the cradle of a paradigm shift, and in the near future we will be the witnesses of a fundamental change in the software development procedures and the applied solutions.

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MODEL DRIVEN ENGINEERING: TWO APPROACHES THROUGH THE SAME CASE STUDY

V. Ribaud, P. Saliou, M. Kerboeuf [1]

The work described in this article presents two model-driven engineering approaches through the same case study. The case study is an shared electronic agenda used as a representative of medium and small sized Information Systems. The first approach relies on the Unified Process, supplied by IBM/Rational Rose. The second approach relies on CADM (CASE Application Development Method), a waterfall process belonging to the family of systemic methods, supplied with Oracle CASE Designer.

1. Introduction

Methods and tools are essential for the achievement of a project. Formerly, the CASE tools were often confined to the analysis and design phases while the programming environments were used for the implementation. Presently, tools vendors promote tool suites which should be able to support an integrated development process driven through a model driven approach. We present a case study, built into two different methods and environments: CADM/Designer and UP/Rose.

1.1. The development cycle

Approaches' presentation follows the development cycle that especially defines role and progress of project phases. 7 phases are hold:

0 - Project set-up from a statement of work

1 - Requirement capture

2 - Analysis

3 - Design

4 - Coding and unit testing

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5 - Integration and integration testing

6 - Validation

Phases 0 and 6 rely on common documents for both approaches: a statement of work is provided to define the case study and a validation plan is used to evaluate software at the end of the development process to ensure compliance with the statement of work.

1.2. Case study: statement of work (excerpts)

Each user freely creates his/her artefact as a person in the system. Agenda let users create meetings, register/cancel for a meeting and consult existing meetings along several criteria: participant, meeting room, subject, temporal interval.

...

A meeting is attended by one to many persons and is located in a unique room that must be available at meeting time. A room can successively hold different meetings. A person can take part in several disjoint meetings.

...

Some operations are right-restricted. Generally, a user can perform any update on objects that he/she created. An administrator is provided with the agenda in order to manage common data ; management right is transmissible and irrevocable.

...

1.3. Validation plan

The statement of work is not structured in order to have any influence on the approach used. It does not contain detailed requirements but rather requirements titles, presented within a numbered list ordered alphabetically. This list order indexes the verification plan too; it makes no sense with the real verification plan issued from each approach, but should permit the comparison between compliances through the indexed list.

Table 1 – List of Requirements

N.	Requirement	N.	Requirement
1	Cancel participation to a meeting	10	Participate in a meeting
2	Create a meeting	11	Retrieve meetings by attendee
3	Create a person	12	Retrieve meetings by date
4	Create a room	13	Retrieve meetings by meeting room
5	Connect [Register]	14	Retrieve meetings by subject
6	Delete a meeting	15	Update a meeting
7	Delete a person	16	Update a person
8	Delete a room	17	Update a meeting
9	Deregister		

2. First approach: the Unified Process with Rational Rose

The development process belongs to the unified processes family. «The unified process is first and foremost a software development process ... The unified process uses the Unified Modelling Language (UML) in order to create elaboration and building plans of the software system ... Nevertheless, the truly specific features of the unified process are as follows: use case driven, architecture-centered, iterative and incremental» [5].

2.1. Requirement capture

Requirement key point is to establish the importance of requirements as a contract between client and provider. A requirement is defined from IEEE Std 729-1983 as a "Condition or capacity which a system or subsystem must exhibit to satisfy a contract, a standard, a specification, or any other obligatory formal document".

Use case model is employed. A use case captures a contract between the stakeholders of a system about its behaviour. The use case as a contract for behaviour relies on two models described by Alistair Cockburn [2] : -1- the system provides interactions between actors with goals, -2- the system has the responsibility to protect the interests of all the stakeholders.

As an example, the use case "Participate in a meeting" is given below.

IDENTIFICATION

Title: Participate in a meeting

DESCRIPTION OF THE SCENARIOS

Preconditions:

I. The system is working.
II. The user is connected.
III. At least one meeting has been created.

Strategic scenario: "Participate / cancel participation in a meeting"

1. The user looks for a meeting.
2. The user selects a meeting among the result of the search.
3. The user can add a person to the meeting's attendees, cancel the participation of a person, or view the list of the meeting's attendees.
4. The user leaves the participations' management.

Main scenario A: add a person to the meeting's attendees
Postconditions:

I. A new person participates in a meeting.

1. The system displays the list of registered persons.
2. The user enters the name and the first name of a person, or it chooses a person in the displayed list.
3. The system checks the person is available during the meeting.
4. The user confirms the participation of the person.

Extensions:

2a. Invalid name or first name.

…

2b. Namesakes.

1. Several persons have the same names and first names.
2. The system gives additional specific information like the phone number.

The scenario restarts in 2.

1-4a. Cancelling

…

Main scenario B: cancel participation of a person
Postconditions:

I. The participation of a person in a meeting is cancelled.

1. The system displays the list of registered persons.
2. The user enters the name and the first name of a person, or it chooses a person in the displayed list.
3. The user confirms the cancelling of the participation of the person.

Extensions:

…

Main scenario C: view the list of the meeting's attendees

1. The system displays the meeting attendees' list.

Figure 1 – Use Case "Participate in a meeting"

2.2. Analysis

The unified process presents analysis as a transition from an external view of the system (written in the client's language) to an internal view (written in the developer's language). The analysis structure is as follows: package, classifier (class, association, interface), element.

The goal is to get a static analysis of the system (in the form of a class diagram) and a dynamic analysis (in the form of collaboration[2] diagrams : one for each use case). Each analysis class belongs to one of the base stereotypes : «boundary», «entity», «control». The analysis class diagram is structured (through packages) in sub-diagrams, overlaying several use cases. Each use case is a collaboration into the analysis model that describes the way a given use case is realized and executed in term of analysis classes and interactions between instances of these classes. Technical requirements that are not defined with use cases (sometimes called non-functional requirements) are analysed in a common collaboration if several use cases are concerned elsewhere in a peculiar collaboration. Collaboration diagrams are structured into packages independently of class diagrams structure. Services' packages can be used at a lower level in order to structure the system from the services that it provides; this is an important step in the development process because it gives the system its initial structure which is subject to further refinement in the design phase.

As an example, the collaboration diagram "Participate in a meeting" is given below.

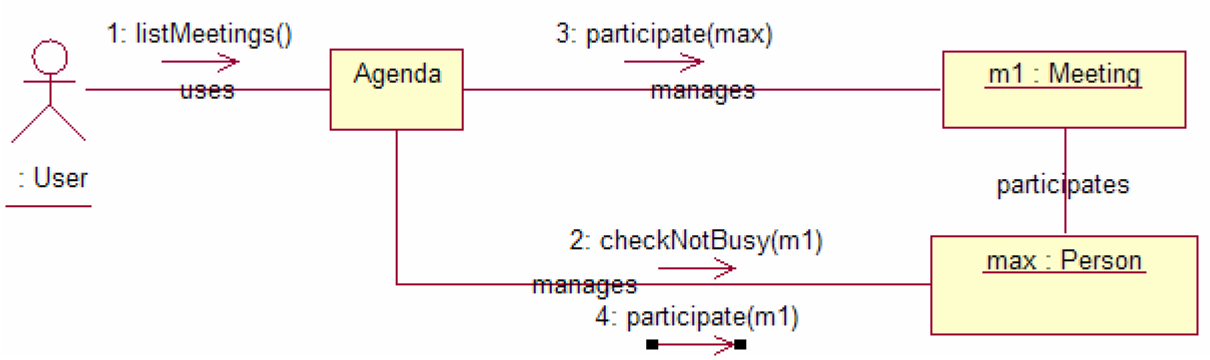


Figure 2 - Collaboration diagram "Participate in a meeting"

[2] Collaboration diagrams are called communication diagrams in UML 2.0 and moved from the structural diagrams to the behaviour diagrams.

The whole class diagram of the Agenda is given below.

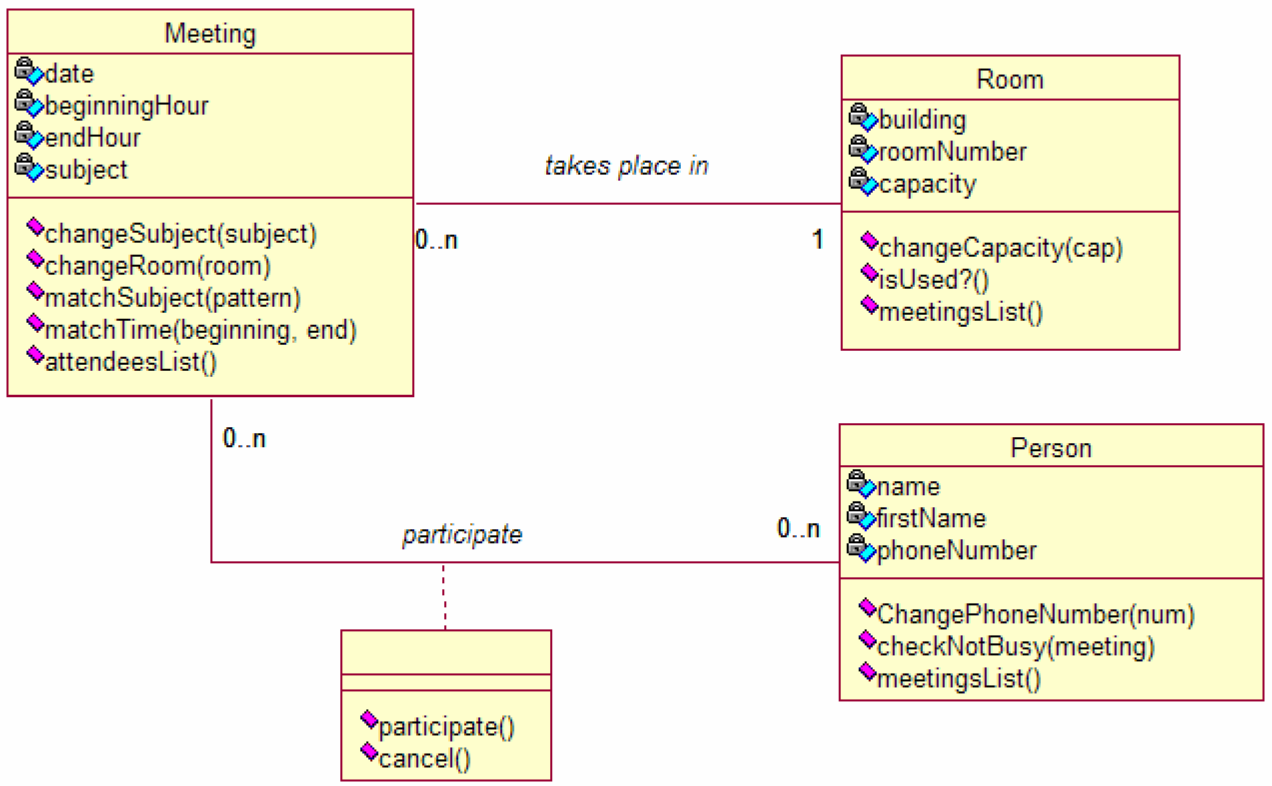


Figure 3 - Class Diagram of "Agenda"

2.3. Design

Product design consists of two broad phases that may overlap in execution: preliminary and detailed design. Preliminary design establishes product capabilities and the product architecture, including product partitions, product-component identifications, system states and modes, major intercomponent interfaces, and external product interfaces. Detailed design fully defines the structure and capabilities of the product components [3].

The unified process presents design as a shaping activity in order to give a form and architecture to the system that meet requirements. As a fundamental basis for design, the analysis model assigns a system structure that we should try to keep. However, the design model is an object model which is an abstract vision of the system implementation; this model is depicted in a hierarchical system with subsystems and design classes.

From the database point of view, there are no fundamental differences between the applicability of UML and traditional entity relationship approach. In the Rational Rose environment, there are two types of model associated with a data modelling project:

- Logical Data Model : used for modelling data relationships among entities at a conceptual level, that means the class diagram from the Analysis section;
- Data Model[3] : used for modelling the physical database.

Each type of model is a UML class diagram with stereotypes (e.g., <<entity>> in logical data model, <<table>> in data model) and properties specific to data modelling (e.g. SurrogateKey). Transforming a conceptual model into a physical database is well-known and will not be detailed in this article.

There are as many design class stereotypes as the implementation language and its architecture are providing with. The architectural model used is MVC (Model-View-Controller).

A «View» design class models the interaction of the system with the actors and often represents abstractions of forms, windows... mostly derived from «boundary» analysis classes. A «Model» design class is used to represent information and behaviour of a phenomenon or a concept; there are mostly stemming from «entity» and «control» analysis classes. A «Control» design class represents coordination, scheduling, transactions and other objects control, as also complex processing that cannot be linked to a given «Model» class.

The design model establishes an obvious mapping between design artefacts and implementation constructs of used tools: «Views» are OCX controls and VB forms, «Models» are relational tables (possibly with object/relational persistence and query service), «Controllers» are SQL stored procedures or queries as also VB procedures. The specification of a design artefact uses the same language as the implementation tool; then operations, parameters, types ... are specified in the tools syntax.

Component diagrams are used to represent design classes and their dependencies. Interaction overview diagrams[4] could be used to depict high-level control (referring to design classes rather than interaction diagrams).

An example of design diagram of the Agenda is given below.

[3] Understand that this means “physical data model”.
[4] Novelty in UML 2.0

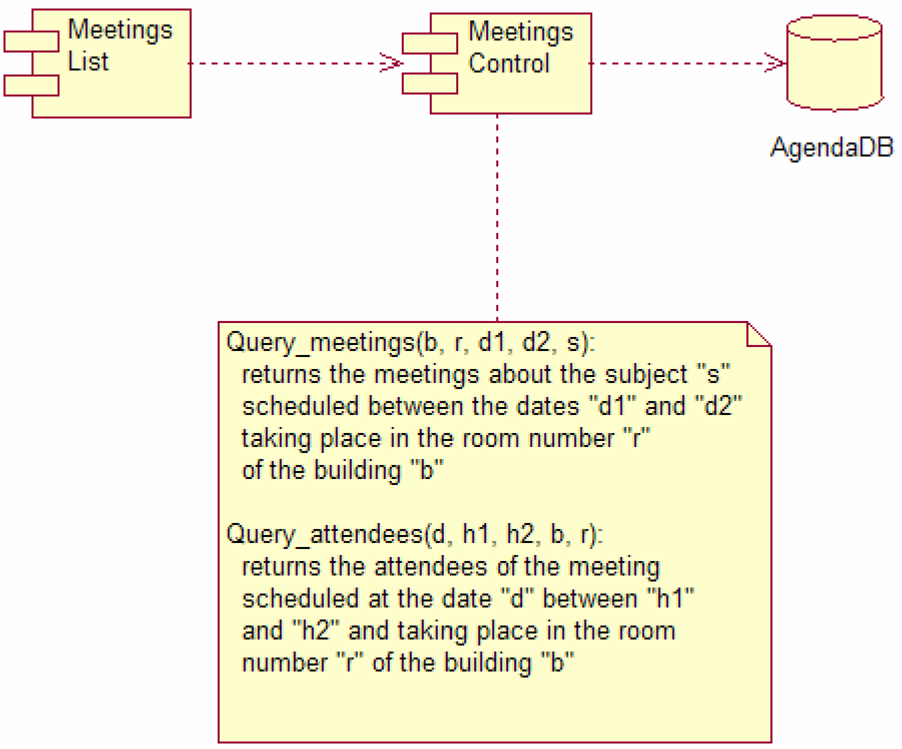


Figure 4 – Example design diagram of the Agenda

2.4. Coding and unit testing

Once the design has been completed, it is implemented as a product component. The characteristics of that implementation depend on the type of product component. Then, unit testing of the product component is performed as appropriate. Unit testing involves the testing of individual software units or groups of related items prior to integration of those items.

Coding uses relational tables; an ODBC-like driver to access to data sources; SQL queries and stored procedures, VB procedures and OCX controls and forms.

An environment must be established to enable unit testing to take place. Testing units incrementally promotes early detection of problems and can result in the early removal of defects.

2.5. Integration and integration testing

The purpose of Product Integration is to assemble the product from the product components, to ensure that the product, as integrated, functions properly, and to deliver the product. A critical aspect of product integration is the management of internal and external interfaces of the products and product components to ensure compatibility among the interfaces [3].

Product integration can be conducted incrementally, using an iterative process of assembling product components, testing them, and then assembling more product components. Testing consists in verifying that a component conforms to its baseline and satisfies all specified requirements. Tests define:

- nominal input data,
- foreseen operator's actions,
- expected results,
- functions scheduling.

Despite the existence of dedicated tools in the Rational suite, we were unable to use them in an automated process. An integration test plan is used and manual verifications are performed in order to find defects. Correcting defects leads to perform the integration tests again.

2.6. Software testing

The purpose of Validation is to demonstrate that a product or product component fulfils its intended use when placed in its intended environment [3].

Tests organization relies on validation plan, structured as follows:

Validation is divided into operations.

- A validation operation consists in verifying a set of functionalities, services, documents or system constraints. An operation is structured in stages.
- A stage is decomposed into actions. Actions define functionalities to be verified at each stage.
- Each action is constituted with trials. Trials should verify results conformance with requirements.

3. Second approach: the CADM method with Oracle Designer

3.1. Designer and the associated CADM method

Oracle Designer is an extremely powerful integrated CASE tool. It allows the whole building of an Information System all along the phases of the software life cycle. To this end, it relies on a unique common repository stored in an Oracle database.

The development approach relies on CADM (CASE Application Development Method), a waterfall process (Analysis->Design->Build->Implement->Production)) created by Paul Dorsey and Peter Koletzke [4]. This approach is a derivative of the Case*Method created by Richard Barker [1]. CADM revises and expands the Case*Method in order to use Designer. CADM does not describe how to build systems or how to use Designer, but how to build systems using Designer. CADM belongs to the family of systemic methods. The data and processing have first to be separately modelized, and then coupled to constitute a unique and integrated system. The building of the system gets through different abstraction levels: analysis, design and implementation.

3.2. Requirements capture

There is no requirements capture model in Designer. <u>During the preliminary analysis phase,</u> the requirements capture materializes mostly in a textual form casually laid out or structured by a requirements plan. <u>During the general analysis phase,</u> the requirements capture becomes elaborate, detailed and reshaped through a function hierarchy and an Entity/Relationship data model. The requirements capture materializes as a function hierarchy. Through this approach, the point of view is the one of the system: which functions must the system offer to fulfil the final user needs? In the use cases, the point of view is the one of the system users: what do the various users expect from the system, what are their aims? We wish to use a “light” use case model in order to describe this external point of view; so we use a short textual form: use cases summaries (resumes). It is then possible to transform automatically an external point of view (use cases) into an internal point of view (function hierarchy), by relying on the organization of use cases in terms of relations as well as functional grouping in packages. Below, an incomplete list of summaries related to meetings.

Table 2 – List of Use Case Summaries

N.	Actor	Goal	Summary
1	User	Cancel participation to a meeting	A person is removed from the meeting attendees' list.
2	User	Create a meeting	A new meeting is created with its own characteristics as well as an available meeting room.
...			
6	User/ Grantee	Delete a meeting	The user/grantee deletes its own/an existing meeting. Attendees' participation to this meeting is cancelled.
...			
10	User	Participate in a meeting	A person is added to the meeting attendees' list only if he/she is available at the meeting time.
...			
15	User/ Grantee	Update a meeting	The user/grantee updates some characteristics of its own/an existing meeting. Updating the meeting room requires a sufficient capacity.

Depending on the complexity of the business area and the level of knowledge of the project team and users, it may or may not be appropriate to include an Entity-relationship Diagram (ERD) in this phase; in this case, it is called a Strategy ERD and it should identify the key entities and their relationships to provide an overall perspective of the business area data.

3.3. Analysis

If not still defined, the Entity-relationship Diagram (ERD) should be established. It is a communication tool as well as an analysis tool. The Analysis ERD attempts to capture as many of the data-related business rules as possible in a diagram. No consideration is given to performance or to the feasibility of implementation of a rule. The goal is to represent business requirements. Rules that cannot be implemented in the ERD are stated as text.

The function hierarchy is the model proposed by Designer to analyse processing. Processing in the information system is hierarchically divided into a set of activities known as functions. Therefore a function is a more or less important activity which can be automatized or manual. Some functions can be shared, in that case they appear several times in the hierarchy with a distinctive sign.

3.3.1. General analysis

<u>The general analysis phase</u> produces a function hierarchy and an Entity/Relationship Data model.

The ERD model for the agenda is given below.

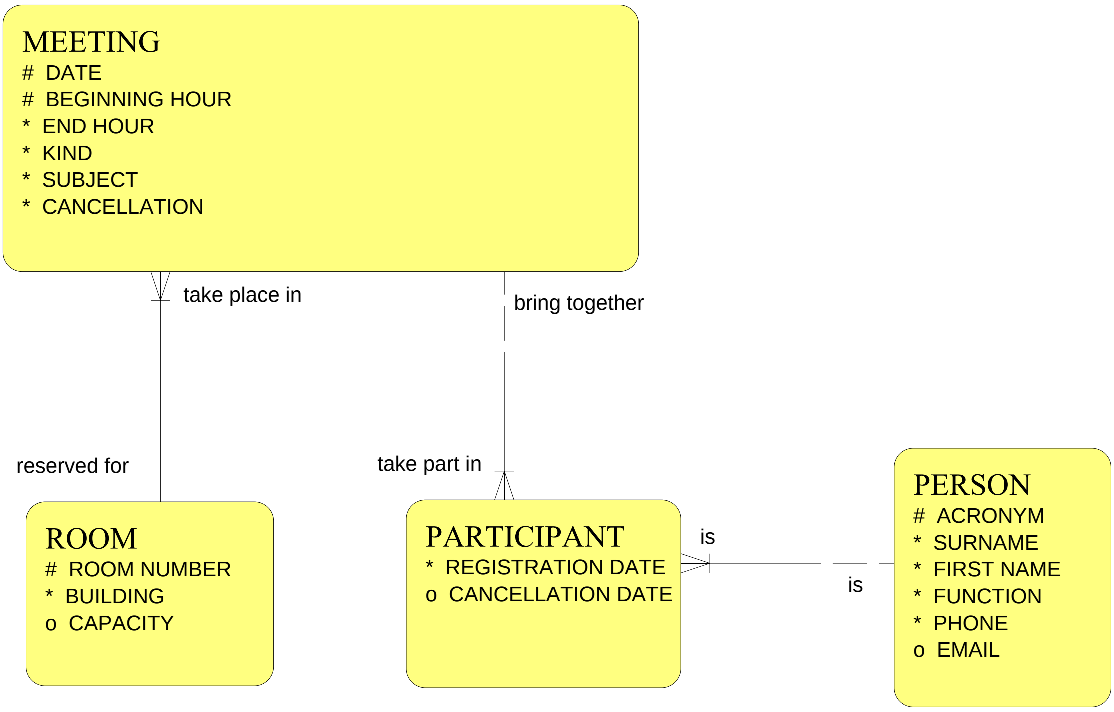


Figure 5 –ERD model for the agenda

Attention should be paid to domains. A domain is a set of business validation rules, format constraints, pre-defined values that apply to a set of attributes. Domains are used to standardize characteristics of attributes and are used later by Designer generators.

For example, the kind of meetings can define either a static domain (all values are defined) or a dynamic one (values can be added during the agenda use). The domain D_KIND_MEETING is given below

Allowable Domain Values

equenc	Value	h Va	bbreviatio	Meaning
1	GM		GM	General Meeting
2	CDMB		CDMB	Computer Department Management Board
3	DIB		DIB	Departement Improvement Board
4	DMC		DMC	Departmental Management Committee
5	OTH		OTH	Other

Figure 6 - Domain D_KIND_MEETING

From the requirement list, we will get a function hierarchy given below.

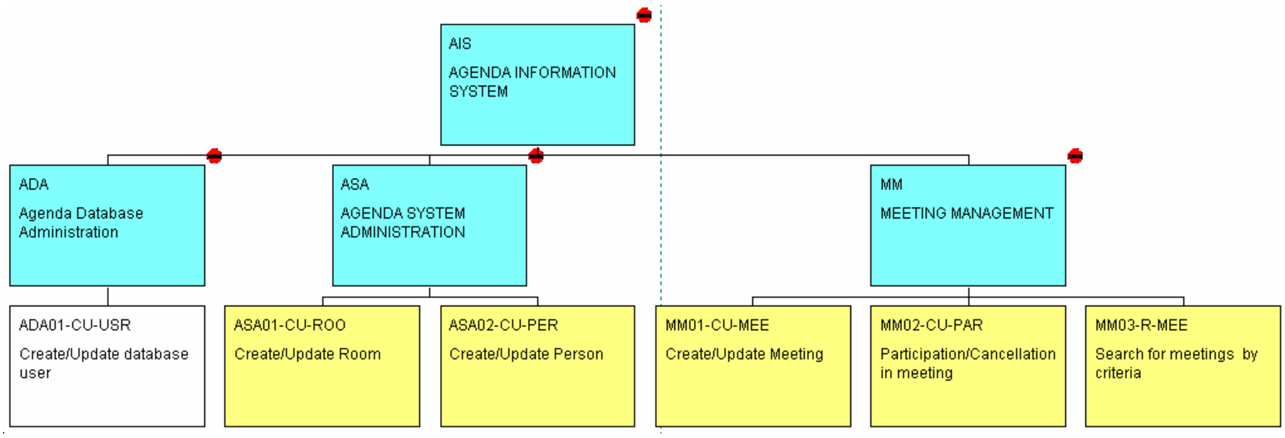


Figure 7 – Function hierarchy

Little attempt should be made at this point to identify functions that will map to application modules. The requirements capture is quite rarely structured, so it is not possible to map the functions and entities obtained throughout this phase. Very often the function hierarchy and the E/R model are used as elements of work and discussion with the users to validate and approve requirements.

3.3.2. Detailed analysis

<u>During the detailed analysis phase,</u> the function hierarchy is refined and completed: entities usages are defined for every function as well as attributes usages while cross-reference controls are performed between data and functions. Let us tell more about the important feature of the definition of usages : which entities (tables) are used by functions (modules) and how do functions (modules) use entities (tables) i.e. does the function (module) Create, Retrieve, Update, or Delete instances of the entity (table) ? The CRUD matrix is a two-dimensional chart that summarizes usages between functions (modules) and entities (tables). Defining usages is a part of security policy, because it defines data access control inside application modules.

As an example, the CRUD matrix for the Create/Update Meeting is given below

Entity	Create	Retrieve	Update	Delete
MEETING	☑	☑	☑	☑
ROOM	☐	☑	☐	☐

Figure 8 - Entity usages

Attribute	Insert	Retrieve	Update	Nullify
BEGINNING HOUR	☑	☑	☑	☐
CANCELLATION	☑	☑	☑	☑
DATE	☑	☑	☑	☐
END HOUR	☑	☑	☑	☐
KIND	☑	☑	☑	☐
SUBJECT	☑	☑	☑	☐

Figure 9 - Meeting attribute usages

Attribute	Insert	Retrieve	Update	Nullify
BUILDING	☐	☑	☐	☐
CAPACITY	☐	☑	☐	☐
ROOM NUMBER	☐	☑	☐	☐

Figure 10 - Room attribute usages

3.4. Design

3.4.1. Model transformation

At the beginning of the design phase, functions are mapped to the application modules and the E/R model is mapped to a relational model. A module is structured into modules components, which can be *in fine* translated either into Oracle 4GL constructs (Forms block), either into a package of Java classes, or a set of Web pages. In the Pre-Design phase, the various design standards, including GUI standards, coding standards, and design naming conventions are determined along with the ways in which Designer will support these standards.

3.4.2. Server Model Diagram

Server Model diagrams present a picture of various physical structures in the Oracle database (e.g., tables, views). The data design model for the agenda is given below.

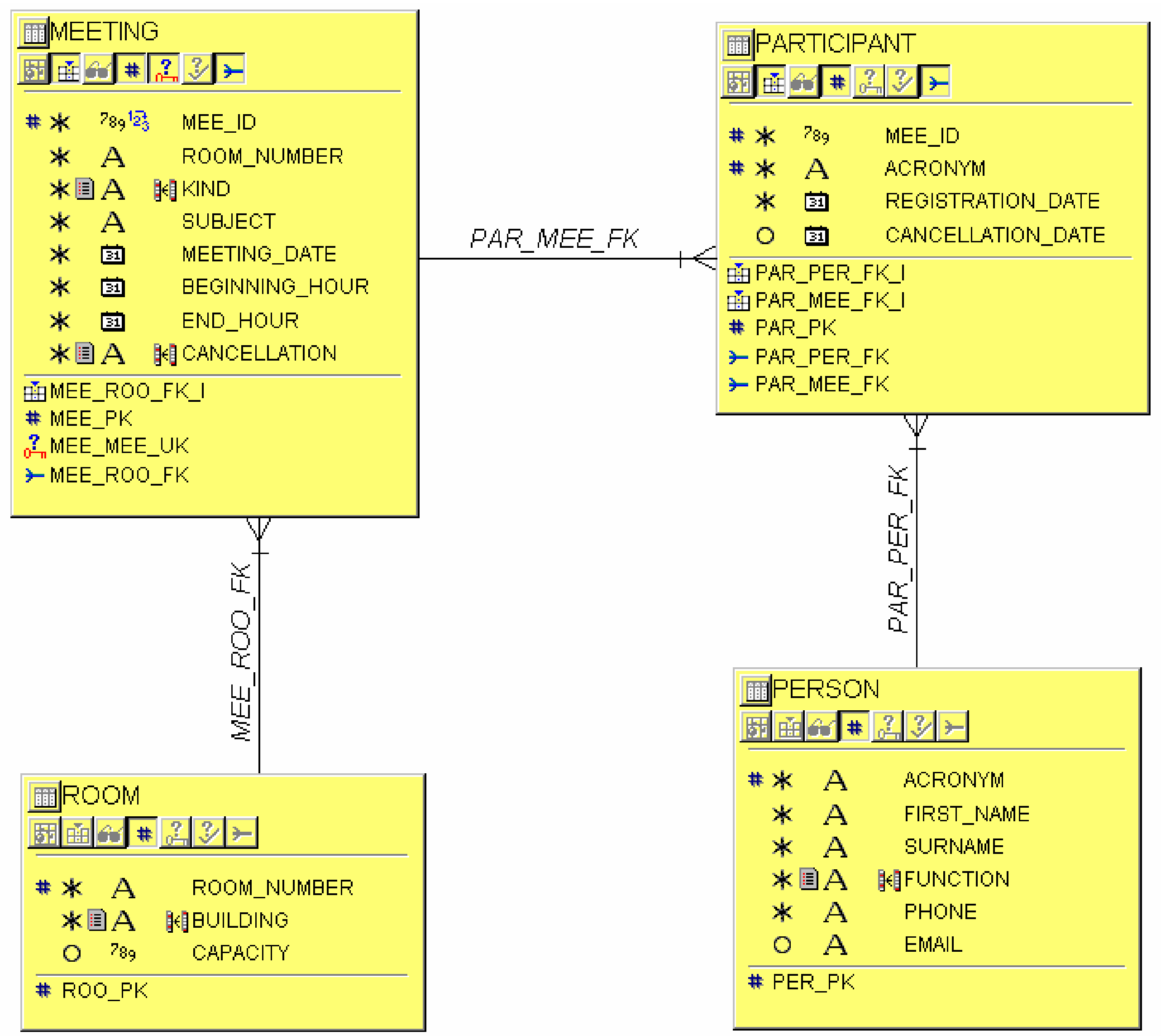


Figure 11 - Data design model for the agenda

3.4.3. Application modules

For each atomic function we obtain an application module.

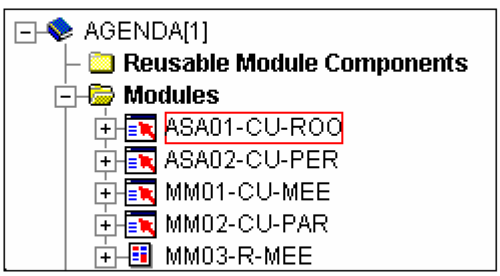


Figure 12 – Overview of application modules

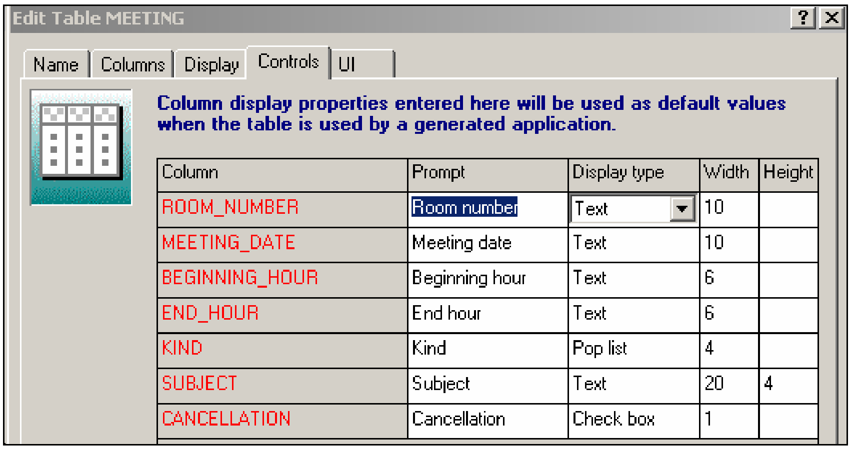
There is a traceability link between design modules and analysis functions.

3.4.4. Model refining

During the design phase, theses modules and database objects are refined and completed: tables usages as well as columns usages are defined for each module while cross-reference controls are still performed. The Design phase includes two broad sub phases:

- physical design of the database (there are already a complete ERD from the Analysis phase and a conceptual design of the applications from the Pre-Design phase);
- physical design of applications : to specify in detail how the application will interface with every field of the database.

As an example, the column display properties of the MEETING table are given below.


Edit Table MEETING

Name | Columns | Display | Controls | UI

Column display properties entered here will be used as default values when the table is used by a generated application.

Column	Prompt	Display type	Width	Height
ROOM_NUMBER	Room number	Text	10	
MEETING_DATE	Meeting date	Text	10	
BEGINNING_HOUR	Beginning hour	Text	6	
END_HOUR	End hour	Text	6	
KIND	Kind	Pop list	4	
SUBJECT	Subject	Text	20	4
CANCELLATION	Cancellation	Check box	1	

Figure 13 - Column display properties of the MEETING table

Security and access control are designed during this phase.

3.5. Coding and unit testing

The build phase involves two areas: the database and applications.

Database building is a straightforward SQL generation operation, including physically configuration and building a quantity of test data and/or data migration.

Application (module) building is a generative process, except for the design and implementation of stored procedures (in this particular case, Designer facilitates modules editing, code generation and ensures the consistency of the repository). Module generation is an iterative process: it generates the modules and assesses how different they are from the desired modules. Completing the internal control system can take different approaches: making change to the design and regenerating the module; otherwise editing code modifications and performing reverse engineering where possible.

3.5.1. Data View Model

A data view model allows to represent the behaviour of a module in terms of use and interaction on the data design model.

Each module has its own data view model, like below for the "Create/Update Meeting" module.

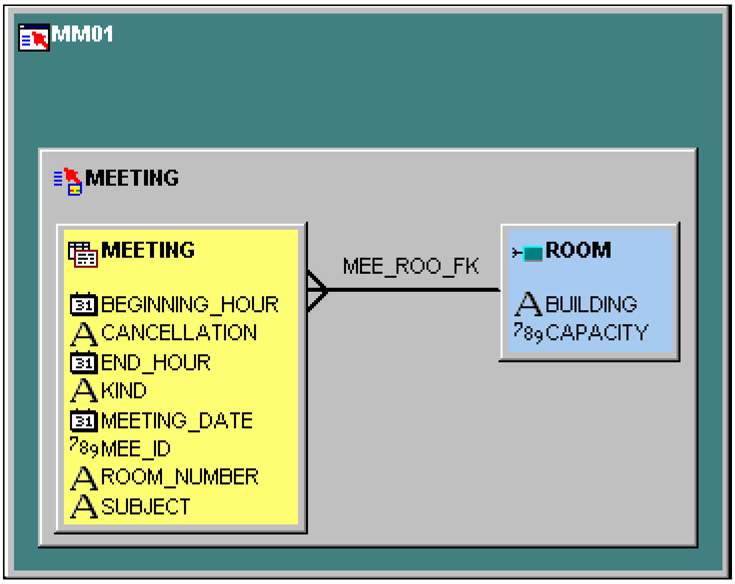


Figure 14 - Data view model of a module

3.5.2. Display View Model

A display view model allows to represent the behaviour of the abstract graphical user interface of the module in terms of presentation and navigation.

As an example, the display view for the "Create/Update Meeting" module is given below.

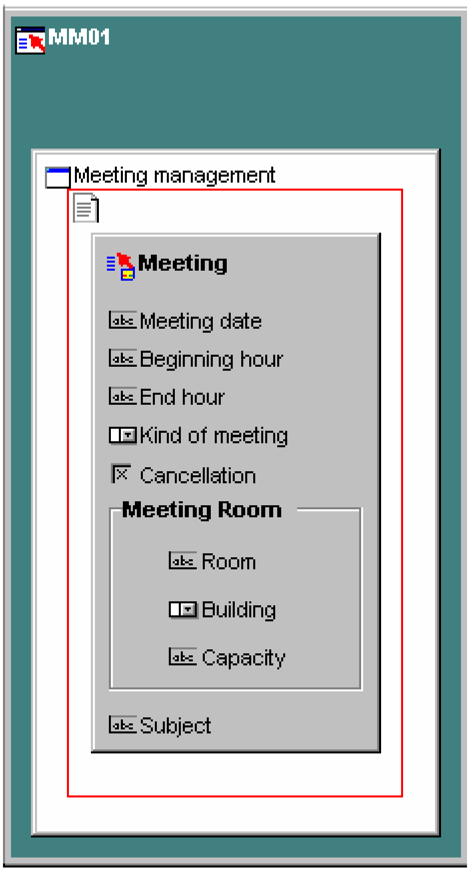


Figure 15 - Display view for the "Create/Update Meeting" module

3.6. Integration and integration testing

The application and the database cannot be tested completely separately. Both components must be tested and tuned together. The unit testing procedure should proceed as follows : to generate the application; to develop the application using dummy test data sets; to work with the application until satisfied; to test applications and reports using a database populated with a sample of realistic data; to run the application using a production-sized test database that will ensure adequate performance. The next step is performance tuning, which will not be discussed in this paper.

3.7. Software testing

Some of the activities and control executed during earlier phases contribute significantly to the success of the software testing phase, especially a formal acceptance of the testing process with the users (through a validation plan); the mapping of requirements to functions and modules; column level usages carefully peer-reviewed. One of the most important features of CADM is that as moving into the software testing phase, there is a complete audit trail that allows to follow logically a system requirement (gathered in the Analysis phase) all the way through the completed system.

Theoretically, all that is left in the final test phase is system-level performance tests and user acceptance testing for the application. However, many phases are subject to changes and will require change control, but the discussion is out of the scope of this paper.

4. Conclusion

Model-driven approaches to systems development move the focus from programming language (3GL or 4GL) to models. The key challenge of model-driven development lies in transforming higher-level models to so-called platform-specific models[5] that can be used to generate code.

For the model-driven vision to become reality, tools must be able to support the automation of model transformation. Many tools are now mature: this article has presented two approaches using model transformation and code generation.

We believe that some further questions need to be issued.

The complexity of a system description can only be described from different viewpoints, hence through the use of multiple models. Models can also be decomposed into other models. Thus, models are used either in a horizontal manner (different system aspects) or in a vertical manner (from higher to lower levels of abstraction) [8]. This 2-dimensional space squares problems and tools complexity.

The two major approaches of system development are transformation and elaboration. The transformation makes an explicit distinction between abstraction levels (for example, between conceptual and logical level [7]) and advocates a transformation process between levels. The elaboration approach is based on a unique level and advocates a process by successive refinements [6]. UML/UP moves progressively from elaboration to transformation (through the MDA), while CADM/Designer relies on a transformation paradigm through an elaboration process. There is a kind of confusion of genders that may be detrimental to learning and mastering any approach.

[5] In the MDA terminology sense

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Digital Business Ecosystems for SMEs

KNOWLEDGE SHARING IN DIGITAL ECOSYSTEMS FOR SMALL AND MEDIUM ENTERPRISES

Anton Lavrin [1], Miroslav Zelko [2]

The knowledge-based networked business ecosystem represents geographical (or virtual) area where specific policy initiatives foster growth and improve innovation, productivity and social aspects through the optimal use local assets empowered by information and communication systems (ICT). Effective human interaction with ICT within such a digital ecosystem depends on the access methods, suitability and form of content and knowledge sharing. A network of digital ecosystems, as public common resource, offers to SMEs and to less developed areas opportunities of participation in the global economy.

1. Introduction

The support of knowledge sharing, of the establishment of worldwide value chains and of business networking promotes global co-operation and alternative ways of developing software applications and conducting business. [1,2]

Generally, it is known that a natural life ecosystem is defined as a biological community of interacting organisms plus their physical environment. In the same way, a business ecosystem is "the network of buyers, suppliers and makers of related products or services" plus the socio-economic environment, including the institutional and regulatory framework.

The digital ecosystem approach transposes the concept to the digital world, exploiting the mechanisms of natural ecosystems. A digital ecosystem is an "evolutionary self-organising system aimed at creating a software environment for networked organisations" that supports the development of open and adaptive technologies and evolutionary business models (see fig. 1).

The digital ecosystem aims to become the ICT-enabling technology for the business ecosystem. The knowledge-based networked business ecosystem represents a community, which, in orders to

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exploit the synergies of the systemic sharing of community's resources, should cooperate and share the following aspects:

- **Services**: sharing vision, decisions and solutions that are able to share the real-time infrastructure: Secure Broadband Wireless, Low-Power-Consumption Mobile/Display Devices, and transition to SOA – Service Oriented Architecture.
- **The business**: aggregating the offer, procurement, customer management, etc…
- **The knowledge**: shared knowledge facilities to support a virtual learning community with training and competence center, knowledge base, e-learning modules, benchmarking, etc…

2. Digital ecosystem developing models

From an initial analysis several models seems the most suitable for the implementation to be used for different layers of the ecosystem:

- for the real-time infrastructure: an **open source model** adopting multiple business models;
- for the specialised digital ecosystem: encouraging the maximum coexistence and diversity of models and licences, supporting as much as possible the equal opportunities of "**service/solution publishing**" and fair competition;
- for the local instances of the ecosystem: the models are decided by the local community on the basis of the local conditions.
- P2P network model (autonomous nods)

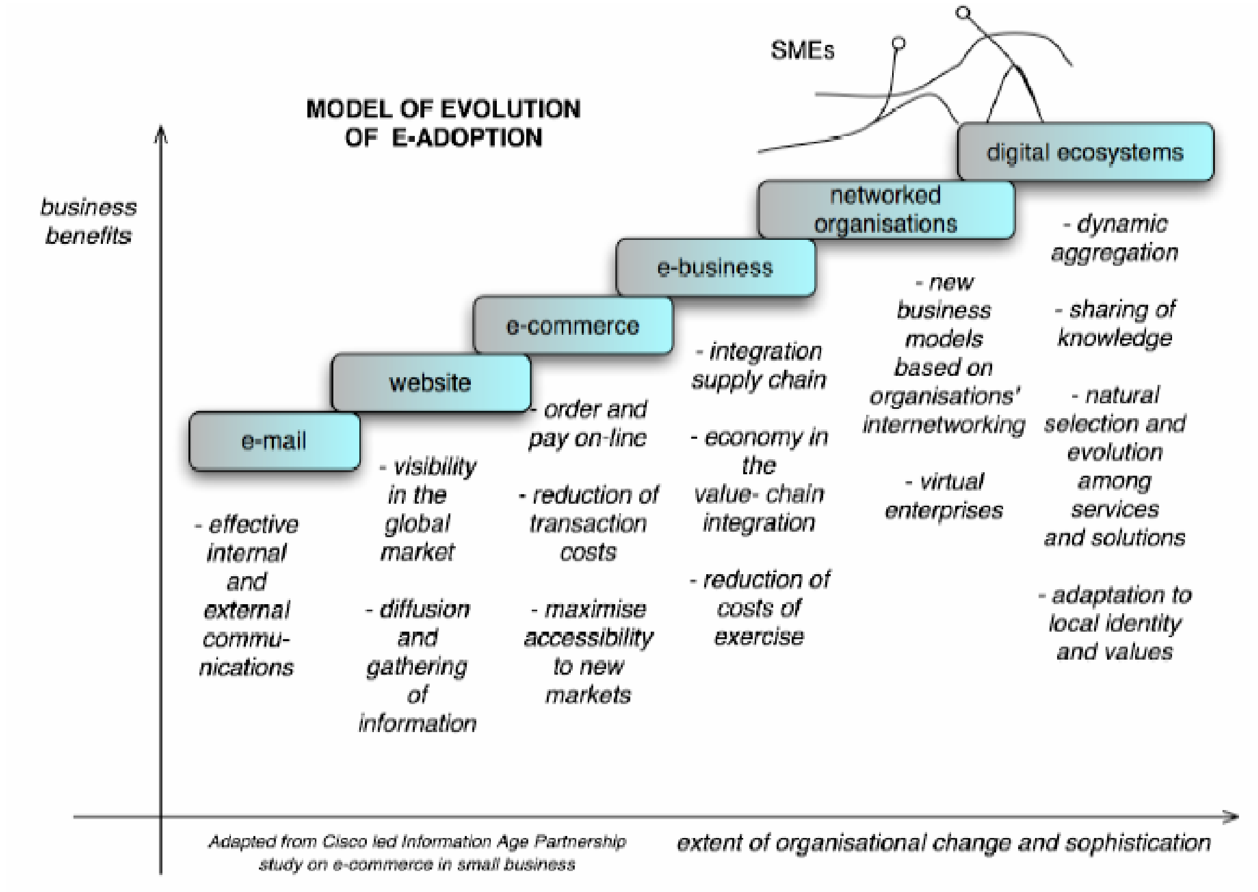

Figure 1 - Evolution of ICT adoption [1]

The basic principles, which inspire the common infrastructure, are linked to the basic guarantee, such as:

- Equal opportunities of access to the infrastructure, affordability for small organisations
- Self-sustainability
- Independence from a specific provider, technology, license
- Critical mass of services and of users
- Maximising the number of digital forms populating the ecosystem, maximizing their evolution

To ensure the open access, and the largest adhesion to digital ecosystem, it is indispensable that the protocols and the data format are open and not depending from a unique provider, to guarantee the independence from ICT platforms, the highest interoperability and the possibility to reuse the pre-existing information and services [1, 2]

2.1. Open source basic real-time infrastructure

To guarantee, that the ecosystems attracts a critical mass of developers of services and therefore of users, it is critical to guarantee evolution and continuity of services in time within an open infrastructure. **The basic real-time infrastructure represents an ecosystem, which connects the applications and the services of the community, it should provide the equal opportunities of business and visibility to all participants, and therefore its mechanisms should be transparent and could be inspected.** The basic infrastructure could not be tied to a single provider or a unique technology; it is necessary that the usability and maintenance of the infrastructure does not depend on the goodwill of the suppliers. For these reason the ecosystem needs a basic infrastructure the development of **which can be guaranteed due to the availability of the source code (open source).**

The digital infrastructure of the common ecosystem environment is composed by the infrastructure of P2P network and by architectural modules, but also provides some basic e--services (e.g. electronic payment, interoperability modules, etc), which could be used as component for developing solutions for different business sectors. These basic e-services provided by the ecosystem, could exist in different versions, with different level of complexity and sophistication, following different license models and costs.

2.2. Models for sector-specific ecosystems

The user could select the more adequate service or component (open source or proprietary), could substitute it as soon a more adequate one appears on the ecosystem, or adapt it to its needs. The broad use and the diffusion of a network of local digital ecosystems:

- provides the digital support for the economical development of SMEs
- fosters the private entrepreneurship on the sector of production of software components and services.

Any player could produce components or solutions, not being forced to adapt a specific business or license mode -- it will be the market to operate a selection provoking a continuous evolution.

2.3. National and local implementation

In order to support the evolution of use of ICT and entrepreneurship, European Member States have deployed a wide range of ambitious policies and instruments and have launched many different actions and initiatives aiming at fostering:

- support networks supported by national or regional authorities,
- common commitment from industrial and sectorial associations,
- cooperation among local SMEs, public bodies, local and regional authorities and institutions,
- consensus on standards and technical interoperability, sharing of solutions and of technical systems

To reach the goals defined by the Council of Lisbon, considering to information / knowledge society development, it is crucial to define and implement in each region a specific strategy of innovation and local development, focused on the identity and the strong points of the local area, in synergy with an common European global strategy, keeping in consideration the global environment. **The success of the implementation depends at local level from the consensus and the active participation of the local players:**

- universities, research organizations, innovation centres;
- enterprises (in particular SMEs and enterprise organizations);
- government and of public administration

The regions (or local areas) which succeed in the application of digital sectorial ecosystems, will be the ones where the above players:

- are fully committed
- work together forming a community
- a critical mass of enterprises/communities (including the small organizations) use the ecosystem as business tool.

The local business digital ecosystem will be an effective instrument for business when will be reached the critical mass in terms of:

- coverage of the territory (with potential to create critical mass for SM businesses)
- number of applications and relevant services present
- diffusion and availability of the infrastructure.

2.4. Stimulus for small and local ICT software and service providers

The digital ecosystems stimulates the innovation and the competition, providing to the small providers equal opportunities to offer their services and products, stimulating the local technological knowledge and development. A new component, although produced by a small producer in remote areas, is visible on the ecosystem and, thanks to the seamless interoperability, could replace a component in a solution. Competitiveness and innovation is then increased, generating a supply of software with better conditions of usability, in a model of continuous improvement. [1]

The set-up of digital ecosystems, therefore offers the possibility to SMEs operating in the ICT field to propose their solution to a critical mass of users. Today the jobs generated by ICT industry in most European regions, mainly concern technical tasks of little aggregate value; at the local level, the technicians who provide support for proprietary software produced by multinational companies do not have the knowledge and the possibility of high-level development.

3. ICT for Digital Ecosystems

Some technologies will be the most transformational in their impact in the five-to-ten year time frame to gain the goals of digital ecosystems. The individual chapter 4 is devoted to one of the most attractive technology for digital ecosystem – Enterprise Content Management (ECM). In this section, let us focus on five another, but as important as the first one [1]:

a) Secure Broadband Wireless

Nowadays is one direction clear: networks go wireless broadband! There are three gating factors to widespread deployment of wireless/broadband for mission-critical applications:

- End-to-end security,
- Standardized endpoints – PCs and personal digital assistants (PDAs)
- Wide coverage areas that are robust

b) Low-Power-Consumption Mobile/Display Devices

The mobile and wireless area continue to be a strong source of innovation, including two technologies at the peak: Wi-Media – an ultra-wideband technology that operates at very low power levels, and Worldwide Interoperability for Microwave Access – an emerging high-speed wireless standard.

c) Real-Time Infrastructure

If an ICT infrastructure is a collection of client devices, servers, storage, networks, databases and middleware supporting the delivery of business applications and ICT-enabled business processes, then a Real-Time Infrastructure is an ICT infrastructure shared across customers, business units or applications where business policies and service-level agreements drive dynamic and automatic optimization of the ICT infrastructure, thus reducing costs while increasing agility and quality of service.

d) Service-Oriented Architecture

One feature characterizes these next-generation applications – it is a service-oriented architecture (SOA) – enterprises require an end-to-end view and integration across processes. These fusion principles are used like provision (build or acquire) applications software and business services. User and vendor communities must integrate these principles into three aspects of their technical environment: **architecture, infrastructure and application software.**

e) Collaborative commerce (c-commerce)

Web services provide a path to Collaborative Commerce. In that case, c-commerce is an expansive model for business applications:

- It is driven by e-business demands and opportunities, and is enabling by Internet and service-oriented technologies.
- C-commerce is the most advanced support for e-business because it achieves dynamic collaboration among and between an enterprise’s employees, business partners and customers.
- In c-commerce, digital ecosystems harness the full power of the Internet by extending business relationships beyond rigid value chains, simple information sharing and unified communications.

- C-commerce includes intercommunity Internet connections and goes a step further by enabling multiple ecosystems to work interactively, often by dynamically restructuring their relationships in near real time.
- C-commerce will be enabled by Web services – functional units of application software made available through the Internet for use by other software systems.

4. Content Management for Ecosystems

The vision of Enterprise Content Management (ECM) from its initial sense is fitting very good to exploit the synergies of the community resources systemic sharing in a digital ecosystem. Users across the community will be able to create, retrieve, manage, and archive all of their content, including electronic and paper documents, email, and computer reports throughout their business and knowledge processes. We could simply perceive E in ECM, instead of Enterprise, as Ecosystem. Then “Enterprise/Ecosystem” content management (E/ECM) will include the needs of an entire business ecosystem rather than just the business processes of a single organization. E/ECM will support the records retention policies of the community so that regulatory systems, audit and compliance requirements are satisfied for both physical and electronic documents. Additionally, document content will be repurposed for presentation via local ecosystem portals and websites.

Today’s “classic” ECM infrastructure technologies **evolved from the primary ECM application categories towards integration**. Let’s summarize the main milestones. [3]

1. <u>Document Management</u> (DM) - include both imaging and electronic document management. The rapid evolution of client-server and Web presentation technologies prevented DM solutions from achieving the platform stability that enterprise resource planning (ERP) applications achieved. The concepts of DM were appealing, but the tools were inflexible and the ECM infrastructure technologies didn’t readily scale to the needs of the enterprise. There is a large number of departmental DM solutions that have been implemented, but very few systems that support the document management requirements of thousands of users.

2. Web Content Management (WCM) - because the initial websites had relatively small numbers of static pages, the WCM tools were more focused on the presentation than the management of content. As a result, these tools had only limited integration with the existing DM or records management (RM) repositories.
3. Records management policies and procedures were standardized long time ago. In the generation of paper-based processes, RM was a very successful function. Many organizations evolved to manage records tracking and retrieval, records retention and disposition, and the user interface with file rooms and offsite storage. However, since the advent of electronic documents, RM has been dysfunctional.
4. Email has not always been considered an ECM technology, but it is clearly a content type that needs to be managed. Today there are clear consequences for not managing email with the same urgency that is applied to RM for paper and electronic documents. There are clear advantages to managing email using the same infrastructure technologies that are used for the other ECM categories.
5. Information lifecycle management (ILM) is a recent development in enterprise storage management. ILM takes advantage of the dramatic improvements in the price/performance of magnetic storage to enable organizations and networked communities to manage all of their structured and unstructured information based on business policies.

Each of the ECM application categories has been gaining momentum, especially at a workgroup or departmental level. But without integration, each of the ECM categories is unable to fulfill its true enterprise/community potential. Enterprise content management includes an entire ecosystem needs. At the community level, each of these elements takes on additional complexity, as the focus becomes all users, processes, applications, and documents in local ecosystem. The benefits of a community-wide approach to E/ECM are clear. Some of these benefits include:

- searching multiple repositories of documents
- sharing and re-using documents across community
- controlling documents on an community-wide basis
- establishing consistent document types and an community-wide taxonomy
- rationalizing and enforcing processes and policies

The new generation of E/ECM products provides a basis for the community - level integration of DM, RM, WCM, and email repositories. This integration allows people to search across repositories, present integrated information from multiple repositories in response to user queries, and personalize these responses based on the relationship of the requestor to the community. **Collaboration, knowledge management, and workflow management applications are able to be established based on these E/ECM products it is becoming a strategic business requirement**. The whole of E/ECM is greater than the sum of the individual ECM application categories. But, there are important E/ECM challenges that remain to be solved. **While the trend towards E/ECM is clear, each investment needs to be justified, and especially in local ecosystems area.**

5. The knowledge-based management

5.1. The dividing line between information and knowledge

It is the distinction between information and knowledge that makes the difference. The distinction is real, substantive, and widely accepted. What we will want is to **turn that information into knowledge**. So what are the characteristics of knowledge in the business community? The subject of "knowledge" has been treated frequently mostly in analyses of the role of intellectual assets and knowledge in business organizations.

Let us focus on the characteristics of knowledge in business ecosystem, especially with regard to how they may influence the application of ECM technology. There are two kinds of knowledge: **tacit and explicit.** Some authors emphasize the difference between **explicit knowledge**, which can be articulated in formal language and transmitted among individuals, and **tacit knowledge**, personal knowledge embedded in individual experience and involving such intangible factors as personal belief, perspective, and values. [4] They stress, that **the interaction between these two forms of knowledge is the key dynamics of knowledge creation in the business administration.**

Tacit knowledge must be recorded - made formal, in order to become an organizational or community resource and not just individual proficiency. What is internal must be articulated and made explicit.

Knowledge is typically complex, often associated with "why" and "how", not just "what" (simply “know – how”). It is not a list of facts or compilation of data. It is not a description of products or services. **It is based on an understanding of what the knowledge-seeker needs to or**

wants to know. It is constructed for effective and efficient communication within digital ecosystem. As such, recorded knowledge is not always associated with specific job roles and work processes. It addresses tasks that may be performed by many people in the community.

In the business environment in particular, knowledge is sufficient. It may have many information components, but is held together by knowledge of consequences and an awareness of completeness. Especially in networked community environment we consider knowledge as a dynamic human process of justifying personal belief toward the truth.

Explicit knowledge may take two forms: recorded knowledge and knowledge in action. Technical communication experts (knowledge management professionals) are concerned with both. For example, trainers are more concerned with knowledge in action, because they interact with knowledge-seekers, help them develop mastery, observe the achievement of that mastery, and serve as competent observers. Technical writers are typically more concerned with recorded knowledge.

5.2. Characteristics/effects of a knowledge interchange

What happens in a knowledge interchange within a digital ecosystem - in the transfer of knowledge from a subject matter expert or recorded knowledge resource to the knowledge-seeker? The traditional model of acquiring knowledge includes:

- **practice or usage** (action itself) - and thereby confirmation of the correctness of the knowledge and competence of the performance
- **a process of dialog**

Knowledge solves a problem so, it produces competence leading to effective action. Building a store of information is not the desired result in most cases, although identifying the relative importance of information often is. Pointers to additional information resources are also often an important part of the interchange. The interchange results in confidence in the truth of the knowledge transferred.

5.3. Managing knowledge in dynamic, interactive environment of digital ecosystems

Do ICT for digital ecosystems change the characteristics of explicit, recorded knowledge in particular? Most of the discussion about knowledge appears to be conducted without consideration for the impact of the all-pervasive networked ICT environment on the development, management, and transfer of knowledge itself. Similarly, much of the academic discussion about computers and knowledge seems to be conducted with little consideration for the imperatives of the business environment. The inter-personal contacts as a method of conveying knowledge are not going away either**.** But it seems certain that the shift to ICT as a way of delivering information and knowledge resources within digital ecosystems has already changed the way, in which we create, record, supplies, and use knowledge resources. **We are moving to interactive relationship between knowledge-holder and knowledge-seeker** [5].

In some ways, we are moving back to a so-called pre-print model of transferring explicit knowledge model that is not dependent on publications or documents. This is happening in part because of a need (the complexity and pace of change of our work environments) and in part because of a compensating opportunity (people and information are increasingly available on line.) and this movement is good for knowledge-seekers.

Print-based literacy fostered a publishing model. ICT doesn't. ICT breaks the publishing model - just in time for the just-in-time business organization.

6. Conclusion

So, when delivering solution or services to digital business ecosystems of a communities and sharing information with partner organizations, communities, and within local ecosystems, the following and common set of issues often arises. These includes:

- **Information Supply Chain** – clustering and networking of SMEs, which involve delivery ERP,CRM and SCM solutions as well.
- **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.
- **C-Commerce environment** – effecting collaborative content/knowledge creation and management on such a services-oriented deliveries (SOA).
- **Knowledge management** - increasing the effectiveness of SMEs valuable business asset – information knowledge

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7.1. Internet Sources

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8. Appendix Short case studies [1], [2]

Essential **business information and knowledge resources**, supported by ICT, so far are 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. Like it had been discussed in previous IDIMT conferences [1,2], mentioned issues were stimulus for creation and rising of demands for an external access to validated **Integrated Business Information, Advisory and Development Services (IBIFADS)** – For providing IBIFADS it is needed some kind of "VIRTUAL AREA" accessible at appropriate costs for all applicants.

IBIFADS is generally some 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 (Business Development Services) and contributes to rational decision making for entrepreneurial and development gains. To create adequate IBIFADS - area, 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 (and stakeholders of IBIFADS as well (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, 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.
- **Business Process Outsourcing** (BPO) to delegate an ICT-intensive business process to an external provider, who owns, administers 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)

The significance for IBIFADS - virtual area creation is in the design and establishment of state-of-the-art ICT based virtual environment in the way, that it would be able to achieve adequate features and objectives of IBIFADSs. It involve as well as development of relevant technological tools for database and knowledge base management, information processing and interactive communication in a complex promotional venture. **Aforesaid involved approaches are fully consistent with ideas and principles of the digital business ecosystem mission and the adequate ICT provision**.

The most important element is a continuous communication between the bases and the market place and the stakeholders as well. They are always influenced by each other and this interactions are very important while providing adequate advisory services to SMEs. But to be able to provide such services, it is important to have a connection to adequate knowledge, which is mostly missed by the managers of SMEs. **The information and knowledge management are open to content management that is somewhere in the background while thinking about providing relevant services to SMEs. At conclusion it is possibility to say that the concept of the IBIFADS-area is potential experimental playground for the "Digital Business Ecosystem" ideas application.**

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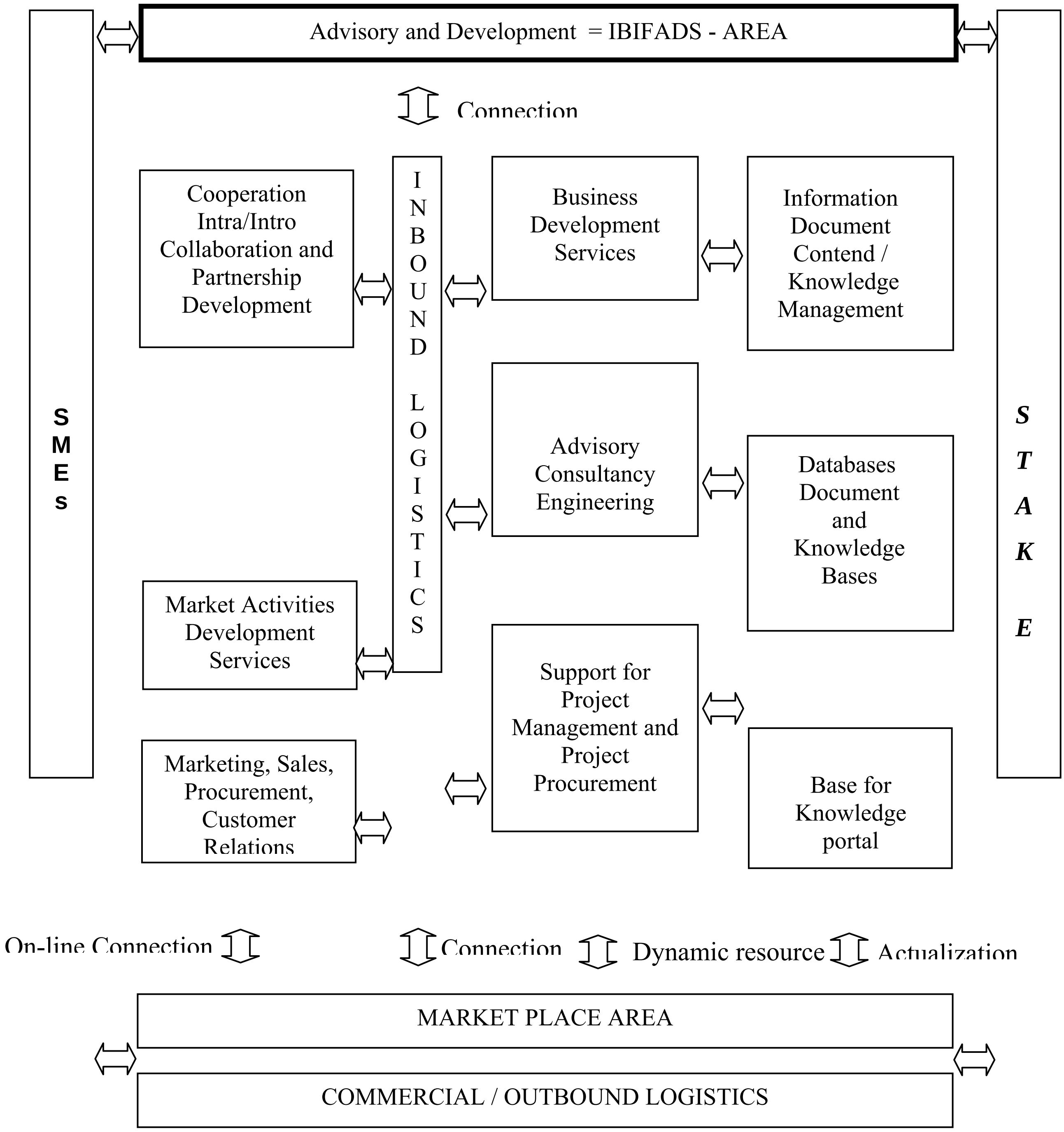

Figure 2 System Structure for IBIFADS

VIRTUAL ORGANIZATION ECOLOGY: INFORMATION MANAGEMENT AND DIGITAL BUSINESS TECHNOLOGY ASPECTS

Jan Klas [1]

Virtual organizations are becoming natural partner in our daily (not only business) lives. The vast numbers of virtual organizations or organizations with virtual features form very complex patterns of interactions, which afford us to speak about virtual organization ecology. This contribution deals with several interesting issues of the virtual organization ecology area, like the role of information and communication technology and the relationship with digital business technology. Most of this contribution is related to micro, small and medium enterprises (with concentration on micro a small enterprises), however it may applicable also to large enterprises (or their organizational units respectively).

1. Introduction and concepts

This contribution deals with virtual organization in relation with e-business systems, both in SMEs area. It discuss different views on virtual organizing – the "top-down" approach from the point of view of information management and the "botton-up" approach represented by the role of technology in digital business ecosystem infrastructure, presented in the session's keynote paper of Lavrin and Zelko.

With growing globalization, more and more organizations are adopting virtual organization features and concepts of virtual organizing are becoming of common use in daily life of organizations and in various forms of coopetion[2], ranging from ad-hoc alliances, over clusters to strategic alliances. Digital business ecosystems could be also seen as specific part of broad virtual organizing concept.

Information management approach is based on transdisciplinary unity of disciplines like management, system approaches, informatics and many others. It concentrates on organization and

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[2] Coopetion – cooperation and competition at the same time, with the same partners/competitors

role of information in organization, based on paradigm, that information need is set by managerial needs and informatics is to support this information need. Thus the driving forces in the organization are the managerial issues, not the informatics and not the technology. The two last mentioned are under this paradigm just means to reach targets set by the management component.

2. Virtual organizations and virtual organizations ecosystems

There are various understandings (theoretical concepts) of virtual organizations. In this contribution, with virtual organization is meant broad range of virtual organizational concepts, from organizations heavily using IS/ICT, via organizations employing techniques of virtual teams to organizations relying on one-time ad-hoc collaborations (both with their suppliers, customers or competitors). The key point is flexibility (especially structural) and intensive work with information.

Virtual organization defined as in paragraph above covers large number of contemporary organizations. These organizations form complex patterns of interactions, which allow us to speak about virtual organization ecology. This ecology evolves now in very fast and expanding manner, mostly not intentionally managed, just self-organizing.

Resulting from nature of virtual organization, many of such relationships are quickly former and quickly disbanded, some of them prevail. But the long-term prevalence is not goal of this concept. The goal of this concept is long-term sustainability and development via mutual interaction, often with fast created and fast abandoned relationships. And it is the system approach, who offers, that high variety (in my opinion presented in this approach) brings potential for the new qualities. More thoughts on this could be found the Application section of this contribution.

3. The role of IS/ICT

The information and communication technology in virtual organization ecosystems plays very important role. Virtual organization existed in deep past, but the spread of the virtual organizing concept is associated with developments in information and communication technology.

The IS/ICT role can be understood (in my opinion) in several perspectives:

- IS/ICT as supporter in single organization
- IS/ICT as connector among organizations
- IS/ICT as integrator of organizations

The first approach, *IS/ICT as supporter* (in single organization) is based on single self-sufficient organization paradigm and concentrates on role of IS/ICT in single organization ignoring the benefits of employing the ICT in multi-organizational work distribution.

The second approach *IS/ICT as connector* among organization lies between the first and the third concept. In this concept, IS/ICT is being used as tool to facilitate collaboration, IS/ICT is still bounded by organization, but special "connection points" have been set up and enable organizations to interchange data and information. Organizations are still not fully using the potential benefits of IS/ICT.

The third approach, *IS/ICT as integrator* of organization predicates IS/ICT with much greater influence. The IS/ICT is being the business driving force, multiple organizations are being concentrated along single complex IS/ICT (such as value chains or logistical chains). In another words, there are multiple business entities using the "same" complex IS/ICT systems. The subject of theoretical discussion can be, if these distinct business entities together with the complex IS/ICT form one organization or not.

This also brings to attention another issue – the relationship among complex IS/ICT systems and the business entities employing these systems. Who is the driving force? Are organizations employing the complex IS/ICT in order to achieve their targets or is the IS/ICT enforcing the birth, evolution and death of the connected organizations? If the second one is closer to the reality, what is the driving force behind the complex IS/ICT systems? Or is IS/ICT another "self-governed" component in complex patterns of interactions in the business ecosphere?

When speaking about complex IS/ICT systems, one has usually in mind the set of computers, software and "lines". But together with advancements in agent theories, concepts like autonomous agents and holons (let's understand holons as unity of technology and logic (hardware and software)) are becoming reality. In my opinion, in the near future, autonomous holonic agents can be part of our every day lives. In the beginnings their intelligence could be very limited, proceeding predefined sets of rules and interactions, but the complexity will growing, mostly in two basic ways:

- increasing the complexity of single agents (more complicated logic, wider sets of predefined interactions, educating) and
- increasing the complexity of agents interactions (sophisticated patterns of interactions, adaptability and learning) among high number of different types of agents can bring the emergence of new agent qualities.

4. Competencies in virtual organization ecology

Knowledge competence (further only competence) can be understood as ability of know organization to apply the knowledge, to put knowledge into action. This point is very important, because of the nature of virtual organizations, organizations must be able to react quickly.

My former research has identified for basic groups (described later) of knowledge competencies in virtual organizations. This division into groups serves only as mental model, or the position or approach, the view depends on observer positions and intentions. The basis for this grouping was to identify substantial groups of competencies for organization in order to be successful in long term in area of virtual organizations.

There four identified basic groups of knowledge competencies of virtual organization or organization in virtual environment are:

- Vision competencies
- Production competencies
- Cooperation competencies
- Intelligence competencies

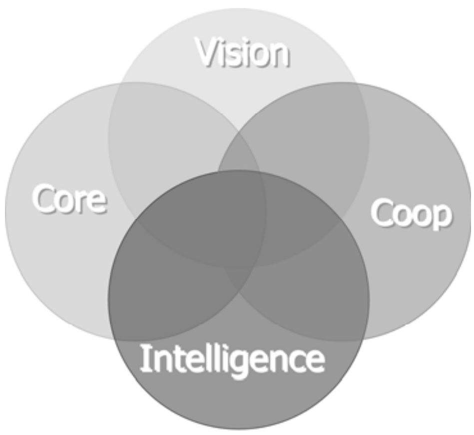

Figure 1 - Competence model of VO

Competencies from area of vision deal with setting vision of organization, organizational values and form the basic approach, which organization undertakes in its strategy and daily life. Other issue of these competencies is to set area of excellence or specialization of organization – effectiveness. Production competencies concentrate on production part of organization – doing the right things right – efficiency. Cooperation competencies are significant for organization in networks. Main areas of these competencies are managing relationships with external and internal subject (customers, suppliers, and partners in networks, cross-organizational teams, intra-organizational units, team leading, employees and contractual workers). Intelligence competencies deals with issues like organizational learning, knowledge transfer, orientation in environment and adaptability. Theses four basic groups of competencies provide managerial framework both for management of single organization in network and network as whole.

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 of organizations, like other organizations or customers)
- internal (with partners inside organizations, like employees)
- both internal and external (like cross-organizational teams, working groups, task forces, …)

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. Competencies conclusion

Competencies provide useful way, how to look at organization competing in dynamic environments. However the way described above is just only one of the many possible ways.

Even competencies depicted above are model abstraction made on purpose. In reality competencies are often so intertwinned and interconnected that it is sometimes really difficult to say into which category it belongs.

5. Conclusions

To conclude, for future trends in development in virtual organizing concepts and in ecology of virtual organization (applicable also to digital ecosystems), questions related to IS/ICT role and infrastructure, agent implementations and holonic system applications are essential. Future will show the answers, but basic alternatives can be described today.

The IS/ICT aspects and competencies aspects are closely related, especially in area of virtual organizations. Actually in background it is more about role of knowledge and information both in reality (society) and in virtual organization ecology.

Virtual organization is broader concept than digital ecosystems, and for successful longterm application it requires further development. When comparing virtual organizations ecology and digital ecosystems, for practical applications the digital ecosystems concept, especially if presented as in [9], has one advantage – it is tangible, more technology oriented.

Contemporary applications of virtual organizations, even successful ones exist, but we are still learning the nature and outcomes of virtual organization. Further search in this area is needed.

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The Impact of
Information and Communication Technology on
Society’s Paradigms

THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY ON SOCIETY'S PARADIGMS

Gerhard Chroust [1]

The Information and Communication Technology (ICT) has changed our private and public life and also the structure of our society with a speed and profoundness unthinkable even 50 years ago. Within the technological sector we observe a strong positive feedback between several technological innovations (e.g. faster computer hardware allows to run more sophisticated software which is used to design even faster computer hardware).

Much more important seems to be the strong positive feedback between the technological capability of computers (in all their forms) and human activities in business and society. In these areas the introductions of computers has not only accelerated existing processes, it has caused numerous paradigm changes with respect to these areas (e-business, e-learning, knowledge management etc.), leading up to the often cited information society or knowledge society.

In this paper we will first discuss some technological innovations, the changed approaches they implied, and the resulting impacts. Based on these results we will discuss several paradigmatic changes for individuals, business, society, and technology, some of which have a strong feedback on new technological approaches.

1. Introduction

1.1. Technology as a Business and Social Driver

Information and Communication Technology (ICT) has changed the private and public life and the whole society structure with a speed and profoundness unthinkable even 70 years ago. The first computers [5] invented during and right after World War II (Zuse Z1, ENIAC, ...) provided a new

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tool which initially was mostly appreciated for its ability to relentlessly perform iterative clericals tasks like accounting and ledger.

Computers were bought for their ability to replace human work because of their higher speed, better memory and untiring ability to perform routine jobs (cf. section 3.1.). But we can notice that a quantitative change also resulted in qualitative changes. Initially only the immediate improvements were seen, which nevertheless caused far reaching consequences, by completely changing relations and communication between individuals (person-to-person communication, business-to-business transactions etc.).

The progress of Information and Communications Technologies is the result of a synergy of many individual innovations. A typical example is: Faster hardware allows larger programs to be executed in reasonable time. This allows to run more complex programs for designing a computer chip (the basis of the hardware) which makes these chip even more powerful and faster. At the same time these faster hardware allowed business programs to be executed (e.g. modelling of complex global problems) which provided the need (and the funds!) to perform the relevant research into hardware development.

1.2. Impacts

History is full of examples where a technological innovation has caused often tremendous sociological changes of paradigms (agriculture, book printing, invention of the automobile, etc.). As examples we investigate three areas where current technological innovations have major impact. We realize that there are many other areas which should be analysed (medical applications, e-government, artistic endeavours, society as a whole, etc.):

- business
- the individual
- knowledge, education and research

For each innovation we compare the old and the new approach and indicate some impacts of this change. These effects go far beyond a simple speed-up or cost-reductions. They establish new paradigms in these domains by often completely reversing effort/effect-relations and as a consequence having dramatic impacts on our society (Fig. 5).

We consider a paradigm as ”a constellation of concepts, values, perceptions and practices shared by a community, which forms a particular vision of reality that is the basis of the way a community organizes itself" [4]. Similarly we find in [17], cited by [27]: *"the complete constellation of beliefs, values, techniques, etc., shared by the members of a scientific community"*. Morgan [20] adds "[a paradigm] denotes an implicit or explicit view of the reality" and "it contains [a discipline's] core assumptions that characterize and define [its] world view"

These new paradigms very often have a mutual feed-forward effect on related innovations and even paradigms. It is often not even discernible which paradigm is the driver of which: a typical chicken-egg cycle.

The rest of the paper presents in chapter 2 important technological changes in computer hardware/software and the resulting approaches. Chapter 3 discusses technology's impact on Business, while chapter 4 describes how technology has changes the individual's life. In chapter 5 the dramatic changed on Knowledge Management, Education and Research are discussed, which to a large extent are due to the internet. Chapter 6 describes some of the recursive effects of technology on neighbouring technologies, or what - due to the convergence of technologies - are becoming neighbouring technologies. The summary (chapter 7) puts the discussed aspects in relation to our whole society.

2. Technological Innovations and their Impacts

2.1. Stored Program

The key to the universal applicability of computers was the paradigm of the *stored program*. The same hardware could be provided with different software to behave as a completely different machine. Initially the instructions for the computer (the 'program') to perform some steps were built into a (hardware) control system (like in the first computer, UNIVAC). Soon one realized that the computer could read ("load") these instructions from an internal or external medium, causing the computer to behave as a *different machine* for each stored program.

New Approach - **Stored Program:**

The control of the program can be changed, allowing the computer to behave differently for each application.

Old Approach - **Hard-wired control:**

The function the computer can perform is defined by its circuits; modifications and replacements are difficult.

Impact: The same hardware can be used for largely different applications actually for any computation which can be programmed (see also section 2.3.).

2.2. Compilers and Higher-Level Languages

The next major technological step was the realisation that software could produce other software (Fig.1). A compiler (i.e. a program) can translate a problem description written in a problem-oriented, human-oriented language (e.g. FORTRAN, PASCAL, JAVA, ..) into the type of language understood by the actual hardware [12] [18] [25]. During this translation other administrative tasks (like assigning variables to storage places etc.) were also taken over by the machine. This allowed higher productivity for the programmers and allowed the creation of more and more complex programs.

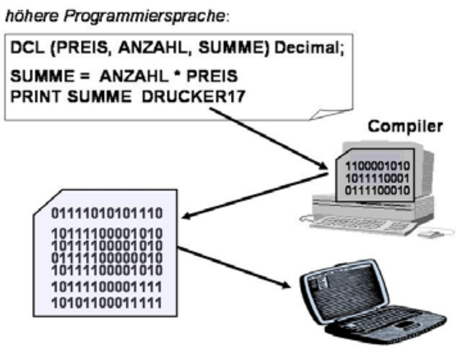

Figure 1 - Compiler

New Approach - **Unstratisfied Control**:

Computer instructions, i.e. descriptions of action, can be treated as data, transformed by other pro- grams and then used again as instructions [11].

Old Approach - **Fixed strata of semantics:**

Data and instructions are strictly separated and treated differently.

Impact: Development of software becomes the responsibility of domain experts (e.g. bankers) for which the software is written and not any more the responsibility of hardware experts (engineers). The key to successful software is the understanding of the business processes and their conversion into programs in a problem oriented language.

This trend has continued to transform our world: Operating a computer today does not require hardware knowledge and computer science but knowledge of the application domain [19]. Every secretary can use the computer to write letters in WORD, to compute even complicated computations via EXCEL, and to prepare presentations via POWERPOINT. In the early days of automobiles a driver also had to be a semi-professional mechanic.

2.3. Firmware

Around 1960 a dramatically new concept appeared for the architecture of computers: Microprogramming [2] [6] [7] [16]. Microprogramming (also called 'firmware') was established as an intermediate level between the software used to write applications and the interface of the real hardware. It established the so-called machine architecture ("the software interface") on which all software basically runs [2]. This layer customized the hardware, with all its idiosyncrasies across different technologies to a given machine architecture, which could be made uniform, despite of the different underlaying hardware (Fig. 2). On this interface the user software is now running.

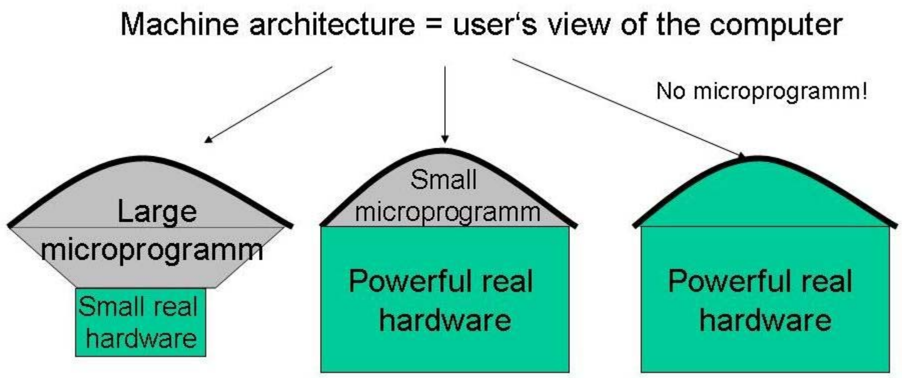

Figure 2 - The concept of microprograms

New Approach - **Soft customization of the software interface:**

Software architectures can be designed independently of the requirements of the hardware [2].

Old Approach - **Hardware-defined interface:**

The hardware structure defines the software interface. This interface in turn defines the structure and syntax of the programming languages.

Impact: Software architectures can be designed to optimally fit the application domain and can be adapted over time to changing requirements.

2.4. Middleware

When running programs on a computer numerous administrative steps are necessary: starting the new job, initial loading of the higher level program into appropriate free storage, starting the compiler, al- locating space to the translated program and its data, and finally starting the translated program. Soon these administrative tasks were handed over to the computer itself: the first operating system [28] [26] was born. As next steps allocating/de-allocating of machine resources (storage, printers, ...) and many additional tasks were delegated to this new hierarchical level between the user's program and the soft- ware interface: communicating with the computer, administration of libraries, provision of software objects, e.g. CORBA [24], as shown in Fig. 3. Eventually all these functions under summarized with the term 'Middleware' [21] providing a service oriented architecture.

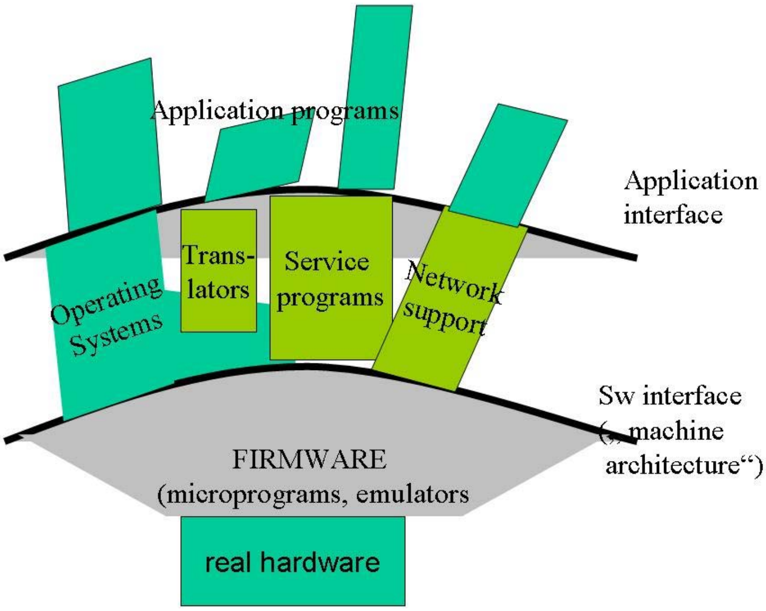

Figure 3 - The layers of a computer system

Here, too, a paradigmatic change took place. Initially the operating system was a comparatively small portion of the software on a computer, taking care of necessary housekeeping functions like transition between computer jobs, allocating and de-allocating the necessary memory space, ensuring proper access to the peripheral units (especially if more than one program was running in parallel), fulfilling the common service needs for many software programs. Now complex tasks are delegated to this intermediate level. Microsoft's WINDOWS Operating System is a classic example of a powerful Middleware layer.

New Approach - **Middleware / Service Layer**:

Large portions of tasks are 'pushed down' into the service level, called 'Middleware'. These tasks are executed on behalf of all computer programs run on that machine.

Old Approach - **Monolithic self-contained executable programs**:

An executable program contains all services which it will (probably) need during its execution.

Impact: Commonalisation of services relieves programmers from providing these services. It reduces the size and the complexity of the application programs. Being used by many routines these services could be build with increased quality, efficiency and usability at less cost.

2.5. The PC, the Personal Computer

Cheaper and smaller hardware brought about the idea to build small machines for the 'personal' use of an individual person. This trend continues at a breath-taking speed with considerable consequences to the computer industry, business, and society at large.

New Approach - **Personal Computer**:

The individual has full control of (and full responsibility for) the computer power at his/her hands. This includes all the operator and maintenance functions. It allows personal adaptations and customizing, freedom of use (and abuse), mobility, home-working, use for entertainment, private interests, etc.

Old Approach **- Large centrally maintained and administered computer centres**:

An efficient, but overhead prone execution of all applications, by necessity in one central location and restricted by the rules of the owning company.

Impact: Liberalization and freedom from centralized agencies, self-responsibility, new user oriented interfaces, use for personal pleasure like games, edutainment, private work, hobbies etc.

2.6. Distributed Computing

Combining computers with telecommunication technology allows computers to be used for local purposes, for using distant computers, and connecting many computers together - solve 'oversized problems', like using GRID-computing.

New Approach - **Distributed Computer Power:**
Communication and cooperation over vast distances, allows solving of 'oversized problems', allows to use slack time in other time zones and even can bind 'stand alone PCs' into a cooperative work like GRID-computing.

Old Approach - **Centralized Computers service:**

Centralizing computer power in large centres with centralized control. It was only accessed via external terminals with little own computing ability.

Impact: Loss of central control but providing additional functionality at the price of reduced reliability and vulnerability due to external connections (e.g. Spamming, viruses, worms etc.

2.7. E-mail

E-mail became the probably most successful networking application. It combines a standard, well-known functionality (letter mail) with an amazing set of additional useful functions.

New Approach - **E-mail**:
It provides low cost, instant connections, fast electronic transmission of data, recordability and auditability of information, and what might be the biggest advantage: the transmitted data are ready for further processing without any intermediate transformation (convergence of transmission technology and processing technology.
Old Approach - **Conventional mail**:

Such mail usually takes longer to create, longer to deliver and is more costly. Due to these factors the number of recipients is usually strongly limited.

Impact: E-mail is delivered faster, allows seamless integration into the next processing steps, but is also the cause of deteriorating writing style, of unreasonable distribution of copies and of SPAM.

2.8. World Wide Web

The World Wide Web is a consequence of Internet and the possibility to access arbitrary nodes all over the world and exchange information with them. The possibility for everybody to post at negligible costs arbitrary pieces of information in the public domain has gained an unexpected acceptability from both readers and writers, and unfortunately also from spammers.

New Approach - **World Wide Web**:

Information is provided and accessed world wide wide practically instantaneously, at almost zero cost using effective link and search mechanisms.

Old Approach - **Classical publication means**:

Information has to be laboriously created and remains bound to physical locations and either the reader or the information has to be transported.

Impact: New ways of data and knowledge dissemination are opened, providing interesting new methods of recherche and cooperation, and offers more flexible means of publication.

2.9. Software Components

The raising cost of conventional software development together with low quality make reuse a necessary new approach. The overhead resulting from calling these components via a standardized interface and the overhead resulting from unneeded additional functionality in a components are easily compensated by the greater speed of the hardware. Technological advances allow the cooperation of individual pieces of software, of packing business know-how into individual components and make them available to a broader user community [1] [3].

New Approach - **Reusable Components:**

COTS, Software Components, and Product Lines provide large units of functionality to be used by third parties with little restrictions on composability.

Old Approach - **Bespoke software:**

This software is individually produced, 'hand crafted' and usually not directly reusable.

Impact: The multiple use of such components together with a global market induces reduced cost, higher quality, and service orientation. The requirements definition process changes considerably in order to accommodate available components. It also forces standardization and uniformity for non- core-business applications. Software becomes a commodity.

2.10. Digitalization, Convergence

The possibility to convert text, pictures, movie, sound into the same digital representations has several far reaching consequences. In contrast to analog data one can restore digital data to their original values without any loss. They can be transported more easily over large distances, stored uniformly and processed by the same software means. Digitalization is even the source for new types of artistic expressions, as one can admire at the Ars Electronica Festival in Linz every September.

New Approach - **Uniform digitalization/Convergence:**

All information is represented in the same form and can be manipulated by the same means.

Old Approach - **Analog representations:**

Different representations for different forms of information require different tools for acquisition, representation and reproduction.

Impact: Data can be more easily and uniformly transported, common tools can be used on them, the original quality can be preserved, new ways of information creation and representation, including new forms of art and entertainment, can be found.

3. Impacts on Business

The creativity and ingenuity of the software engineers, very soon provided applications which went far beyond the improvement of existing business processes and ventured in areas which previously were the sole domain of the human brain: this type of applications was collectively addressed by the notion of *Artificial Intelligence*.

3.1. Software as a Business Driver

Initially the computer was a faster, cheaper, more reliable substitution for human work ("colleague computer"), the processes and activities themselves were not changed. Gradually, however, the applications themselves changed and as a consequence the business world changed. Business models which a few years earlier were unthinkable, could now be realized in reasonable time and with reasonable cost, e.g. the electronic bookstore a la Amazon or the immense possibilities of data mining

(Fig. 4). The concept of just-in-time delivery, too, heavily relies on several innovations of information technology. This again was a major incentive to invest in the improvement of computer hardware and software.

New Approach - **Software defines innovative business:**

Complicated decisions and aggregations become possible, including almost instant world wide searches and data mining, enabling completely new business models.

Old Approach - **Software supports classical business models:**

Software is used to improve classical business models with respect to cost and speed.

Impact: Business men have to understand and creatively use the new possibilities of software. Once defined, the supporting software must be produced fast with high quality.

3.2. Process View in Software and Business

Basically software is the execution of programs which can be seen as a description of the process a computer hardware is supposed to perform. This view carried over to business [23]. Business, too, is more and more seen as consisting of processes, each of them crossing several departments of a company (cf. the concept of business process reengineering [15]). Analysis concentrates on 'end-to-end' processing, taking a holistic view of business processes.

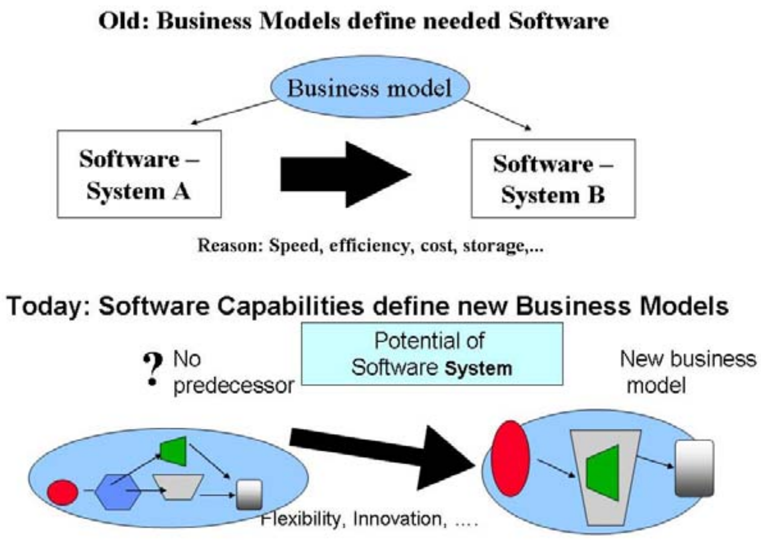

Figure 4 - Old and new relationship between business and software

> *New Approach* - **Process view**:
>
> Business consists of number of processes across many departments and functional units. The focus of interest is the optimal performance of the end-to-end process, not the suboptimisation in one department.
>
> *Old Approach* - **Departmental organisation**:
>
> Each department has its functions to perform, business is performed by interfacing these departments.
>
> ---
>
> **Impact:** A holistic, process-oriented view of business appears, department boundaries become irrelevant.

3.3. Ergonomic User Interfaces

Initially the input and output functionality of computers was very poor with respect to human needs and ergonomics. Both the need to interface with persons who were no computer specialists and did not have any interest to acquire this know-how. The availability of cheap computing power made it necessary and possible to modify and re-create user interfaces in a way, which correspond to the needs and expectations of the average human.

> *New Approach* - **Ergonomic User Interfaces:**
>
> User interfaces are adjusted and modelled after the needs of the (different classes of) users, special new input/output devices are offered.
>
> *Old Approach* - **Frugal, parsimonious interfaces:**
>
> Users have to learn both the way computers expect input and output and have to live with cryptic, abbreviated pieces of information.
>
> ---
>
> **Impact:** Nowadays interfaces attract, even lure, users into using them, making the use of computers ever more attractive. Special user-interfaces and input/output devices cater for different needs, including disabilities, but also for pure ’fun’ devices, often referred to as ’edutainment’.

3.4. User-centric View

The more every day people get into contact with computers, the more user-oriented applications, especially user-oriented interfaces, become a need and a unique selling point at the same time.

> *New Approach* - **User-centric view:**
> The usability and user friendliness is the key to market success. This is one of the prime marketing concerns.
> *Old Approach* - **Computation-oriented view:**
> Programs were designed to run efficiently and to effect the necessary transformation of data. Special user concerns were not considered.
>
> ---
>
> Impact: The requirements are largely dictated by the market. Once the user requirements are re- ally understood, implementation is usually not the problem, given today’s performance and cost of hardware. Converting user requirements into appropriate software is still a problem.

3.5. E-business, Web-Services

Internet provides a growing market place for all kinds of goods. Goods which can be sent via internet (information, electronic books, music, graphics etc.) gain a considerable advantage and special importance. Even it is finally necessary for the end-user to revert to the standard representation, e.g. to print an electronic books at his/her own cost. Due to its growing number of users, Internet also increasingly becomes a prime platform for advertising, be it passive by attractive portals, be it actively by sending messages to potential users and becoming in its worst form SPAM-mail. Another growth area are web services, where software services are sold/rented via the Internet. Completely new types of business (cf. Amazon) were created, new forms of services like e-payment are growing fast.

New Approach - **E-business**:

A global, just-in-time market has been opened, providing everything which can electronically be provided to customers; the sellers are located world wide, competition and user information made a quantitative jump.

Old Approach - **Classic markets**:

Many products had to be acquired in shops or painfully sent by parcel mail. Shopping was (except for some mailing shops) a rather local business with difficulties to compare offers.

Impact: A completely new way of doing business has been opened. The market is global, just-in-time and offers good comparability.

4. Impacts on the individual

Both the Internet and the PC provide to the individual users the possibility to utilize individual support functions which go far beyond simple mechanical service devices for manual processes. The human individual is supported in his/her mental processes. These services provide functionality not envisioned even 20 years ago. They have a tremendous impact on the lifestyle of everybody, on learning methods [8] , on communication patterns, interpersonal relationships, etc.

4.1. Personalization of Services

The available computing power provided in miniature gadgets ('wearable computing') allows also to support humans in way, never possible before. In the workplace such support systems have been discussed and implemented under the general term of 'EPSS' ('Electronic Performance Support Systems') and shown to be an effective way to enhance personal performance [10].

New Approach - **Personal Software Assistants:**

The miniaturization together with low prices allow to supply users with many intelligent products which relieve them from work and at the same time allow instant, interactive information access.

Old Approach - **Paperbound Personal Assistants**:

Many paperbound Personal Assistant systems were offered in the past. Their success was limited, both due to size and weight, but also due to the inflexibility and limitations of paper-based systems.

Impact: Personal Digital Assistants will take over many previously human tasks, anywhere, anytime. The organisations of one's personal life will change dramatically.

4.2. Electronic markets

Internet provides access to globally offered goods, primarily those which can be sent in electronic form. But sales of physical good (cf. Amazon using parcel mail for books) also profit from the new business methods, since all administrative tasks can be performed with electronic speed, reliability, traceability and auditability. Spamming is just an unfair, reckless way of trying to be effective in the electronic markets.

New Approach - **Global Electronic Market:**

Users can access sellers everywhere and often anytime. This provides greater transparency of the market, but also high levels of risk with respect to honesty of the offers. Shopping is disassociated from physical movement, the market is global.

Old Approach - **Classical market:**

The market has to be in reachable distance and thus local. The provider are, in many instances, personally known.

Impact: Completely new and innovative products, especially digitized products are offered. Sales efforts are supported by intelligent applications and electronic agents for searching, etc.

4.3. Always Connected

Wireless communication together with the provision of small really 'handy' mobile phones and minute receptors allow all humans to be connected all the time to the 'world' and thus to whoever wants to communicate with them. this also holds for the accessibility of data bases etc. This has far-reaching consequences which are hardly understood yet. A survey has shown that the expected answering time on a e-mail is four hours. With world wide wireless mobile communication, instantaneous response is probably expected. One consequence is that many decision cannot be delayed and 'slept over' so easily. It also changes the ways (and the etiquette) how we see privacy.

New Approach - **Always connected**:

Communication both private and business will be anytime, anywhere.

Old Approach - **Defined points of location and time**:

Bi-directional Communication was bound to selected, fixed points (stationary telephone units) or had to be performed asynchronically (fax and letter).

Impact: A complete new approach to communication will arise, also requiring new ways of behaviour and etiquette.

5. Impacts on Knowledge, Education and Research

The instant availability of information, facts, and the low cost of publishing one's opinion (e-publishing) causes tremendous changes in how humans will create, access, filter, evaluate, and use information. These means that education and research will on the one hand reap in tremendous profits from the global availability and on the other hand must come up with new methods and tools to teach, to utilize and to critically evaluate and filter these new offers [8] [9].

New Approach - **Electronic support of Knowledge Dissemination, Education & Research**:

Information both about facts and new results, will be available almost instantly and globally - but - at least at the moment - with little guarantee of quality. The role of teachers will change dramatically.

Old Approach - **Classical Knowledge Dissemination, Education and Research**:

New information is only available with a certain time delay, often only in a limited scope and at considerable cost.

Impact: A long learning phase with respect to education and research will be needed. Both the way what and how we teach and learn has to undergo considerable changes. Research will become even more global and more competitive with reduced interaction time [8] [9].

NEW PARADIGM (**Teaching and Learning**):

Less emphasis will be put on memorizing facts and data, both will be fetched on-line, just-in-time from appropriate sources. Main emphasis will be put on problem solving, effective ways to find and analyse data, perform critical evaluations of data, enjoy the flexibility of access, and accept life long learning.

NEW PARADIGM (**Research**):

Research will be globalised, both with respect to cooperation and competition. Innovation Cycles will be strongly reduced.

6. Reciprocal Impacts on Technology

The discussed innovations in ICT (section 2.) depend to a large extent one another and provide reciprocal support and incentive. These technologies also have impacts on all domains of society, initially in a push mode. In many cases, especially in the case of the IC-technology there is positive feedback in form of a pull-drive for better, more and new technology. A few examples are:

- Without a firmware layer a meaningful Middleware layer would not be possible, because the software architecture would reflect the idiosyncrasies of the hardware.
- Without the PC (and its smaller follows like PDA and powerful mobile phones) digitalization of music would not had the impact it got.
- E-Commerce needs not only the internet but also digitalization in order to be able to have a seamless process from offering digital goods (text, music, movies) to ordering, delivery and payment.
- E-commerce, often being based on high volume transactions, in turn triggers the development of automatic ordering and payment systems.
- The possibilities of internet open the gate to new business ideas. Both the speed of the market and the need to use an often small window of opportunity need fast production of the necessary (software) systems. One of the solutions are prefabricated software components which are offered on a global (internet) market [14] [13].

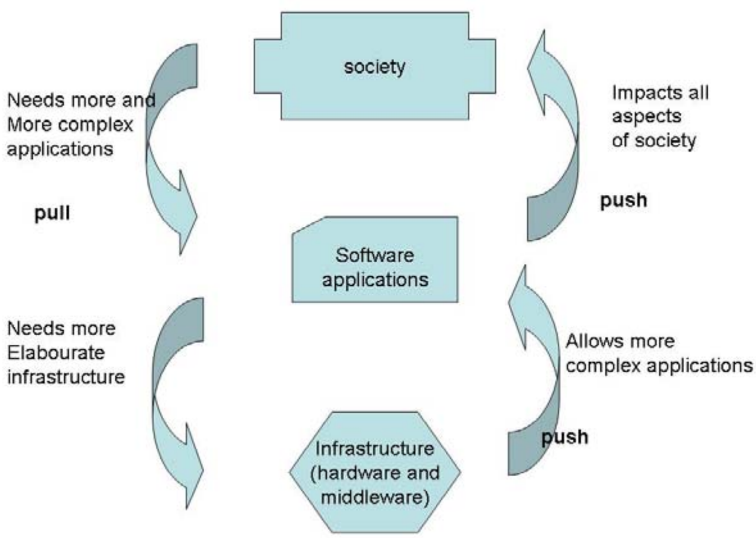

Figure 5 - Pull/Push phenomena in current ICT system development

The interaction between these various domains of our life is indicated in Fig. 6. Changes in the technology oriented part of the structure cause paradigm changes even in the society oriented part of the cycle. It indicates how the push via improved infrastructure enables more interesting applications which have an impact on some aspects of society, e.g business. This in turn generated the need for even better (faster, larger, ...) software which can only be run on even faster hardware to reach the necessary level of performance. This in turn is a trigger for hardware specialists to build even faster computers etc.

> NEW PARADIGM (**push-pull effect of technology**):
>
> Modern technologies have strong interactions with one another and with many domains of the human society. After initially pushing technology into a human domain, the perceived advantages and new need create more demand for even more advanced technology. After a short delay with respect to technology adoption, these domains will create a pull-situation for more technology to even better fulfil the promises made by technology.

7. Summary - Impacts on Society

Due to its ubiquity, the information and communications technologies (ICT) not only affect all aspects of society, these paradigms impact one another strongly, often strengthening one another. Apparent impacts can be seen in business, in the human individual and in learning, education, and research. Other domains are also affected.

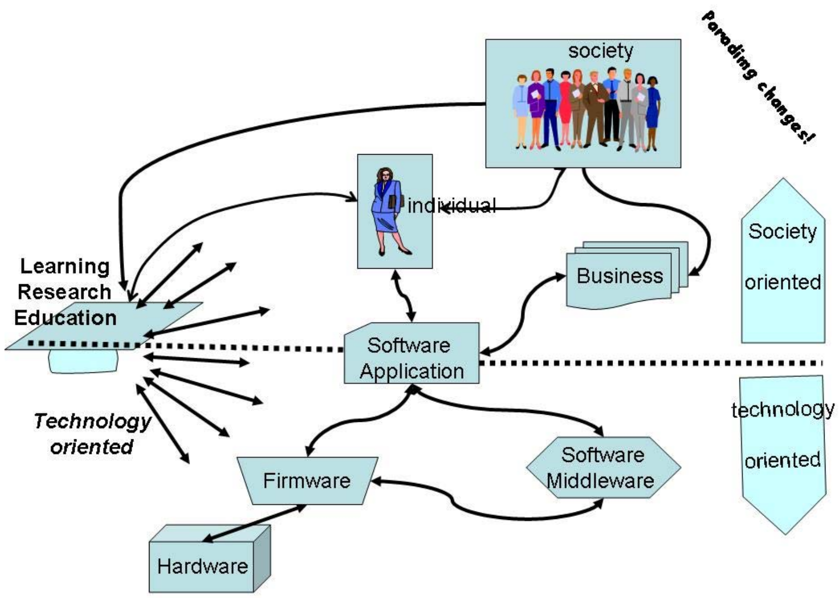

Fig. 6. Feedback loops between different impact domains of ICT

By necessity this will have profound changes on the society at large. We do not venture to provide a deep analysis, but would like to point out some observable facts:

- globalisation of production and business,
- dominance of technology [22],
- improved possibilities for communication in parallel to increased loneliness of individuals,
- a growing gap between the possibilities of the 'haves' versus the 'have-nots',
- a growing gap between those who know and those who are ignorant,
- a growing need for mental technical abilities with growing negative consequences for the incapable ones,
- a global offering of information and learning units up to virtual universities.

In summary ICT provides us with great hope, with phantastic chances, but at the same time induce, require or even force dramatic changes in our lives, be it private or business. Many of these changes will have profound effects on our society.

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ASSESSING ICT: A TRANSDISCIPLINARY VIEW

Hellmut Löckenhoff [1]

Communication constitutes the network of life, which means co-living. Language information opened the evolution to humankind, providing new modes to transfer information, knowledge and intent, Writing, complementing brain based memory and oral transfer by scripture and written document, enabled a new kind of evolution: history, paving the path to culture and complex societal systems. Equally fundamental ICT changed and changes with increasing dynamics the 'basic modes of perception' E.KANT), that is space and time. The shrinking of distance and of transfer time alter the communication base (N.Luhmann[23]) of societies, local and global. A growing information transfer and processing has become precondition as e.g. to act successfully. Increasing intensiveness of ICT and its and penetration into virtually all domains of societal life transform ever accelerating societal change into societal phase transitions. Concomitantly growing complexity has not yet given birth to a new simplicity of societal forms.

To meet these challenges, societal policy needs transparency, founded expectations concerning the future and knowledge how to guide change by innovation. Contributions from individual scientific disciplines only will not suffice. They need be integrated on a transdisciplinary scientific base. The paper focuses on challenges and possible answers, employing the multidimensionality of ICT as a key example.

Prologue: Guiding ICT Driven Transition

From the very beginning of ICT its impact on society has been critically observed. In particular its connection with societal transition has been studied from different aspects. With a growing fund of information and scientifically based knowledge as well as opinions and recommendations attached an integrated overview needs be reconsidered. Mere interdisciplinarity proves not sufficient. Typically a appropriately wide and shared base appears missing. It is caused by the specifity of the disciplinary models behind which prevent a full integration of individual disciplinary aspects. Concerning the societal sector during the last ten to fifteen years the development of

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transdisciplinary approaches has been vividly discussed. The growing influence of modern means of representation and communication on ever more sectors of societal life requests the application of transdisciplinary concepts predominantly to ICT sector. There are many open and hidden aspects: the well known impact from e.g. television and mobilphone on social communication (e.g. 'SM-ification' of individual communication) to the rise of ICT criminality and to the use and misuse of government intending to produce the easily to govern fully transparent subject. All aspects come as multiply networked and extend from limited domain-specific and 'local' effects to the general level of constitution and democracy. Addressed worldwide, globalisation seems neither possible nor understandable without the connecting technology, hard and soft and organisation, of ICT. The above list contains but a small part of as well urgent as important challenges pressing.

Three main fields of challenges and possible consequences for society can if but very roughly be distinguished. *First,* the contribution of ICT to everyday societal functions is scrutinised. Ubiquitous, for example, appears the influence of the Internet and mobilphone, both changing the ways of social communication. Other not so obvious phenomena are originating from the political sector; e.g. its recent share of the press in toppling corrupt cadres from communist times in Eastern Europe. *Second* and superficially more urgent, the direct *impact of ICT* development on *societal development* needs be explored in depth focusing on the process of fundamental societal transitions. Current research is centred on the attenuation of sudden changes, on the bridging of emerging gaps and on minimizing of however small revolutions. In reverse there may be also positive roles ICT can play alleviating processes of change, e.g. on the educational sector. *Third,* the necessity of a *long range prospect* is urgently felt. As well ICT policy in particular as social policy in general needs an however rough idea on probable future developments and future states of societies national, continental and worldwide. Such an outlook will provide a base for a strategy, wherefrom political measures can be targeted as tactical steps to an strategic goal. (Non-) wanted side effects have to be identified and assessed.

More specific research needs deal with the various disciplinary aspects e.g. from psychology, the behavioural sciences, sociology, technology and technology assessment. As virtually all projects related to societal development ICT tends to include a variety of disciplines affected. For an actual overview the preliminary ad hoc connection of disciplinary aspects may seem sufficient. For a long term preview of possible or even probable developments a transdisciplinary base appears a condition qua non.

1. Meeting ICT Challenges of Transdisciplinarity

Science can be seen as a means for orientation in the life environment and as to change it favourably for survival and development in a process of co-evolution. Gradually rational analysis of 'man's world' and 'man is his world' induced encompassing philosophy to be branched into a growing variety of disciplines focussing on particular aspects and employing specifically adapted methodologies. For scrutinizing analysis such specialisation is unavoidable. To solve multi-factorial practical problems the contributions of individual disciplines need be re-integrated under essentially pragmatic auspices. With mounting complexity of technological/societal structures and diminishing option and action space offered by environments the necessity of problem oriented focussing increases often dramatically. Aspectual solutions will not only produce non-wanted side and long term effects as e. the 'tragedy of the commons' made obvious. Likewise serious, they lead to inefficiency and ineffectiveness, to the waste of scarce resources. Instead of opening much needed new potentials for evolution they close developmental spaces. The closure is effected eventually not directly, but through negative societal reactions. As a typical case concerning ICT the controversial discourse may bee seen concerning the non-absorbed societal consequences of internet, tv, extended 'handy' technology etc.

It is from such practical experiences the active research on transdisciplinarity gained new momentum. The following reasoning seems typical not only for the particular issue ICT but for applied (and basic) science in general. The basic argument emphasizes the responsibility of science for the societal welfare; positively as to pay back investments of the society via contributions to a worthwhile life, negatively as to avoid unwanted side and long term effects. By critics science is reminded to provide appropriate support to meet challenges and problems as they may arise at any level and from any aspect of society. Science is expected to open creatively new potentials for development. At the moment, however, attempts often must turn out but to attenuate negative consequences of socially uncontrolled technology proliferation. For the unwanted consequences concerning societal bind the resurrection of an ICT empowered Leviathan presents an example as well as the rising criminality following the spreading of ICT. These distortions need be assessed transdisciplinarily. Also the quest for efficacy in technology assessment and environment restitution, globally and long term, constitutes a mayor driving force for transdisciplinarity.

Summarizing: Guided by pragmatism transdisciplinarity ties closely to *problem orientation* and to *participative modes* of problem solution. Relating to the scientific side all disciplinary aspects which might be of influence to a *sustainable* problem solution and its *feasibility* are to be consulted. Seen from problem solving as a societal activity all *owners* and all *stakeholders* of the problem are actively to be involved. By participation sustainability and feasibility need be reinforced towards *social robustness* of the solution. Issues and answers are *'contextualized'*. The knowledge employed and won in the act of the *dialogic* solution process needs be *'transferable'*. [It should be noted here that the topics pointing to 'transgressive' information and knowledge are worth to be discussed in depth elsewhere.] An even wider triangle of societal acceptance is claimed to connect Science, Market (meaning competition and synergetic co-operation) and Democracy.

The transferability of information/knowledge moves on to conceptual and methodical demands a transdisciplinary science has to meet (de Zeeuw [8]). Mere interdisciplinarity can scarcely be successful as long as a shared, that is a transdisciplinary base, is missing.

2. Towards a Methods Base of Transdiciplinarity

To meet the above pragmatic demands of society science needs a common and hence compatible methodological and methodical grounding; reminding of the old ideal of a *unity of science*. A first inroad opens when reconsidering the formal disciplines at the base of science. *Logics* and *Order Theory* e.g. prescribe basic structures, (formal) differences that make the difference, and set rules for the validity(ies) of a (scientific) statement. Recently the predominance of *syllogism* over formal logic (FREGE) has been claimed; research on pre-logic is in progress. Related to ICT, as an ad hoc working term, the author of this paper introduces *Representational Theory*. The theory encompasses language, in particular its emergence via Proto-language. Touched are Pre-Geometry and Symbol Research, leading over to Semantics and Semiotics. Shared Paradigms can be grounded here as shared Models and shared Semantics building a representational prerequisite of transdisciplinarity. To be emphasised: representation, pre-staging communication, lies also in the formal and in salient concrete aspects of the societal base of ICT. Moreover: understanding ourselves in our world (constructivism) rests upon a set of assumptions on the essence of the world: *Ontology*. Ontology is covered by 'the branch of metaphysics dealing with the nature of being' (Encyclopaedia Britannica, 2001). Well known from philosophy (N. Hartmann; M Heidegger) et alii) ontology depicts the basic characteristics of reality. The 'essence of the nature of being' in turn determines the mode the world is ordered by. Simplified: following individual human perception and evaluation on the one hand and a supposed 'real' structure e.g. indicated by the laws of physics on other hand ontological positions basically form identification, classification, taxonomies etc. Ontology also offers a common base for scientific paradigms, possibly in form of a basic scientific paradigmatic model. *Logic, representation and ontology* lay the foundation of transdisciplinarity. (New developments in the domain of e.g.non-linear mathematics cannot be dealt with here).

The emergence of Post-Renaissance science, replacing e.g. Pre–Renaissance alchemy and astrology as pre-forms of science, led to the physical paradigm, claiming rigorous physical rules valid for all sciences. It can be observed up to today as physicalism. With first attempts in the beginning of the previous century (v. Uexküll et alii) and gaining momentum about the 1950th (K.Lorenz et alii) basic models from biology and biology related sciences were gradually accepted as paradigms also for non-biological sciences in particular in the anthropologies. Qualification and extension were driven by a rapid development of biology related research as e.g. into evolution, but also by the anthropologies and the humanities up to psychology. At a closer look closely related to each other in parallel Systems, Evolution Complexity sciences and Non-linear Mathematics emerged. Together these attempts provide seminal approaches to the transdisciplinary paradigm.

The bloc of *System Sciences* (Systems, Cybernetics, Systemics, General Systems), *first*, fosters a holistic and in tendency comprehensive description of an object. Its formal rules permit well ordered and transparent taxonomies of systems, institutional structures (systems) and processes (cybernetics) . The advantage shows when dealing with complex, in particular living or viable systems. Models of Life Systems, of proto-intelligent Artificial Logic systems help to understand processes constituting the highly complex human and societal systems. In particular Systemics and General Systems (v. Bertalanffy [2]) from the biological point of argumentation or the Dialectic Systems Concept (M.Mulej) aid to understand and eventually control societal processes. 'Hard' and 'soft' methods can be integrated e.g. by *Integrated Systems* Method [ISM; M.Schwaninger [29]. The *Fuzzy Systems* concept opens access from logic and non-linear mathematics. *Complexity Sciences*, *second*, explore the emergence of complexity and the faculties of complex systems. They include so differing approaches as for example theories of Dissipative Structures, of Synergetics and of Hyper-cycles. In sum they will cover the *formal side* of the dynamic part of a transdisciplinary models.

Any complex systems has to be understood from its actual state and from its (historical) becoming. *Evolution Sciences, third*, focus on the (geo-)historical development of life, of species and, recently, in particular of consciousness and higher consciousness. Evolution science has contributed in particular to anthropologies, base models and methods transferred e.g. to psychology (Evolutionary Psychology) or economics (Evolutionary Economics; K.Dopfer [11]). Interconnections and cross interconnections have come up: ‘Systems’ branches from Systems Management to Systems Sociology and Socio-Cybernetics.

In relation to ICT research, connections to the emergence of *language* promise valuable contributions. To understand the mutual impacts of ICT and societal evolution, the nature of information, of knowledge and their representation in language appears crucial. Early research by D.BICKERTON is complemented by ‘languaging’ investigated by Maturana Varela [21]. Most challenging and still controversial comes the attempt to hypothesize the emergence of consciousness and higher consciousness by G.M. Edelman [12]. His Theory of Neural Group Selection (TNGS) undertakes to draw a line of evolution from physics to a biology of human higher consciousness. Scientific approaches contributing to a more comprehensive understanding of ICT in particular virtually span a bow from computing physics and logics to human behaviour and to human thought and feeling. As pointed out above, crucial advances serving the rather exigent purpose in the scientific fore fields have been accomplished. They need be integrated under the auspices of an ITC focused societal policy, assessing possible futures of ICT societies in terms of strategy planning.

3. Strategy Models: Past and Future of ICT Societies

Strategy planning rests on a set of models both of society and of ICT. The models of society should emphasise the *communicative* aspects of society; the models of ICT accordingly should focus on the factors which influence and alter the way of individual and societal information. They should emphasize also information processing, communication and resulting human behaviour. Tentative modelling necessarily will be *qualitative* only, *quantification* belonging to a later stage when preparing programming and subsequent simulation.

As modelling theory states, already the building of simple pre-models will preclude the assumption of shared crucial qualities and regularities: structural, procedural, concerning rational rules and atmospheric ‘*qualia*’. As elaborated in previous papers, the model needs be built from a transdisciplinary base, responding to factual complexity of then problem touching several disciplines. Such a model will be constituted by a ‘systems’ model derived from systems and systemic concepts of *living systems*. Aspects of *societal behaviour* will pose specific methodical questions, dependent mainly from the mode of processing and evaluation: e.g. by simulation using system dynamics or agent based procedures (Fleissner [15]); where simulation serves as a means of learning. Crucial for the prognosis of a developmental course societal *universals* turn out. They include both structures and procedures, functions /functional networks and their functional dynamics. Universals extend into *evolutional universals*, comprehending developmental regularities (e.g. rise and fall) and recurring irregularities (e.g. bifurcation, phase transitions or catastrophes) of evolution. The so called *social physics* attempt a model of societal evolution supported by mathematics e.g. on a demographic base.

The in essence but highly abstracted, situational and general model of a society serves as a *frame* for these detail regularities and concepts applicable to complex systems (here: social and societal). Being dynamic themselves, regularities foster though from differing aspects a *dynamization* of the model necessarily employing dynamic programming. Such programming of the second order does not assume fixed functions, but dynamic change of parameters and their interrelations, describing a dynamic developmental course.- Each of the concepts originates from sets of assumptions. *Macro curves* by definition base e.g. on observations in the field of economics cycles and those of technology innovation: short, middle and long range curves. How do many per se complex detail micro-developmental curves result into, from the non-scientific view rather simple appearing, macro developments as e.g. in retrospect described e.g. by historians? Do constraining probability fields for future development need be proposed, and how can they be described? To what extent does the *past* constrain and predestine the *future* (Bayesian Syllogism)? Can it partly be explained, as A*nticipatory Theory* sets on, by the qualities of living systems containing of model of themselves and of their probable future? *Natural Drift* is an offspring of Systems Biology tied to evolutional learning. It offers a concept to assess the probable course of development emerging from experiential learning of living systems. *Complexity Sciences* (Regsdell [25]) denote a still but loosely connected set of usually mathematically expressed hypotheses on complexity emergence. They include bifurcation, phase transition, chaos, catastrophe; introducing dissipative structures and eigen-dynamics of systems. How does -observable- -*simplicity, adaptation, stability* etc. arise from complexity and complexity evolvement? *Evolution* gives examples e.g. concerning the emergence of life, of species, of language and higher consciousness.

Which of the concepts and in which context, how interrelated, networked etc. might be integrated depends on the actual case. It may be referred to presentations of IDIMT-04, where a model of the ICT Society (Loeckenhoff [20]) was presented. A simplified input-output model it is open to be complemented by an elaborated *autopoietic* approach as contained e.g. in the concept of natural drift as above.

The rather rough outline and listing above described the access to interdisciplinarity which is constituted by shared *formal* models. For practical application these are not sufficient. They need be concretised and validated by *content* and *context* for actual case employment. Attempting transdisciplinarity cannot mean to search for a theory of everything. It has to strive for pragmatic case orientation.

4. On Heuristics, Learning, Interference and Innovation

Posing questions from different angles, transdisciplinarity basically provides a *heuristic frame of reference*. Methods towards transdisciplinarity serve as a instruments of *transdisciplinary heuristics*. Their qualities comprise transparency and retraceability beyond the boarders of disciplines. In particular in coping with highly complex societal phenomena as e.g. ICT the interdisciplinary context provides *validity* and *plausibility* tests. Knowledge gains scientific and pragmatic 'contextuality' and becomes 'transgressive'. Complex problems may be analysed from different particular aspects, which can systematically be networked with analysis results from other disciplines into an consistent overview. Targeted 'requisite holisticity' can be planned, represented and tested.

These *heuristic* qualities of transdisciplinarity and their employ demand remain open to specific investigation. Transdisciplinarity, more dedicated than science in general to the immediate solution of *practical* problems is intended to support *policy design* and *action programming.* Whether there are e.g. consequences to be derived from PISA results relating to ICT (e.g. influence of TV on pupils) as part of the policy concerning education, needs be explored both specifically and transdisciplinarily. By nature practical solutions will produce *side and long term effects*. Plausibility checks from other disciplines offer insights to detect non-covered uncertainties, non-plausible assumptions or dangers for chaotic developments. In addition the grounded formal base of transdisciplinary approaches proposes frames to distinct *macro-, meso- and micro-level* of developments to be analysed and their connection towards a policy decision. ICT affects as well the individual (micro) behaviour as the group relations, institutional conduct (meso) and communication as a factor holding together and governing the society a whole (macro).

If targeted for sustainability, societal control best is conceptualised as a learning process. *Societal learning* and *control* constitutes an intricate process of mutual adaptation. Stressed here are the advantages for *mutual dialogue learning*, for guiding policy support, for strategic *interference* and for a sensible control within an ICT policy. As has been elaborated in IDIMT-2004 (Loeckenhoff [20]) ICT as the information base for societal learning policy also sets the crucial stakes determining a stagnant or an innovative society.

Epilogue: Guided Evolutional Learning for Innovation

ICT as a constituting factor of the present societal structures and processes has been the object of research with respect to its role for society's future development. In particular for a long term assessment its contribution, positive and negative, to societal learning proves essential, as it does to societal innovation. Learning embodies in many aspects the fundamental process of life and evolution on all levels and domains. In which ways is learning affected by ICT? How can ICT support in particular further creative, evolutive learning to support societal innovation?

The quest for an innovative society has been emphasized as the only way to cope with societal change culminating in societal phase transactions as structural unemployment, the 'Methuselah Complex' and peoples migration. Aggravated by other local and global, geological and civilisation faults they cause severe cultural tensions to be alleviated only by a continuous process of innovation. Ubiquitously anomie is on the rise, even if so far partially held down by governmental restrictions and force. Both act but as fool and fish traps, increasing the problems and diminishing the existing scarce potentials to solve them. Anomie can be quelled by transfer only into new structures by steady and in many cases fundamental innovation and the positive development innovation carries.

In this context innovation it to be seen as a multifactorial societal process; encouraging, rewarding and enacting new ideas, transferring them into new processes, structures and developments. If it qualifies as As e.g. C has shown, the effective innovation potential depends essentially on the social and societal environment. Actually the atmosphere, the societal qualia and the general mentality e.g. in Germany are markedly adverse. They favour social envy and parasitism; quenching performance and initiative. Actual initiative and propensity to change remain on a rather low level. To reverse the spiral down presents a complex and stony endeavour, to be encouraged from many aspects. A reversion, however, necessarily begins with appropriate *information* on the state of society and on the possible paths to overcome the crisis. The complexity of the challenge needs be presented in understandable presentations non reductionist and not distorted by ideologies. Fortunately the serious part of societal media are still – how long ? – threatened, but yet uncurbed.

As the toppling of a corrupt old-communist government is Poland exemplified, information, communicated by ICT can induce innovative change. Society should systematically employ the potential for survival.

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TECHNOLOGICAL DEVELOPMENT FOR SOCIETY'S NEEDS

Marko Ivanišin

This paper is dealing with the problems of assigning a definitive role to social processes. It claims that these are to complex to be clearly structured. The example of technology shows that human needs cannot be interpreted as the central cause for development, as often claimed, they are more the side effect of it. A new perspective, in this paper explained upon the model of communicative management, would however help to put human (needs) back into the center of technology (development).

1. Introduction

Talking about technological development and the interdependence of technology and man, one is soon faced with the question, who or what is promoting technological development. Is it the self-reproduction of technology that shows the edge of (technologically) possible, or is it the human needs that strive to be satisfied? I believe there is no one-sided answer. Neither is it a well ordered circle that gives on one curve dominance to the technology and on the other to the man, like shown in the Figure »Pull/Push phenomena in current ICT system developments« [2].

2. Technology and Man

I believe that nowadays it is hard to define whether the process between human and technology is one of the push or the one of the pull manner. Same goes for many other processes, e.g. media (as technology) and "public interest" (as human needs). Many things are done and much information in media is published with the reference to the public interest as an equivalent to what public wants/needs. But hardly anyone defines what the public interest (in general or in the particular concern) is. Because if he/she did, it would be obvious that public (practically) shows interest only in what has been offered to it[1]. Hereafter one can talk of "prescribed public interest" (by media), in media theory known as agenda setting[2]. But the process of media-pushing has its equivalent in media pulling. Being profitable corporations in a competition market media has to produce contents that sell. Buying by recipients (pulling of contents) constitutes media just as much as setting the contents. However I still believe that drawing a figure of development with clear distinction between push and pull processes is not possible. In the case of public interest and media this would mean to determine which contents have been published because of the selling proposition and which to fill up the media-space. If a newspaper editor is firm in answering this question by counting down articles of his paper for each side, the higher level interdependencies are to complex to make the same for the "whole" media system.

Next to the argument of blurring push and pull processes in a system, there is another problem. Talking about technological development like Chroust [2] does I believe one has to distinct between human and business' needs, in other words between homo sapiens and homo economicus[3]. One can call me minimalist but I believe that homo sapiens needs much less to exist (whether this means to live or to survive) that it is offered today. Homo economicus however can satisfy its needs only by being competitive and that means up-to-date which means using the technology it is offered. At this point one could conclude that technology arrives into our lives only by push processes (of marketing) that overwhelm sapiens and satisfy economicus. However this would be consistent if in every homo sapiens (in the developed world) has not been a homo economicus (that pulls the industry to produce) as well. The problem of living in a society that blurs the private and the business and that furthermore positions the business over the private is transparently demonstrated when strategies are put into every action we do – even into love[4]. I see this problem as a big problem of (communication) management as well and it shows that the "lack of humanity" in the "world of business" is not only a problem for "humanity pleaders" but also for businessmen.

Let us come back to the argument, that today's level of development of the society does not allow us any more to say what products have been developed out of the needs of customers and what have

[1] In theory the interest can be measured only on known objects of interest, which are in its most abstract form (if we assume public not to be innovative) ideas discussed in public debates (and presented in media).

[2] The agenda-setting hypothesis has been modified to an agenda-building hypothesis in which the recepient plays an active role of putting (building) different agendas into its own agenda (as opposite to the passive role in agenda-setting in which the recepient simply takes over one of the agendas). However media-concentration makes various (media) agendas alike and higher information flows cause needs for more solid (one sided?) orientation, so in the end recepients tend to fall back into the passive role.

[3] Homo economicus refers here to the modern human that lives upon the principles of profitable (unsustainable) economy, not to the human that organises its life in an economic manner (to provide sustainable environment).

[4] Developing the thought „Put emotions into strategies instead of putting strategies into emotions" would need a separate paper. I will come back to that at the end of the article. See also [5].

been developed because the industry thought it would sell. As argued above, the business solutions might to a much greater extent derive from the needs of costumers than the general market solutions. So the question in the end is: Are there any human (not business) needs that can be identified as inducers of today's technological development? If yes than the pull process can be determined on the market.

In a way Chroust [2] gives the answer to this question, as he writes that »improved possibilities for communication« exist »in parallel to increased loneliness of individuals«. With no further explanation or definition of terms this statement is not possible in a society that is ordered by symmetry of pull and push processes (that are shown in the Figure stated above). Possibilities for communication (interpreted as Infrastructure or Software Applications in the Figure) can (following the Figure) derive only from society's needs and, on the other loop, they push the society to use them. So in no way there can exist possibilities of communication parallel to loneliness of individuals (interpreted as Society in the Figure) unless one constitutes no correlation between the two (but in this case it would be irrelevant to name them together). So the parallel existence of individual loneliness and technological communication solutions indicates that greater technological development does not mean greater satisfaction of human needs which means that technological development goes its own way independent of society's development.

3. Role of Science and Participatory Approach

It would be the role of knowledge (based on research) to better satisfy human needs by technology. As Chroust writes, »a long learning phase with respect to education and research will be needed« [1]. Therefore it stays a big question, how to provide this long learning phase and guarantee the quality of knowledge when »the research will become more global and more competitive with reduced interaction time.« [1] Under this conditions it is almost impossible to wish that the »main emphasis will be put on problem solving«[5]. Less time means less quality unless more workers are employed. The globalization does offer more workers but at the same time it offers more problems. So who is about to choose what problems are worth to emphasize on globally?[6] I believe that »global« (being a very common term) exists for the individual mainly on the abstract level (knowledge) and that »local« is still the level that the individual mainly acts in (action). Following

[5] Problem solving refers here to focusing on a specific problem that can be hardly solved by copying (without adaptation that itself requires time) globally available solutions.

[6] It is clear that academia and investors are those who decide what is worth researching. Probabely that is why the results do not satisfy human (but only business) needs.

this argumentation I can agree that global knowledge will be used to cope with local problems but I furthermore express the hope that there will be enough time to conduct the global research in the way to be useful for satisfaction of local needs and to adopt the global knowledge in the way to be able to take local action.

I believe that a different approach is needed to proceed in both matters discussed above (satisfaction of society needs by technology and solution to specific problems by global knowledge). A participatory approach: those who are affected need to be included into the process of their problem solution instead of being merely the source of information to what the problem is. Their inclusion and participation in the problem solving project guarantees high motivation for the project and enables control at every stage of the project development. Science (meaning research and development) could learn a lot by stepping in the middle of its research object. Not only facts about the object (like it is used now) but also methods of problem solving that are immanent to the object. Looping back to the context of the article this would mean that the technological development would derive from human needs (not from industry selling propositions). However this does not mean that innovation will be inhibited (because of waiting for the human need to arise) it would just be focused on satisfying human needs instead of generating profit for the industry. Is such a participatory approach possible at all on the level of society development?

4. Communicative Management

Here I am trying to establish communicative management as an approach to communication and management that is different to implemented practices of communication management. Communicative management is based on the distinction between the very essence of communication and management. In my opinion the dialectics of these two terms show the problems that are immanent to many phenomena in that one can distinguish between structure (management, technology) and culture (communication, humanity).

Communication (like emotions) is based on personal characteristics, whereas management (like strategies) is based on interest to reach final results. On the one hand communication is a learning process (always re-)defining its aim in accordance with the current situation, on the other hand management has a goal that it has been built upon. Joining the two into “communication management” should be a process worth discussing. But practically it is done on the line of least resistance by establishing characteristics of the one (management) over the characteristics of the other (communication).

To agree with that one has to agree with the interpretation that communication is closely connected to (if not dependent on) the subject that it is about and the partners that it is between[7]. By that one attends to avoid the gap between »existence and appearance«[8]. I believe that today it is important to implement this thinking (that one could also name »to act in balance with one-self«) because the communication trainings today show that communication is not any more about understanding (existence) but about strategy (of persuasion)[9] (appearance) [2]. However I am trying to oppose this interpretation of today's society by distinguishing between communication as function/goal and communication as principle/process [3]. I will try to demonstrate it on the example of one of the most popular entitlements: within a company the »Communication Management« (depending on company also entitled »Corporate Communications«) usually refers to structuring, organizing, leading and executing company's communication functions[10]. Communication is hereby defined as an object that needs to (or can) be managed similar to human resources, finances or the company as the whole. In these interpretations the management and its object are in an asymmetric position. The management rules over the object by shaping its structure. By being managed the communication is considered to gain extra value. The vice-versa dependence has obviously not been recognized yet. To put it more clearly: it is not expected that communication management could gain an extra value if communication was the principle/process of management (and not only vice-versa). The reason for such lack of perspective might be the fact that the management itself is a principle/process that (when well handled) is proven to improve results of company's divisions (one of which is traditionally considered to be also the communication function). Business literature that would make the (inter)dependence of management on communication explicit has not yet crossed my eyes. I have yet not heard somebody talking about communicative management instead of communication management.

[7] There are several theories and philosophical approaches demonstrating that communication exists only under conditions stated above. One of the most complex, best structured, and best argued is the Habermas' Theory of Communicative Action that proclaims truth, rigthness, comprehensibility and veracity as the necessary pretensions for (functional) communication.
[8] Translation of the German idiom „Sein und Schein" that expresses the stated gap more suitable.
[9] At some point Dorer and Marschink [3] go even further and state that the trend of introducing interpersonal communication into mass-communication literature (as the most effective way of persuassion) is the proof that the interpersonal communication at its core has never been anything else but strategy (by which they opose the long tradition of »communication as understanding«).
[10] Communication function within a company would traditionally include „internal communication" (also „internal PR") such as intranet, employee newsleter, white-board, achievement awards and events, employee excursions etc. and „external communication" such as advertising, PR, promotive events etc.

Communicative Management should signify »management by communication« and should mean that managing is done by communicating. From here on one can implement established models of PR that are based on communication (information, dialogue, discourse).

On the one hand the idea of communicative management builds on the Burkart's model of PR [1] but on the other it improves it. It answers to one of the main problems that Burkart faced when criticized. He stated that the role of PR is a communicative one and it ends before the execution of the negotiated action starts. Herewith he withdraws the PR from any responsibility that it might have in the case that the executed action is not in correspondence with the negotiated action. Communicative management closes this gap of »blank responsibility« as it joins the communicative and the executive (management) function. It is communication and management in one at all stages of actions implementation.[11]

5. Conclusion

Introducing communication as the core principle of management might show the way to introducing human needs as the core principle of technological development. Like claimed above the technological development seems to function (completely) separated from human needs taking an own development path that in some stages is not only useless but also endangering for the human being (e.g. weapon production). By shifting the focus of technological development from (well selling) products to (learning) process human needs would gain importance as sources of information (teachers). In this role human needs would not require any further argumentation to become the cause of technological development.

[11] In my dissertation [4] I concluded from a slightely different perspective that communication is organisation and organisation is communication so the two can be put into equation: communication=organisation.

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ENHANCING THE ROLE OF HUMAN RESOURCES IN TRANSNATIONAL TECHNOLOGY TRANSFER FOR SME IN A "EUROPEAN INNOVATION ASSISTANTS" MODEL

Gilbert Schreiber, Wilfried Enzenhofer [1], Gerhard Chroust [2]

Small and medium-sized enterprises (SMEs) represent the cornerstone of Europe's competitive position and are of utmost importance for employment. European networks for Transnational Technology Transfer (TTT) give support by international partner search, project development, integration into the EU innovation landscape etc. Problems arise, however, when it comes to sufficient resources, qualifications and structures in SMEs in order to bring TTT-projects to a successful conclusion inside the organisation. Regional Innovation Assistants Initiatives across Europe give specific support to establish young graduates from university in SMEs representing these required qualified and internationally capable human resources. This paper presents a model for enhancing the role of human capital in TTT on European level. So called European Innovation Assistants EIAs are positioned as bridgeheads for transnational technology transfer (TTT) in SMEs and as interfaces between SME's internal innovation structures and European technology networks and services. By rendering specific coaching services at European level towards placement of human resources, technology adoption and innovation management barriers for SMEs in TTT can be overcome. The model aims at better sustainability for TTT-processes in SMEs and decisive improvements concerning competitive capability and employment in SMEs.

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1. Introduction

1.1. Background

Innovation is the weaving of technologies, human resources and markets into a complex web. Qualified and competent human resources (HR) are the indispensable impetus for successful innovation and technology transfer. Small and medium-sized enterprises (SMEs) represent the cornerstone of Europe's competitive position and are of utmost importance for employment.

A main shortcoming on the European innovation landscape especially at SMEs is the inadequate transformation of innovative ideas into internationally marketed products/services. In many cases activities in Research and Technology Development (RTD) are inadequately planned and underfinanced. Due to an inactive approach towards co-operation RTD often takes too long and innovations therefore come too late into the marketplace or are wrongly positioned.

In this respect external support is being given by European technology transfer network and innovation services such as the Innovation Relay Centres (IRC), Euro Info Centers (EIC), the IPR-Helpdesk, gate2growth etc. Clients especially benefit from their offers in long-established international working relationships, integration and experience in regional and EU innovation landscape, international partner search and project development towards transnational technology transfer (TTT) etc.

Concerning the efficiency and sustainability of these TTT-services there, however, arise problems when it comes to sufficient resources, qualifications and structures in order to bring TTT to a successful conclusion inside the organisation of SMEs. This relates to severe shortcoming in the ability to access and adopt new technologies, interact with the research community and finally manage complex international innovation projects.

From several examples (Germany, Austria, France, United Kingdom) it can be derived that Innovation Assistants programmes proved to be a very valuable instrument for boosting the innovative performance in SMEs. Young graduates from tertiary education (university or university of applied sciences) are placed as Innovation Assistants in SMEs with the purpose of supporting the implementation of innovation and internationalisation projects. They represent the required specifically qualified and internationally capable human resources that are, often much more than in large companies, offered the opportunity to directly work on the innovative edge of a company.

Being graduates from university they moreover build an immanent link to RTD-institutions fostering technology transfer from science to SMEs.

1.2. European Innovation Policies concerning Human Resources, Employment and Productivity in SMEs

The European Spring Council held in March 2005 highlighted the need to reinforce innovation and links among industry (mostly SMEs) and RTD providers as one of the top priorities in the ”Lisbon Strategy”. Janez Potočnik, Science and research commissioner speaks of streamlining and focusing the renewed Lisbon efforts and in the Commission proposal for the seventh framework programme, the heading “Research for the benefit of SME” raises explicitly our topic: “Most Member states actions relevant to SMEs do not encourage and support transnational research cooperation and technology transfer. Actions at EU level are necessary to complement and enhance the impact of actions undertaken at national and regional level. “

Furthermore Europe undertakes huge efforts to fulfil the “Barcelona Goal” of 3% EU GDP investment into research and development. By improving innovation related structures and methodological project approach, quality and efficiency of project management as well as RTD and internationalisation competence in SMEs the EIA-project will trigger RTD-investments in SMEs. On the other hand, in parallel, adequate measures to facilitate the transfer of European RTD-results to industry, users and even the European citizens, need to be set up. The EIA-project will produce, test and implement an innovative methodology to support TTT in order to effectively increase the competitive capability of SMEs. Further following the Presidency Conclusions on competitiveness of 18th April 2005, such a model will enforce the role of human resources in science and technology in the ERA. Being able to make European SMEs ready to generate innovation and apply advanced technologies will directly enable them to gain competitive advantages by providing and guaranteeing a higher level of quality, service, reliability of their products and services as compared to their foreign competitors. History shows that companies active in innovation in order to enhance their production methods, processes and management, gain competitive advantages by increasing their rewards, and take on the lead in the race for world wide market share - and retain it. Based on the experiences of regional Innovation Assistants programmes this has an enormous effect on international turnover and employment at SMEs.

1.3. Impact of Human Resources for SMEs in Transnational Technology Transfer

Concerning the individual SMEs the implementation of qualified and capable human resources as Innovation Assistants has the following specific impacts (backed by a recent survey in the Upper Austrian Innovation Assistants programme):

- Innovation projects being highly relevant for SMEs' long-term strategies are realised in a significantly improved manner regarding systematic and methodological project approach, quality and efficiency of project management as well as professional competence. This improves the success rate and therefore their competitive capability.
- Innovation Assistants become pulse generators for innovation in SME. As they are often promoted in the course of the project they reach a responsible position multiplying the positive effect on TTT along their career. This long-term orientation towards innovation has significant effects on employment and creation of value in SMEs in Europe.
- Being graduates from university Innovation Assistants personally bring in scientific knowledge and contacts to RTD-institutions. Therefore they enhance technology transfer between RTD-institutions and SMEs and anchor co-operation in the corporate culture.

With reference to European networks and programmes for TTT Innovation Assistants have strong relevance:

- Innovation Assistance enhance the role of human capital in transnational technology transfer (TTT) by acting as interface directly in SME for international networks and co-operation and being graduates from tertiary education (university or equivalent) for transfer between science and business.
- Projects Innovation assistants deal with are designed to take concrete actions and achieving results in a strict time frame therefore boosting TTT-activities by importance and urgency. Moreover Innovation Assistants are not seldom promoted to positions responsible for RTD and innovation in SMEs. Therefore they multiply the impact on TTT along their career and secure self sustainability of processes originally initiated with the support of public money.
- Being supported by public programmes such projects are guided by methodologies. Broadening the scope of TTT effects range from new methods of innovation emplacement and distributed collaboration that enable to build the base for TTT. Participation in

international networks foster innovation management, exchange of best practice and most importantly innovation through optimal human resource allocation.

2. The European Innovation Assistants Model

2.1. Importance of an European Approach

Lifting the Innovation Assistants model to a European level ("European Innovation Assistants", EIA) adds new dimensions to this successful HR and SME related approach:

- Services rendered (e.g. international technology working groups, staff exchange etc.) to the EIAs are clearly designed to boost the technology transfer activities of SMEs on a European level. In a diligently coached process these SMEs acquire an international market and technology oriented strategy and gain capabilities to run TTT-processes.
- By linking the SME via the Innovation Assistants "ad personam" to TTT-networks and innovation services as well as international partners SMEs will be more aware of new international trends and ideas will be encouraged to embark on new technologies
- At European level TTT-networks (e.g. IRCs) gain bridgeheads for their activities directly inside the SMEs which dispose of adequate qualification and function to carry TTT more effectively to SME-internal structures and decision processes.
- By methods and know-how provided to Innovation Assistants the SME will personally experience the essential skills for communication and cooperation with partners and clients in Europe which will finally engage the whole company.

A European approach requires, however, a well tuned consortium involving intermediaries situated in all parts of Europe and the associated countries. The project partners need to bundle competencies in the following respects:

- Strong access to regional SMEs, young graduates from tertiary education and RTD-institutions and experiences on deficits and potentials concerning innovation in SMEs and human resources
- Specific knowledge in TTT-methodologies e.g. technology audits, IPR-management, strategy management, financing, HR-mobility

- Access to services, RTD-intelligence and networks that can further support the TTT-approaches of the SME-teams

In a final upgrading the dissemination to several European intermediaries offering TTT-services is essential to multiply effects in Europe:

- The active and effective dissemination of all methodological insights, developments and tools to regions where this approach is new as well as TTT-networks and programmes has to be a priority. Following a dissemination strategy and action plan adequate measures range from information tools (website) to direct involvement of partners beyond the project consortium in the activities (e.g. technology-working-groups, innovation services).
- The project consortium should involve partners situated in all parts of Europe and the associated countries. Activities will result in a decisive advancement of existing Innovation Assistants programmes and more importantly implement the EIA-initiative in regions where there have been no such programmes before. Experiences from other European countries (France, Italy) and America (Canada) need to be integrated and regions not covered by the consortium involved by further external network partners. Early and purely operative dissemination activities are intended to prepare the ground for the future challenges for TTT even beyond Europe.
- Intermediaries need to combine all skills and expertises to finally reach the goal to increase competitiveness and international turnover with innovative products and services contributing to creation of employment in SMEs located in various geographical areas.
- Within a geographically well balanced project consortium methodologies and best-practices need to be identified, evaluated and comprehensive HR and SME related TTT-methodology developed. In the course of the final upgrading this methodology will be applied and implemented in all partner regions and beyond. This aims at profoundly influencing the way European regional decision makers approach the topic of support to transnational technology transfer.

2.2. Goals

The European Innovation Assistants (EIA) Model aims at forming a pilot project for implementing a comprehensive SME and HR oriented methodology for TTT. The main goals are:

- Establishing Innovation Assistants as highly qualified and dedicated TTT-managers directly employed in SMEs and by specific support activities linking them to international TTT-networks (e.g. IRC). Visually they will be the bridgeheads for TTT-projects inside the SMEs for overcoming the barriers for TTT between SME's internal structures and external TTT-networks and services.
- Positioning Innovation Assistants as pulse generators for international commercialisation of SME-technology and innovation projects bringing along contacts to RTD-institutions, competence in marketing and economics as well as a strong international background.
- Developing an overall HR and SME related TTT-methodology at European level with strong TTT-support elements in technology (international technology working groups, expert days), human resources (international placement of Innovation Assistants, staff exchange) and innovation (strategy development, IPR-issues, financing etc.)
- Transferring the methodology and related practical experiences inside the consortium from existing programmes in Austria, Germany, Sweden and United Kingdom to newly created ones in Spain, Israel and Latvia and later on dissemination ready for application to European and national programmes and networks Europe-wide.

The target groups of the project consist of:

- SMEs: technology oriented enterprises that intend to carry out a strategically highly relevant, international innovation project by expanding their human resources, qualification-base and international background
- Young graduates from tertiary education (university or university of applied sciences) having completed studies in technical areas or business economics with strong social and international competencies that will be placed as European Innovation Assistants (EIAs) in SMEs

2.3. Functions

Relevant SMEs in the different European regions need to be identified which employ a young graduate as European Innovation Assistant for managing and dealing with their innovation projects. One of the project's goals is to achieve international placements of EIAs at SMEs. EIAs will be directly linked to the project and represent "pilot-partners" all along the project who will apply, implement and evaluate the methodologies and services rendered in a project.

In order to individually support the EIAs in their development of international innovation projects TTT-coaching on European level will be provided by the EIA-Initiative regarding:

- Technology: SME-projects will be focussed in a cluster oriented approach on technological areas such as environmental technologies, mechatronics, wood or medical technologies. For these areas international technology-working-groups of EIAs will be formed and guided by experienced research institutes, research professionals or technical consultants providing scientific knowledge and conducting TTT from scientific organisations to companies.
- Human Resources: Young graduates being well educated in latest technology will be motivated to spread and implement their knowledge transnationally. For this purpose Innovation Assistants will either be recruited from the international partner regions or staff exchanges between the SMEs will be organised to secure international "Brain-Transfer".
- Innovation: Each EIA will be rendered European standard methodological and practical support concerning innovation related matters such as IPR-issues, finding of appropriate international strategies, technology monitoring, sourcing, financing etc.

Finally the EIAs should be precisely docked to national or international TTT-networks and innovation services. By supporting a client oriented access to such services and installing a web-platform for information guidance and follow-up individual co-operation approaches to the following systems will be effected:

- Technology Networks: Thematic Groups (TGs) within the IRC-network, newly forming cluster initiatives of European approach, FP technology platforms or potential sources for TTT such as EUREKA, ESA or other national sources
- Innovation Services: providing specific interfaces to existing national or international services such as IPR-Helpdesk, gate2growth, INSME, international financing schemes etc.

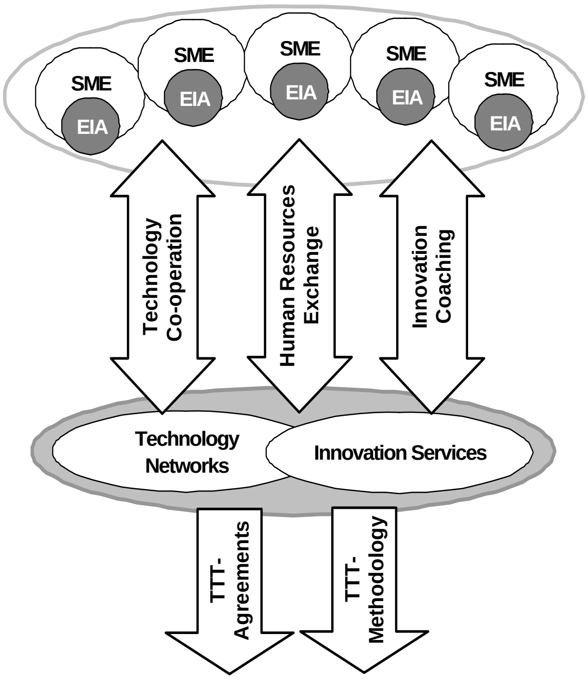

Figure 1: Function chart of the EIA-Model

The development of a HR and SME related TTT-methodology as well as dissemination and exploitation of results embrace the activities described as horizontal brackets. This is meant to secure on the one hand that activities are based and accompanied by a thorough methodological approach that will be constantly further developed. On the other hand dissemination and exploitation of results is intended to start very early and involve partners beyond the consortium on an operative level already during the project.

2.4. Results

European Innovation Assistants need to be established at SMEs in different partner region and will be directly linked to a project consortium on operational level. Therefore all methodological developments are immanently tested and evaluated by their success and acceptance within the project. Furthermore the EIA-project is clearly oriented at producing quantified results in TTT for the SMEs involved.

These are:

- Development and implementation of a comprehensive HR and SME related TTT-methodology
- Placement of European Innovation Assistants in SMEs in European partner regions

- Organisation of transnational placements or staff exchanges of EIAs
- Set-up of transnational innovation service-packages and assisting SME-teams
- Establishing Technology Working Groups and holding R&D-workshops/expert days
- Completion of TTT co-operation agreements with EIAs involved

The development of a HR and SME related TTT-methodology as well as dissemination and exploitation of results embrace the activities described as horizontal brackets. This is meant to secure on the one hand that activities are based and accompanied by a thorough methodological approach that will be constantly further developed. On the other hand dissemination and exploitation of results is intended to start very early and involve partners beyond a consortium on an operative level already during the project.

3. Conclusion

This paper highlighted the importance of human resources in transnational technology transfer (TTT) processes, especially concerning SMEs in oder to improve the transformation of innovative ideas into internationally marketed products/services and the ability to access and adopt new technologies, interact with the research community and finally manage complex international innovation projects. It was shown that Innovation Assistants programmes are a very valuable instrument for boosting the innovative performance in SMEs representing the required specifically qualified and internationally capable human resources.

By lifting the Innovation Assistants model to a European level and linking it to TTT-networks and innovation services (e.g. IRCs) a “European Innovation Assistants” (EIA) model was formed that provide European TTT-networks with bridgeheads for their activities directly inside the SMEs, help SMEs acquire an international strategy and gain capabilities to run TTT-processes and make them more aware of new international trends and ideas will be encouraged to embark on new technologies. The model aims at a set of results, primarily the development and implementation of a comprehensive HR and SME related TTT-methodology.

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