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- Management of Software Projects
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- Information Capacity of New Systems Theories
- Enterprise Application Integration
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Welcome to IDIMT 2007!

A heartily welcome to the 15th IDIMT-conference! For the fifth time we meet in Budweis to enjoy 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 will inspire our discussions; small streets, lovely little shops and a wide central plaza will invite us to stay, to stroll and to shop. What started in 1993 as a small bi-lateral conference between Czech and Austrian scientists in the Bohemian Forest has now become a well established conference of a scientifically and geographically diverse group of scientists.

This year we were able to accept 27 papers coming from 12 nations; they were arranged in 7 sessions, each introduced by a keynoter. We preserved the fundamental idea of the conference: providing a solid base for an interdisciplinary and informal exchange of thoughts and interests about economical, technological, and sociological topics. This is one of the outstanding features of IDIMT.

The main focus of the conference are the current and future needs of a world dependent on Information and Communication Technology. The participants discuss innovations, advantages, problems, and risks of information technology on the one side, and innovations, trends, problems, and risks in business engineering and business management on the other side.

This year’s session topics are:

- IS/ICT Security and Privacy
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- Enterprise Application Integration
- European Projects
- A nostalgic session ‘The Last 15 years’

We repeat the successful PhD-day concept from last year: 10 young PhD-students will meet one day before the actual conference and will tackle a truly European challenge: formulating with expert help from CATT, the Innovation Management GmbH, Linz, a proposal for a European project which will cover to a certain extent the research topics of all participanting students.

The preparation and realization of IDIMT-2007 would not have been possible without the support of many organizations and persons. Therefore we would like to thank:

- the Austrian Federal Ministry of Science and Research for financially supporting the preparation of the proceedings,
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- all session organizers for establishing contacts and soliciting contributors,
- all keynote speakers, speakers and contributors of position papers,
- the secretaries of the involved institutes,
- all other unnamed persons contributing to the success of this conference.

To a good conference!

Christoph Hoyer

Gerhard Chroust

July 2007

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IS/ICT Security and Privacy

IS/ICT SECURITY AND PRIVACY

Michael Sonntag

Security and privacy are important aspects for the trust people place in computer systems. But while lacking security is felt rather fast and directly, as are attacks when countermeasures are in place, this is not true for privacy. Only when the information is finally used, e.g. to transfer money after phishing attacks or when a job is refused after an internet search, its "loss" becomes obvious. And contrary to security, remedies are typically more difficult: Cleaning a system is perhaps not easy and some work, but removing information from the Internet can be nigh impossible. It is there-fore argued that the control must be put back directly into the hand of the users, although these are often non-specialists. There comparatively simple measures can prevent problems, while otherwise only very intrusive and general approaches like mandatory data retention can ameliorate the ef-fects. These issues are discussed in some exemplary areas.

1. Introduction

"Security" in its broad sense is heavily discussed at the moment: There seem to be large amounts missing because of all the needs the police and e.g. video studios, copyright owner groups, software industries etc. perceives to combat actual and potential crime. In contrast to this, incidents, apart from illegal copying, do not seem to be as prevalent or threatening. So in my opinion a dangerous shift of security to "others" looms: "The state is responsible for protecting me, but there is little or nothing I have to do, to protect myself". But those crimes occurring comparatively often, e.g. phishing with subsequent unauthorized bank transfers, can best be combated by the individual (end-) users. This does not mean that there should be no criminal sanctions or no investigations by police, but rather that a certain adequacy is necessary: To combat small crimes no complete surveillance should take place. For instance, in an English school every room, including toilets, is under video surveillance to prevent, besides others, graffiti. No property of the school is destroyed and the school is very clean as a result, but what is the consequence of such measures? Pupils are trained to accept and follow each and every single rule, because there is no room at all for protest or any kind of nonconformist behavior: Not the best training for a conscientious society (see also [14] for such an example). Also, if they never experience and kind of "problems" (perhaps by having one toilet less for some time because of its vandalization), how will they later cope with it when actually confronted with them? If there was never anything, even trivial, stolen or withheld from you, how will you deal with it mentally and physically (where to go to and what to do in the meantime) when it does happen? And that surveillance alone cannot solve all problems can be seen by riots in football stadiums, which occur regularly despite extensive surveillance, security precautions, and even sometimes personal registration required for entrance.

Therefore in my opinion a need exists to bring security and privacy closer to the persons directly affected: If simple personal precautions can prevent or ameliorate them, the need for extensive and obligatory measures targeting everyone declines. That this is not always easy or possible, see e.g. below about the problems of patches, is a technological challenge. To ensure people are actually able to manage security by themselves not only needs education, but especially technical measures: Software should be designed (in addition to other restrictions) along the following guidelines which, although seemingly trivial, are often ignored:

1. Secure default configuration and difficult to configure insecure ones: To make sure that normal users, who will probably just unpack and start the device/computer are reasonably secure and that dangerous configurations cannot be created accidentally, but only through deliberate and explicit changes. Although not new, software often does not fulfill this goal.
2. Ease of use even in secure mode: Full functionality should be available without a need for additional actions or configuration, once or recurring. This can be a technical and especially organizational and interoperability challenge, but should be reached as far as possible.
3. Logging to ensure traceability: To be able to prosecute crimes when they occur, some logging is necessary. Otherwise, the Internet would really become a law-free zone. However, the minimalistic and proportionality principle should be observed. Logs must be secured extensively to prevent misuse and privacy risks and should remain under distributed control.
4. Rules for when and how to destroy information: Data should not be kept forever, especially personal information as log files. But rules for when they are to be deleted

often do not exist and the process of deletion is in many cases problematical too, e.g. regarding backups or destroying printouts.

2. Changing security needs

The need for security is general, but many persons experience it to a different degree. However, this feeling is often at odds with real dangers. For example, most home PCs are quite save from hacking attacks to acquire personal data, but prime targets for phishing and to control as zombies. On the other hand, sometimes company computers cannot really be secured even if known to be vulnerable, as they must run old versions to work with other software. Additionally, crime continues to "professionalize": When phishing mails were quite easy to recognize in the past because of numerous grammatical errors, they are nowadays nearly perfect and results are exploited very quickly to circumvent countermeasures surely introduced after some time like blocking the web-site they redirect to. And while breaking into a computer is a crime, currently a push exists towards official secret online searches (with methods otherwise clearly forbidden: "State-Trojan").

2.1. Security for the non-specialists

Computers penetrate ever more into the society, which includes now also sizeable portions of older persons, children, and other non-specialists regarding IT. One reason is, that computers are becoming a commodity and are no longer reserved for business purposes and some enthusiastic persons, but are introduced into new appliances and remain visible in them. While the latter is no security issue as such, the fact of adding an externally accessible computer usually also introduces the (natural) desire for interoperability. To make this work, security is often ignored, as its main purpose is to restrict such communication. Therefore in practice security often means that connecting products is not as easy as it should be for, and is expected by, lay persons. But even with simple precautions security can be enhanced significantly: See for example a bluetooth keyboard. It can connect to the computer only after a "connect" key has been pressed on both the computer and the keyboard and additionally a code shown on the screen has been entered on the keyboard. This procedure is not very elaborate and suitable for everyone. Still, it provides significant security improvements compared to just connecting to the nearest computer, i.e. the one with the strongest signal.

To this category also belongs as a special example the Windows operating system: For years working was only really possible if logged in as an administrator. Only with the latest version, Vista, this changed (User Account Control; UAC). Still, many problems exist and Microsoft even reduced its claim that this is a security feature [2] and expanded, that there exists a trade-off between security and convenience. That exceptions from this policy exist at all is tied in with compatibility issues (see also below!) of older software.

An approach to reduce the risks of widespread computer use could be a license system. At the start of the previous century, cars were not really regulated: If you could afford one, you could also drive it everywhere. Only when they became widespread, problems developed and finally their use was restricted: A license was necessary to be allowed to drive one so danger for others was reduced. Similarly, up to now there are no such regulations if a vehicle is used solely on private property. A comparable state ICT might now have reached: Computers are no longer rare machines in dedicated buildings or separated from each other through lack of communication abilities, but in every home and connected to each other through the Internet, introducing hazards to others. It might therefore be now the time to restrict their usage somewhat. That dangers actually exist can be seen by the amount of Spam and the number of zombie PCs (see [3] and [15] for statistics, which however must be taken with a grain of salt because of originating from companies providing countermeasures). A start for introducing such a "license" system is the ECDL (European Computer Driving License; [4]), which however includes only a tiny part about security. Here a similar distinction as with cars could be possible: Single computers can be used without any requirements, but for an internet connection some proof of moderate proficiency would be required. This need not even be an official guideline: Extending the liability of ISPs would be sufficient for them to require this from their customers to pass it back again. While in the end costs would obviously be borne by end-users, simultaneously the Internet would be much safer. And as relocating to another country is no option here (a remote server still requires a local Internet connection!), national singular initiatives would help and bring no significant discrimination compared to other countries without restrictions. Still, Internet usage might decline, although currently strongly promoted. As intermediate measure, similar to the not-yet-really-safe UAC of Microsoft, an obligatory security course without examination could be introduced, similar to the obligatory course in first aid required for obtaining a driving license.

2.2. Software requiring old or unpatched versions

Connected with security are certain software problems: Even when people are willing to do something for security, this is not always possible. Examples include e.g. software for logging telephone calls in call center environments, which is a normal program, i.e. it must be executed on a computer continuously running and with a user logged in (not a Windows "service"). The result is, that installing patches is difficult and the computer must be configured for automatic log-in. Other instances of similar issues are plug-ins tied to specific versions, perhaps because the interface was not made public officially or just changed in the new edition. Because updates to the dependent software obviously cannot be created instantly, this opens up a larger window for attackers.

A solution to this problem can be the use of stable interfaces with compatibility modes for old version counterparts. While such do exist and professional products sometimes employ them, their use, especially internally, occurs more rarely. In computer science education more emphasis should be put on such *stable* interoperability. E.g. in universities, programming courses often explain, design, and use interfaces. But these almost never include versioning capabilities; only the immediate needs. Teaching "design for lifetime" seems often to be lacking.

2.3. Phishing

Phishing is best combated by individual users: These are the primary targets who usually can easily prevent losses. Other measures are complicated and typically only serve to trace the culprit. Still, apart from educating users to recognize phishing attempts, the system design should already provide some protection. This could mean e.g. starting with "overblown" security features, like electronic signatures or two-way authentication (in [16] it is argued that they are a failure: but everything that makes it harder to circumvent security and does not burden the users should definitely be introduced). Although more costly than TANs, it is also more secure. But his is not the main argument here: Users cannot be expected to continually cope with changing security features. When they started with TANs, they will have problems when suddenly specific numbers instead of arbitrary/sequential ones are requested, or when additional verification through the mobile phone is introduced. Security for laymen works best, when staying the same: Any change from the routine then stands out and is viewed with suspicion. However, this requires the main routine to be secure, as for this no attention is spent after some time.

A novel approach to render phishing more difficult and specifically targeted at lay persons are so-called "security-skins" [5]. There images are used as the background of "dangerous" forms (e.g. for password entry), with the image being determined locally. So if the website is secure, i.e. encrypted and the domain name matches, the image is visible, otherwise not (or a different one). As the image is stored only locally, this display cannot be forged e.g. through constructing a "window" as an image. Other methods to over come this exist, but they are more complicated.

Phishing also serves as a good example for the main aim of this paper: As long as users are human persons, they will make mistakes and reveal confidential information. Technological measures can help reduce this risk, but not remove them. And at some point, e.g. calling your personally known bank employee for every E-Mail you receive from them and for every transaction to confirm it orally, is going to be problematic, although it would prevent security breaches. The main goal must be to find a balance between responsibility and security: If users are too careless and ignore security measures provided to them, this should affect them only personally, but not everyone through increased observation for all, like mandatory data retention.

2.4. Mashups

Apart from security issues of the underlying technology typically used in mashups (for Ajax see [17]) and potential privacy problems, the concept as such exhibits problematic aspects. The main idea is combining information from others and displaying the aggregate result seamlessly. So while the ease-of-use is high, which is the main reason for their success, their reliability is low. Other as on Wikipedia, which is a singular high-profile website, also no correction mechanisms exist for wrong data. If the base data is wrong, the end user has little chances to detect it and often no possibilities at all for correction: Everything goes through a single server (browser security models!) and therefore the original source is "lost". As this source is hidden from end users, trust transitivity is impossible too, forcing them to rely solely on the aggregate display. And through server impersonation the real data source could also easily and unnoticed by the end user be replaced by a fake one [12]. If not taken to this extreme, there still is the semantic trap: Data might be correct within a specific context, but if taken out of it can be completely wrong. While no technical solution seems apparent, organizational measures like again exact disclosure of sources could improve the situation.

Therefore mashups should include more security features themselves: Verifying the source (is it the genuine server, secure transfer etc.), registering "downstream" users (legal obligations for removing material might extend to these as well and might reduce security concerns, like in [6]), … For example, the widely-used Amazon webservices do not employ any kind of encryption and only a simple access key to authenticate users [1]. If such services have to be paid for there exists also the possibility of account hijacking, which should be secured against.

2.5. Online searches

Currently hotly disputed in Germany is the legalization of online searches of computers as the BGH decided that the current legal situation forbids them [4]. The discussion is a bit askew, as the main issue is not the "online" search, but rather the "hidden" search: computers can be searched at the moment without any problem through obtaining a search warrant, which would still be needed, and seizing the computer. However, then they would not have to rely on forensic evidence but could gather usage data in realtime, therefore obtaining a provably comprehensive picture. But for this also surveillance at the provider, like telephony interception, could be available (only encrypted traffic would be inaccessible). Apart from privacy problems this is a security issue as well. The basic idea is that law enforcement officers hack a computer or infect it with a Trojan so they can then inspect its content over the Internet. This is exactly the same as criminals do and so might be indistinguishable for users noticing it: Am I officially and legally spied at or is it a criminal? Additionally, most criminals, especially the more dangerous ones this scheme is intended to help against, will secure their computer against unauthorized access and not click on every attachment or download various software, so this attack will not work easily on them. To protect against this, backdoors might be introduced or the patching of security holes delayed, resulting in severely reduced security for the rest of the world. The result would be a kind of race between police and hackers, who builds the best hacking kit/Trojan. Moreover, it can reasonably be assumed that the "official" software will be disclosed to the public at some time (probably rather early) and then be used by those criminals it was designed to work against for their own uses.

The Trojan would remove itself or be deactivated after the search. Still, in the period up to this point in time the computer is not only an object of search, but if the method of access is know (as can be expected) open to the world at large. This means, that everyone can inspect the computer, not only law enforcement (unless the Trojan itself employs extensive security measures like encryption and authentication of the information recipient). Especially for companies this can be dangerous: Suppose in a large company one person employs the computer for private and illegal activities besides the work, or just comes under suspicion because of actions taken solely at home. Then the computer might be infected to search it, including measures to overcome all security boundaries. At that time competitors can easily contact this computer and start new attacks from the inside. And note: bringing someone under suspicion is not that difficult, and because such searches are hidden, might be preferred by the police and even the accused to avoid publicity. If they manage to hack at least one other computer, subsequent removal of the "official" Trojan won't matter: Security has been breached by the help of the government, who would become the associate of a crime.

In addition to obtaining information, through the direct computer access files could be added or modified too. They would be indistinguishable from genuine files, allowing planting evidence unnoticed. While this may rarely be a real problem, it can be exploited by others, is a psychological problem, and might be used as a defence by real criminals. E.g., obtaining a hash value of the complete disk as currently done in forensic examinations would not help: The disk *will* change because of innocent actions after the search; only separate backups could help.

3. New assessment of privacy

In the last decades, privacy was seen as an important asset, although people usually cared not too much about it: Only if they were personally affected or a case with sufficient publicity occurred, it was considered as important. This can also be observed through the prevalence of club/customer/membership/… cards, where each purchase made is stored for future use, for instance in advertisements, in exchange for often extremely minor benefits (1% of the yearly total is e.g. in shops with rare purchases only a negligible sum).

The war on terrorism changed this and privacy is primarily seen as a hindrance in combating it and a defence for criminals: "Good" people don't have anything to conceal. Because of this, and not a widespread rise in crime actually affecting many people, privacy is being reduced through many means, including legislation; see e.g. the EU directive on data retention.

The importance of bringing privacy to the end-users is made clear by a study [13] which found out, that an important factor influencing people to read privacy notices on web sites is, whether they perceived that they were able to understand these in the past. Privacy notices easy to read are therefore not only read more often, but also influence people to read them on other sites.

3.1. Video surveillance

Apart from the surveillance mentioned in the introduction, increasing the feeling of security (and as a response to singular incidents) is often the reason for the introduction of video monitoring. It should be noted, that in the area with the largest number of cameras, Great Britain, a study by the home office [9] found that only small benefits in certain areas/circumstances could be gained because of them (see also [18] for similar comments from the police). It mentions specifically, that improvements were experienced in closed and small areas and regarding premeditated crimes, especially car theft from parking lots, and that, although not statistically significant, the feeling of safety increased. Privacy issues seemed not to occur, as no significant shift of persons visiting monitored areas occurred. However as a counter-argument, despite e.g. a 100% video surveillance of banks, still many bank robberies occur every year and several of them remain unsolved. And caught are especially the "amateurs", which perhaps might have been caught otherwise as well.

In essence it could be argued that in most cases video surveillance is just a replacement for a physical guard with the added benefit of a perfect memory. However, staff reduction is only possible to a certain degree, as cameras still must be monitored: The best effects bring manually guided cameras, while auto-sweeping or fixed cameras are less successful both as deterrent and for gathering evidence according to the British study. Cost reductions are also not that easy, as good systems are expensive and require additional measures, e.g. improved lighting of streets in residential areas to produce useful pictures at night.

Obviously especially ineffective would surveillance be against terrorist attacks. Not only suicide bombings, but also other modes are typically performed by up to then unknown persons and with a very brief window for countermeasures.

3.2. Data retention

Data retention is mainly about keeping log files for future use. This is also the most controversial aspect in this context. Basically, the concept is the same as with video surveillance: Helping to identify culprits after the crime and acting as a deterrent through the knowledge of being observed. Therefore it also suffers from the same problems, sometimes to an even larger degree: While "personal" crime cannot easily be shifted because of the need to travel, serious computer crime can easily be outsourced to (or routed through) a remote location with no retention rules. In comparison, only the very naïve or careless will be caught by data retention as countermeasures are simple, like encryption, book codes, non-standard ports, alternative communication software etc. Because of the amount of data in transit, only a tiny amount can actually be retained technically, i.e. typically only the IP address assigned to a computer at a certain point in time and start- and endpoints of communication (VoIP calls, E-Mails), but not the communication content. In comparison, an individual surveillance in case of specific suspicions can easily encompass the whole communication data. So data retention is probably even worse as a security feature when compared to video surveillance: Huge amounts of personal data are amassed to combat small misdemeanours.

This is exemplified by the groups most interested in it and who use the existing measures extensively: Software and music industry trying to obtain information on file sharers. The current modus operandi in Germany is starting criminal proceedings, resulting in the identification of the person through the provider. Then industry inspects the court records and starts private proceedings for compensation. Criminal proceedings are typically abandoned because of small value/low guilt. Examples involved e.g. 20.000 such proceedings in 6-7/2005 (computer game uploads; [10]) or approx. 1000/month (music industry; [11]) with courts complaining about the additional work not resulting in judgments. This lead to problems for providers too, who received hundreds of E-Mails with requests to retain the identification information; these requests were in the end declared as illegal.

The logical solution would therefore be the automatic retention of all such information as required by the directive and the automation of disclosure. Then the question arises, who may access these logs and when, i.e. which proofs are needed before the logs can be inspected? So secure logging is very important, as not everybody should easily gain access (music industry e.g. pushes for direct access without court orders). Hotly debated is also the final destruction of the information: When will logs be deleted? This might range from seven days (suggestion by data protection officials) to 15 years (plans of Poland). In this context it should also be noted, that long retention means less options for persons to prove their innocence, as it is difficult to remember (compare this e.g. to receipts, which need be kept only for three years by private persons and seven years for companies).

3.3. The "digital curriculum"

A factor in recruiting employees has always been their history. For example, in Austria there is an obligation to provide employees a written reference when they leave, with the additional precaution, that nothing detrimental to them may be contained in it. The latter resulted in a set of "codes" used and direct phone calls to obtain a more informative picture of applicants. But with e.g. Google now a lot of information about the past conduct of a person in the Internet or its "surroundings" (like various result/attendance lists put online) can be gathered about a person, for which no filter exists at all, neither regulatory nor through a person. This can be especially troublesome if other persons with the same name exists (which is quite common), as very often no unique identification is possible: If someone called "Michael Sonntag" posted on a bulletin board, this will be accessible for the public for many years. But whether this person actually is named "Michael Sonntag" and which of the several ones (including the ones from academia) it was, cannot be determined. But these important distinctions are often ignored during such searches or unknown.

Moreover, typically no facilities for removing elements exist. Although deletion is technically simple, applications often forbid it (e.g. "abandoned" child posts in forums). So anonymisation is very important right from the start for all publicly accessible data. And while author information should not be available publicly, it can easily be logged (securely) so court proceedings remain possible (see e.g. discussion boards which just show the IP address or the fact that the IP address/Registration name has been logged). In addition, every website operator should identify whether there is a need for complete indexing of the website or whether the homepage and a few levels below suffice. An alternative are (simple) security features, like captchas or obligatory registration (→ valid E-Mail address, which could then be used to identify the person through ISP data retention).

3.4. Data (Non-) Destruction and computer forensics

Both a privacy and security issue is the (non-)destruction of data, which often does not occur at the end of its lifecycle. Typically only some information is deleted, but numerous backups and copies exist. This is even worse for non-digital, i.e. paper information (see the custom of "dumpster diving" for obtaining information on companies and persons for various uses). Even in high-security areas laptops get missing and hard disks are sold or thrown away without wiping. This is especially prevalent for "normal" users, who do not possess knowledge about this and the associated dangers. This might be a bit different e.g. in the

USA, where credit card fraud because of receipts thrown away (applying for a new/replacement credit card to be sent to a different address which is possible because of the information such obtained) occurs more often.

While computer forensics is a complex area for specialists, users are often not aware what can be extracted from a computer even with very simple utilities or trivial methods. This includes E-Mail correspondence, browsing history, files opened etc. If such information is gathered or stored by a program, it should be designed so users can control such features and delete the data. See e.g. the Firefox browser, which contains a menu entry for clearing all private data and allows configuring when which information will be deleted automatically (download history, cookies, form information, cache, …). However, increased use of such features might prompt further requests for hidden searches, although the persons they are intended against probably use them already.

Computer forensics can also be seen as a measure to (partially) replace data retention: Instead of affecting all persons, only specific ones are touched in their rights. More importantly, it contains an automatic balancing factor: There are costs associated with it, so it will not be used for trivial crimes. The biggest drawback is, however, that only the presence of some information can be proven, but there is no guarantee that the information had not been there at some point in time and been deleted since. Comparatively advantageous is, that much more data is available, perhaps identifying not only a computer which uploaded music, but the actual user who installed and used the software and to which extent this took place.

4. Conclusions

As can be seen from the examples discussed briefly, security has many facets and moves from technical aspects and decisions to issues a society must decide upon and each person must take care of herself. Apart from this, also a technological challenge exists: Users must be empowered to protect themselves from attacks on both general information (security) and personal data (privacy). This means more options for users to select which information is available for whom and under which circumstances it should be deleted.

Such a mismatch in perception can also be seen in a recent study [7] exposing that hackers are only responsible for 31% of incidents resulting in compromised personal data, while 60% involve missing or stolen hardware, insider abuse or theft, administrative errors or accidentally exposing data online. However, regarding the amount of data number are in reverse: hackers account for 45% of data disclosed unintentionally, while organizational mismanagement is responsible for only 27%. This shows that hackers are not really a widespread problem, but rather professionals aiming at comparatively large targets. Specifically securing these targets therefore seems more important than observation of all users.

Specifically problematic is therefore the increased gathering of information "just in case": data retention, (video) surveillance, search engine archives etc. Because if information exists, it will later be used for various purposes it was not originally intended for (and is not necessarily useful for; see above). The main argument "you don't want to let a criminal go free, do you?" is very deceptive: If everyone is in jail, so are all the criminals, but this is certainly not the position the non-criminals want to experience. Gathering information should therefore be restricted to specific instances with good justification, but should then be available to encompass even larger areas.

The first consequences of this extensive data gathering now comes back to the persons it refers to: "Digital curricula" provide not only embarrassing, but actually damaging information. Although a negative result, it might spark improved consciousness in end users. Remembering to restrict information divulged and providing tools to manage this easily is therefore a very important challenge for the future, both for technology and education.

5. References

[1] Amazon Web Services, http://aws.amazon.com/

[2] Broersma, M.: Microsoft: UAC not a security feature. Techworld, http://www.techworld.com/security/news/index.cfm?NewsID=8031

[3] CipherTrust: CipherTrust's Zombie Stats: http://www.ciphertrust.com/resources/statistics/zombie.php

[4] Decision of the 3. penal senate of the BGH from 31.1.2007, StB 18/06, http://juris.bundesgerichtshof.de/cgi-bin/rechtsprechung/document.py?Gericht=bgh&Art=pm&Datum=2007&Sort=3&nr=38779&linked=bes&Blank=1&file=dokument.pdf

[5] Dhamija, R., Tygar J., The Battle Against Phishing: Dynamic Security Skins. Symposium On Usable Privacy and Security (SOUPS) 2005, ACM 2005, 77

[6] Eberly, J., World's worst use of a jpeg. http://blog.eberly.org/2006/10/12/worlds-worst-use-of-a-jpeg/

[7] Erickson, K., Howard, P., A Case of Mistaken Identity? News Accounts of Hackers and Organizational Responsibility for Compromised Digital Records, 1980-2006. Journal of Computer Mediated Communication, 4(12) (2007)

[8] European Computer Driving License Foundation http://www.ecdl.com/

[9] Gill, M., Spriggs, A.: Assessing the impact of CCTV. Home Office Research Study 292, 2005

[10] Heise: Strafanzeigen-Maschinerie gegen Tauschbörsen-Nutzer http://www.heise.de/newsticker/meldung/63635

[11]Krempel, S.: Musikindustrie verteidigt geplante Massenanzeigen gegen P2P-Nutzer http://www.heise.de/newsticker/meldung/83670

[12]Marks, P., 'Mashup' websites are a hacker's dream come true. http://www.newscientisttech.com/article.ns?id=mg19025516.400

[13]Milne, G., Culnan, M., Strategies for reducing online privacy risks: Why consumers read (or don't read) online privacy notices. Journal of Interactive Marketing, 3(18), 15 (2004)

[14]Orwell, G., 1984.

[15]Prolexic: The Prolexic Zombie Report http://www.prolexic.com/zr/

[16]Schneier, B., The Failure of Two-Factor Authentication, http://www.schneier.com/blog/archives/2005/03/the_failure_of.html

[17]Sonntag, M., Ajax Security in Groupware. 32nd Euromicro Conference on Software Engineering and Advanced Applications (SEAA) 2006. Los Alamitos: IEEE Computer Socitey 2006, 472

[18]taz, Details unbekannt - Polizeiliche Kriminologen sehen Forschungsbedarf: Nicht alles, was die Polizei tut, macht nachweislich Sinn http://www.taz.de/pt/2005/07/09/a0326.1/text

UPCOMING PRIVACY ISSUES IN ASYNCHRONOUS ADAPTIVE HYPERMEDIA SYSTEMS

Andreas Putzinger*

This paper introduces the concept of asynchronous adaptive hypermedia systems for the first time.

Furthermore, the related upcoming new features are shown and put in context of privacy.

1. Bigger picture

It is widely acknowledged that Adaptive Hypermedia Systems (AHS) can successfully be applied to several different application domains. The first summarizing taxonomy was published in [7] and later updated in [8]. The term AHS identifies systems, which " [. . .]build a model of the individual user and apply it for adaptation to that user, for example, to adapt the contents of a hypermedia page to the user's knowledge and goals, or to suggest the most relevant links to follow.[. . .]" ([7]). To be more precise adaptive techniques empower applications to feature personalization, like individual recommenders (e.g. [24]) or personal guidance functions (e.g. [27], [9], [10]). Although the community originally working on User Model research reacted to the upcoming web by establishing AHS, technologies, commonly referred to as "Web 2.0" (e.g. [19]) have yet to make their mark on the scene. The focus of research in the author's ongoing PhD thesis is the concept of asynchronicity in AHS, whereas "asynchronous" in the context of the World Wide Web refers to the actual transmission of data, which takes place out-of-band, i.e. not within the main HTTP request–response cycle. So far it seems that to date no research group has published results yet regarding this topic, which would specifically focus on the impact of asynchronous communication in AHS, related privacy issues or the range of upcoming possibilities. Some individual publications address very specific parts. Barla in[4]e.g. uses asynchronous techniques to get more precise information from the client's context.

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2. Person Related Data in AHS

The field of AHS has by nature always been tightly connected with privacy and legal issues, because many kinds of personal information as well as user performed actions are retrieved, transmitted, processed, deduced and finally persistently stored on the server side. These data are used to model different aspects of the realworld, which are mostly user specific facets, as e.g. personal preferences, skills, interests and information about the user's environment, etc. Using acknowledged and well-established techniques, as e.g. collaborative filtering (e.g.[20]), data mining algorithms, stereotyping ([22],[23],[5]),help to deduce additional information. So the system has to handle a broad variety of data, which are uniquely linked with real people. The system itself as well as the processes must therefore correlate with international, country and state law. Legal precautions must be followed, so that the required level of privacy can be guaranteed.

3. Legal situation

Legal restrictions about privacy apply as soon as a "virtual" user in a system can be mapped to a real person. Some authors have already addressed privacy issues in AHS, especially Alfred Kobsa([15], [16]or[17],to name but a few).

The European Union has released several directives which regulate privacy issues in electronic communication. In the year 2002 the "directive on privacy and electronic communications"[1] was published, and finally implemented in Austria within "Telekommunikationsgesetz 2003 (TKG 2003)"2[2], whereas the usage of browser cookies, spamming, log files and location based services are mainly addressed, to name only internet related services. § 99 addresses traffic data, which are not directly relevant to asynchronous AHS, because the transmitted data in AHS are of a higher level. According to § 101 our data are classified as "content data", which may not be stored at all, if storing is not part of the service itself or storing is not a technical requirement for fulfilling the requested service. In this case the content data must be deleted immediately as soon as the service has been fulfilled. § 96 contains the main privacy paragraphs. The main points are, that the service provider must inform the clients, which person related data are retrieved, processed and

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[1] http:europa.eu.int/eur-lex/pri/en/oj/dat/2002/l l201/l20120020731en00370047. .pdf f

[2] http://www.rtr.at/web.nsf/deutsch/Telekommunikation nTelekommunikationsrecht tTKG+2003

transferred. The provider must refer to the law which allows him to use the data, for what reasons he would like to do this and for what period of time the data are being stored. All this information has to be included e.g. in the general “terms of business”.

The second relevant European Union directive is “on the protection of individuals with regard to the processing of personal data and on the free movement of such data”[3]. The directive was implemented in Austria in the year 2000 within the “Datenschutzgesetz 2000” (DSG 2000)4[4] and defines again among other things requirements for retrieving, processing and storing data. If we exclude the so called “sensitive data” of § 4(ethnic, political attitude, religion, etc.), which must be handled more strictly, the law defines to name all the data retrieved, collected, processed and stored in the terms of business, to mention the exact reasons why these data are needed and to inform the user concerning what happens with the data. Furthermore, the service provider has to guarantee that the data will be deleted as soon as it is no longer needed. There are further restrictions applied in DSG 2000 which will not be elaborated on due their length.

4. The Upcoming Aspect of Asynchronicity

Techniques for asynchronous communication in the web are wide–spread and provide the substantial base for many so–called Rich Internet Applications (RIA,[2]).A rather well known catch phrase in this context is AJAX (Asynchronous JavaScript and XML), which was introduced in [13]. Usually XMLHttpRequest ([26]) is used as underlying communication technology. Many different frame-works inherently support AJAX by providing high–level components and therefore abstracting from technical low–level details. The following are examples of such: Dojo[5], Echo[6] ,DWR [7],GoogleWeb Toolkit GWT [8] or ASP.NET AJAX [9] to simply name some important ones. One main goal of the Web 2.0 is to bridge the gap between desktop and web applications in aspects of the look and feel, but also in

[3] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0058:EN: :HTML

[4] http://www.dsk.gv.at/dsg2000d.htm

[5] http://www.dojotoolkit.org

[6] http://nextapp.com/platform/echo2/echo/

[7] http://getahead.org/dwr/

[8] http://code.google.com/webtoolkit/

[9] 9http://ajax.asp.net/

communication and latency matters. Investigations about former constraints in the web, i.e. without modern Web 2.0 technologies, have been made in [6].

Asynchronous calls make it possible for a page not to be blocked and still usable during the period of actual communication. Therefore, unless the user monitors his internet activity, theymay not even be aware of the fact that there are data transfers going on in the background. The asynchronously sent data per se cannot differ from synchronously transmitted data due to sandbox restrictions. The fact, however, that detailed information about user context and actions can be sent in realtime [10] can mean a deep intrusion into one's privacy, as explained in more detail in the following sections.

The question may arise as to how far this asynchronous technology actually provides new possibilities. Since asynchronously transferred data could theoretically be also transmitted synchronously by transparently bundling it with the next page–request; therefore all messages haveto be collected and cached locally at the client and "piggybacked"on the next HTTP request. Yet, on closer examination this technique is not of equal potential as asynchronous transmissions. E.g. if the user manually leaves the site, closes the browser window, etc. all accumulated data from the point of entering the site until the point of leaving are lost. In addition, and this represents the main drawback, the advantage of a communication with only a short latencyis lost. Thus piggybacking data is not always an alternative to asynchronous communication. Further considerations concerning AJAX security can be found in [25]and[12].

The new facet in asynchronous systems is the aspect of the point in time when the actual communication takes place. Thus, data about any inspectable property or monitored user behaviour could technically be sent to the server at anytime without the user's explicit approval or even awareness. In the author's opinion, it is legally relevant to add the "any time" fact to the privacy declaration, wherever person related data is transferred that way, because it does not represent the state of the art. Therefore, the user must be additionally informed in detail when and how often his performed actions, properties, etc. are monitored and transferred. In many cases it is not obvious to the user when and what data is being transferred, and therefore the user's approval cannot legally be taken as implied, because

[10] In this paper "realtime" means thefact, that data are transmitted withouta long latency on the client side, regardless of the time of physical transmission. The term used here does not imply such strict criterias as e.g. in the context of operating systems.

asynchronous data transfer take place in the background and the user is mostly unaware of them.

5. Impact on Functionality of AHS and Privacy

The combination of AHS and asynchronous techniques opens a great variety of new possibilities in the adaptive field and will, at least in the opinion of the author, start a new era of AHS. Not only more responsive and desktop–like user interfaces will be possible, but also enhanced adaptive technologies empowered by constant bidirectional channels between browser and server ([1]),as described in detail below.

The pool of information which can be inspected and monitored is the same as in synchronous application, because in both cases the complete variety of JavaScript objects can be accessed. The following enumeration shows the most important examples for new low-level techniques together with their high-level impact in adaptivity as well as upcoming privacy issues.

5.1. Monitoring the user's mouse

In some cases of applications it is helpful to get realtime information about the mouse activity on the client–side, i.e. the current position of the mouse cursor, what's currently under the cursor (which text, picture, etc.), any cursor movement, miscellaneous timing data, i.e. how fast or slow the user is moving the mouse e.g. or how high the latency between double-clicks is, which mouse button is clicked on which position, etc. All these data are obviously interesting in Human Computer Interaction research (HCI) in order to remotely monitor users' behaviour while using a site and therefore to simply test certain aspects of us-ability. These data are also useful for user modeling purposes. First studies about recording and evaluating mouse activity on the client side has already been done in[3]. Mouse movements are also a good example for the fact, that in many cases a single value at one certain moment in time is not relevant, but in fact the delta or the calculated trend of that value over a period of time could be significant. The information of mouse movements e.g. can be deduced from the position information of the cursor over a period of time.

The following example shows, how the position of the mouse cursor can help to retrieve valuable data for the short term user model. Many children at school portray a specific behaviour when they learn to read: they use one of their fingers as a "marker" and "guide" for the characters they are just reading, which helps them not to get lost in the text, to visually and therefore mentally focus on the specific word. Many users show a similar behaviour when using computer applications, as e.g. websites in browsers. [21]shows that if the task solving process requires mouse operations and the visual feedback of the results of these mouse operations appears close to the mouse cursor, then the visual focus and the mouse cursor position on the screen are highly correlated: between 76% and 95% correspondence. The current focus of users on a website is a very important and frequently asked-for information and could e.g. be used to unobtrusively offer context-sensitive help, etc. Further, many users have acquired a specific form of behaviour in the web, to position the mouse cursor over the object of interest, because in some cases yellow hint texts with further information appear. A consequent application of this pattern would be desirable in AHS research, because it could be an excellent source for interest derivation.

From the perspective of privacy transmitting mouse events in realtime is an extensive invasion. So the user must in any case be informed about that. The data could be processed on the server in realtime, so that the raw data are not saved permanently. Should this still be done e.g. for HCI purposes, then it is recommended to store the usage data in an anonymized form after the actual web session has ended. If the user decides not to accept the transfer of mouse data over the web, the application should be designed robust enough to handle the lack of this kind of non-vital data and should continue working as efficiently as possible.

5.2. MonitoringKeyStrokes

A second category of usage data contains raw key strokes, which could be transmitted key-by-key in realtime or also bunched. So the application not only gets the finally submitted form data, but also the intermediary states, the involved timings, etc. The user's typing speed together with some other aspects can in some cases e.g. be regarded as a good indicator for the user's overall computer skills. A second example is the introduction of adaptive text completion or recommendation. Adapted to the user model the system suggests words or even complete paragraphs, which fit in with the context and presumably the user's current needs.

The two just mentioned groups (i.e. mouse events and keystrokes) can individually or combined improve results in plan recognition ([11],[18],[14]) by modelling a clearer picture of the user's current activities. Furthermore the simple transmission of a key stroke or of a mouse event is an implicit indication for the fact, that the user is still working with the application, and that the application session should not timeout, which e.g. sometimes accidentally occurs when users write long emails in web mailing systems, because the users do not interact with the server a longer time span.

The privacy issues here are very similar to the ones previously mentioned. The user must be informed in detail about the fact, that keystrokes are asynchronously transmitted, how the data are being processed, why this happens, and for how long it is stored. The application should again be built in a way that these data are treated as optional and not as vital.

5.3. "Still Alive" Messages

If neither keystrokes nor mouse events are asynchronously transmitted, explicit "still alive" messages could be introduced to inform the server about the fact that a person is still working with the web application, if this is really the case. This could e.g. be used in e-learning environments, where the user gets lots of texts to locally read and learn and therefore does not interact with the server in regular intervals.

If the "still alive" message does not contain any further personal information it is not absolutely necessary to add this fact to the privacy declaration, because no personal data per se are transferred or stored. Performing dummy requests to the server which uniquely identify the current web session in order tokeep the session alive, is state of the art for years. Many web applications do e.g. a periodic reload of a frame whereby the "stillalive" information is implicit and for free. So there is no need to add the usage of this technique explicitely to the privacy declaration.

5.4. Subscriber Model

Another concept, which becomes possible by using asynchronous techniques, is the general concept of an on-change subscriber model. The server can subscribe to certain values on the client–side. If these values change, a notification is forwarded to the server containing the property, the old and new values and a timestamp.

As an example the server could subscribe to the scroll position of the browser window. As soon as the user scrolls up, down, left or right on the page, the server gets informed about this action. This also works well with the mouse position, for example, or window width and height, content selection, etc.

Because the subscriber model is a very general concept and only becomes possible in AHS through asynchronicity, privacy issues are not directly relevant in this context, but must be treated individually in consideration of the subscribed value.

5.5. On–Demand Data Retrieval

Due to the possibility of establishing a bidirectional communication channel also the server can initiate a request. Whenever some data are needed from the client, the server simply asks for it. The communication itself is of course done asynchronously in the background and even without the user's awareness.

Again privacy issues have to be solved individually in respect of the content.

5.6. Instant Adaptation

The author has developed concepts which allow page fragments to be dynamically exchanged according to results of the underlying adaptive system11. The chosen name for this technique is "instant adaptation". Changes to the user model, which in turn cause changes on the currently shown page, can instantly be pushed to the client as fragments. Thus the possibilities for adaptation are becoming much richer. In traditional adaptive web application the actual adaptation takes place once, when the page is generated. From this point onwards, the page is static in respect of adaptation, because it is sent back to the client and no further adaptation takes place until the next complete page is generated.

The technique of instant adaptation enables AHS to exchange parts of pages, which are already shown in the browser, on the fly by pushing this fragment to the client. Some client logics dynamically replaces, adds or, modifies the specified part. This technology is new and seems to be quite powerful, but nevertheless the designer of a such system has to be very careful in using these methods. Studies have shown, that a dynamically changed user interface often confuses people and therefore does not always have a positive impact on the overall system ([28]), as for example the Microsoft Office Assistant shows12 .

Due to the fact that the nature of instant adaptation only foresees a server to client communication, privacy issues are not relevant in this context.

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[11] 11To be published in the author's PhD thesis

[12] see http://www.microsoft.com/presspass/features/2001/apr01/04-11clippy.mspx

6. Conclusion and Future Work

This paper has presented certain parts of the results in context of the author's ongoing PhD thesis with a special focus on privacy impacts. As far as asynchronous AHS are concerned it has to be investigated how the proposed techniques can successfully be applied in real and non-academic adaptive hypermedia applications. Empirical studies have to show how stable these systems can be built because of the variety of different browsers, latencies, etc. It has also to be investigated which further information could be deduced from the retrieved raw data.

As far as privacy is concerned synchronous web applications have already had a tremendous impact due to the broad variety of inspectable information in the browser environment. The aspect of asynchronicity raises the problem to the next step. Realtime communication facilities again lower the level of privacy in the web. In theory the existing legal regulations are still good enough to handle the current situation, but in practice users are often overcharged in understanding and assessing the impact of the shown terms of business and therefore in the privacy declaration in case that these are correct or existential. Further, user do not always have a fair chance to decline, because they would simply be barred from the service completely instead of getting a feature-reduced version of the same application.

For service providers it is now an extensive effort to legally be on the safe side, especially when the application relies on user models, which is the case in the majority of AHS. In the future efforts will be dedicated to the investigation if and to what extent it is possible to programmatically assist in the process of creating the textual terms of business regarding privacy by inspecting rules within the user modeling process. As a result the obligatory individual declaration of privacy should be created automatically. The resulting text should contain information about the quality and quantity of collected data, modalities in the retrieving process, information about the processing, deducing and storing of the data. In a further step a complete framework could be designed and implemented, which features complete processes and implements a lifecycle of privacy enhanced user modeling.

7. References

[1] Alessandro Alinone. Changing the web paradigm -moving from traditional web applications to streaming-ajax. *published online: http://www.lightstreamer.com/Lightstreamer Paradigm.pdf*, 2005.

[2] Jeremy Allaire.Macromedia flash mx -a next generation rich client. *published online: http://download.macromedia.com/pub/flash/whitepapers/richclient.pdf*, 2002.

[3] Richard Atterer, Monika Wnuk, and Albrecht Schmidt. Knowing the user's every move: user activity tracking for website usability evaluation and implicit interaction. In *WWW '06: Pro-ceedings of the 15th international conference on WorldWideWeb*, pages 203–212, NewYork, NY, USA, 2006.ACM Press.

[4] Michal Barla.Interception of user's interests on the web. In *Proceedings of the International Conference on Adaptive Hypermedia (AH)*,volume 4018 of *Lecture Notes in Computer Science*, pages 435–439. Springer,62006.

[5] I. Beaumont. *User Models and User Adapted Interaction*, chapter User modeling in the interac-tive anatomy tutoring system ANATOMTUTOR, pages 21–45. Springer, 1994.

[6] Alan Borning, Richard Lin, and Kim Marriott. Constraints for the web. In *MULTIMEDIA '97: Proceedings of the fifth ACM international conference on Multimedia*, pages 173–182, New York,NY, USA, 1997.ACM Press.

[7] Peter Brusilovsky. Methods and techniques of adaptive hypermedia. *User Modeling and User-Adapted Interaction*, 6(2-3):87–129, 1996.

[8] Peter Brusilovsky. Adaptive hypermedia. *User Modeling and User-Adapted Interaction*, 11(1-2):87–110, 2001.

[9] Peter Brusilovsky. Adaptive navigation support: From adaptive hypermedia to the adaptive web and beyond. *PsychNology*, 2(1):7–23, 2004.

[10] Peter Brusilovsky and MarkT. Maybury. From adaptive hypermedia to the adaptive web. *Commun.ACM*, 45(5):30–33, 2002.

[11] Sandra Carberry.Techniques for plan recognition. *User Modeling and User-Adapted Interaction*, 11(1-2):31–48, 2001.

[12] StefanoDiPaola. Subverting ajax. In *Proceedings of 23rdCCC Conference, Berlin*, 2006.

[13] Jesse James Garrett. Ajax: A new approach to web applications. *published online: http://www.adaptivepath.com/publications/essays/archives/000385.php*, 02 2005.

[14] Kristina Hook. Evaluating the utility and usabilityofan adaptive hypermedia system. In *IUI '97: Proceedings of the 2nd international conference on Intelligent user interfaces*, pages 179–186, NewYork,NY, USA, 1997.ACM Press.

[15] Alfred Kobsa.Tailoring privacy to users' needs. In *UM '01: Proceedings of the 8th International Conference on User Modeling 2001*, pages 303–313, London, UK, 2001. Springer-Verlag.

[16] Alfred Kobsa. Personalized hypermedia and international privacy. *Commun.ACM*,45(5):64–67, 2002.

[17] Alfred Kobsa. *Privacy-Enhanced Web Personalization*. Lecture Notes in Computer Science, Vol. 4321. Springer, Berlin, 2007.11

[18] H. Kristina,J. Karlgren,A.Waern,N. Dahlback,C. Jansson,K. Karlgren, andB. Lemaire.A glass box approach to adaptive hypermedia, 1996.

[19] TimO'reilly. What is web 2.0? *published online: http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html*, 09 2005.

[20] Stefano Guida Antonio Piccinno GiuseppeTesoroPaolo Buono, Maria Francesca Costabile. In-tegrating user data and collaborative filtering in a web recommendation system. In *Proceedings of the Eight International Conference on User Modeling, 2001*, 2001.

[21] Matthias Rauterbergand Christian Cachin. Locating the primary attention focus of the user. In *VCHCI*, pages 129–140, 1993.

[22] E. Rich. User modeling via stereotypes. *Cognitive Science*, 3:329–354, 1979.

[23] Elaine Rich. Users are individuals: Individualizing user models. *International Journal of Man-Machine Studies*, 18(3):199–214, 1983.

[24] Alan F. Smeaton and Jamie Callan.Personalisation and recommender systems in digital li-braries. *International Journal on Digital Libraries*, V5(4):299–308, 2005.

[25] Michael Sonntag. Ajax security in groupware.In *32nd EUROMICROConference on Software Engineering and Advanced Applications (EUROMICRO'06)*, 2006.

[26] Annevan Kesteren. The xmlhttprequest object. *http://www.w3.org/TR/XMLHttpRequest/*, 2007.

[27] G. Weber and M. Specht.*User Modeling and Adaptive Navigation Support in WWW-based Tutoring Systems*, pages 289–300. Springer–VerlagWien, 1997.

[28] Jun Xiao, John Stasko, and Richard Catrambone.An empirical study of the effect of agent competence on user performance and perception. In *AAMAS '04: Proceedings of the Third International Joint Conference on Autonomous Agents and Multiagent Systems*, pages 178–185, Washington, DC, USA, 2004. IEEE Computer Society.

Management of Software Projects

SOFTWARE PROJECT MANAGEMENT: MAKING SOFT FACTORS' IMPACT MEASURABLE

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Majority of the activities in XXI century, especially at software companies, is realized in the form of projects. In consequence, the success factors of any enterprise became the research objectives and practical target of all those who get involved in project management: the researchers, project managers, investors, department leaders. State-of-the-art recognizes the social aspects as the key success factor of software project management. Many researchers and practitioners proved an importance of soft factors (interchangeably called also human factors) in software project management and concluded that further research in that area is justified and still needed.

In this keynote an overview of soft factors and their classification within the several dedicated project management processes along the L-Timer™ methodology is given. An individual contribution of each soft (human) factor process to the overall software project success is considered. Influence, relevance and impact of soft factors vary in different project phases as presented hereafter. The keynote aims at defining what competent human factor project management means and what are the benefits out of it. Conscious deployment of the soft factors management is a powerful tool in the hands of project manager. Vast literature demonstrates that mastering the soft factors management reduces the number of failed or challenged projects. In my paper presented at IDIMT 2006 I demonstrated an impact of team cohesiveness on project team performance. I am thankful for the opportunity to follow a broader approach within the area of human factor management at IDIMT 2007. The social skills of project manager and soft factors processes are immeasurable. However, their impact on project success might be measured. Certain model is developed and the research objectives are set. An approach to collect the necessary data to verify the usefulness of this model is presented in the keynote. I look forward to fruitful exchange of opinions and scientific discussion of the soft factors issues during the conference.

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1. Soft factors in project management - State of the art

Many thought leaders and academics suspect a major link missing from the project management armory is a focus on the humanity of the human beings that ultimately have to work together for a project to succeed.
Sue Bushell, 2006 [5]

Software project management is one of sectors with the highest rate of the project failure in the world [32]. Since the late 1960s (at least) project management researchers have been trying to find out the main reasons of this unsatisfactory situation [2, 13, 26]. Until 1990 the answers, why projects success or fail, were searched along the Golden Triangle Theory. Here the time, cost and quality parameters are considered to be the key factors to control and manage [1, 19]. The Golden Triangle Theory changed only slightly over more than thirty years: e.g. by extensions like technical objectives [11], user requirements [3, 9, 30] and so on. However, project success was always estimated from the Golden Triangle perspectives.

Only recently researchers turned their attention to the factors like human interaction, project team satisfaction, effective communication, etc. [33]. An emphasis has been put on the project manager soft skills in particular. Several different theories about project success factors can be met in literature [1, 3, 9, 22, 28, 30, 31] and discussion about that what is more important: hard or soft factors, is still the subject of a dispute. Nevertheless, nowadays no one opposes the facts, that:

- soft (human) factors have to be taken into consideration in successful project management and
- project leader needs to master special soft skills necessary for successful team management [18].

A number of organizations, like Polaris, Sun Microsystems and Mastek [32] recognized the importance of human factor and adjusted subsequently their trainings for project managers.

But what means “human or soft factors”?

2. What is the "Soft Factor", what is "Human Factor"

The only definition of "soft factors" may be found in Wohlin article [35]. Author refers to all non-technical aspects, which are difficult to quantify, as "soft factors" in project management.

IPMA baseline [6] refers jointly to aspects like qualification of project personal, social behavior in conflicts, motivation of work and management style as "soft factors". The definition of "soft factors" is missing.

Far better situation is when we refer to the "human factor". A number of literature and search results [34, 36] put human factor in various contexts. However, the search of first 600 out of 316000 references under "human factor" definition gives no clear, cohesive answer as how shall it be defined. Only Burke et al [4] in their publication conclude that in essence the human factors relate to the interpersonal skills of the individuals involved with the project – individual abilities to work together toward a common goal, in the face of conflict, competition, turf, status, etc.

The search under "human factor in project management" results in 17 references. Neither gives a satisfactory definition of the term.

PMI [27], the leading organization in project management standards, built twofold classification scheme:

- Interpersonal skills, which includes:
    - Effective communication.
    - Influencing the organization – the ability "to get things done".
    - Leadership. Developing a vision and strategy.
    - Motivation. Energizing people to achieve high levels of performance.
    - Negotiation and conflict management.
    - Problem solving.
- Project human resource and communication management processes

The later includes among others also team and conflict management, too.

In majority of publications, where "human factor" occurs, authors consider the interaction of humans with a particular piece of software or hardware. This meaning originate from the scientific discipline called "human factor engineering" devoted to the interactions between humans and other elements of system [37]. A system may be IT hardware or software module but also a car production line or civil engineering solution.

Certain ongoing activities are said to be taking place within the CMMI-standard (7). Yet, no definition of “soft factor” or “human factor” originating from that standard is known to me so far.

For the purpose of this paper we adopt the term “human factor” and define it as a term used for the group of project management processes dealing with the impact of a human on the interpersonal relationship in project management. The list of human factor processes is given in the next chapter.

3. Human Factor Processes in Project Management

Project management processes may be split into two groups:

- measurable, “classical” project administration processes like planning, controlling, change management, risk (called by DeMarco “formulaic parts” [8]) and
- human factor related processes, where management impact is yet to be quantified [14].

Both groups are bound into the management system of L-Timer [15].

The international standards differentiate in their approach and identification of the project management processes. The L-Timer™ system in most comprehensive and complete way comprises these processes as far as the current research allows to conclude. Hence, in the following part of this paper the L-Timer™ system will be used to classify the forthcoming aspects.

A short characteristic of each of the human factor related processes along L-Timer system [15] is given hereafter.

3.1. HRM: Human Resource Management

HRM is the first of four processes which deal with the external interrelations between team members.

In HRM processes, project managers’ selects team members, assigns them to formal roles and assesses informal roles according to skills and experience. The most important questions which project manager has to answer during this process are:

- Whom does he need to the project?
- What does each member of project team expect?
- Do the people match with each other?
- How will he check whether he or his team expectations are fulfilled [16]?

Incorrect selection of people to roles and incompetent staffing fluctuation, not making efforts to meet team members needs and passing over training courses cause to failures in Human Resource Management process with negative consequences for the project.

3.2. TM: Team Management

The goal of team management process is to ensure the best possible efficiency of the complete project team measured against yielded performances, staff commitment, client satisfaction and process improvement.

The efficiency is determined by mutual trust, built on knowledge of the personalities and smallest details of daily life of each team member. It is achieved in the process of group integration. Luft [17] defined - what is now known as Johari Window – four combinations of a person's perception, built from the characteristics which are known by one himself and which are not known, the particularities, which other persons know about someone and an area which remains unknown to everybody. An integration process shall maximize the area of commonly known characteristics of all team members (Figure 1).

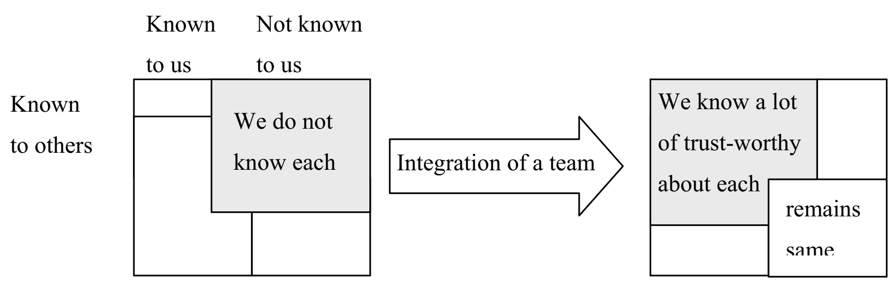

Figure 1 - Integration process

Tuckman's Stages model for a group states that the ideal group decision making process should occur in four stages:

- Forming (pretending to get on or get along with others);
- Storming (letting down the politeness barrier and trying to get down to the issues even if tempers flare up);
- Norming (getting used to each other and developing trust and productivity);
- Performing (working in a group to a common goal on a highly efficient and cooperative basis) [33].

Appropriate team management has significant impact on team performace and productivity [24].

3.3. CFM: Conflict Management

There is no team where sooner or later a conflict situation does not occur. Conflict dramatically reduces the efficiency of a team up to the point where a real crisis (no one believe in positive outcome any more) reduces the productivity to practical zero.

Project managers shall identify potentials of conflict in project teams and between team members and persons relevant to the project from the outside, further undertake actions to solve conflicts with suitable methods and technologies and finally secure the sustainability of the solution.

Conflict solution means weighting up possible strategies: shall I behave cooperatively or go militantly towards a confrontation? With the same possibilities for other conflicting party we get four combinations commonly deployed and known in gaming theory.

It is author strongest conviction that only a cooperation strategy for both parties is effective in software project management. Due to the vast number of possibilities a looser can pay back in software project, the final outcome of the conflict might be a Pyres win if we choose a confrontation course.

3.4. COM: Communication

Effective communication is one of the key motivators in a project. Maxfield [21] claims that 75% of all problems left after all “administrative” measures are applied are due to the missing communication between the team members and with the stake holders.

Communication comprises project marketing and unsolicited information, both exchanged ambiguously within the project team as well as with the outside world, which is relevant to achieving project goals.

Sending a message does not necessarily means that the other side understood us exactly the way we wanted. Beside, the interpretation of the message in a context, which is often unknown to the sending party, may result in a complete adverse picture compared to that, what was originally sent.

3.5. SM: Self Management (Work & Life Balance)

Self- Management is the first one of two equally important introvertical processes, targeting the personal contribution towards reaching the project objectives. SM is dedicated to the development of a personality, personal attitude, capability and objectives, work and life balance. It is a personal process of project managers, and shall be a process of each team member, too.

If we can handle our own resources well: time, health, intellectual capability, we can be expected to handle the complexity of a project. The emotional stability: a balance between the social and personal views on one side and positioning between the perception and behaviour on the other one, is decisive for trust of other team members. A positive attitude: I am ok – you are ok helps to preserve the balance and deploy efficiently the motivators, to the benefit of the project.

3.6. L: Leadership

Leadership is a particular process where skilful and conscious control of the behaviour of team members has an objective of causing actions towards the achievement of the project goals.

Motivating people is a key activity of a leader. According to Nash [23] leaders distinguish themselves by:

- strong will to win,
- focus on achieving the results,
- establishing the culture of readiness for changes,
- creating an atmosphere of trust.

The above characteristics are among the strongest motivators for the team. Average people, who never worked together and accidentally joined a project, being well motivated behave like gifted, uncommon geniuses, building the well functioning team together. This is called Pygmalion effect [20].

Perfect manager with all leadership skills is the key to the project success.

The above characteristics of the human factor processes shall allow the reader to understand better the scope and activities executed in each of the processes.

There are a vast number of the activities to be performed by a project manager in each process. It shall be mentioned here, that the activities are not a single action, but rather a cyclical perpetual occurrence within the project progress.

Subsequently vast is the number of the capabilities [25], which project manager shall master. As human can handle only a limited number of activities a role system and priorities within the individual roles and tasks have to be settled.

4. Impact of Human Factor in Project Management Phases

In literature is possible to find the schemes ranking from three to seven project management phases. Examples:

- three: initial - intermediate – final [31],
- five: concept/vision - feasibility - design/development - production - phase out [10] and
- seven: pre-feasibility - feasibility - design - contract - implementation - putting into operation - hand - over and take - over commissioning and project finish [7].

Thorough this paper we adopt the four-phases-model, used also otherwise by renowned standards like Cobit [10] or Prince2 [29].

Each of the four phases differs in its goal and subsequently in the type of activities performed by project teams in each phase:

1. An initial phase

   Goal: Development of the project vision, motivation build-up.

Activities: Analysis of the potential benefits and rough costs, assessment of the success probability and realization risks, motivation build-up measures like meetings etc.

2. Planning and design phase (detailed elaboration, changes)

   Goal: Elaboration of the realization concept and exact project planning.

   Activities: Elaboration of the products and projects structures; calculation of different financial indicators like e.g. ROI; roles, resources, times and expenditures planning, project set-up and initialization of all project processes.

3. Realisation (execution and delivery)

   Goal: Realisation of the task and implementation of the results.

   Activities: Staff and resources deployment, exact controlling and risk assessment, care about the staff and stake holders, documentation and knowledge management.

4. Closing (evaluation, securing service and documentation)

   Goal: Wrap-up of the project, evaluation of the final benefits and lessons learned, contribution to the operational improvements.

   Activities: Final evaluation of the project success indicators, summary of lessons learned, stabilization of the deployment, discharge of the project team.

Bearing in mind the perpetual nature of the multiple project management processes and their variation in the above described phases, following research objectives in the area of human factor can be identified:

- Is it possible to measure the relative importance of each process in each individual phase and its contribution to the project success?
- Is it possible to prioritize the individual activities performed in each single process?
- Is it possible to classify the skills required from project manager along the current project needs, determined by the activities to be performed?

- Is it possible to quantify the overall contribution of the above quantified human factor aspects to the overall project success?

As far as it could be identified, there are a very limited number of publications addressing the above questions. Sukhoo et al. analyzed the relative meaning of the selected ten human factor capabilities of the project manager in five project phases [32]. The results of this research shall yet be validated. The only reasonable conclusion of their work is the practical difference in the importance of human skills in each project phase. Similar results have been reached by Kuzniewska in [12].

Both contributions do not go far enough as to which detailed process, which capabilities when are need. Some examples are given below.

Looking back at the goals and activities to be performed in the initialisation phase we may conclude with certain heuristics that the following human factor processes are significant to the overall project success:

- Human resource management: by identifying the individual needs and proper dialog level we could better communicate the vision and faster motivate the team.
- Communication: the better understanding the faster is the concentration on the essence and build-up of the motivation.
- Leadership: only leaders can convincingly communicate the vision and build-up the motivation of others.

In the planning and design phase relevant are the processes:

- Human resource management: by identifying the individual capabilities we better plan and match the staff with the project roles securing higher satisfaction and lower fluctuation in the project.
- Leadership: the partially tedious and labour intensive tasks are not everybody's strength. A good leader can motivate his staff to put the utmost efforts in careful detail elaboration.

The main phase - the realisation - calls for the best performance of the project manager in all human factor processes:

- Human resource management: by identifying the individual needs and proper dialog level we could better communicate the vision and faster motivate the team.

- Team management: in the otherwise proven impact of the human factor on the efficiency [24] trust and confidence, resulting form the best possible mutual openness and transparency may be decisive to the project success.
- Conflict management: in any group working together on a common task and in geographically limited environment sooner or later emerge conflicts, which if not properly handled – may amount to real crisis. Knowledge and mediator capabilities are decisive to set up the proper prevention and – upon occurrence – proper approach to solve the conflict.
- Communication: with each information, which do not reach the recipient, each information which is misunderstood , rises the risk of incorrect execution of the tasks, conflict emergence up to the complete collapse of the project
- Self management: particularly project manager, as highly visible person, shall keep the balance of his personal resources. The convincement of the project staff as to the planning and to the correctness of the project manager decisions has same impact as the motivation on the project effectiveness.
- Leadership: it is even stronger to be exercised in this phase if compared to it's meaning for the planning and design. Remember Tom Sayer in "The Adventures of Tom Sayer" by Mark Twain, who get even paid by his colleagues to for allowing them to paint the fence, the task he should have done in the first place himself?

Last not least in the closing phase two processes dominate the scene:

- Communication: project is considered successful not only when it was successfully performed but also – and even to larger extends – by the successful marketing and information, which both are part of the communication. The perception of the project by the project sponsor and by the stake holders is essential to the discharge of the team.
- Leadership: one of the key targets of leadership is to create an atmosphere of trust. Only in such an atmosphere team members will honestly and openly report from the projects and lessons learned convey some meaningful message.

As said a forefront the above argumentation has a heuristic background. It is now a scientific objective to research in depth on the subject and either confirm or deny the above statements.

At this phase we stress again the cyclical occurrence of all human factor processes in each project phase.

5. Evaluation System for Human Factor Impact Measurement in Project Management

So far we could identify the main processes related to human factor in project management and indicate that with a limited level of confidence different human factor processes are relevant in different project phases. The elaboration of the measurement system for:

- Human factor impact on project course
- Human factor capabilities relevance, determining this impact

is considered in this chapter.

The starting points are the human factor related processes. The processes, complex in their nature, are divided in several sub-processes (see [25]).

We consider hereafter an example of conflict management process described above.

In this process we have five sub-processes:

1. Conflict solution preparation process
2. Project team preparation
3. Analysis of the source of conflict
4. Elaboration of conflict solution
5. Securing the persistence of the solution

The activities of the sub-process “Conflict solution preparation process” are illustrated in Figure 2.

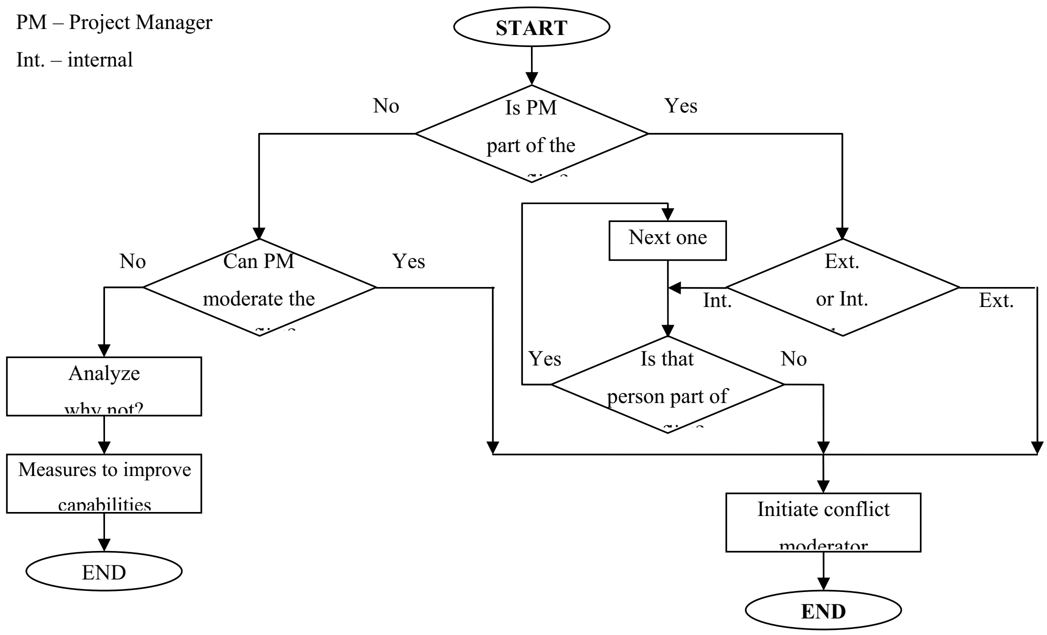

Figure 2. Risk Management sub-process preparation

Choice of decision criteria depends here on the path chosen by the project manager or the person in charge. The capabilities needed in the decision process are as follows:

Table 1. Activities and skills for Conflict Management process preparation

No.	Decision activities	Skills, capabilities
1.	Is project manager part of the conflict?	▪ Analytical situation analysis ▪ Communicative personality ▪ Capability to assess the personalities of conflict parties ▪ Capability to keep distance and neutrality ▪ Stability
2.	Can he moderate?	▪ Capability to asses people ▪ Objectivity
3.	External or internal moderator?	▪ Capability to assess the acceptance of an external moderator ▪ Capability to choose wise the internal moderator
4.	Is that person part of conflict?	The same as for decision activities no. 1

In the following step we assign the weights to each activity, related to the overall total of e.g. 100 (percent). Shall we have 50 activities in a Conflict Management Process, mean value is 2%. An assignment of a higher value (e.g.10%) means that this specific activity is 5 times more relevant to the project success than median. Subsequently we have somewhere to have activities with jointly contribute those 8% above (e.g. 8 activities with only 1% relevance). The elaboration of the weighting scheme is subject of the ongoing research as well as practical management decision of any applying company. In the next step we shall evaluate the relevance of each individual capability. As last we assess the actual capabilities of the project manager (or any other project team member!) and identify the skills to be developed. Figure 3 shows the schematic process of evaluation.

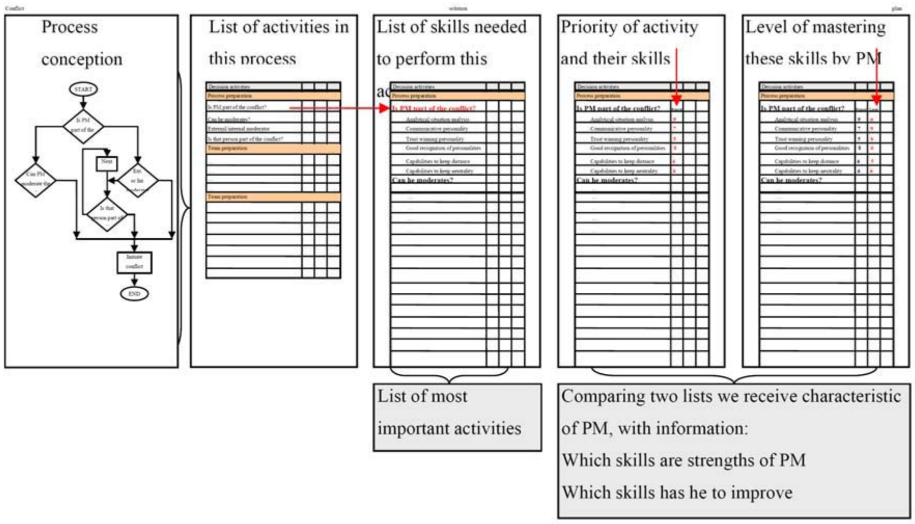

Figure 3. Evaluation system for human factors processes impact measuring

6. Further Research Objectives

As it may be noticed the above approach is a generic theoretical concept yet to be practical applied:

- Analysis of the human factor processes needs to be thoroughly verified and extended where necessary. The criteria of the completeness are yet to be determined. Various profiles of projects are to be examined and eventually individual processes are to be specified.
- The relationship between the capabilities, needed to master the specific activity and each individual activity is to be scientifically elaborated.
- The relative weight allocation of the capabilities is to be elaborated and confirmed by praxis.

- The measurement system, which secures the objectivity of results, shall be elaborated and justified.

The objective of a strife to find out the measurable effect of human factor, considered widely as immeasurable is a challenging and fascinating task. There are virtually no published works treating this subject.

Yet, once we will be able to support the project manager with clear criteria, what is important, and with a mechanism, how to influence the behaviour and enforce the advantageous capabilities of the team members, we will be able to take a major impact on the project success.

7. Conclusions

The best conclusion of this paper and a repel to all those, who search a remedy in technological („formulaic") improvements are the words of DeMarco [8]:

> *Human interactions are complicated and never very crisp and clean in their effects, but they matter more than any other aspect of the project work. If you find yourself concentrating on the technology rather than the sociology, you're like the vaudeville character who loses his keys on a dark street and looks for them on the adjacent street because, as he explains, "The light is better there".*

The paper attains to contribute towards the identification of the impact of the human factor on the software project management and indicate possible quantification of the relevant capabilities. There is a long way to go. Author expresses her hopes, that this contribution stimulates the renowned participants of IDIMT 2007 to pursue the research in this fascinating and economically most justified area, resulting in innovative and significant achievements.

I wish to thank my both supervisors, Prof. Dr. Keretho, Director of the I-Nova Institute of Kasetsart University in Bangkok and Prof. Dr. Lent from Bern for their continuous support and motivation to pursue my research.

8. References

[1] ARCHIBALD, R.D., Managing high – technology, programs and projects, John Wiley, NY, 1992.

[2] BAKER, B., MURPHY, D., FISHER, D., Factors affecting project success. In: Cleland DI, King WR, Project management handbook. (2nd ed.). New York: John Wiley, 1988.

[3] BLANEY, J., Managing software development projects, Proc Project Management Institute Seminar/Simposium Atlanta, GA, USA, 410 – 417, 1989.

[4] BURKE, R., KENNEY, B., KOTT, K., PFLUEGER, K., Success or Failure: Human Factors in Implementing New Systems, California, 2001.

[5] BUSHELL, S., Just Human, Would Do, CIO Bussines, Techology, Leadership, 6 November, 2006.

[6] CAUPIN, G., KNÖPFEL, H., MORRIS, P., MOTZEL, E., and PANNENBACKER, O., ICB. IPMA Competence Baseline Version 2.0. Satz&Druck, Bremen: Eigenverlag, 1999.

[7] CMMI Product Team Capability Maturity Model® Integration (CMMISM), Version 1.1 CMMISM for Systems Engineering, Software Engineering, Integrated Product and Process Development, and Supplier Sourcing (CMMI-SE/SW/IPPD/SS, V1.1), 2002. URL: http://www.sei.cmu.edu/cmmi/models/ss-cont-v1.1.doc Accessed in June 2006.

[8] DEMARCO, T., LISTER, T., Peopleware: Productive Projects and Teams, Dorset House Publishing Company, 2 edition, 1999.

[9] DUNCAN, W, Get out from under, Computerworld, 89 – 93, 9 March, 1987.

[10] ISACA "CobiT 3rd edition. Der international anerkannte standard für IT–Governance", 2002. URL: http://www.isaca.ch/files/CobitBroschuere.pdf, Accessed in March 2006.

[11] KERZNER, H., Project Management: A Systems Approach to Planning, Scheduling and Controlling, Wiley, 8 edition, 2003.

[12] KUŹNIEWSKA, A, Opracowanie narzędzia badań i przeprowadzenie analizy silnych stron i potencjału ulepszeń prowadzenia projektów telekomunikacyjnych i informatycznych w wybranych przedsiębiorstwach, eng: Research tool and an analysis of strengths and improvement potentials in ICT-project management in selected enterprises., University of Technology and Life Sciences, Bydgoszcz, 2006.

[13] LECHLER T., When it comes to project management, it's the people that matter: an empirical analysis of project management in Germany. in: Hartman, F., Jergeas, G. and Thomas, J. (eds.), IRNOP III: The Nature and Role of Projects in the Next 20 Years: Research Issues and Problems, Third IRNOP Conference 6-8 July, The International Research Network on Organizing by Projects, Calgary, University of Calgary, 1998.

[14] LENT, B., PINKOWSKA, M., Assessment and Management of the Human Factor Impact on Human Factor Intense Projects – Challenging the Challenge, The Proceedings of 20th IPMA World Congress on Project Management, Volume 2, Shanghai, 2006.

[15] LENT, B., IT-Projekte lenken – mit System, Friedr. Vieweg & Sohn Verlag, Wiesbaden, 2003.

[16] LENT, B., My Dream Project, LentGroup, Bern, 2005.

[17] LUFT, J., INGHAM, J., The Johari Window, a graphic model for interpersonal relations. Western Training Laboratory in Group Development, August 1955; University of California at Los Angeles, Extension Office, 1955.

[18] MARTIN, P., TATE, K., Getting Started in Project Management (Getting Started In.....), Wiley, 1st edition, 2001.

[19] MCCOY, E. A., Measuring success: Establishing and maintaining a baseline, PMI annual Seminar and Symposium, Montreal, 1986.

[20] MCGINNIS, A. L., Bringing Out the Best in People: How to Enjoy Helping Others, Excel Augsburg Publishing House, Minneapolis, 1985.

[21] MELYMUKA, K., Want to kill a project? Keep quiet about problems, study finds, Computerworld, Scottsdale, Ariz, 2006. URL: http://www.computerworld.com/action/article.do?command=printArticleBasic&articleId=9001006, Accessed in March 2007.

[22] MORISS, P. W. G., HOUHG, G. H., The anatomy of major projects, A study of the reality of Project management, John Wiley, UK, 1987.

[23] NASH, S., Vision, Leadership in Project Management 2005 v1, Project Management Institute (PMI), Pennsylvania, 2004.

[24] PINKOWSKA, M., IT Software Project Management: Impact of team cohesiveness on productivity and performance, IDIMT 2006.

[25] PINKOWSKA, M., Unpublished work – Human Factors In Project Management, 2006.

[26] PINTO J., SLEVIN D., Critical success factors across the project life cycle. Project Management Journal 1988 19(3):67–75, 1988.

[27] PROJECT MANAGEMENT INSTITUTE (PMI), A Guide to the Project management Body of Knowledge. Third Edition, CD-ROM, Pennsylvania, 2004.

[28] POWERS, R. F., DICKSON, G. W., MIS project management: Myths, options and realities, California Management Review, 15 (3), 147-156, 1973.

[29] PRINCE2, 2006, URL: http://www.prince2.com/whatisp2.html#processmodel, Accessed in March 2007.

[30] REDMIL, F. J., Conidering quality in the management of software based development projects, Information and software Technology, 32(1), 18 – 22, 1990.

[31] SHENHAR, A., RENIER, J., WIDEMAN, R., Improving PM: Linking Success Criteria to Project Type, PMI, Calgary, 1996.

[32] SUKHOO, A., BARNARD, A., ELOFF, M. M.,VAN DER POLL, J. A.,MOTAH, M., Accommodating Soft Skills in Software project Management, University of South Africa, April 2005.

[33] TURNER, J. R., The handbook of Projects-Based Management, McGraw – Hill, 1993.

[34] VICENTE, K., The Human Factor, Routledge, 1 edition, 2004.

[35] WOHLIN, C., AHLGREN, M., Soft factors and their impact on time to market, Software Quality Journal, Springer Netherlands, 2005.

[36] URL: http://ergonomics.about.com/od/glossary/g/defhumanfactors.htm?terms=human+factor%20definition, Accessed in March 2007.

[37] URL: http://www.paraengr.com/HumanFactors.asp, Accessed in March 2007.

HUMAN FACTOR IN PROJECT MANAGEMENT: AN EMERGING NEW SCIENCE

Bogdan Lent*

Project management evolves into the new science of Service Science Management and Engineering (SSME). The correlation of the organisational, IT, business and human factor aspects shall support effectively the project management. A particular process of self management, named sometimes work and life balance, is chosen for closer analysis in this paper. The aspects of decision making, with all influencing factors are thoroughly analysed, in alignment to C2 NATO RTO studies. The emerging fields of further research close the paper.

1. Evolution in Project Management

Within the next five to ten years project management is viewed as one of the five top "hot skills" around the world [1]. As such, Project Management is a corner stone in an emerging new science of Service Science Management and Engineering (SSME). Major software and system companies like e.g. IBM recognized, that their turn-over changed within the last 20 years to increasingly service-generated incomes: more than half of the IBM revenues came 2004 from services [2].

The skills required to master the SSME and indirectly project management are cross-over of the information technology (IT), organizational culture and business methods (*Figure 1*) with consequences for the sciences such as computer science and engineering, management and operations research, business and economy, social (including media impact research) and cognitive sciences, administrative and legal sciences, political science, cultural anthropology and demography, social psychology and individual psychology.

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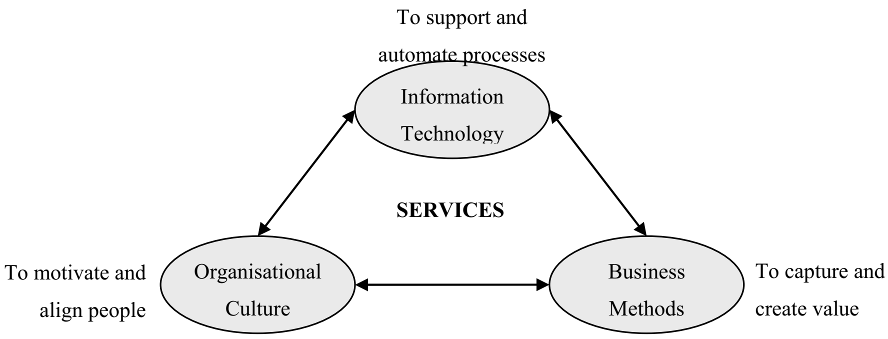

Figure 1 - Skills needed to master SSME

The emphasis of SSME on management, social and computer sciences positions today's ICT-Researchers in pool position to develop the comprehensive, competent approach (see *Figure 2*).

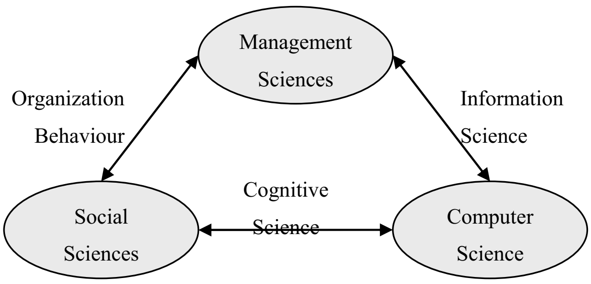

Figure 2 - Research areas SSME

Most honest and demanding project management occurs whenever human life is at stack.

The NATO approach Command and Control C2 differs from the traditional military organizational analysis (OA) by the completely new and particularly strong emphasis on human dimension of decision making. Model, used in C2, depicted schematically in *Figure 3* has been adapted from Mandeles [5].

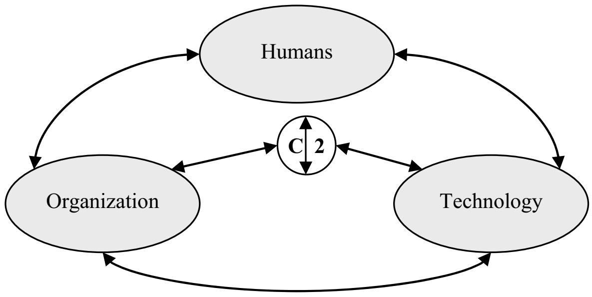

Figure 3 - C2 System [8]

In this model the organization, technology and humans are in closed interaction. Performance of a C2 system may change as anyone of elements in these three categories changes.

Code of Best Practice for Command and Control Assessment, SAS-026, 2004 [8], quotes that due to a close link between humans, organizational and technological elements, optimizing each one of them at a time under ceteris paribus assumptions for the other two rarely ever results in an efficient C2 system. So as the organizations and technology are widely developed and corresponding research and education are well established, the human factor still remains as an underestimated factor.

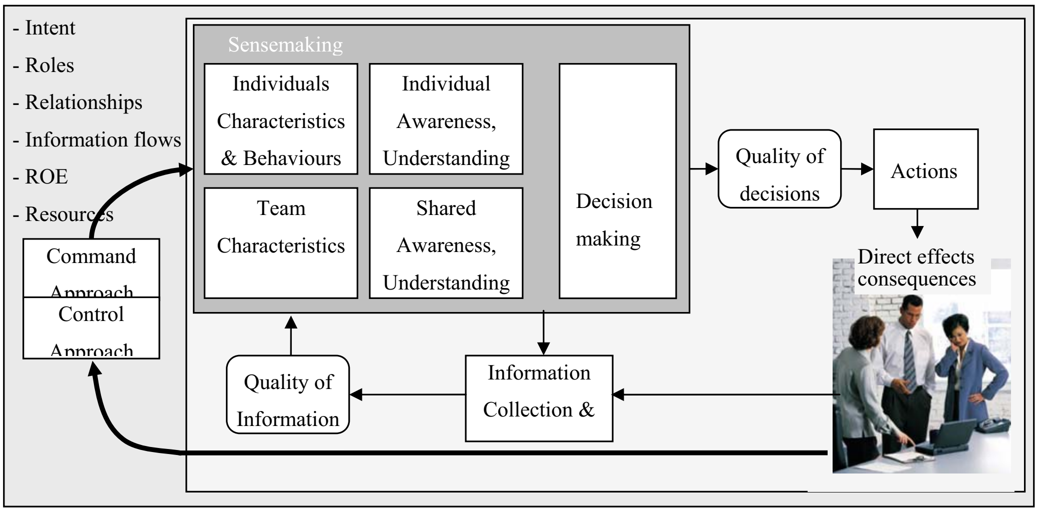

Figure 4 - C2 Approach [8]

Human factor addresses numerous issues in the particular areas [4]:

- Human Resource Management on how to match personal needs, capabilities with job requirements.
- Team Management on how the team cohesiveness influences the overall project performance.
- Conflict Management on methods, experience and impact of persistent conflict solution on team performance.
- Communication covering the project internal and external information and marketing skills.
- Self management or otherwise named work and life balance: how well the project manager manages himself, by what means? How he decides?
- Leadership: what it takes to lead a project team? Skills, methods, experience.

During last year IDIMT Malgorzata Pinkowska presented an impact of the group cohesiveness on team performance [7]. Hereafter author would like to pick up the issue of individual performance and behaviour, decision making in particular in alliance with [9], being part of self management. The integration with the technological IT support closes the considerations.

2. Individual Performance and Behaviour

Individual performance of a human affects behaviour and vice versa. The performance depends on psychophysiological variables (e.g. stress, fatigue, sleep deprivation, hunger, and alertness) and on ergonomic and external factors limiting performance and behavioural freedom. Individual and group behaviour is the result of social interaction. It includes interactions by project manager and team members, underlying psychological processes and factors (e.g. fear, morale, and values), and the cultural, educational, and religious background of individuals.

The issues may be modelled in two ways. They can be treated stochastically, in a manner that reflects their occurrence in “real” systems depending on situational factors (black box approach), or in terms of process-oriented behavioural models, describing the psychological processes behind the observable behaviour of individuals or groups in a given situation [9].

The decision that human performance and behaviour may vary meaningfully will have a clear impact on the choice of models and analytic approaches (e.g. stochastic processes or action-theoretic models such as Norman's Activation Trigger Scheme (ATS) for simulating the dynamics of actions or reactions) [6]. In the following the decision process as a part of self management will be more thoroughly examined.

3. Mental Models

The concept of Mental Models is a key to analyse the sense making in a team and the factors that influence it: cognitive abilities, personality traits, training and experience. Mental Models are deeply integrated in individual understanding. The process of sense making has, at its core, the construction of Mental Models, and understanding can be thought of as the mapping of relevant Mental Models to observed reality. The connection of Mental Models and understanding is bi-directional because Mental Models are the repository of previous understandings, which are drawn down in the process of current understanding and updated for the future by that process. However the existence of Mental Models has wider impacts. They shape the process of observation itself, impacting directly upon awareness. In a very real sense, person is incapable of becoming aware of phenomena for which he does not posses Mental Model. This reveals the criticality of training and experience to the cognitive process. Similarly, project manager cannot act with any deliberation or expertise without having formed Mental Models that allow him to connect actions with intents.

Mental Models according to [9] are characterised by the following three variables:

- Mental Models Richness, breadth and depth of the Mental Models an individual can bring to bear. Richness is influenced by a variety of individual characteristics and directly impacts upon a range of characteristics of awareness and understanding, including correctness and accuracy, as well problem solving style and decision style.
- Mental Models Relevance, the extent to which the Mental Model in use is appropriate to the situation and task at hand. In line with naturalistic decision making theories, this is influenced by situation familiarity, which in turn depends upon training and education. Relevance directly affects, amongst other things, awareness, understanding, decision style, decision speed and response speed.

- Mental Models Confidence, the degree of subjective confidence that the Mental Model in use is appropriate to situation and task. This subjective confidence is influenced by, but not wholly dependent upon, the Mental Model's Richness and Relevance variables, as well as aspects of understanding. It directly affects awareness uncertainty, understanding uncertainty, ambiguity tolerance, and various behavioural factors, such as conformity and risk taking.

Figure 5 depicts important relationships between these and other variables.

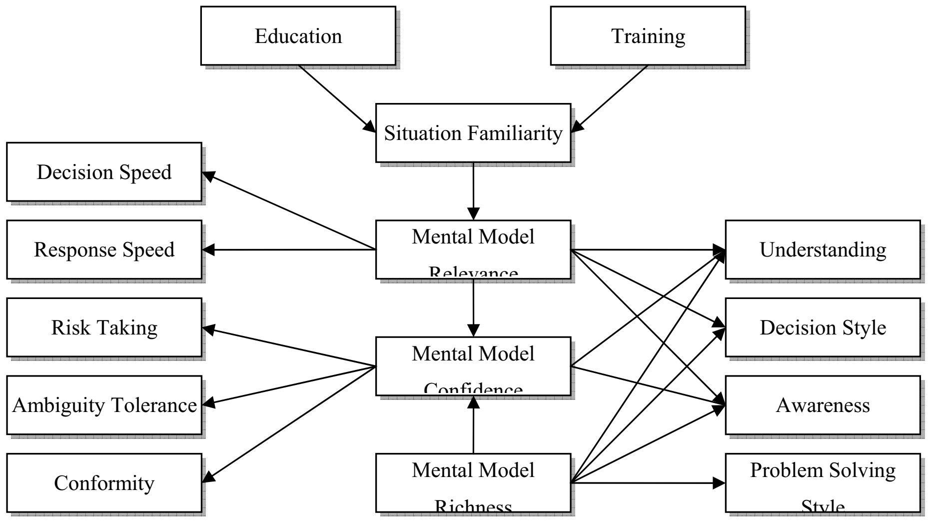

Figure 5 - Mental Model

4. Cognitive Abilities of Project Manager

Cognitive Abilities are key capabilities for decision making. They are characterised by the variables:

- general intelligence (number aptitude, verbal comprehension, perceptual speed, inductive reasoning, deductive reasoning, spatial visualization, and memory).
- cognitive capacity (amount of information the human brain can hold and process within a given time).
- cognitive complexity, the degree to which a person is able to differentiate cognitive elements, and the degree to which these elements can be integrated or related to each other [11]. Cognitive flexibility involves the willingness and ability of an individual to

change their understanding of a situation when confronted with information that apparently contradicts their current understanding of the situation.

- cognitive flexibility, the willingness and ability of an individual to change their understanding of a situation when confronted with information that apparently contradicts their current understanding of the situation.

5. Personality and Values

Variables that describe an individual's personality and values include personality traits, styles referring to an individual's approach to process information, and values held by an individual. The literature proves that these variables are crucial for information processing and decision processes. Personality factors and styles as well as personally held values are typically quite constant for a specific individual and can hardly be changed, and if they change only very slowly.

The Big Five model applied in the analysis of the personality [9] contains five personality traits.

- Emotional stability: the opposite of the trait Neuroticism, which is more frequently discussed in the literature, characterised by nervousness, tenseness, moodiness, and temperamentality.
- Conscientiousness: characterised by organisation, thoroughness, reliability, practicality.
- Absence of carelessness and negligence.
- Agreeableness: characterised by kindness, generosity, warmth, unselfishness, and trust.
- Openness to experience: characterised by imagination, curiosity, and creativity; the opposite of shallowness and imperceptiveness.

Further we distinguish:

- Extraversion (an individual's style to interact with their environment, characterised by awareness and reliance on the environment for stimulation and guidance, an action-oriented, sometimes impulsive way of meeting life, frankness, ease of communication and sociability).

- Sensing vs. Intuition: sensing refers to perceptions observable by way of the senses; intuition refers to the perception of possibilities, meanings, and relationships by way of insight.
- Thinking vs. Feeling: thinking is the function that links ideas together by making logical connections, it relies on principles of cause and effect and tends to be impersonal; feeling is the function by which one comes to decisions by weighing relative values and merits of the issues, it relies on an understanding of personal values and group values and is thus more subjective than thinking.
- Judging vs. Perceiving: in the perceptive attitude, a person is attuned to incoming information, in the judging attitude, a person is concerned with making decisions, seeking closure, planning operations, or organizing activities.

Individuals differ in their Decision styles in that they tend to decide:

- Analytically (high ambiguity tolerance, orientation to task and technical concerns; performance is achieved by analysis, planning, forecasting);
- Behaviourally (low ambiguity tolerance, orientation to people and social concerns; performance comes from focusing on people and their needs);
- Conceptually (high ambiguity tolerance, orientation to people and social concerns; performance is achieved by exploring new options, forming new strategies, being creative, and taking risks); or
- In a directive way (low ambiguity tolerance, focus on task and technical concerns; implementation of operational objectives in a systematic and efficient way).

In the flowing section we evaluate the decision making process and the factors influencing it.

6. Decision making

Human factors research on stimuli that influence human decision making points out that human decision making capability is degraded in some situations and enhanced in others. The sources of the stimuli may be found among others:

- Biological/physiological processes (e.g. physical overexertion [fatigue], own chemical processes, and/or sensory deprivation);

- Cognitive sources (e.g. confusion arising in unfamiliar or unknown situations);
- Psychological processes (e.g. processes causing emotions and stress);
- Social processes (e.g. group dynamics that coerce or reinforce individual decision making depending on accepted social norms, organisational infrastructure and procedures);
- Environmental factors (e.g. darkness, austere and/or uncomfortable environments); and the decision support tools and technologies that humans use (e.g. information displays and decision support software). It is important to look beyond technology at whether or not human decision making is improved, or even constrained in some cases, by using computerised decision aids depending upon their functionality and configuration.

7. Types of Decisions

Following [8] three useful decision types can be distinguished:

- Automatable decisions;
- Contingent decisions; and
- Complex decisions.

7.1. Automatable Decisions

Automatable decisions fall into the category of "simple decisions". The range of decision options is finite and known, and the criteria for selecting among them are clear. The decisions can be automated. For example, task scheduling in team can be seen as an optimisation problem in which time, space, and priorities are traded off to generate a "best" answer. Even though the decision environment is constantly changing due to factors such as project progress or major software error, scheduling decisions are characterised by rules and algorithms. Models of automatable decisions of this kind can be built relatively easily.

In these fully automatable decisions the assumption is that "to know is to decide". In these cases, if uncertainty were adequately reduced, the correct course of action or decision would be obvious. In that case, decision theory classifies the problem as a "decision under certainty." These problems are trivial except for the determination of the utility function in case there are more than two selection criteria that need to be considered and/or when constraints need to be accounted for to complete the analysis [8].

7.2. Contingent Decisions

The next level of decision making complexity is best thought of as contingent decisions. These are cases where the project manager has thought through the situation and developed a set of alternative actions or decisions that are appropriate to the situation, but further information on the operational environment will be needed to determine which the proper course of action is. In other words, “to know is to decide, but knowing is not yet possible.” It is also called “opportunistic decision making” [8].

In most cases a lack of clear, precise knowledge is unavoidable. Modelling contingent decisions is much more difficult than modelling automatable decisions, but is similar in that an underlying set of rules or algorithms still drives the process. The added complexity comes from the need to find the time when information is adequate to select one of several actions.

The best models for that purpose are essentially hypothesis testing models. They align information about the operational environment against a finite set of alternative futures and perform probability calculations to determine when project manager has enough confidence to act or to estimate the information gain in terms of the expected value added to decisions as new information arrives.

7.3. Complex Decisions

Finally, “complex” decisions are very difficult to model. These require the decision making system to:

- Recognise when a decision needs to be made;
- Identify the relevant set of options;
- Specify the criteria by which they will be judged; and
- Determine when the decision will be made.

Examples of complex decisions include the definition of missions at the operational level, decisions to change the fundamental activity of the project team (e.g. basic focus on error correction instead of software development).

Complex decisions are very difficult to model and even more difficult to validate or accredit. Most successful efforts dealing with complex decisions have used "human-in-the-loop" techniques and relied on the quality and variety of experts employed for reliability and validity. Some promising research on modelling complex decisions in military operations has been completed in the UK, yet it is an open issue in project management supporting tools.

8. Risk taking

Risk taking is the degree to which an individual willingly undertakes actions that involve a significant degree of risk [10].

Project manager faces the complex and tightly coupled issues arising from human and organisational factors in the project.

Figure 6 has been used to illustrate the relationship between the time available to make a decision, the complexity of the decision, and the uncertainty of the information available about the situation. These three factors also reflect the risk or opportunity inherent in a project course. The more complex a situation, the less time available, and the greater the uncertainty of the available information, the greater the risks (and opportunities) present.

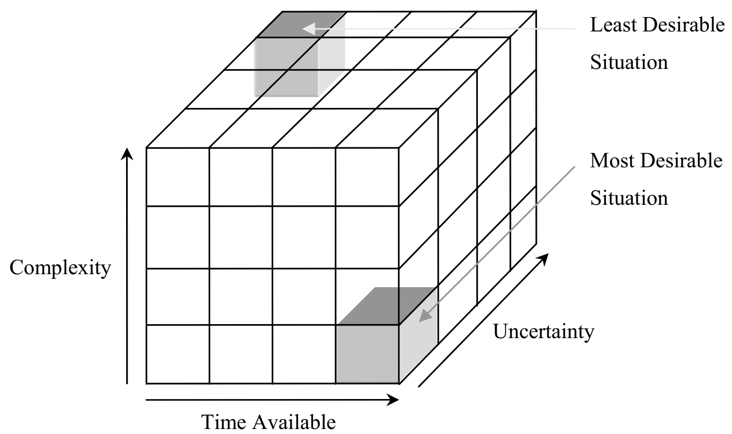

Figure 6 - Decision making drivers [8]

While each of these three dimensions can be examined independently, considerable insight can be derived from examining them as a related set. This examination normally begins as an exercise in hypothesis generation, but can, as research is accomplished, be converted into a component of a knowledge base.

That is, as evidence confirming or calling for revising the key hypotheses is generated, the graphic becomes a way of conveying known relationships and generating new propositions about regions or subspaces that have not yet been examined empirically. In some sense, one corner of this cube represents the worst of all situations – almost no time available, an enormously complex problem, and considerable uncertainty about the situation. Past research suggests that when these conditions exist the decision maker has no choice except to use "best professional judgement" to match the operational situation to some class of well-understood military situations and act accordingly [8]. However, decision making theory also indicates that the wise project manager will take short-term actions designed to create more time and/or more information and thereby relocate the problem to a "better" portion of the space. A "risk averse" project manager will clearly attempt this transformation of the situation. However, a more risk oriented leader may attempt to cut through the fog of project with decisive action.

The opposite corner of this analytic space, defined as ample decision time available, limited complexity, and low uncertainty, provides the ideal situation for decomposition of the problem and development of "optimal" project plans.

With "faster" projects, proactive decisions are possible. When the pace of operations is faster, decisions must be reactive. The project manager who is capable of making decisions that transform the operation from reactive to proactive is rare and enjoys vision not only about what is, but also about what is possible [8].

9. Technological Support

The assessment of the human-technology relationship is a critical requirement that implies challenges that can be both social and technical in nature. Without adapting human thought and behaviour patterns and organisational structures it may be impossible to exploit the potential of new technology.

On the other hand, the performance of new communication and information technologies may exceed human capabilities of processing information (information overflow) and thus result in a degradation of human performance and overall effectiveness, the improvement of technical parameters notwithstanding. The challenges of adapting technological capabilities to meet human capabilities and the requirements of the social interaction processes of project manager and staff require socio-technical assessment approaches of the kind that evolved in the fields of SSME. These include, just naming few:

- Computational areas to generate the supportive models, complex in their nature of data, comprehension and engineering capabilities of programmers;
- Communication strategies of selective secure data communication across all technological, social and political borders;
- Variability oriented software modelling;
- Decision complexity analysis, solution spaces and automation systems;
- Architecture of delivery information management systems;
- Interoperability vs. specialisation trade-off;
- Human factor maturity models.

10. Conclusions

Issues of human factor should be incorporated in models used to analyse issues that require human activity either in the form of performance parameters or appropriate sub-models on behaviour.

Decision making that is rule or algorithmically based can be modelled directly, but error rates should be estimated if humans are involved in the relevant decision making. Simple decisions are programmable (with appropriate error rates), but also require estimations of when decision would be made. Complex decisions can be treated with “human in the loop” tools and techniques, but new techniques are being developed and applied.

Capability of risk taking is inherent to project manager quality.

Style of project management and decision making should be considered in systems that focus on specific decision making.

New areas of technological-organisational-human factor sciences and practices shall help to professionalize the software project management.

11. References

[1] COLLETT, S., Hot Skills, Cold Skills. The IT worker of 2010 won't be a technology guru but rather a 'versatilist.', Careers: IT Profession 2010, Special Report, Computerworld, July 17, 2006. URL:www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=112360&pageNumber=2. Accessed in June 2007.

[2] IBM, Service Science, Management, and Engineering, URL: http://www-304.ibm.com/jct09002c/university/scholars/ssme, Accessed in June 2007.

[3] KEENY, R.L., & RAIFFA, H., Decisions with Multiple Objectives: Preferences and Value Tradeoffs. New York: John Wiley & Sons, 1976.

[4] LENT, B., IT-Projekte lenken - mit System, Vieweg, Wiesbaden, 2004.

[5] MANDELES, M.D., Managing "Command and Control" in the Persian Gulf War, Westport, CT: Greenwood Publishing Group, 1996.

[6] NORMAN, D.A., Organisation of Action Slips. Psychological Review, 1988, 1-15.

[7] PINKOWSKA, M., IT Software Project Management: Impact of Team Cohesiveness on Productivity and Performance, IDIMT2006, 14th Interdisciplinary Information Management Talks, Budweis, 2006.

[8] RTO/NATO, NATO Code of Best Practice for Command and Control Assessment, RTO TECHNICAL REPORT TR-081 SAS-026, RTO Studies, Analysis and Simulation Panel (SAS), 2004.

[9] RTO/NATO, Exploring New Command and Control Concepts and Capabilities, RTO TECHNICAL REPORT TR-SAS-050, 2007

[10] REBER, A.S., The Penguin Dictionary of Psychology. London: Penguin Books, 1995.

[11] VAN HIEL, A. and MERVIELDE, I., The Measurement of Cognitive Complexity and Its Relationship With Political Extremism. Political Psychology 24, no. 4: 781-801, 2003.

TEAM BUILDING PROCESS IN SOFTWARE PROJECTS IS NEEDED FOR SUSTAINING EFFECTIVE TEAMWORK

Dr. Somnuk Keretho*

The purpose of this paper is at least two folds. Firstly, the author provides evidences and proposes that team building process is needed within any software development projects such that effective teamwork could be sustained. Secondly, the author provides his approach and calls for more research work in this area.

The classic "people, process, and technology" triangle has well been recognized by software development organizations for many years as the three key success factors for software development projects. An analogy is a three legged stool that cannot stand with one leg missing (or shorter). This is the strategic triad of leverage points that have a major effect on cost, schedule, and quality. However, among these three dimensions, "people or human factors" seem to be comparatively the most neglected or the shortest leg both in the real-world software development and in the literature, for example, the well-known process improvement framework like CMMI has provided very few practices related to these social factors (e.g. referring to the Integrated Product and Process Development (IPPD) discipline within the CMMI model) [1].

Although modern IT development work poses many technical challenges, the problems that seem to cause the most trouble are not technical at all. To have a successful project, Watts S. Humphrey [6] provided evidences showing that there are four key challenges to be managed which are:

- "negotiating commitments",
- "maintaining control of the projects",
- "delivering quality products",
- "sustaining effective teamwork".

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Few software development teams can simultaneously handle all four of these challenges, which is why so many software projects are in trouble (as described in the Standish Report [8]). Falling short on any of these aspects will seriously damage and possibly destroy our projects almost regardless of how well we handle the other challenges or how fine a technical job we do in designing and building the product [6].

For so many years, many standards, techniques and tools have been developed to address the first three key challenges such that the software team can effectively negotiate commitments, maintain project control and deliver quality products, e.g. by applying software project management processes as recommended within the ISO/IEO 12207 Software Life Cycle Standard, or by practicing CMMI-based Project Planning, Project Monitoring and Control, Validation and Verification Process Areas [7, 1]. Again, the challenge to deal with the issue of "sustaining effective teamwork" is largely missed or less emphasized, at least, within the above mentioned standard and framework.

It is a common knowledge that large software projects are almost always troubled, the key question is why. The reason is that as teams grow larger for larger software projects, it becomes progressively more difficult to build cohesive and motivated teams and it is much more challenging to maintain team energy and commitment.

Teams can be enormously effective when they work properly, however without adequate guidance and support, they can fail miserably. Team performance depends largely on the capability of the team members to work together. To be fully effective, teams must be:

- properly formed,
- guided,
- led.

Unfortunately, in the development world, team formulation, guidance, and leadership are largely a matter of chance. There is no teambuilding process, team leaders are rarely trained in effective leadership methods, and there is little or no team coaching [6]. As a result, software teams are rarely as effective as they could be. The mentioned topics are also neglected or less emphasized within the software engineering education arena.

Team building and team development process is a necessity for any successful software projects. The purpose of team development is to lay a foundation for working effectively as a team, for each team member to understand the stages for creating a successful team, and to establish key elements of the team charter. Right from the beginning of the project, each member of the team should be built within each self a sense of belongings such that the group can call themselves as a team with a reason or purpose for working together, a need for each other's experience, ability and commitment to obtain a mutually held goal, a belief that working cooperatively will lead to more effective output than working alone, and the group's accountability and commitment.

From the author's experience, team training and team building process is always needed and conducted from the beginning of the IT project. The combination of Drexler/Sibbet Team Performance™ Model and Stephen Covey's 7-Habits of Highly Effective People are often used in the author's team building process.

Drexler and Sibbet provide a comprehensive team performance model that shows various predictable stages involved in creating and sustaining high-performance teams *(see Figure 1).*

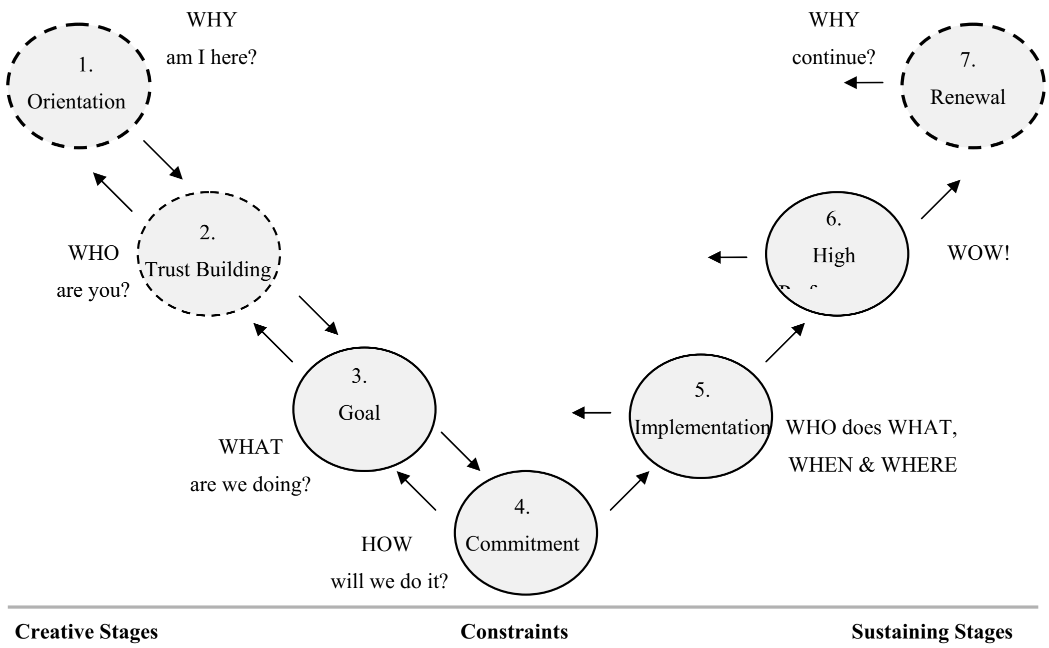

Figure 1 - Drexler/Sibbet Team Performance™ Model [9]

The model illustrates team development in seven stages, Four stages are needed to create the team – Orientation (why am I here?), Trust Building (who are you?), Goal/Role Clarification (what are we doing?), and Commitment (how will we do it?). Three stages are recommended to describe levels of performance – Implementation (who does what, when and where?), High-Performance (synergy stage), and Renewal (why continue? And sharpen the saw).

The 7 Habits of Highly Effective People as developed by Stephen Covey [2] is a human improvement framework that presents a holistic, integrated, principle-centred approach for solving personal and group problems, and for enhancing personal and team effectiveness (*see Figure 2*). The author finds that several insights and anecdotes within this framework could be used to prevent and solve human issues among the project team effectively, e.g. by applying within the team the paradigms of interdependency, the Habit-5 to seek first to understand – then to be understood, and the principles of creative cooperation (Habit-6 Synergy).

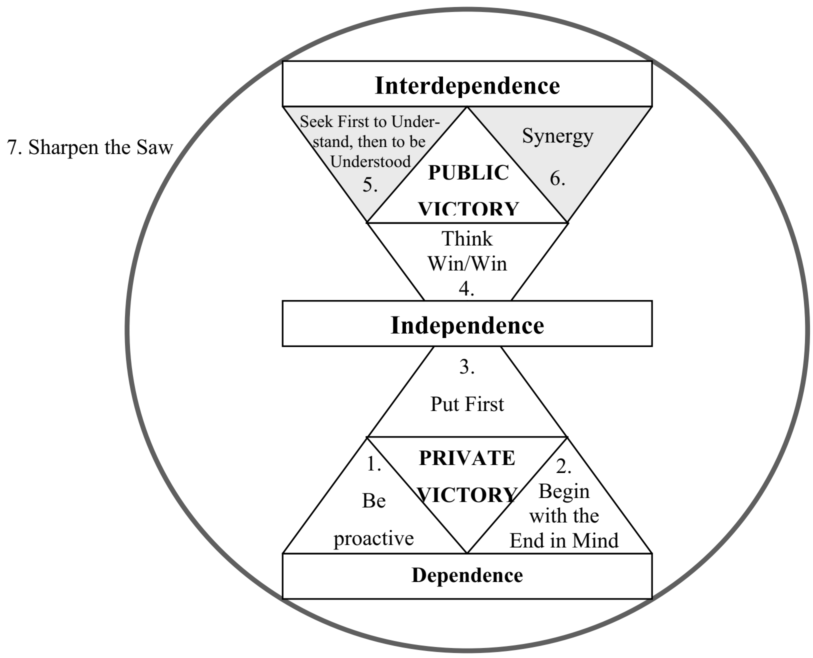

Figure 2 - Seven Habits Paradigm

As another example, the metaphor of an emotional bank account is often used by the author to build group norms among the project team. An emotional bank account as explained by Covey is a metaphor that describes the amount of trust that's been build up in a relationship. Each and every team member is encouraged to deposit into an emotional bank account within other colleague's heart through courtesy, kindness, honesty, keeping promises, honouring expectations, making apologies sincerely (if you make any wrong doings) to that colleague.

When this trust account is high, communication and coordination among the team members is a lot easier, more instant and effective.

The author proposes that more research work should be called for in this much needed area.

References

[1] CHRISSIS, M.B., KONRAD, M., SHRUM, S., CMMI Guidelines for Process Integration and Product Improvement, Second Edition (CMMI for Development, version 1.2), Addison-Wesley, 2007.

[2] COVEY, S.R., The 7 Habits of Highly Effective People, Simon & Schuster UK Ltd, 1989.

[3] DAVIS, N., MULLANEY, J., Team Software Process (TSP) in Practice, SEI Technical Report CMU/SEI-2003-TR-014, September 2003.

[4] DEMARCO, T., LISTER, T., Peopleware: Productive Projects and Teams - Second Edition, Dorset House Publishing Company, 1999.

[5] DYER, J.L., Team Research and Team Training: A State-of-the-Art Review, Human Factors Review, 1984.

[6] HUMPHREY, W.S., PSP: A Self-Improvement Process for Software Engineers, Addison-Wesley, 2005.

[7] ISO/IEC TR 12207 Information Technology – Software Life Cycle Processes, International Organization for Standardization and International Electro-technical Commission, 1995. URL: www.jtc1-sc7.org. Accessed in June 2007.

[8] DANNIS, M.A., Chaos: A Recipe for Success, The Standish Group International, Inc., 1999. URL: www.standishgroup.com. Accessed in June 2007.

[9] SIBBET, D., DREXIER, A., Graphic Guide to Nest Team Practices, Graphic Guides Inc., 1992.

SOFT FACTORS IN PROJECT MANAGEMENT FOR ENTERPRISE CONTENT MANAGEMENT

Miroslav Zelko*, Anton Lavrin**

Management of SW project is a vivid organism. The systems approach to project management problems emphasises the need to consider both hard and soft factors. Hard factors are those that can be defined, measured or assessed in an objective way whereas soft factors are more imprecise and are matters of individual values and tastes. Project methodologies provide the champion with concepts, steps, techniques, and templates to support project management. One of the key steps that experienced practitioners find useful, when managing an enterprise-wide project to implement ECM into corporation, is to determine the soft factors in PM to be eliminated during the project phases.

1. Introduction

The systems approach to project management (PM) problems emphasises the need to consider both hard and soft factors. Hard factors are those that can be defined, measured or assessed in an objective way whereas soft factors are more imprecise and are matters of individual values and tastes. Most project problems contain both hard and soft features.

A typical hard factor in PM - for instance an inventory control system, has the structure of the system well known and relatively standardised, quantitative decision project methods are suitable for setting re-order levels, ordering quantities and other key project elements. The project can be judged by readily acceptable quantitative measures. In short the project is structured and relatively mechanistic. A soft factor in PM are characterised by more vagueness and irrationality. Objectives are hard to define and are subject to change and argument, decision making is more uncertain, measures of performance must often be formed in qualitative terms, and above all, the projects must include recognition of human behaviour with all its attendant conflicts, aspirations and irrationalities [6]. To a greater or lesser degree

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it will be apparent that any project in an organisation contains soft factor elements because of the presence of people. Because individuals pursue personal goals as well as those of the organisation some sub-optimality is present in all organisations.

Generally, a project management complexity, perceived as a system, is such that a quick fix is not possible. A range of methods are used in a complementary fashion. They cover the need to appreciate the strengths and weaknesses of different project methodologies; the systemic, iterative cycle of enquiry.

2. The ECM Project Case Study Description

From a longer-term perspective, we are in the midst of a long-term migration to the electronic management of information. Processes were almost 100% paper-based in 1975, and it seems likely that they will be almost 100% electronic in, say, 2025 [1]. In between, processes will be converted as they are justified, one at a time. The work to change business processes will always be challenging, and all of the project-based, productivity-based, or intangible-based justifications for ECM investments will still apply. The components of the new rationale are much more compelling for many enterprises that have wrestled with discovery, compliance, disaster recovery, and records management. The economics of an investment in ECM systems can be very strong or weak, and ECM systems may still need to be implemented for strategic reasons. The question is not if but when.

The vision of electronic document management system or enterprise content management (ECM) has always been a compelling one, especially within a large manufacturing company. Users across the enterprise are able to create, retrieve, manage, and archive all of their content, including electronic and paper documents, email, and computer reports throughout their business processes. “Enterprise” content management will include the needs of an entire organization rather than just the business processes of a single department. ECM will support the records retention policies of the enterprise so that audit and compliance requirements are satisfied for both physical and electronic documents. Additionally, document content will be repurposed for presentation via enterprise portals and websites.

ECM systems integrate repositories of unstructured information that traditionally have been separately managed [5]. These repositories include paper, local area network storage, electronic documents, websites, email, and records. “Unstructured” differentiates this information from the information in the “structured” databases of custom applications or vendor packages. The benefits of an enterprise-wide approach to ECM are clear. Some of these benefits include:

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

What has not been clear has been how to address the scope and scale of enterprise-wide challenges. Forging ahead with unmanageable enterprise-wide projects designed to address every document in the organization in one large project has resulted in binders of consulting reports and complex project plans that are never implemented. Deferring to workgroup or departmental projects could result in the implementation of islands of automation; adopting specific applications deployed without any plan for integrating them. Organizations following these paths have found themselves further away from the desired results.

Several recent developments in the environment for ECM have fundamentally changed the nature of the ECM investment justification. The costs associated with litigation "e-discovery" and compliance with new legal requirements is frequently so large that investments in ECM systems that support these areas seem more sensible. Disaster recovery is no longer an abstract concept. Many organizations have analyzed these areas and have discovered that ECM applications provide the foundation for managing information needed to support these requirements. That was also our case. The following paragraphs explain this perspective:

- ECM was Required for Regulation/Compliance

  The list of applicable regulations seems to grow every day: Sarbanes- Oxley, HIPAA, European Privacy Rules, Basel II, etc. While there are complexities associated with each set of regulations, the common thread is that enterprises must apply multiple sets of rules to manage the access, processing, and retention of documents. This is what ECM systems have always been designed to do. The solution in this area is not to panic, it is to design thorough and sensible systems that will manage the documents in an integrated manner and will be flexible enough to adapt to changes in the business or underlying regulations.

- ECM was Required for Disaster Recovery

  For most Americans, the requirement for disaster recovery is exemplified in one phrase, "September 11." What modern disaster recovery means is that if a disaster hits one site in an enterprise, the users not at the affected site will quickly be able to continue to perform their functions without the loss of information. The declines in the costs of network bandwidth and the availability of massive amounts of storage make this an achievable goal for all of the information stored on magnetic disks. This is driving organizations to standardize their ILM infrastructure and to get rid of their tape backup, optical jukeboxes, and paper to the extent possible, thereby enabling the ECM applications to be included in a disaster recovery implementation. While large organizations have led the way in disaster recovery, competition amongst backup service providers has made this capability cost effective for medium-sized businesses as well.

- ECM was a Prime Enabler of Business Strategy

  ECM systems can enable a variety of strategic initiatives in modern enterprises. If all of the unstructured information is available in an ECM system, it is much easier to redistribute the work of an enterprise for either strategic or tactical reasons. These systems free the organization from their geographic footprint. They enable virtual offices, where users can be productive while away from fixed offices and desks. They enable meetings via webcasts and videoconference calls, and can enable users to exchange information without using airplanes and hotels. They enable organizations to effectively collaborate with vendors, partners, and clients in ways that were not possible only a few years ago. This could also include business process outsourcing, either on-shore or offshore. These benefits are derived from investments in ECM technologies.

- ECM was Required for Records Management

  The tradition of records management works well for enterprise paper records, but not enterprise electronic records. Records management for the enterprise can only fulfill its mission if it includes both the physical and electronic records, including email. Projects and experience have shown that electronic records management is different from paper based records management, because it requires that the attributes about documents are acquired or defined in the creation and initial processing of the documents. Without this business process-based context, it will not be possible after the fact to accurately assign attributes, which has always been the approach in paper-based records management. Auto-classification is the use of search and categorization technologies to automatically define the attributes of a document. Studies have shown that auto-classification is useful but will never be complete, because records management cannot accept the levels of errors that are inherent in auto classification.

- ECM—The Punch Line

  The straightforward conclusion is that successful "enterprise" records management requires "enterprise" electronic document management system, because such a system is needed to support the capture of document attributes. The implications for enterprises and vendors are staggering. "Enterprise" document management systems are, by definition, systems that capture all of the important documents and document processes in an enterprise. In many organizations, this includes thousands of processes and tens of thousands of users. This will be an effort that requires significant levels of investment and many years to achieve.

3. PM for Enterprise Content Management (ECM)

An investigation of current domestic document management initiatives shows that there was a need for structured document management for all facilities. For example, as a company we needed to ensure that all safety and maintenance-related documents are up to date and readily and easily accessible by all employees.

The ECM project management team has facilitated a number of high-level discussion sessions with various groups domestically to identify if there are document processing areas of concern that are having impacts to the performance of the company, group, line of business or mission critical processes. Project team works with end-users to help them improve their business results by focusing on their document intensive business processes and the unstructured information that drives and support these processes. The document management concerns and requirements documented during these sessions were used to identify an area or areas within the company where implementing an ECM solution would be of great benefit to the company. This was an open discussion forum.

The transformation to ECM model requires transforming an enterprise's culture, organization, and systems in that order. Successful organizational transformations have emphasized the decisive role of leadership, which is also termed visionary leadership, strategic leadership, or charismatic leadership. This next leadership wave involves specific leadership behaviors, actions, and strategies to initiate and survive the organizational transformation to ECM. Strategic, operational, and tactical managers / leaders must demonstrate it. First-movers are making the transition necessary to reap the benefits of ECM. Transforming an enterprise to ECM requires change management in organization, culture, and projects.

Project management is needed to oversee the development and growth of ECM initiatives. Project management involves three critical processes: building a shared vision, conducting inter-enterprise architectural assessment and gap analysis, and building inter-enterprise organization and work teams [2]. All must take into account soft factors within PM. With an overall function of project management established, multiple subprojects may be undertaken simultaneously, in parallel. Four key processes are involved in project management: engineer customer processes, engineer value-chain processes, engineer internal business processes, and incrementally develop ECM applications. Business Drivers for ECM project were to reduce workforce & increase productivity, speed up processes, increase ease of access to information, improve retrieval of parts and **r**educe dependency on paper.

4. Definition of the problem / Feasibility Study

The definition of the problem that the ECM project was trying to solve was important, because all too often problems are defined by those commissioning a project in vague terms. For example, a problem might be stated in nebulous terms such as "we need to better manage our business content," or "we need a content management system." Irrespective of the terms of reference given to an ECM project team, it is incumbent upon the project champion to have the problem analyzed to ensure that the "right" problem is being addressed during the analysis of the business and technology solution options. Once the problem was clearly defined, the ECM project team then has considered business and technology solution options that were relevant to solving the problem. Planning within enterprises is usually in a hierarchical structure that involves strategic *(visionary objectives)*, tactical *(short-term objectives)*, and operational *(routine objectives).* [2] Feasibility for ECM projects needed to be investigated within the context of these three levels of management planning. The approach used to conduct the feasibility analysis may depend on the methodology that the enterprise uses for IT projects. Most approaches to analysis incorporate the following activities:

- **Determination**: includes tasks such as conducting interviews with representatives from strategic, tactical, and operational areas of the enterprise; obtaining quantitative data, business process modeling; and data flow analysis and preparing requirements, document, and user catalogues.
- **Analysis**: involves analyzing the facts obtained during determination, reviewing options for addressing the problem to be solved, and considering emerging issues that may impact solution options.
- **Documentation**: the production of a Feasibility Study report, which covers the problem definition; the alternative business, technology, and solution options considered; and recommendations regarding the preferred option.
- **Validation**: the outcomes of the Feasibility Study substantiated by key stakeholders.

On average, the chances of success for an IT project aren't all that good. Of course, it does come down to how you quantify success but many statistics imply a failure rate of 50-80%. Many of the causes of failure can't be effectively avoided. These are quantified as soft factors. Even so, there are some things you can do that will truly improve your chances. During implementation of a company-wide ECM project, mentioned above, we shared some practices and principles that all project members have found useful over the years. Hopefully they will add some skills to your projects as well. I’d like to break this down into three key chunks: planning, communications, and a useful tactics.

5. Project Planning

Let's start with **project planning**. You can really screw up a project by over-planning, but let's be realistic; you do need to think things through to get it right. You increase your chances a lot just by taking time to think things out - including making sure you should even be doing this in the first place.

5.1. Perform a Feasibility Study

The Feasibility Study is a fundamental component of ECM project planning - it is the preliminary investigation of a business opportunity to determine whether the application of an ECM solution is a viable proposition. It assesses the business opportunity to determine whether it is viable, and this assessment is based on three feasibility indicators: operational, technical, and financial feasibility. Its goals are to define the problem that the project is trying to solve; examine business and technology solution options; assess these in terms of operational, technical, and financial viability; derive a preferred option; and determine priorities, initial tasks, and resource estimates. The Feasibility Study process should include the following steps:

- Prepare for the study by developing a project plan, securing funding and resources, and developing a quality plan.
- Define the problem and have the problem definition statement signed off by the project sponsor or project board. The *problem definition statement* is an interim deliverable for the project sponsor/board that clarifies the problem being examined, and seeks sign-off before reviewing business and technology solution options.
- Investigate business and technology solution options, and select a preferred option.
- Assemble the Feasibility Study report.

5.2. Be realistic in your project estimates.

Optimists will estimate a week, pessimists will estimate a year, and it should really be somewhere in between. Most of time people are committed to do a good job, but they have outside forces trying to screw up their schedules just like you do. Remember to allow for your team member's other projects (things they're supposed to do). Take into account potential vacation time, sick time, meetings, and other stuff that just seems to happen (holidays, sports discussions, etc…).

5.3. Break things into small stand-alone chunks.

If you have components that are completed and functional, projects are harder to kill. You do have some pieces that may get used and perhaps most importantly, your developers will get some satisfaction for completing some of their work.

5.4. Create a risk management plan.

It forces you to do some conscious thinking about potential problems and solutions and it gives you something to check and review on a regular basis.

6. Communications

Communicating effectively is something that too few people do well and yet has a major impact on everything you do. Any communicating that you do will increase your chances to succeed.

a) **Create a communication schedule.** Keep people updated as to what's been done, what you're working on now, and what you're working on next.

b) **Network with experts** that know about the type of technologies and obstacles that you will be working on. Things, and usually unexpected things will happen and having a good network can be a lifesaver. Keeping people in the loop as to what you've been working on will increase the odds that they will help you out if you need them. It also lets other people know what you're working on (become one of the future experts).

c) **Ask for problem solving hel**p from others on the team. It gives you a broader base of knowledge to work with - you really can't do everything, and it increases buy-in from team members because it shows that you value their input.

7. A useful tactics for PM taking into account soft factors

- **Break your project into small chunks.** Keeping things in small chunks is an important part of planning but it's also an important tactical approach. Not only are smaller chunks easier to understand and manage, but they seem more doable and are small enough to almost seem easy. Mixing work and satisfaction in a balanced way is possible if you do a good job of decomposing your project efforts into palatable bites.
- **Do the big stuff first.** At first, this may sound like a contradiction to the previous point but it's not really. The idea is to tackle the greatest challenges, the true unknowns, up front instead of wasting critical time and energy working on stuff you know is possible. Anytime you have things that have never really been done before, you'd better make sure it's possible. Many managers wanted exact estimates of how long it would take for me to develop and implement a new technology. You really don't know how long it will take when you're inventing something new because too much is unknown at the start. Start out working on solving the unknowns and it'll be a

lot sooner when you can give realistic estimates to your management. Even more importantly, you'll know sooner if what you want to do is even possible.

- **Use prototyping.** Some people think that spending a great deal more time on planning, brainstorming, designing, and extensive documentation will enable you to avoid prototyping. They believe that prototyping and then building a final product is building something multiple times. That is true. They also believe that it is wasteful to build something multiple times instead of building it once. I think that is false. The reason that I think it's false is that if you spend a huge amount of time playing the "building it perfect the first time" game, you spend a great deal more time and money and since nobody's ever built anything perfect the first time, you still need to re-do it to get it right. Planning, brainstorming, designing, and documentation are important but use them with prototyping not as an effort to eliminate prototyping.

8. Conclusion

The Project Planning and the Feasibility Study are useful steps in the development of an ECM project, because it helps to clarify the scope of the problem to be solved, and the various solution options that might be relevant. Business and/or technology solution options must satisfy each one of the three feasibility assessment indicators (operational, technical, and financial), in order to be a viable proposition. The preferred option is typically a combination of business and technology options (e.g., a new process may be supported by an ECM system) and that which best satisfies operational, technical, and financial objectives.

The very important factor managing such projects is to take into account soft factors in project management. These projects must include recognition of human behaviour with all its attendant conflicts, aspirations and irrationalities. To a greater or lesser degree it will be apparent that any project in an organisation contains soft factor elements because of the presence of people.

9. References

[1] AIIM, ARMA, and Cohasset published a detailed survey of the status of Electronic Records Management in January of 2004. The complete survey can be viewed at www.aiim.org/industrywatch.

[2] Len Asprey and Michael Middleton. Integrative Document and Content Management: Strategies for Exploiting Enterprise Knowledge. Hershey PA: Idea Group, 2003.

[3] Lavrin A., Pupáková K., Zelko M., "Business Information and Knowledge Services for SMEs", IDIMT – 2004, Č. Budejovice, Proceedings, edited by Ch. Hofer, G. Chroust. Schriftenreihe Informatik Band 12, Universitätsverlag Rudolf Trauner, 2004, ISBN 3-85487-665-3, pp.269 – 282.

[4] Lavrin A., Zelko M.: ICT Trends and Technology transfer to e-Business in SMEs. IDIMT-2003, České Budejovice. Proceedings, edited by Ch. Hofer, G. Chroust. Schriftenreihe Informatik Band 9, Universitätsverlag Rudolf Trauner, 2003, ISBN 3-85487-493-6, pp.275 – 286.

[5] Anton Lavrin and Miroslav Zelko, Knowledge Sharing in Digital Ecosystems for SMEs, IDIMT-2005 - Proceedings of Interdisciplinary Information management Talks, České Budejovice, 2005 ISBN 3-85487-493-6

[6] Lavrin A., Zelko M., *A complex systems view*, STIQE´2000 conference, Maribor, Slovenia, Proceedings, 6/2000

LINKING SOFTWARE DEVELOPMENT PRODUCTIVITY RESEARCH TO SOFTWARE DEVELOPMENT MANAGEMENT – AN ORGANIZATIONAL LEARNING PERSPECTIVE

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The paper shows the need to relate research on software cost estimation and on factors affecting software development productivity with the broader problem of improving Information Systems development management through enhanced organizational learning. The latter can be facilitated through ways of analyzing the factors affecting productivity that are easy to use, allow for the systemic incorporation of all issues influencing a software project through application of combination of methods from diverse methodologies.

1. Introduction

A better understanding of the factors affecting software development productivity and the relationships between them is essential for the improvement of the management of the information systems development process through improved cost and effort estimation (see [11]). Boehm and Sullivan [12] present thought provoking ideas on the need for renewal in the capabilities to reason about major software decisions in economic terms. They note, "The new software development techniques demand new estimation methods" [12]. One way to address this is the periodic calibration of existing cost estimations models, like COCOMOII to reflect the new development practices (e.g. see [14]). The introduction of agile approaches and internet-speed software development, poses new demands towards the improvement of our understanding about what drives software development (see [5], [10], 11] and others).

Boehm and Sullivan[12:937] point out that an important issue is to empower high-level managers to choose the best available economic reasoning techniques for use in their projects.

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The same authors conclude that “the pressures for improved cost-benefit and return on investment analyses are causing more software researchers and business analysis researchers to come together to integrate their knowledge and tools into more effective capabilities, not just for analysis, but also for more effective software management” [12:945]. This is another justification for the need of a deeper analysis of the factors affecting software development productivity.

The multiple dimensions of the factors affecting software development productivity represent a challenge for an interdisciplinary research to their nature. Past research on software development productivity and related areas such as cost and effort estimation was carried out predominantly within the paradigms of Computer Science and Software Engineering. Information Systems Development (ISD) is also the core of the field of Information Systems [20]. Hence the field of software development productivity can be viewed as one of the areas of intersection of research interests within Information Systems, Software Engineering and Computer Science. The contention of this paper is that it needs to be studied in an interdisciplinary manner even if we recognise differences in the core competencies of the disciplines. Hirschheim and Klein [20] identify the four ISD process core competencies (organizational alignment of IT; user requirements construction, organizational implementation, and evaluation/assessment of IT artifacts) possessed by IS specialists and that distinguish them from Software Engineers. Very few authors have attempted to analyze the factors affecting software development productivity outside of the domain of competencies that is characteristic of software engineering. It is true that the other two disciplines have changed over the years towards recognizing the role of the human element. Thus, Kemerer [25] states that, “because of the significant role played by people, software engineering is already one of the computer science disciplines that is closest to the social sciences”.

The importance of research on factors affecting software development productivity is both of a practical and theoretical nature. From the point of view of the needs of the software industry, there is a gap between the claims of publications in the area of software measurement regarding its usefulness and the actual degree to which such approaches are applied in practice [37], [38]. One of the ways to reduce this gap is to provide better methods for the assessment of factors affecting software development productivity that are intuitive and easy to use by managers and at the same time are rigorous from the point of the current state of decision making as a scientific field.

The majority of the research in software development productivity is only indirectly linked to it through the definition of productivity. It is primarily focused on effort and cost estimation or software project management and control. According to [12:939], "…most of today's successful estimating procedures are largely empirical in nature. It would be good to have theoretical models that would capture, explain and permit us to reason from an understanding of the underlying dynamics…" This has been one of the inspirational ideas behind this research. Here, past work on factors affecting software development productivity is linked to the area of software process improvement and information systems development management in general, pointing to some work of interpretative nature that has been done recently in the Information Systems field. To the best of the authors' knowledge, this is the first attempt at a comprehensive critical analysis of the multifaceted work on the factors affecting software development productivity exceeding the domain of cost estimation and providing links to related publications within the broader goal of the improvement of software development management through methods enabling organizational learning.

The paper continues with a critical review of previous publications on issues related to software development productivity. It is followed by an analysis of research that is indirectly related to cost and effort estimation through improved understanding of what drives software development, focusing on how both research areas might benefit from exchanges of results. At the end are provided some conclusions on potential future work.

2. Software development productivity and the factors affecting it

Since software is intangible, it is not possible to measure productivity directly [47]. According to the same source, in software systems, what we really want to estimate is the cost of deriving a particular system with given functionality and that is only indirectly related to some tangible measures as those used by various methods from the literature.

The best definition of productivity as a process, according to Boehm [9:44], is:

$$\text{Productivity} = \frac{\text{Outputs produced by the process}}{\text{Inputs consumed by the process}}$$

Thus, evaluation of productivity in a software project depends on the ways we define the inputs and the outputs of the software process. Following [9], inputs to the software development process generally comprise labour, computers, supplies, and other support facilities and equipment. The same author points out that there might be other meaningful inputs in the organisational context of a particular environment and frequently one can use present-value monetary expressions as a uniform scale for various classes of resources as inputs.

Our concern in this paper will be with factors affecting productivity over the entire systems development life cycle. Some authors concentrate only on one phase or aspect of it. For example, historically, researchers were predominantly interested in programmer productivity.

Empirical research into productivity in the system development process had its beginnings in the 1960s . It can be classified in various ways (see also [16]:

- Field studies versus laboratory experiments;
- Prescriptive or descriptive models;
- Analytic models, e.g. COCOMO [8] versus analogy-based models [45];
- Machine learning methods using neural networks (see [19]) or Case Based Reasoning (CBR) [33].

Another classification reflecting the recent development in cost estimation involving a Bayesian analysis [14] and systems dynamics [1], [28] is provided in [12]: expertise-based methods, model-based methods, regression-based methods, composite-Bayesian methods, learning-oriented methods and dynamics-based methods. It can be noted, that this categorization does not mention analogy-based methods including Case Based Reasoning.

It has been argued by many researchers that the cost estimation models discussed in the literature do not seem to capture productivity factors very well. A major problem in most of the research surveyed has been the insufficient precision of the results. Thus, Kemayel et al. [24:157] left 53.1% of software development productivity unexplained through their statistical analysis. Relatively little precision of different analytical models had been reported in [25], [22] and others. This is particularly true when a certain model is applied to an environment that is different from the one used as a basis for gathering statistical data for deriving the model [31].

Pfleeger [37] lists the best-reported values on parameters characterising the precision of ten well-known methods for effort and cost estimation and concludes that the statistics for most models are disappointing. This raises the question as to how successful the methods currently applied within the domain of software cost estimation are. A major concern limiting their usability and precision is the need to calibrate them according to the specific conditions of a given organisational environment. This need is partially recognised through the research on calibration of existing cost/effort estimation models with company specific data (see [31], [21].

According to [49], the poor performance of normative models, especially in foreign sites, has lead researchers to consider descriptive estimation techniques. These approaches estimate effort through the provision of a better insight into the estimation of the development effort. Such ideas are reflected in the work in the area of software effort estimation on analogy-based reasoning and case based reasoning [33], [45], [46].

The issues related to the factors affecting software development productivity have been identified in the past as a major area of research in the literature on software productivity/cost/effort estimation [31], [7]. In most cases, these factors have been analysed with respect to the tuning or validation of a particular metric for cost/effort estimation. These factors are labelled differently in different models: in Boehm's COCOMO model [8], they are called cost drivers; in [4]: name them as input to the model, while in Function Point Analysis (FPA) they are called Adjustment Factors (see [2]).

Due to their large number, a certain classification of these factors is appropriate. Benbasat and Vessey [6] discuss 19 factors grouped in seven classes: organizational operations characteristics, computer hardware characteristics, source language characteristics, programmer characteristics, programming problem characteristics. Kemayel et al. [24] focus their attention on the controllable factors affecting software development productivity. According to them, controllable factors are those pertaining to the software process that a typical software manager has the latitude to determine. They investigate 33 controllable factors placed in three groups: factors pertaining to personnel; factors pertaining to the process; and factors pertaining to the user community. Finnie et al. [17] investigate 18 factors grouped in four groups: technical attributes, project attributes, developer attributes and user attributes.

It can be concluded that the major factors affecting software development productivity are those included in the contemporary version of COCOMO, known as COCOMOII model (see [14]) and in the Function Point Analysis approach (see [2]). The majority of the researchers in the field accept their formulations, although there are a number of cases when additional factors are introduced in the literature. COCOMOII is synthesizing ideas from the original COCOMO and FPA. It uses Source Lines of Code and/or Function Points as the sizing parameter for inputs, adjusted for both reuse and breakage, a set of 17 multiplicative effort multipliers and a set of 5 exponential scale factors [14].

A brief observation of the lists of the factors affecting software development productivity in various publications shows that a small number of them evolve with time and the development of technology. Thus, these days it seems inappropriate to consider the effect of memory size or storage devices, as did [6]. Another conclusion that comes to mind is the fact that various researchers focused their attention on quite different sets of factors, thus it is very difficult to compare results from previous surveys.

A relatively little researched issue is the importance of time in software productivity estimation. As far as factors are concerned, the later the estimate, the greater the percentage of the factors that are related to more accurate estimates [7:253]. They also claim that different factors could be used, depending upon the development phase at which the first global estimate of the development effort is made. Thus, estimators are encouraged to use specific methods and factors at specific phases. Similarly, in [38] is promoted the need for early measurement in the software life cycle, but they also note that project managers are often intimidated by the effort required to track process measures throughout development.

A conclusion that can be drawn from an overall analysis of the various research attempts in the field of software development productivity is that there is no consensus on the relevant factors that have to be reflected in a particular method or model (see also [30]). Most of the studies only include an analysis of a few factors, ignoring others. As most of the researchers indicate how complex the process of software development is, it can be assumed that any attempts to drastically reduce the number of factors under concern may lead to over simplification of a model and its subsequent inadequate performance. In addition, there is usually little justification in the literature as to why certain factors are not included in a particular model. For example, user characteristics, application type and programming language are omitted from COCOMO.

Maxwell et al. [31] note that in models such as COCOMO [8], the factors are treated as if they are independent, even though some are not. Furthermore, they conclude that some of the factors used in existing models for cost and effort estimation were not among the underlying factors affecting productivity, hence the need for the development of a simple model based on the determination of a small number of independent factors [31]. Determining the necessary factors is still an open research goal.

Therefore, there is a need to reduce the number of factors that may be included in a particular model to a reasonable quantity so that it may be sufficiently understandable and comprehensible. This problem requires further research into the nature of each factor, its relationships with other factors and their ranking according to their contribution to software development productivity. The latter issue shows the need for models guiding the prioritisation of software development productivity factors. The identification of a smaller number of factors that are most important within a particular project allows management efforts to be directed primarily towards those factors, thus leading to more effective corrective action if needed.

While qualitative methods were observed to be related to more accurate estimates, no clear conclusion could be drawn concerning the usefulness of quantitative methods [7]. It is interesting to note that qualitative research based on psychometric measurements was generally neglected up until 1990, with few exceptions (eg see [18]). Subsequently there has been a greater interest towards them (e.g. see [32], [46]).

A related point to the above question is the limitation of statistical variance theories in explaining social processes, including the process of systems development. As Robey [41:443] concludes "...by conceiving of processes as systems of variables, the variance strategy affords little insight into the dynamics of the social processes it purports to explain. While some percentage of variance in one variable may be "explained" by the variation in another, little "explanation" of how and why social events occur is possible". According to him, in addition to valuable tools for research, such as the traditional science approaches, are also interpretive research methods that allow novel theoretical insights to be induced from both qualitative and quantitative data [41].

Research carried out in [30], [31] and others on the role of the company, country and the industrial/business environment is aiming at providing light on how the results from modelling the factors affecting software development can be generalised for different organizational environments. The issue of transportability of the results from one environment to another is an unresolved one, however. Many like [25], [16], and in particular [1], have indicated the low utility of historical project statistics for cost and schedule estimation. Many of these criticisms are expressed as an insufficient capability of the models to reproduce their results in different environments. One major obstacle to the transportability of these models to environments that are different from those used for the original collection of data to build the model appears to be a lack of understanding of the factors explaining the differences in productivity among projects [31:787].

Software cost or effort estimation involves well-established analytical methods. However, their application is a time consuming activity, which aims to be objective. The ability to reproduce results is a significant feature of the scientific approach (see [3], [15]). Another issue is the role of subjectivity in the estimation process. Thus selecting particular adjustment factors always requires an expert opinion by the estimator. We may observe that all of the "algorithmic" methods or models actually involved an element of subjectivity in choosing the productivity factors, e.g. in choosing the cost driver ratings in the COCOMO model. An excellent review of expert estimation in software development effort can be found in [23]. However, the majority of the theory and practice of software measurement community shows that there is a deep concern within researchers about the involvement of subjectivity in this process. To answer whether or not subjectivity has some role to play in the assessment of factors, affecting software development productivity requires further investigation.

On the other hand, some researchers like [25], correctly note that the socio-cultural background and the computing tradition in a particular country inevitably affect results in cost and effort measurement. All the above probably indicates a need to rethink the traditional claims to strive towards pure objectivity in cost and effort estimation and to accept that it is not achievable in real IS project management, due to the human factor involved. These ideas are further explored in the next section.

3. Research on factors affecting software development productivity dealing with broader issues of software management

According to [13:24], besides "setting budgets and schedules and supporting make-or-buy analyses, software estimation techniques have several additional decision support uses:

- supporting negotiations or trade-off analyses among software cost, schedule, quality, performance and functionality;
- providing the cost portion of a cost-benefit or return on investment analysis;
- supporting software cost and schedule risk analyses and risk management decisions;
- and supporting software quality and productivity improvement investment decisions".

The factors affecting software development productivity play an important role in the management of the Information Systems development process. They influence the way in which the work of software development teams is organised and controlled (see [1] and others). They play an important role in the broader field of software measurement (see [38]). Most of the above topics represent a separate stream of research in the Information Systems and Software Engineering literature with specific epistemology. The diverse use of factors affecting software development in so many research fields justifies the need for their deeper analysis. One of the initial steps may involve some standardization of the definitions of certain factors used in well-established methods for cost and effort estimation like COCOMOII and Function Point Analysis for the whole field of software management. Thus, Rainer and Hall [39] investigate the influence of 26 factors affecting software processes. These factors were identified through extensive computerised qualitative analyses of the text of past papers in the software engineering literature on software process improvement, which provides credibility to their list. At least six of them have some similarities with those factors featuring in COCOMOII, but their wording is different. One reason could be the fact that software productivity improvement (SPI) researchers are still seeking to identify the key factors that affect SPI programs [39:19].

Most of the IS research reported in the literature is limited to statistical analyses of cause-effect type of relationships between two or three factors only. An alternative way for modelling the relationships between factors affecting software development productivity is the application of a multi-criteria decision analysis approach, the Analytic Hierarchy Process in [17]. The latter paper suggests a simple model that allows the prioritization of the factors according to their importance for a given project. The smaller number of factors that are identified as important factors for a particular development situation allows management to concentrate only on these.). Support for the idea of this investigation can be found in [39:15]. The same authors conclude that although past research seems to assume independence of factors affecting software processes, attention should be directed at how such factors relate to each other.

The previous approach can be extended further in the direction of capturing all the interrelationships between the factors affecting productivity using an extension of AHP for models with feedback (Saaty, 1996). Such models are also known as Analytic Network Process [42]. Such a model of the factors affecting software development productivity is explored in [34]. In essence it serves a somewhat similar purpose as the use of Bayesian Belief Networks in modelling software projects (see [48] and the application of Systems Dynamics for that purpose which is discussed next.

Abdel-Hamid and Madnick [1] summarize their work conducted in the 1980s on modeling the software development micro-world through systems dynamics. Subsequent accounts can be found in [28]. This approach explores the relationships between various factors affecting software development focusing on the existing feedback influences between them. It acknowledges that software development, a dynamic and complex process, requires new ways of thinking in order to improve the current software environment. Systems dynamics involves thinking in circles and considering interdependencies, closed loop causality versus straight-line thinking, seeing the system as a cause rather than an effect, internal versus external orientation, thinking dynamically rather than statically, operational versus correlation orientation [28]. Systems dynamics modeling can provide insights by investigating virtually any aspect of the software process at a macro or micro level.

Besides systems dynamics, other techniques for modelling software process dynamics have been used as well. According to [40] these include Petri nets, fuzzy logic, and combinations of fuzzy logic and systems dynamics. Recently, was proposed the use of Bayesian belief networks as another way to support expert judgment in software cost estimation [48]. One possible direction for further research is to compare the expressive power of models applying the above approaches, including Systems Dynamics and the Analytic Network Process. The major issue of concern in such a comparative study should be the determination of the effort associated with the application of a particular method. The latter is important since according to [40], “modelling of software process dynamics has, however, not attracted widespread interest. The level of expertise, data and resources required to build and calibrate such models did not appear justified in a perception of limited benefit”. Similar criticism can be stated about another direction line of research in the 1980s and 1990s by Scacchi, aimed at development of knowledge based systems that model software production (see [43]). Hence, the need for simpler modelling approaches that still capture the complexity of software development.

Kitchenham et. al. [26] point out the need for software cost estimation approaches and models that incorporate the instinctual ways that humans organize and manipulate the information at their disposal. The factors supporting organizational learning in software development are investigated in [50]. Systems dynamics modelling is an example of a method supporting organizational learning in the context of a software process [28]. Hence, the idea to link the fields of software measurement and organisational learning in efforts towards improvement of the ISD process.

Another approach supporting organizational learning for improved understanding of factors affecting software development productivity within a specific software project is presented in [35]. It draws on the growing number of attempts in IS research towards the application of qualitative approaches and methodological pluralism(see [20]). Based on the analysis of the research in software metrics, we can conclude that an investigation of factors affecting software development productivity is a complex problem, with many intertwined sub-problems, and as such, it can be classified as a "messy" problem, to use the term coined first in [3]. It is an important and worthwhile problem, both from a theoretical and practical point of view. A framework is proposed in [34] and [35] for its analysis that is relatively easy to use, which allows for the incorporation of all relevant factors affecting software development productivity in a holistic way. It incorporates available quantitative and qualitative data on a particular project environment, as well as the expertise of those involved in its management. It combines techniques from soft systems thinking and multi-criteria decision analysis, enabling experiential learning about the relationships between the factors involved. This approach is in line with the call by Scacchi (see [43]) for development of setting-specific models of software production which "can be tuned to better account for the mutual influence of product, process and setting characteristics specific to a process".

The development of understanding of a particular software project environment for the purpose of making better judgments about the cost factors involved in cost and effort estimation is supported also by the work of [35]. They implemented a pluralist systemic framework for the evaluation of the factors affecting software development productivity within a particular organizational environment. It combines techniques from several paradigms; stakeholder identification and analysis, from SSM [15] and the Analytic Hierarchy Process [42]. The framework is based on the principles of Multimethodology, a powerful systemic metatheory for organizing an intervention in Operations Research [29] through mixing methods from different methodologies. This framework is complementary to the existing cost estimation approaches and does not aim to replace them. The result of its application is a better expert judgment in the usage of other existing methods for software cost and effort estimation, as well as for IS project management.

There are very few accounts of the use of Soft Systems Methodology (SSM) (see [15]) in the mainstream SE literature. More details on that and a recent example of combining SSM and UML for business process modelling are presented in [44]. It is significant that Boehm has recognised the potential of SSM as he quotes Checkland in a recent paper: "… software people were recognizing that their sequential, reductionist processes were not conducive to producing user-satisfactory software, and were developing alternative SE processes (evolutionary, spiral, agile) involving more and more systems engineering activities. Concurrently, systems engineering people were coming to similar conclusions about their sequential, reductionist processes, and developing alternative 'soft systems engineering' processes, emphasizing the continuous learning aspects of developing successful user-intensive systems" [10]. The cited research in [1], [28], [34], [35] and [44] represents examples of promoting organizational learning for the purpose of improving software development management and software development productivity.

The challenges of software and systems engineering for improvement of software development productivity may be addressed better through the application of a systems approach. This is advocated recently in [36]. The latter work extends some of the ideas in [1], [28], [34] and [35].

Most of the suggestions on integrating IS, SE and systems thinking in [36] relate to issues of organizational learning facilitated by a systems approach. Soft systems methods have a significant track record of producing results in management [15], [29].

According to [10], "recent process guidelines and standards such as the Capability Maturity Model Integration (CMMI), ISO/IEC 12207 for software engineering, and ISO/IEC 15288 for systems engineering emphasize the need to integrate systems and software engineering processes". The same author further proposes a new process framework for integrating software and systems engineering for 21st century systems, and improving the contractual acquisition processes.

Boehm [11] presents a deep analysis of the history of SE and of the trends that have emerged recently. These include the agile development methods (see [5]); commercial off-the-shelf software and model driven development. The traditional software development world, characterised by software engineering advocates use plan-driven methods which rely heavily on explicit documented knowledge. Plan-driven methods use project planning documentation to provide broad-spectrum communications and rely on documented process plans and product plans to coordinate everyone [11]. The late 1990s saw something of a backlash against what was seen as the over-rigidity contained within plan-driven models and culminated in the arrival of agile methodologies, which rely heavily on communication through tacit, interpersonal knowledge for their success.

The above paragraphs indicate major developments in the area of software process management and software development management. Research in this direction should not ignore previous related work in software cost and effort estimation and software development management. Presently a hot topic in it is what happens at the level of large systems-of-systems (see [27] for details on some issues related to cost and effort estimation for large and complex software projects).

4. Conclusion

This paper attempted to review the past research on factors affecting software development productivity. The links between this issue and the broader aspects of software development management were also explored. Our findings show that:

- the models of relationships between such factors have so far not contributed significantly to the improvement of the precision of estimates for development effort or costs;
- the number of factors affecting software development productivity quoted in the literature exceeds seventy. There are no universal classifications accepted in the fields of Information Systems, Software Engineering and Computer Science. There is not enough evidence about justifying the selection or exclusion in a particular model of certain factors;
- there is a need to provide a link between work on software measurement with research on the management of the software development process;

- the stakeholders in a project in some cases are easy to identify, but more often, there are subtle stakeholders that need to be uncovered to avoid a potential over-simplification of the understanding of the role of a project and its environment;
- a better understanding of the relationships between the factors affecting software development productivity can be achieved through application of methods promoting organizational learning. The result of this is an improved Information Systems Development process;
- there is a need for relatively simple approaches to identify which are the most appropriate factors affecting software development productivity for a given organisation and project, how they relate to each other, and how their ranking evolves at different stages of the software development process.

Different organizational environments may justify the inclusion of various factors affecting software development productivity. It seems that the choice of those that need to be considered in a given situation must be more flexible. Such decisions depend on the actual dynamic circumstances of a particular IS project and how well these are understood. The survey showed that very few researchers attempted to address this issue in its full complexity.

Another dimension of possible future analysis can be concerning the benefits from mixing methods from different paradigms and methodologies in frameworks promoting better understanding of the factors affecting software development productivity compared to the use of a single methodology like systems dynamics. A starting point could be raising the awareness of a particular research community of what another one is doing. The results of the review point that a pluralist approach, breaking down the paradigmatic isolation between various research methodologies may lead to improvement of our understanding to handle the complexity of improving software development productivity.

There have been a number of comparative studies of various cost and effort estimation methods (see [25], [37], [26]). On the other hand, there have been few comparisons of approaches promoting better Information Systems Development process management through organizational learning in spite of the several attempts discussed in the paper. Most of the work analysed in the second part of this review focuses on its own research agenda with little comparison of how it fits within the greater body of knowledge on software development management. As mentioned earlier, most of it is from the perspective of Software Engineering with few exceptions like the IS oriented work reported by [35]. Hence, there is a need to research systemically the problem of software development productivity factors across the current disciplinary divide in order to produce better practical, relevant and rigorous understanding of what drives software development productivity.

5. References

[1] ABDEL-HAMID, T.K. AND MADNICK, S., Software Process Dynamics, Prentice Hall, Englewood Cliffs, NJ., 1991

[2] ABRAN, A. AND ROBILLARD, P.N. , Function Point Analysis: An Empirical Study of Its Measurement Process, IEEE Transactions on Software Engineering, 22(12), 895-910, 1996

[3] ACKOFF, R., Science in the Systems Age: Beyond IE, OR and MS, Operations Research, 21, 661-669,1973.

[4] BAILEY, J.W. AND BASILI, V.R., A Meta-Model for Software Development Resource Expenditures, Proceedings of Fifth International Conference on Software Engineering, 107-116,1981.

[5] BASKERVILLE, R., RAMESH, B., LEVINE L., PRIES-HEJE, J., AND SLAUGHTER, S., Is Internet-Speed Software Development Different, IEEE Software, November/ December, 70-77, 2003.

[6] BENBASAT, I. AND VESSEY, I., Programmer and Analyst Time/Cost Estimation, MIS Quarterly, 4(2), 31-43,1980.

[7] BERGERON, F. AND ST-ARNAUD, J.,SOS: Estimation of Information Systems Development Efforts: A Pilot Study, Information and Management, 22, 239-254,1992.

[8] BOEHM, B.W., Software Engineering Economics, Prentice-Hall, Englewood Cliffs, NJ.,1981.

[9] BOEHM, B.W., Improving Software Productivity, IEEE Computer, 20(9), 42-57,1987.

[10] BOEHM, B., Some future trends and implications for systems and software engineering processes. Systems Engineering, 9(1), 1-19, 2006.

[11] BOEHM, B., A view of 20th and 21st century software engineering, Proceeding of the 28th international conference on Software Engineering. Shanghai, China, 12 – 29, 2006.

[12] BOEHM, B. AND SULLIVAN, K.,Software Economics: Status and Prospects, Information and Software Technology, 41, 937-946, 1999.

[13] BOEHM, B. AND FAIRLEY, R., Software Estimation Perspectives, IEEE Software, November/December, 22-26, 2000.

[14] BOEHM, B, ABTS, C. AND CHULANI, S., Software development cost estimation approaches - A survey. Annals of Software Engineering, 10: 177-205, (2000)

[15] CHECKLAND, P., Systems thinking, systems practice. Wiley, Chichester, 1999.

[16] CONTE, S.D., DUNSMORE, H.E. AND SHEN,V.Y., Software Engineering Metrics and Models, The Benjamin Cummings Publishing Co. Menlo Park, 1986.

[17] FINNIE, G.R., WITTIG, G.E. AND PETKOV, D.I., Prioritizing Software Development Productivity Factors Using the Analytic Hierarchy Process, Journal of Systems and Software, 22(2), 129-139, 1993.

[18] HANSON, S.J. AND ROSINSKI, R.R., Programmer Perceptions of Productivity and Programming Tools, Communications of the ACM, 28(2), 180-189, 1985.

[19] HEISAT, A., Comparison of artificial neural network and regression models for estimating software development effort, Information and Software Technology, 44, 911-922,2002.

[20] HIRSCHHEIM, R AND KLEIN H.K., Crisis in the IS Field? A Critical Reflection on the State of the IS Discipline, Journal of the Association for Information Systems, 4 (5), 237-293, 2003.

[21] JEFFERY, R., RUHE, M. AND WIECZOREK, I., A comparative study of two software development cost modeling techniques using multi-organizational and company specific data, Information and Software Technology, 42, 1009-1016, 2000.

[22] JONES, C., Applied Software Measurement: Assuring Productivity and Quality, McGraw Hill, New York., 1991.

[23] JØRGENSEN, M., A Review of Studies on Expert Estimation of Software Development Effort, J. Systems and Software, 70 (1-2), 37–60, 2004.

[24] KEMAYEL, L., MILI, A. AND OUDERNI, I., Controllable Factors for Programmer Productivity: A Statistical Study, Journal of Systems and Software, 16(2), 151-163, 1991.

[25] KEMERER, C.F.,Progress, Obstacles, and Opportunities in Software Engineering Economics, Communications of ACM, 41(8), 63-66, 1998 .

[26] KITCHENHAM, B., PFLEEGER, S.L., MCCOLL, B. AND EAGAN, S., An empirical study of maintenance and development estimation, The Journal of Systems and Software, 64 (1), 57-77, 2002.

[27] LANE, J.A. AND BOEHM, B., System-of-systems cost estimation: analysis of lead system integrator engineering activities. Information Resources Management Journal, 20(2), 23-32, 2007.

[28] MADACHY, R.J., Process Modeling with Systems Dynamics, Proceedings of the Eight Software Engineering Process Group Conference, Atlantic City NJ, May, available at http://www-rcf.usc.edu/~madachy/sd/sd.html#research_group , 1996.

[29] MINGERS, J., Multimethodology- mixing and matching methods. in Rosenhead J. and Mingers J. (Eds), Rational analysis for a problematic world revisited, Wiley, Chichester, 2001.

[30] MAXWELL, K.D., WASSENHOVE, L.V. AND DUTTA, S., Software Development Productivity of European Space, Military, and Industrial Applications, IEEE Transactions on Software Engineering, 22(10), 706-718, 1996.

[31] MAXWELL, K., VAN WASSENHOVE, L. AND DUTTA, S., Performance Evaluation of General and Company Specific Models in Software Development Effort Estimation, Management Science, 45 (6), 787-803, 1999.

[32] MIRANDA, E., Improving subjective estimates using paired comparisons, IEEE Software, January/February, 87-91, 2001.

[33] MUDHOPADHYAY, T., VICINANZA, S.S. AND PRIETULA, M.M., Examining the Feasibility of a Case-Based Reasoning Model for Software Effort Estimation, MIS Quarterly, June, 155-169, 1992.

[34] PETKOVA, O., A framework for evaluation of factors affecting software development productivity, PhD thesis, University of Pretoria, South Africa, 1999.

[35] PETKOVA, O. AND ROODE, J. D., An application of a framework for evaluation of the factors affecting software development productivity in the context of a particular organizational environment, South African Computer Journal, 24, 26-32, 1999.

[36] PETKOV, D., EDGAR-NEVILL, D, MADACHY R., O'CONNOR, R., Information systems, software engineering and systems thinking – challenges and opportunities, in print: Journal on Information Technology and the Systems Approach, 1 (1), 2008.

[37] PFLEEGER, S.L., Software Engineering: Theory and Practice, Prentice Hall Inc., 2000.

[38] PFLEEGER, S.L., JEFFERY, R., CURTIS, B., AND KITCHENHAM, B., Status Report on Software Measurement, IEEE Software, March-April, 33-43, 2002.

[39] RAINER, A. AND HALL, T., A quantitative and qualitative analysis of factors affecting software processes, The Journal of Systems and Software, 66, 7-21, 2003.

[40] RAMIL, J.F. AND LEHMAN, M.M., Modeling Process Dynamics in Software Evolution Processes – Some Issues, submitted to the Workshop on Software Change and Evolution (SCE'99), Los Angeles, May, 1999. Available at http://www.doc.ic.ac.uk/~mml/feast2/papers/pdf/619.pdf

[41] ROBEY, D.,Modeling Interpersonal Process during System Development: Further Thoughts and Suggestions, Information Systems Research, 5(4), 439-445, 1994.

[42] SAATY, T., The Analytic Network Process, RWS Publications, Pittsburgh, 1996.

[43] SCACCHI W., Understanding Software Productivity, In D Hurley (Ed). Advances in Software [10] Engineering and Knowledge Engineering, Vol 4, 33-70, 1995.

[44] SEWCHURRAN, K. & PETKOV, D. (2007). A systemic framework for business process modeling combining soft systems methodology and UML. Information Resources Management Journal*,* 20(3), 46-62.

[45] SHEPPERD, M. AND SCHOFIELD, C., Estimating Software Project Effort Using Analogies, IEEE Transactions on Software Engineering, 23(12), 736-743, 1997.

[46] SHEPPERD, M. AND CARTWRIGHT, M., Predicting with sparse data, IEEE Transactions on software engineering, November, 27 (11), 987-998, 2001.

[47] SOMMERVILLE, I., Software Engineering, 8th Ed., Pearson, Harlow. 2007.

[48] STAMELOS, I., ANGELIS, L., DIMOU, P., AND SAKELLARIS, E., On the use of Bayesian belief networks for the prediction of software productivity, Information and Software Technology, 45 (1), 51-60, 2003.

[49] SUBRAMANIAN, G.H. AND BRESLAWSKI, S., An Empirical Analysis of Software Effort Estimate Alterations, Journal of Systems and Software, 31,135-141, 1995.

[50] VAN SOLINGEN, R., BERGHOUT, E., KUSTERS, R., AND TRIENEKENS, J., From process improvement to people improvement: enabling learning in software development, Information and Software Technology, 42, 965-971, 2000

The Last 15 Years

THE IDIMT HISTORY

Petr Doucek*

The history of the IDIMT conferences (Interdisciplinary Information Management Talks) started in the beginning of the 90's. These meetings provide a wide platform for students, scientists, lecturers and employees where they can present and discuss their experiences, opinions, ideas and visions in area of informatics, information and communication technology, information systems, information management sociology, philosophy, systems theory, and other related topics. Interdisciplinarity is the big advantage of these conferences. It allows experts from disciplines which on the first view often appear quite dissimilar and often strange, to meet and to discuss. What was the history of these small and smart conferences and what were main milestones? This is described in this contribution. This contribution should also express my thanks to all founders, organizers, contributors and participants.

1. "The times they are a-changin'…."

Nowadays the IDIMT (Interdisciplinary Information Management Talks) conferences are a normal part of the calendar for a group of young and older scientists in majority from Middle Europe. The second week of each September became a period, when they meet in the Czech Republic (currently in České Budějovice) to present here their results of annual surveys, information system improvement, research and development work, their opinions, new proposal and ideas.

Let us look back into the past time when Europe was in a transition period: the Iron Curtain is breaking down and integration of the former political enemies – the Eastern socialist countries and the Western democratic countries - could start.

We write 1991 when I got information about the possibility to perform my post-doc study in Austria with the support of the funding of the "Action Austria Czech Republic". The chance

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was to study with Professor Gerhard Chroust – the new head of the department of "Systemtechnik und Automation" at Johannes Kepler University in Linz. I started there a two-month study assignment and since that time I have my first personal experience of academic habits, duties and manners, which are normally performed in the Western European countries and at their universities.

What was the general political and social climate in Europe at the beginning of the 90's? All Europe was excited by the coming down of the Iron Curtain and all "modern Europeans" wanted to establish co-operations between the up to this time enemy blocks, without having to respect former borders between democratic and socialist countries. It was the time of getting to know one another - people from eastern part of Europe wanted to know how the life is in the West and Western people wanted to visit formerly forbidden parts of their continent. This desire to get to know the other part of Europe occurred in different areas of human activities as – traveling, business, and culture and at last but not at least academia, education, science and research and development framework. The general frame of the Bologna process and conception of the European education is the fruit of this optimistic and enthusiastic period.

Touristic visits are useful for knowing nature and buildings, but only few of tourists are able to know, understand and accept specific features of the country where they stay. Usually they like to stay in n-stars hotels with comfortably equipped rooms, with international foods on the menu etc., but they have only few occasions to experience the touch and to feel the spirit of the country and the nation where they are on visit. When one wants to find a real long term partner for common work, be it for business, scientific or research and development work, one must visit the partner in his/her country and live thee under her/his own conditions. This was the main reason, why I went to Austria to perform here my study assignment focusing on project management and software engineering.

2. IDIMT – From Prehistory to the Future

My first feeling after arriving at the Johannes Kepler University at the department of "Systemtechnik und Automation" was: there was, judged by ideas and flexibility, a very young, good working department with the charismatic boss with plenty of life energy. The main characteristic of Gerhard Chroust is – a lot of positive energy that he offers to all partners, students and staff of his department. He was the right engine all time full of activity and every time prepared to support good ideas of his colleagues not only with advice, but also with concrete activities, large professional experience and wisdom of life. I finished my study at Johannes Kepler University at the beginning of June 1992 and went back to Prague.

At home, we discussed these results of my Austrian "trip" at our department meeting and came to the conclusion to form and to formulate a general proposal for a further common co-operation between these two departments. The best approach seemed to be in the form of a conference. The former head of the department and the vice-rector for research and development work at the University of Economics, Prague, professor Jan Ehleman supported this proposal. He arranged a visit to the Johannes Kepler University in the end of winter in 1992. Professor Gerhard Chroust as a co-founder of co-operation accepted the proposal for small conference type meetings and at this historical meeting in Linz all participants proclaimed common interests to work together and to start common research and development work. In this way, these founders built a new platform for co-operation between the J. Kepler University and the University of Economics, Prague. The real expression of this platform was to be a conference – the future IDIMT.

Other persons that contributed from the beginning of the IDIMT history were:

- professor Ernest Kulhavy, the former vice rector of the J. Kepler University,
- professor Leo Vodáček, guru of management science at University of Economics, Prague and founder of the research discipline and master study program "Information management", the first guarantor of all courses of information management at Faculty of Informatics and Statistics,
- associate professor Prokop Toman, University of Economics, Prague, the renaissance person, in majority focused on philosophical and social aspects of information system improvement into human community.

Thanks to You all! You were the first visionaries of the IDIMT way to actual and hopefully future success.

We had to solve a lot of partial small and big questions and problems during this co-operation. The first of them were to find for our conference:

- a location – main criteria for the conference place were:
    a. approximately the same distance from Linz and Prague – from this point of view we selected the first conference place in in Kubova Huť in the Šumava Mountains (Böhmerwald),

   b. convenient price level of the Czech Republic in comparison to Austrian – this aspect was and is up to this time, the reason why the conference is in the Czech Republic.

- name - the first year was run under the name “Information Management Workshop 1993”. The programming and the organizing committee changed the name of the conference to “Interdisciplinary Information Management Talks” in October 1993. This name is still valid and accepted up to our time – for thirteen years!

Annually since that time our participants present many contributions at this conference under the title of “Interdisciplinary Information Management Talks” (IDIMT). Under the acronym “IDIMT” this conference is known on five continents in the world. We find plenty of conferences all around the world, but what is the main advantage, according to my opinion, and the benefit of this small but smart meeting?

1. At the meeting regularly person from different countries of central Europe (usually from Austria, Czech Republic, Germany, Hungary, Slovak Republic, Slovenia) take part.
2. Knowledge and experience background of each group of participants is a little bit different. It runs from the more technical orientation of Austrian and German participants on one part of the spectrum to some regular Czech participants focusing on philosophy and human aspects of information and communication technology (ICT) improvement; this feature offers ideal conditions for know-how interchange and for a large field for discussion,
3. The scope of presented contributions, information, ideas, opinions and knowledge is wide – from technical oriented contributions through contributions focused especially on human aspects of ICT and on philosophical aspects of ICT impacts on society to managerial aspects of ICT and informatics management and modeling, not to forget the systemic aspects.
4. The specialization of the participants as well as their age and practical experience are different, so those participants provide a wide scope of presented opinions and ideas; from young, dynamic and self-confident PhD students to wise and more “conservative” professors.
5. Different concepts of the education process are presented and discussed.

6. Results of different national and international projects are presented here and new alliances are established at these conferences aiming at the preparation of new common projects.
7. Discussion, formal as well as informal, is an integral part of the conferences; we provide enough time to discuss all aspects of presented contributions.
8. The orientation of the conference programme is regularly updated such that new and leading edge themes are included into conference topics.
9. From the beginning, we had proceedings of the IDIMT conference. Now on the average we have some 30 papers totaling some 300 pages per conference. They show a proud record of our conferences [3].
10. Extraordinary international or "exotic" guests use to come from time to time to this event.

Figure 1 - Proceedings from the first 14 IDIMT conferences

3. Conference locations

The first chapter of the IDIMT conference wrote participants in Kubova Huť in Šumava Mountains (Böhmerwald) in hotel Arnika in 1993. Kubova Huť is a marvelous little village near Boubín's wild forest in the heart of Sumava Mountains, but with very poor accessibility. The conference was located here for two years. In 1995 they started the reconstruction of the hotel and we had to find a new location for the conference. The organizing committee moved the 1995 conference nearer to the "civilization", to Zadov – to famous tourist and skiing center in Šumava Mountains. The Zadov village has the same distance from Prague as well as from Linz – 156 km. In hotel Olympia, under the gestation of Mr. Pavlik, the director of the hotel, the conference was held for eight years. Combination of professional approach of the hotel staff, especially catering and other supplementary services, and wonderful mountain nature gave inspiration to participants and formed spirit of the conference. During these eight years several innovation of the conference program were also made, more details can be found in Gerhard Chroust's paper [1] and my paper from 2006 [2]. Both session topics as well as the schema of the conference underwent considerable changes.

The most important innovation happened in 2002, at the tenth anniversary of the IDIMT meeting. The organizing committee decided to divide the conference into two parts. The first part was held in Prague and was the PhD-part of the conference under the gesture of the former rector associate professor Jaroslava Durčáková. She invited all participants to the private audience and to the cultural part of the PhD-session. Participants visited the Charles University - the oldest University in the Middle Europe. A special – cultural - feature of the 10th IDIMT was a very successful paintings exhibition under the title "Impressions of Vienna" – Mag. Dr. Traude Loesch and "Impressions of Linz" – Janie Chroust.

In the Prague event several young perspective PhD students from three countries were involved. The presented contributions were mainly their PhD theses. All participants discussed them in the plenary forum in formal and informal ways. The final results of this part of IDIMT were presented by selected PhD students during the main IDIMT conference in Zadov. This PhD meeting was the base for other actions especially appointments of Czech and Slovak PhD students. We realized one of these common actions in May 2003 in co-operation with the TU in Kosice [4]. We split it into three sessions with the following session leaders as invited speakers:

- Prof. Anton Lavrin (Slovak Republic) – topic: Information And Communication Technology in E- business
- Prof. Karel Pstružina (Czech Republic) – topic: Thinking in Information Society
- Dr. Antonín Rosický (Czech Republic) – topic: Information and/or Knowledge Management

Also professor Richard Hindls – the dean of the faculty – with his vice dean for research and development work, professor Stanislava Hronová, took part as honor guest at this conference.

In the same year (2003) an organizational problems appeared in hotel Zadov and the organizing committee moved the conference to České Budějovice – a marvelous city in South

Bohemia. Here we arranged the conference with support of the theological faculty of the South Bohemian University. Center of the conference is the PVT hotel, which provides the accommodation and the conference room. Catering is in restaurant Metropol not far from conference place. From other point of view, conditions in České Budějovice, especially accommodation, creates a set of limits for IDIMT's further development. Main limits are accommodation capacity – no more then 50 persons can be accommodated in the PVT hotel. The conference room capacity is no bigger then 40 participants and it seems to be low for the future. It is slowly time to think over some innovations of the IDIMT location. There are possibilities to move it to Jindřichův Hradec (here is located one of the faculties of the University of Econonics, Prague) or to Tábor (the city with the history from fifteenth century).

The IDIMT conference became, not important in what location, an ideal platform for scientific work results presentation especially by young and/or younger colleagues and PhD. students. At the last two conferences (2006 and 2007) we again added a new PhD-day with a session in the main conference [5].

I would like to express here great thanks to all members of organizing and program committees and to all participants. My thanks also *náleží* to all founders of the IDIMT conference and especially to You, Gerhard, that You started this small but smart conference and I also thank You for Your vitality, the wisdom of life and for rich experience.

Figure 2 - Gerhard Chroust, Petr Doucek, Jan Ehleman

4. References

[1] Chroust, G.: 15 Years IDIMT – 15 Years of Change, IDIMT 2007 (in this volume)

[2] Doucek, P.: The History of the IDIMT Conferences in: Hoyer, C. and Chroust, G. (eds.): IDIMT 2006 - 14th Interdisciplinary Information Management Talks, Verlag Trauner Linz, 2006, pp. 11-16, ISBN 978-3-85499-9

[3] IDIMT Conferences 1993 – 2006 : ISBN 3-902457-06-6, 3-486-23147-2, 3-486-23502-8, 3-486-24033-1, 3-486-24526-0, 3-85320-955-6, 3-85487-046-9, 3-85487-153-8, 3-85487-272-0, 3-85487-424-3, 3-85487-493-6, 3-85487-665-3, 3-85487-835-4, 978-3-85499-049-9

[4] Klas, J., Gregor, S.: Information Management and Society, ISBN 80-245-0524-X

[5] (Doucek, P.; Hoyer, C.; Chroust, G.; Klas, J.: The Impact and Value of a PhD in the Information Society, University of Economics, Prague, Faculty of Informatics and Statistics; Scientific and Research Papers, No. 10, Nov. 2006, ISBN 80-245-1

15 YEARS IDIMT - 15 YEARS OF CHANGE

Gerhard Chroust

The 15th anniversary of the IDIMT Conferences is a motivation for looking back. This paper will give a personal reflection of the evolution of the IDIMT Conferences during these years, identify major changes and improvements, provide some statistical material, add some personal observations, and will - in a limited way- relate the conferences to the development of the Information and Communications Technologies in general. It will also give thanks to many collaborators and participants for all the improvements we can observe in retrospective. In a parallel paper Prof. P. Doucek will describe his personal reminiscences of the various IDIMT Conferences.

1. The IDIMT chronology

It is hard to believe that we are celebrating the 15th anniversary of IDIMT. The chronology below shows remarkable growth of IDIMT over the years, not so much with respect to the number of participants and papers, but with respect to the friendship and cooperation carried on by many participants.

1992, the initiative:

In Spring 1992 I was serving my first few months as the newly appointed professor for Systems Engineering and Automation at the Kepler University. A young, talented and very ambitious assistant, Ing. Petr Doucek (now Professor), from the University of Economics, Prague had been awarded a two-month scholarship enabling him to study in Linz. I was informed by Prof. Dr. Ernest Kulhavy from the Kepler University Linz, who was in charge of intensifying external relationships, that this young man was going to spend his scholarship at my institute. Prof. Kulhavy also suggested this should be just the first step in establishing a close collaboration with the University of Economics, Prague where Prof. Dr. Jan Ehleman (fig. 42 and fig. 39), was in charge of external contacts. The Department of Systems Engineering and Automation in Linz (which then was part of the Institute of Systems Sciences) and the Department of Systems Analysis in Prague were to be the key contacts for this new cooperation. After a visit from colleagues from the University of Economics, Prague we agreed on starting a small bilateral conference in 1993 to establish and consolidate the cooperation. This suited me very well since I was, though not very young, only in my second year of duty at the University of Linz. It was an important step into an academic cooperation. Petr Doucek offered his help and know-how to organize the envisioned bi-lateral event.

Part of the challenge (and also the fun) was that in many ways the two partners were quite different: the Department of Systems Engineering and Automation of the Kepler University Linz was technology-oriented and the Department of Systems Analysis of the University of Economics, Prague was primarily economically oriented. At that time there were considerable differences in the economic situation and the political and economic and social environment between Austria and the Czech Republic. The Czech Republic was actively striving to abolish the remainder of the old communist system.

1993, the first meeting:

Key conference topics: In 1993 the topics were information management in the classical sense and software engineering in relation to technology and its management.

Petr Doucek found an inexpensive conference site: Hotel Arnika in Kubova Hut', near Vimperk, in Sumova (Bohemian Woods) some 110 km north of Linz (fig. 1).

Figure 1 - Hotel Arnika, Kubova Hut, 1993

The conference facilities were not too exciting. We had to transport all conference material to this location, but it was cosy and since there was no other diversion, we had long discussions at the bar and thus we became real friends. In this first meeting we took upon us the challenge to bridge the multidimensional gaps between Linz and Prague. We were very concerned about balancing everything in the meeting: the number of papers from both sides, the number of chairpersons, the mix of nationality within sessions, the sequence of speakers, etc. etc. and - I may say - we were successful! Despite the small number of attendees (around 14) we not only enjoyed the interdisciplinary exchange of ideas, we also recognized the need and potential of further and more intensive talks.

I may cite from the opening paper by Profs. Ehleman and Vodacek: "...managerial thinking and management systems have been rapidly undergoing substantial, sometimes even painful changes. The political transition [and] the transformation to the market type economy have created quite new tasks and problems we were not used to." (fig. 3). The presented papers were published in the first volume of the IDIMT-proceedings (fig. 2), see also section 2.

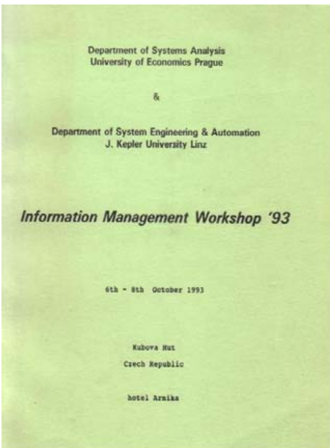


Figure 2 and 3 – Proceedings of the first IDIMT-Conference, 1993 and Leo Vodacek at the IDIMT Conference 1993

IDIMT 1994:

Key conference topics: 'Transition' in many fields was the overriding theme, especially with respect to the changes of the Czech economy.

The conviction that the conferences will become a permanent institution, made us think of an appropriate acronym: Petr Doucek coined "Interdisciplinary Information Management Talks (IDIMT)". This expressed most of our intentions : to be interdisciplinary, put information in the center of our interest and to use a considerable part of the meetings for interdisciplinary and informal discussions and not just for presenting papers.

The publication of the proceedings of IDIMT 1994 was handed over to a professional publisher: Oldenbourg Publishers in cooperation with the Austrian Computer Society (fig. 4).

Figure 4 - IDIMT 1994 Proceedings

IDIMT 1995:

Key conference topics: Issues of networking in office work made its first impact on the programme (Workgroup computing).

We had to abandon Kubova Hut' because the hotel was being refurbished. Petr Doucek, after considerable effort of trouble and travel selected hotel Olympia in Zadov. Hotel Olympia was remarkable since it was located in the well known skiing resort of Churanov Mountain. The summit of Churanov (1140 meter) was only a 10-minute walk away from the hotel and the hotel was surrounded by deep, beautiful woods.

Figure 5 - Hotel Olympia, Zadov

Fig. 6: Meetingroom in hotel Olympia, Zadov, 2002

Figure 7 - IDIMT 2002, Zadov, welcome party: Erwin Grosspietsch, Hana Krivankova, Gerhard Chroust, Antonin Rosicky, Jan Ehleman

The problem was finding the location, driving from Linz. Once we arrived in the vicinity, but it was already dark and raining, nobody was there to ask and no signs to be read - I actually drove all around Churanov before finally finding the hotel, arriving more than an hour late. Hotel Olympia had much better facilities and especially a very nice and cosy conference room (fig. 6). On the gastronomic side, too, the quality had improved. 1995 was the first truly international meeting with participants from 5 different nations. In that year a new format for the proceedings was chosen by our publisher, giving the proceedings a much more professional impression (fig. 8).

Figure 8 - IDIMT 1995 Proceedings

IDIMT 1996:

Key conference topics: Tele-training, communication, and technology transfer in parallel to transition problems; information management became a standard topic in all following meetings.

Hotel Olympia in Zadov also proved to me the dynamics inherent today's Czech economy. Year after year there was continuous improvement, something new, something more professional. Mr. Pavlik, the owner always had a few pleasant surprises for us (fig. 9). The welcome dinner on Wednesday night was always an enjoyable get-together (fig. 7).

IDIMT 1997:

Key conference topics: Human aspects and issues of systemic thinking appeared, as well as quality management.

This conference included for the first time two invited speakers: Prof. Franz Pichler from the Kepler University Linz ("On the Concept of Holarchy by Arthur Köstler") and Prof. Jareslav Vlcˇek ("The Role of Systems Thinking and Systems Methodologies in the actual State of Conditions"). The (pleasant) problem of too many papers to be accepted has resulted in adopting a new conference scheme: one keynoter introducing a subject, and short position papers supporting (or opposing) the presented subject. This new structure has proven to be very helpful. It has provided much more valuable discussion time than before.

Figure 9 - Lunch at Hotel Olympia, Zadov 2001: Petr Doucek, Antonin Rosicky, Karel Pstruzina

IDIMT 1998:

Key conference topics: From this year onward, systemic thinking, quality management and human interfaces became central topics. The outlook on future technological advances has became part of the topics we discussed.

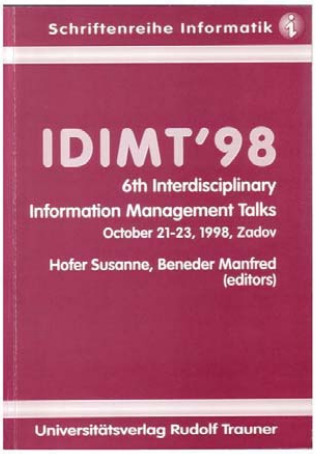


Figure 10 - IDIMT 1998 Proceedings

Due to a change in the publishing arrangements of the Austrian Computer Society, the OCG, we thought it advisable to change to a different publisher (fig. 10): the Trauner Verlag Linz. For this purpose I established a new series "Informatik" at Trauner Verlag. Other proceedings, too, were published there: today 22 volumes have been published in total.

Manfred Beneder and Susanne Hofer (fig. 11 and fig. 12) officially became the editors of the IDIMT 1998 proceedings, after having helped to organize the scientific programme of the IDIMT Conferences from the start.

Figure 11 - Manfred Beneder

Figure 12 - Susanne Hofer

IDIMT 1999:

Key conference topics: Development and Management of IS/IT processes, Cooperative Processes and Human factors.

Triggered by the keynotes of 1998, systems related papers achieved a prominent place in the programme, especially due to the involvement of Matjaz Mulej (fig.16). The topic of cooperative environments was especially supported by Konrad Klöckner (fig. 26). and Tom Gross (fig. 13)

Figure 13 - Tom Gross, Christian Hofer, 2002

Up to 1998 the IDIMT conferences were traditionally held early/middle of October.

In 1999 we decided to move to late middle/late September to to make attendance for our university participants easier.

IDIMT 2000:

Key conference topics: The development of information systems (10 of 32) and human factors dominated the programme (8 out of 32), including ethics and regulations.

We had an official dinner talk (Gerhard Chroust "Internationalization is more than translation!") on Wednesday evening, before the official opening of IDIMT on Thursday morning.

A panel discussed the questions of 'Ethics, Regulations and Professionalism' were discussed, exploring some controversial issues. In their introduction the editors (Susanne Hofer and Manfred Beneder) stressed the importance and usefulness of e-mail and internet for submitting, reviewing and collecting the papers, not a standard feature in 2000!

IDIMT 2001:

Key conference topics: Electronic commerce appeared in the program, together with tele-learning, tele-teaching, and tele-work.

A new traditions was established: from this date on Christian Loesch gave every year a technology forecast on some ICT-technologies and developments (fig. 14). "’Trends in Business, Technology, and Research & Development". His presentations became one of the highlights of each of the following IDIMT conferences.

Figure14 - Christian Loesch presenting technological forecasts

Manfred Beneder and Susanne Hofer left the Kepler University Linz. Manfred Beneder accepted an interesting and challenging job with a software company. Susanne Hofer came down little Alexander and stayed home for some time. Christian Hofer fig. 15, Susanne’s husband, took Susanne’s place at the institute, also administering IDIMT and acting as a co-editor of the proceedings. The organizers even remembered that I had turned 60 in 2001 and they a arranged a beautiful celebration in Zadov (fig. 16 and fig. 17).

Figure 15 – IDIMT 2001, Christian Hofer

Figure 16 - Celebrating Gerhard's 60th birthday at IDIMT2001: Gerhard Chroust, Matjaz Mulej, Petr Doucek

Figure 17 - Celebrating Gerhard's 60th birthday at IDIMT2001: Janie Chroust, Gerhard Chroust, Petr Doucek

IDIMT 2002:

Key conference topics: E-commerce and e-Government and associated security problems are important topics. Interdependence and Ethics elicit several papers with a long-range vision. Three papers explicitly address small and medium enterprizes.

Proudly we could announce the 10th Anniversary of the IDIMT-Conferences.

Figure 18 - Happy Birthday IDIMT!

A special cultural event was an exhibition of paintings by Traude Loesch ("Impressions of Vienna") and Janie Chroust ("Impressions of Linz") showing sights of these two cities (fig. 19).

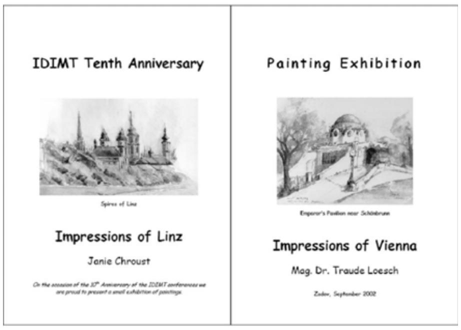


Fig. 19: Painting Exhibition at IDIMT 2002: Traude Loesch and Janie Chroust

Fig. 20: Traude Lösch and Janie Chroust at the entrance with some of their pictures

In 2002 we introduced another first: the 'PhD-Student Forum'. Nine students from Austria, Czech Republic and Slovak Republic (fig. 21) came together in Prague one day before the IDIMT Conference and discussed not only their specific PhD-themes, but also questions of general relevance, moderated by Antonin Lavrin. They then presented their ideas and findings during the actual conference.

Figure 21 - PhD-Day 2002, Prague

IDIMT 2003:

Key conference topics: 'Trends' are a favourite topic, followed by system thinking,

e-business, cooperative environments.

In Spring of 2003 we reveived a very unpleasant message: due to some misunderstanding the Hotel Olympia in Zadov was unable to accommodate our group, not even if we shifted our conference dates slightly. A hectic search began for a replacement. Thanks to Prof. Helmut Renöckl (Kepler University Linz and University of Southern Bohemia) and his assistant Martin Bilek, we were able to find a new location: the "Hotel Garni p.v.t." (fig. 22), in České Budějovice, a historical city, founded in 1265 by the famous King Premysl Otak. It is also world-famous for its beer.

Figure 22 - Hotel garni p.v.t., České Budějovice

The move brought about considerable improvement: We were able to stay in a beautiful little town, with an impressive central square and many small, scenic streets (see fig. 23). Lunch and dinner hand to be taken outside of the hotel. This provided additional gastronomic improvements (fig. 24).

Figure 23 - The central square of České Budějovice

Figure 24 - Delicious Roasted Pork

Honouring České Budejovice’s long standing brewing tradition, we visited the famous Budweiser Brewery as part of the official conference programme.

IDIMT 2004:

Key conference topics: e-society, educational aspects, cooperative environments and economic aspects are discussed.

In this year we were able to welcome the Czech Republic as a member of the European Union: the opening address had as its title "Welcome to IDIMT! Welcome to Europe!" We also observed that information and its management is a key concern of the European Union and its research programs. Thus IDIMT can be considered an interesting contributor to the common European goal.

In this year our publisher, Trauner Verlag, decided to refresh the appearance of all its published publications. The proceedings of IDIMT were given a new cover layout (fig. 25). This made was a considerable improvement to its appearance.

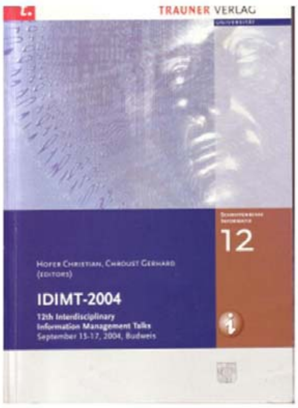


Fig. 25: IDIMT 2004 Proceedings

IDIMT 2005:

Key conference topics: European Projects and SMEs, Innovation and Creative Thinking, Cooperative Information Environments, and Human Factors.

Christoph Hoyer, who succeeded Christian Hofer at the Kepler University Linz, took over the co-editorship of the proceedings. To accommodate more papers and discussions we started the conference with an opening session on Wednesday late afternoon. Topics of societal implications gained more impact in the submitted papers.

Figure 26 - Erwin Grosspietsch, Konrad Klöckner

IDIMT 2006:

Key conference topics: Innovation and New Technologies are lead topics, 5 papers discuss European issues of research and especially education, software project management makes an entry into list of topics (fig. 30)

We revived the idea of a PhD-day, and with the help of Christoph Hoyer we organized it in České Budějovice the day before the conference (fig. 27). As topic we chose "The Impact and Value of a PhD in the Information Society". Moderated by Gerhard Chroust and Petr Doucek eight students from 5 countries (Austria, Czech Republic, Germany, Hungary, and Pakistan) discussed for a full day procedures, curricula and the resulting appreciation of a PhD-degree in the various countries. Some interesting details and differences came up in these discussions. The findings were later collected in a small proceedings booklet (Doucek, P.; Hoyer, C.; Chroust, G.; Klas, J.: The Impact and Value of a PhD in the Information Society, University of Economics, Prague, Faculty of Informatics and Statistics; Scientific and Research Papers, No. 10, Nov. 2006, ISBN 80-245-1133-9).

Figure 27 - Shahid Nazir Bhatti and Christoph Hoyer

Figure 28 - Dinner in Budweis, Maria Raffai and Christian Loesch

Figure 29 - Dinner in Budweis, Traude Loesch and Gerhard Chroust

Figure 30 - Lunch at restaurant Metropol - Petr Doucek, Karel Pstruzina

IDIMT 2007: (status June 20, 2007)

Key conference topics: System theories occupies a large portion of the programm together with European projects, especially personal experiences with them. Four papers give an overview of the history of IDIMT.

IDIMT 2007 is the 15th confernece in a row and we decided to have some extra celebrations. As a preparation of IDIMT 2007 we have sent explicit invitations to participants from previous IDIMT-conferences asking them to attend. The success of the 2006 PhD-day has encouraged us to repeat it in 2007. In 2007 we challenge our PhD-students to conceptualize a EU-project in which all students should be able to contribute. Let us be surprised by the outcome. A bus tour to visit beautiful Ceskye Krumlow and together with a celebration dinner will honour this 15th anniversary of the IDIMT conferences.

2. The History of the Proceedings of IDIMT

A few statistical data will underline our achievements and allow us to be proud: Fig. 31 shows the evolution of the proceedings. The proud gallery of proceedings is shown in fig. 32 and in fig. 43.

Year	Authos	Papers	Pages	Editors / ISBN	Time	Location
1993	14	14	151	G. Chroust, P. Doucek 3-902457-06-6	6.-8.10.	Kubova Hut'
1994	27	23	233	G. Chroust, P. Doucek 3-486-23147-2	9.-11.11.	Kubova Hut'
1995	33	25	228	G. Chroust, P. Doucek 3-486-23502-8	8.-10.10.	Kubova Hut'
1996	30	21	215	G. Chroust, P. Doucek 3-486-24033-1	16.-18.10.	Zadov
1997	35	30	320	S. Hofer, P. Doucek 3-486-24526-0	15.-17.10.	Zadov
1998	39	27	390	S. Hofer, M. Beneder 3-85320-955-6	21.-23.10.	Zadov
1999	46	34	424	S. Hofer, M. Beneder 3-85487-046-9	02.-03.9.	Zadov
2000	48	32	440	S. Hofer, M. Beneder 3-85487-153-8	20.-22.9.	Zadov
2001	45	29	397	C. Hofer, G. Chroust 3-85487-272-0	19.-21.9.	Zadov
2002	38	24	350	C. Hofer, G. Chroust 3-85487-424-3	11.-13.9.	Zadov
2003	38	24	310	C. Hofer, G. Chroust 3-85487-493-6	10.-12.9.	České Budějovice
2004	31	23	304	C. Hofer, G. Chroust 3-85487-665-3	15.-17.9.	České Budějovice
2005	30	22	313	Ch. Hoyer, G. Chroust 3-85487-835-4	14.-16.9.	České Budějovice
2006	46	29	364	Ch. Hoyer, G. Chroust 978-3-85499-049-9	13.-15.9	České Budějovice
2007	37	27	384	Ch. Hoyer, G. Chroust, P. Doucek, 978-3-85499-256-1	12.-14.9	České Budějovice
Sum	**537**	**384**	**4823**			
avg.	36	26	322			

Figure 31 - The History of the IDIMT Proceedings

3. Topics of the IDIMT Conferences

It was very difficult to aggregate in a meaningful way the various topics which have beeen presented during the past 15 years. I have tried to identify 'general topics' (cf. fig. 33). Each presented paper has been associated with one and only one of the general topics. In some instances this was only possible in an approximative way, the result is shown in fig. 33 and fig. 34.

The distribution of topics over time is shown in form of a table in fig. 35. Two graphical time-line show the variance of the number of papers for the individual general topics (xreffig.f:idimt07-nop-1-6 for topics with the higher total frequency, fig. 37 for those with lower frequency).

no.	Generat Topics	no of papers
GT1	Systems Thinking	60
GT2	IS Development	52
GT3	Cooperative Environmts	47
GT4	Business Processes	40
GT5	Quality Management	34
GT6	Information / Knowledge Mgmt	27
GT7	Human Factors	26
GT8	Education	22
GT9	Technology Management	22
GT10	Information Society	19
GT11	e-Business, E-Governmt	18
GT12	Economic Aspects	12
GT13	European Projects	10

Figure 33 - General Topics and number of papers

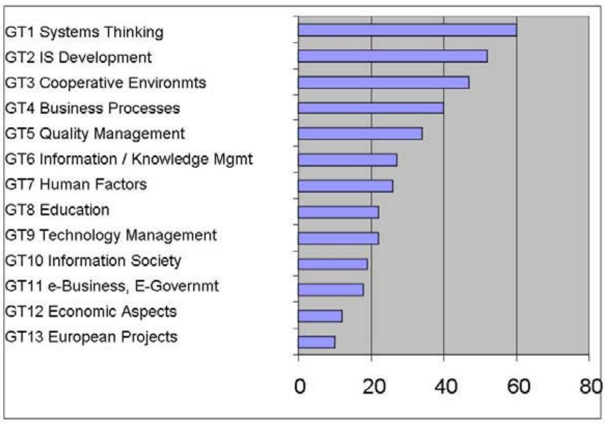


Figure 34 - Total number of papers per general topic, IDIMT 1993-2007

	93	94	95	96	97	98	99	0	1	2	3	4	5	6	7
Systems Thinking	3	0	1	0	6	6	6	5	4	0	6	2	5	7	9
Development of Info-Systems	5	3	7	3	0	3	4	10	3	4	1	0	2	5	2
Cooperative Environments	0	0	3	4	0	3	5	4	4	2	5	4	5	4	4
Business Processes	0	3	7	9	5	3	4	0	2	0	1	0	0	3	3
Quality Management	0	3	0	0	5	5	9	4	0	4	0	1	0	0	3
Information / Knowledge Mgmt	4	0	3	1	5	1	0	0	5	0	0	3	0	4	1
Human Factors	0	3	1	0	4	4	5	8	0	0	0	0	0	1	0
Education	0	0	3	2	5	0	0	0	4	2	0	6	0	0	0
Technology Management	0	7	0	0	0	1	0	0	2	3	3	1	2	2	1
Information Society	0	0	0	0	0	1	1	0	0	6	0	4	4	3	0
e-Business, E-Government	0	0	0	0	0	0	0	1	5	3	9	0	0	0	0
Economic Aspects	1	4	0	2	0	0	0	0	0	0	0	3	2	0	0
European Projects	0	0	0	0	0	0	0	0	0	0	0	0	2	5	3

Figure 35 - Time line of the number of papers per general topic, IDIMT 1993-2007

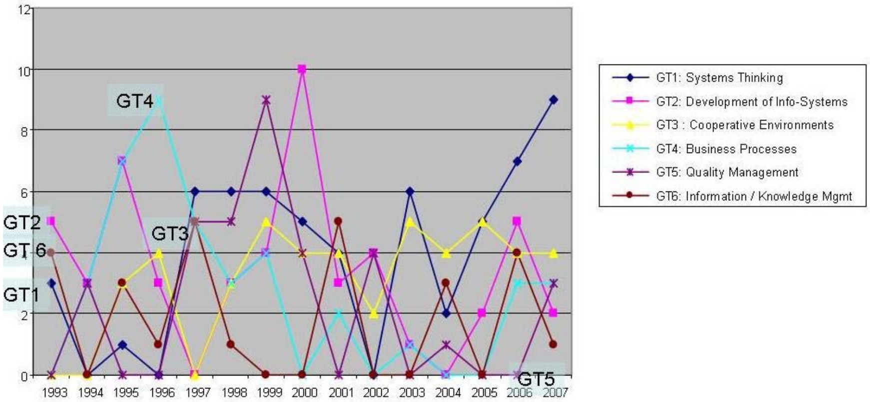


Figure 36 - No of papers per general topic, general topic 1 - 6, IDIMT 2007

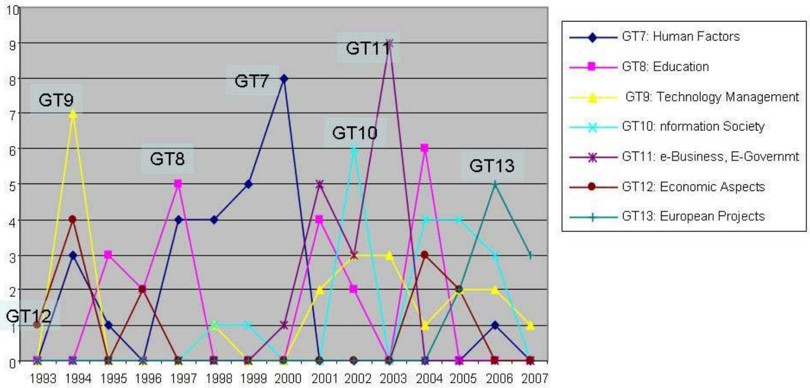


Figure 37 - No of papers per general topic, general topic 7 to 13, IDIMT 2007

4. Looking back

15 years is a long time, but it has gone by very fast. One of the reasons is the speed with which the field of information management and information processing has advanced, always posing new challenges and finding exciting solutions. These solutions, in most cases, have triggered even more challenging problems. Founding IDIMT was an important decision. As it often happens, a good chance was offered and we grabbed it. Looking back

on the development of IDIMT I think that one of the key foundations of IDIMT's success has been the friendship and loyalty of the key people and the friendly, people-oriented atmosphere we were able to create. Proof is the observation that quite a few of us have attended most of the previous conferences, and my guess is that more than 50% of the participants of one conference also attend the following one again. Another indication is that in the last session of our conference we sketch next year's topics, identify some of the keynoters and session organizers - a tremendous and re-assuring contribution to the continuity of the conference.

In software engineering we say *"Quality is, if the customer comes back and not the product."* This seems to be true for IDIMT, too. Let us hope and strive that this characteristic of IDIMT will be sustained in the future.

Figure 38 - IDIMT 2006

5. Acknowledgements

I would like to express my sincerest thanks and my greetings to two persons who have initiated the international IDIMT conferences in 1992: Prof. Jan Ehleman, then Professor and Vice-Rector for international cooperation at the University of Economics Prague (fig. 39), and Prof. Ernest Kulhavy, then Professor and University Representative for international contacts at the Kepler University Linz.

Fig. 39: Jan Ehleman, Jan Skrbek

Special thanks have to go to Prof. Petr Doucek for all his efforts through these 15 years in organizing the infrastructure of the conferences, finding and negotiating with hotels, arranging excellent dinners, etc. Without him all this would not have been possible. Some of his personal memories of the IDIMT conferences are also included in this volume (Doucek, P.: The IDIMT History, Proceedings IDIMT 2007).

Figure 40 - IDIMT 2006: Petr Doucek

We also should recognize the contribution of Jan Klas (fig. 41) for all his efforts and support in these organizational efforts. He is the key person behind the curtains, solving all kinds of "small" problems.

Figure 41 - Jan Klas, 2002

Furthermore I want to thank all editors of the proceedings Petr Doucek, Susanne Hofer, Manfred Beneder, Christian Hofer, and Christoph Hoyer for organizing the papers in the sessions, chasing the papers to be included in the final program and taking care of many other small details. And I would like to extend this thanks also to Trauner Verlag Linz, our publisher, and its lectorat, Special thanks also go to the secretaries of our two institutes, to Dagmar Reinmann from Linz and Anna Konupkova and Hana Krivankova from Prague.

Figure 42 - Founders of IDIMT (from left to right) : Gerhard Chroust, Petr Doucek, Jan Ehlemann, Richard Bebr at 2006

Fig. 43: IDIMT proceedings 1993 - 2006

Ad Multos Annos, IDIMT!

15 YEARS IDIMT

15 YEARS MOVING IN FASCINATING SCENARIOS

Christian Loesch*

Discussing the scenario of the last 15 years we have the privilege of the presence of eyewitnesses and even of contributors to these developments.

In 1992 when IDIMT started, an advanced PC ran on a processor like i486 with 0,8 µm technology and 1,2 mio transistors, today's processors will use 45 nm technology packing more than 400 mio transistors into a chip of size of half a postage stamp, and come in dual- and quad- core versions.

Rarely a single technology like information technology has been the driving force for such dramatic technological, economic, social and scientific developments. We look at intertwined developments as e.g. the computer becoming a network and the network becoming social network or how information technology is even changing the way the world changes.
Many life-altering innovations were made in these years with information technology enabling advances from decoding the genome to the Internet or WWW. Two figures may characterize the dynamics of the scenario. October 1994 when the W3W (WWW consortium) was founded the number of web sites was approx.3000, ten years later it surpassed 50 million. The change of the scenario literally reaches from the bottom of the sea to the sky. Innovations which laid the groundwork can be found on the bottom of the sea where fibre optics has improved communications up to satellites which have helped to turn the world into a global village.

We also look onto developments close to us, as the closing-up-race of Central and Eastern Europe, with a leading role of academia, to which personalities participating in the IDIMT contributed personally.

* IBM Corporation (ret.)

1. Scenario

Complimenting the specific history and development of IDMDT which will be addressed in a special paper we will restrain us to spotlights on selected global political, technological, and economic scenarios.

1.1. General scenario

When IDIMT started in 1993 the prevailing mood was positive to enthusiastic, full of hope, energy and dedication to realize the tremendous potential and opportunities at our doorstep. The feeling of final victory of democracy persisted.

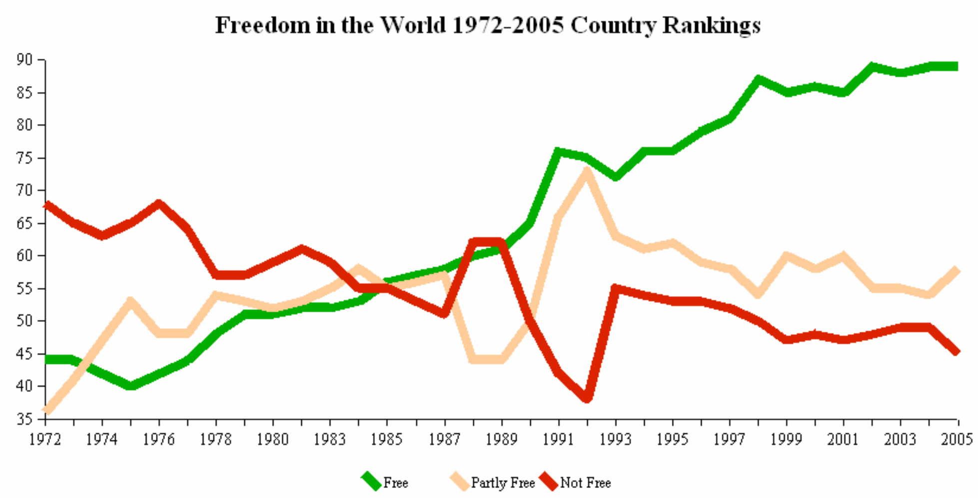


Figure 1- [Freedom House county rankings 1972 – 05]

Francis Fukuyama wrote his famous book "End of history and the last man" in 1992 (based on his article published in 1989).

Japan was the admired example of a leading industrial nation, with everybody looking at it and trying to learn from Japan. A book like "Theory Z" by W.G. Ouchi sold more than 130000 hardcover copies in the US alone, quality circles where established around the world a.s.o...

Europe was busy with reshaping itself with major challenges as German reunification, the re-establishing of the former COMECON and Yugoslavia to Glasnost and Perestroika and Yelzin taking over from Gorbatchov to mention some processes.

It was a period of liberalization and significant decreases in prices ranging from air fares to communication cost, TV sets and mobile phones; it was also the period of changing paradigms from Concord and TU 144 to Airbus and 767.

Expressions like SMS, blog, surfing or outsourcing were unknown to the public. Nor was "terrorist" a household word.

Civil rights and freedom were highly valued. Strong protests were questioning censuses or fingerprints on ID cards as intrusion into the private sphere.

The euphoric atmosphere was supported by the progress in technology. The ITRS (International Technology Roadmap for Semiconductors) roadmaps as shown below were improving from review to review accelerating the exponential growth even further.

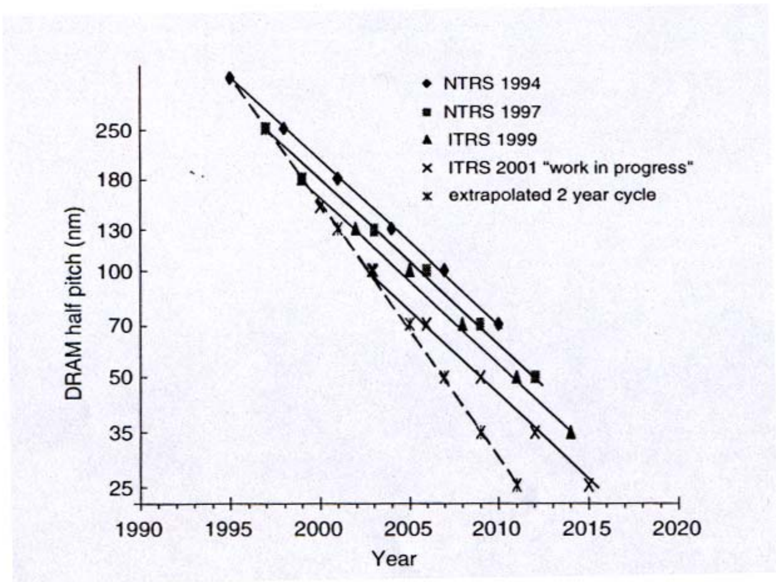


Figure 2 - roadmaps 1994 -2003

In Europe we were proud of the new 64 k line connecting the University of Vienna with CERN, and the impressive closing up race of Central and Eastern Europe countries with a leading role of the academia and universities (CS being the first former COMECON country becoming 1993 attached), the start of supercomputing and the transition from EARN to

Internet (or PROFS to e-mail). We were contented users of PCs with 386 or even 486 chips, running as main application word processing and spreadsheet calculations. The migration of the C-net to the D-net using first mobile phones (costing about thousand EUR) and was a privilege for few. The upcoming CDs or even DVDs were praised as latest technology. It has been a time of over-confident political statements like that the EU will overtake the USA in few years.

But it was not a world of unspoiled peace and happiness. Just recall events as the

- 1992 Kuwait invasion
- 1994 NATO war in Serbia and the first Gulf war
- 2001 Sep 11 and the invasion of Afghanistan
- 2003 invasion of Iraq
- 2005 increasing inter-religious tensions (cartoon crisis)
- 2006 Israel Lebanon conflict (with use of phosphorus shells cluster bombs)
- or threats as SARS, Aids, Ebola virus or avian influenza,
- to mention a few.

We would transgress the framework of this short paper to comment in detail on social developments as the weakening of family structure, changing to patchwork families, the decreasing role of trade unions, the increasing re-awareness of well-known ecological and environmental, worldwide weather and climate change problems, the public attentiveness to generation/social security problems, increasing criminality or rising inequality in the distribution of wealth etc.

1.2. Economy

The development with the largest long range impact might be the rise of BRIC (Brasilia, Russia, India and China).

The period was also the timeframe of the boom and bust of the ".com bubble". Peaking in sky rocking investments as e.g., a billion $ flowing a week into Silicon Valley, this bubble burst in 2000 with a historic point loss in US stock market and the disappearance of many companies.

We have also seen deregulation from airline industry, financial service industry to telephone industry and we are going to see it in utilities.

It has also been a period of M&A's (mergers and acquisitions); many of them failing. Among the biggest flops was AOL (American Online) acquisition of Time Warner. The stock price of Time Warner fell to about one fourth of what it was in early 2000. Daimler Chrysler has lost half of its value since the automakers combined in 1998. And it's continuing, in the first half of 2007 M&A's reached (according to UBS) a record level of 2,5 Bio $.

We have seen the rise of globalization and some of the most extraordinary financial scandals of all times in the history of business. Enron collapsed WorldCom or Tyco and CEO's enriching themselves and ending up in court.

2. Science and technology

Even for those of us who have been around long enough to experience how the pace increases over time, our intuition nonetheless provides the impression that progress changes at the rate that we have experienced recently. A reason for this may be that a curve can be approximated by a straight line or tangent when viewed for a short interval. But exponential growth is a feature of any evolutionary process, of which technology is a primary example. One can examine the data for a wide variety of technologies ranging from electronic to biological, and the acceleration of progress and growth applies. We find not just simple exponential growth, but "enhanced" exponential growth, meaning that the rate of exponential growth is itself growing. These observations do not rely merely on an assumption of the continuation of Moore's law (i.e., the exponential shrinking of transistor sizes on an integrated circuit), but is based on a rich model of diverse technological processes. What it clearly shows is that technology, particularly the pace of technological change, advances (at least) exponentially, and has been doing so since the advent of technology. It also shows the acceleration of the process the shortening of the doubling time from 20 to 18 month from the post-war period 1945 -1975 to the period 1975 -2000. [14].

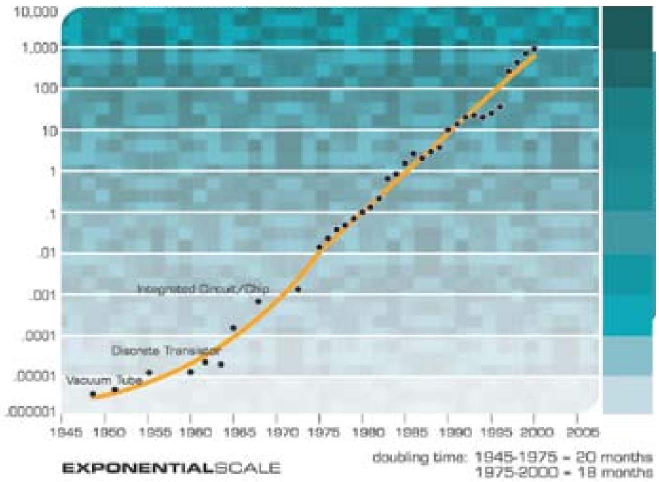


Figure 3 - Acceleration of development [RAM in KB/$] [14]

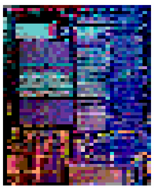
3. C & C (computer and communications)

Dr. Koji Kabayashi, President of NEC Corp. coined the term and wrote the book "A Vision of C&C" in 1977 foreseeing the convergence of computer and communication technology.

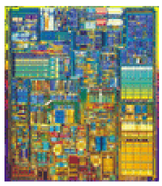
3.1. Computer technology

We have covered the impressive developments of computer technology in previous IDIMT sessions and other papers in more detail; therefore let us mention here only some key facts and figures.

The pictures 5 and 6 below illustrate the increase in function, density and features of integrated circuits.



INTEL 80486



INTEL Pentium 4

Some key facts and figures in table 1 demonstrate this for examples of INTEL products:

Table 1 [INTEL, Technology today]

	80486	PENTIUM	ITANIUM
MIPS	20	112	>10000
TRANSISTORS (MIO)	1,2	3,1	410
CYCLE (MHZ)	16 -50	60 -200	1000 - 1600
WIDTH	32	32	64
CACHE	8	16	256 KB 3/6 MB

To achieve these improvements and preserve the improvement speed several technological breakthroughs have been necessary. Let us recall some of them. Silicon dioxide has been used to make the transistor gate dielectric for more than 40 years, it has been made even thinner and thinner and has been shrunk to a little as 1,2 nm. This thickness is equal to five atomic layers on the previous 65 nm process technology. Transistor gate leakage associated is one of the most formidable challenges we are facing. The combination of a high-k technology and metal gates are improves the drive current by 20% (because high k gate dielectric) and five times the source drain leakage.Hf-based material reduces leakage by the factor of more than the 10 times (1970), reduces switching power by approximately 30 % and improves transistor density approximately two times over the previous generation. Innovative design rules expand the use of 193 nm dry lithography to manufacture its 45 nm process because of its cost advantages.INTEL (Penryn) and IBM have developed new processes with more than 400 million transistors in the chip of the size of a postage stamp. The recipe used by Intel and IBM has not been disclosed but importantly both companies have said they could incorporate them into cutting production technology with minimum effort. [11]

The picture below illustrates an IBM's view of major breakthroughs of the last ten years.

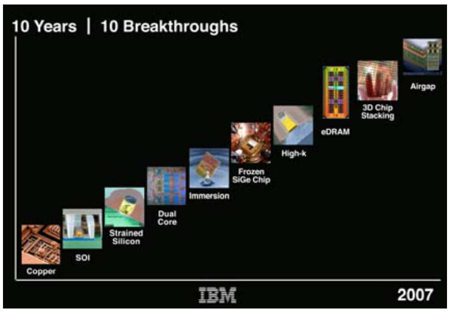


Figure 6

3.2. Communication Technology

The most dramatic developments impacting the way we live may have come from C&C. It was the dramatic improvement of price/performance in communications that enabled the range of applications we use today.

Electronic Mail was not really created in the year when IDMDT started. An IBM system named PROFS (for PRofessional OFfice System) was already made available in 1981. You might remember the e-mail aspect of the application, known colloquially PROFS notes, featuring prominently in the investigation of the Iran-Contra scandal, examined by US Congress [21].

3.2.1. The Internet

Many people regard Internet and WWW as the overwhelming success story of this timeframe. Starting from the US Defence Department's ARPA net it finally merged into Internet which it has helped to create. [19] The acceptance of this development can be reflected in many ways, one of them is the number of hosts shown in picture 7.

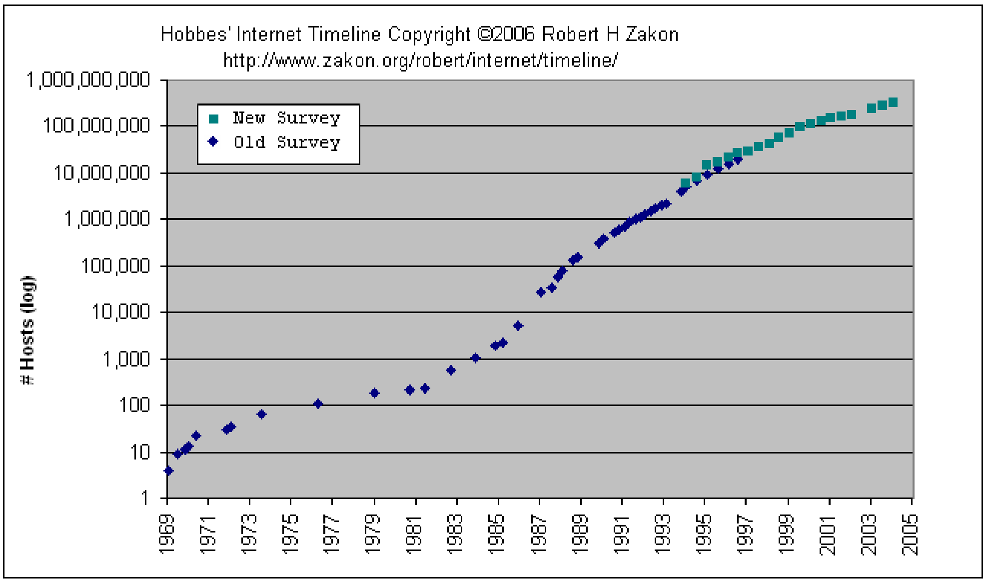


Figure 7

3.2.2. The WEB

In Switzerland at CERN Tim Berners-Lee addressed the issue of the constant change in the currency of information and the turn-over of people on projects. Instead of a hierarchical or keyword organization, he proposed a hypertext system that will run across the Internet on different operating systems. This was the World Wide Web.

Tim Berners Lee created HTML and http:// unveiled the World Wide Web in August 1991 for the scientific community of physicists and in April, 1993 CERN made WWW technology and code free for everyone. It was not as easy as it might look today. He had to defend this idea against uninterested superiors at CERN, Internet-organisations like IETF and later against commercial covetousness of companies like Microsoft and Netscape. [4]

But nothing succeeds as success.

- 1991 100 documents were retrieved per day at CERN,
- 1992 1000
- 1993 10 000

Today more than a billion pages are retrieved per day just in the US alone according to Media Matrix.

Soon after the scientific commercial use started to boom when in August 95 Microsoft released Internet Explorer as part of Windows 95, followed 1996 by Hotmail.

The success story of Internet remained a story of idealistic, dedicated engaged individuals who were interested in the progress and the plethora of the new possibilities made this tool available for their communities and brought Internet to their countries. Czechoslovakia, Hungary and Poland established centres connected via Vienna to the world. They overcame numerous problems ranging from space to finance and the availability of lines and personnel, the absence of legal frameworks and responsible persons not to mention obstacles like telephone regulations prevailing at this time. Outstanding personalities engaging themselves without consideration for fame, financial or carrier advantages made it possible that e.g. the University of Vienna becoming the hub node of the Ebone-net the backbone of Internet which meant also the start of the commercial internet (providers did not need to establish expensive leased lines to connect to Internet but could connect via this hub. This node became the hub of the first nationwide system library system BIBOS, and a supercomputing Centre connected to CERN and many others.

None of them was making any money from it. Internet/WWW remained a field of individual creativity and endeavour. Think of PGP, released in 1991, Linus Torvald´s release of the free kernel for LINUX V1.0 in 1996 or of Wikipedia founded by Jimmy Wales in 2001. [21] Worldwide this looked a little bit like Eden not a snake in sight, but soon afterwards were we mired in problems caused by things like online scams viruses and traps aimed at your computer and sometimes even your identity, making mischief on the Web, stalkers, predators, identity thieves, a.s.o.. Picture 8 attributes the sizing and sourcing of some these troublemakers.

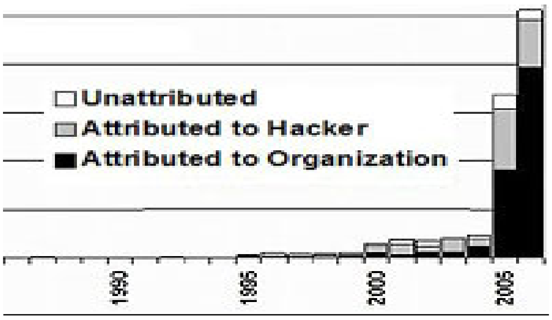


Figure 8 - Sizing and Sourcing of troublemeakers

3.2.3. How Internet/WWW transformed business

Internet has not only transformed business but also transformed the way we do business. For a long time people have thought of information as being a destination, you had to go to a book, you had to go to a library you had to go to a specialist or an office. But now the new mobile and wireless technologies are turning information into a companion. Surfing the net on your PC has become as commonplace as making a phone call used for everyday purchases from buying a car to ordering a book or a pizza,

Figure 9 - IBM Think research

But not everything emerging successfully in the 15 years of IDMDT has been invented in this timeframe.

Laser technology was patented in the 1960s but it took years before it found practical applications as in medicine, CDs, DVD's etc., but when it arrived and merged with Internet/WWW it changed the way music industry does business, gave birth to new dimension of downloading, MP3 players etc.

Increased competition leads to lower prices, larger ranges of goods and lowering costs of transactions especially in the service sector and creating an online market of 170 bio $ in 2006. Also developments like globalization and outsourcing were facilitated by Internet/WWW and its growth enhanced. [3]

It might be worth to remember that overinvestment served as basis of broad band revolution.

Simultaneously we are witnessing a massive M&A process. The process is ongoing is not finished; with a potential Internet superpower or powers emerging. GOOGLE which started its first office in a garage in California in1998, has in US 63 % market share (measured in requests) versus YAHOO's 21 %; and continues to grow by ventures like buying for 3,1 Bio $ DoubleClick - the largest independent broker between online publisher and advertisers in the market and also YouTube. Google forecasts operating profits of almost 5 Bio $ this year and a growing rate of 36 % for the next three years (while Microsoft's online business may loose 2Bio $ this year and even more the next two years).

Google is already starting to offer word processing and spreadsheets as free online services and will soon offer presentation software to rival Microsoft's PowerPoint. Microsoft itself bought for 6Bio $ aQuantive.

4. Perspectives

4.1. IT community's perception

4.1.1. What were the Best Tech Products the IT community remembers?

What were the qualification criteria for the "best" tech product to come out of the digital age or what qualified a product as being "best"? First it must be a product, that means a piece of hardware or software that has changed our lives and that we can't live without (or couldn't at the time it debuted). Beyond that, a product should have attained a certain level of market acceptance, staying power, and perhaps made some sort of breakthrough or paradigm change, influencing the development of later products of its like. [18]

This is how PC World survey ranks the best tech products.

1. Netscape Navigator (1994)
2. Apple II (1977)
3. TiVo HDR110 (1999)
4. Napster (1999)
5. Lotus 1-2-3 for DOS (1983)
6. Apple iPod (2001)
7. Hayes Smartmodem (1981)
8. Motorola StarTAC (1996)
9. WordPerfect 5.1 (1989)
10. Tetris (1985)
11. Adobe Photoshop 3.0 (1994)
12. IBM ThinkPad 700C (1992)
13. Atari VCS/2600 (1977)
14. Apple Macintosh Plus (1986)
15. RIM BlackBerry 857 (2000)
16. 3dfx Voodoo3 (1999)
17. Canon Digital Elph S100 (2000)
18. Palm Pilot 1000 (1996)
19. id Software Doom (1993)
20. Microsoft Windows 95 (1995)
21. Apple iTunes 4 (2003)
22. Nintendo Game Boy (1989)
23. Iomega Zip Drive (1994)
24. Spybot Search & Destroy (2000)
25. Compaq Deskpro 386 (1986)

This ranking shows the outstanding creativity and fertility of the time period we peruse. Fifty percent of the ten best ranked products and 56% of the 25 best ranked products are stemming from this timeframe.

4.2. Users Perception and Role

C & C is not science and technology but daily life. Many people turn off their PCs, HDTV's plasma screens and grab their cell phones and their laptop computers as they leave their homes, some use GPS to plan their route and bring along their digital cameras.

The technologies that make this possible are taken for granted by the average consumer, like ATM's or MEMS (Micro-Electro-Mechanical System). Its safe to say that few people surviving a car accident walking a way unharmed will say "thanks goodness for the advent of nanotechnology and MEMS…." but without these technologies the airbag would not have deployed in time.

It's interesting that the groundwork for many of these innovations mentioned above can be found underground where fibre optics has helped to turn the world into a global village. The change of the scenario literally reaches from the bottom of the sea to the sky. A key innovation which laid the groundwork for the advancement in many fields can be found on the bottom of the sea where fibre optics has improved communications up to satellites which have helped to turn the world into a global village.

The general users perceptions of the top technical breakthroughs are reflected in a general survey CNN made in celebration of its 25th anniversary asking for

Top Technological breakthroughs [6]

1 INTERNET
2 CELL PHONE
3 PC
4 FIBRE OPTICS
5 E-MAIL
6 GPS
7 LAPTOP COMPUTER
8 CD DVD
9 DIGITAL CAMERAS
10 RFID
11 MEMS
12 DNA FINGERPRINTING
13 AIR BAGS
14 ATM
15 ADVANCED BATTERIES

5. Summary and Outlook

Great expectations and optimism characterised the beginning of the time period perused. Unfortunately some of these hopes have been in vain, especially those in the geopolitical and humanitarian area. We were fortunate having had the chance to witness or even participate in of one of the most fulfilling parts of Information Technology.

This period might be once seen as one of the most dynamic and fascinating periods in the history of Information technology. The symbiosis of computer and communications lead to a further acceleration of the exponential development and further on to an unprecedented rise of complexity, the convergence of technology, physics and biology improving thus human performance and by cross-fertilization of many fields enabling decoding and manipulation the genetic makeup of many organisms, DNA testing to the way we conduct our life from banking to shopping and entertainment.

Computer networks develop to social networks (10% of US marriages first contact happened over Internet). It is as well a story of community and collaboration on a scale never seen before. IT did not only change the world, but also change the way the world changes. People are developing themselves, reaching out to others, become more creative better educated and even richer than they otherwise would have been. [10]

It is also about the many wresting power from the few and helping one another for nothing. The tool that made this possible is not the world wide net as a way for scientists to share research. The new Web is a very different thing it's a tool for bringing together smaller contributions of millions of people and making them matter. It's about compendia of knowledge like Wikipedia or the million channel people's network YouTube.

It changed the way business operates and from a users perspective it lead to increasing competition, cheaper services and cheaper goods. [5]

For the sake of objectivity we have to look at the other sides of the coin too. Not all effects have been exclusively. We mentioned above the dot.com boom. Now we seem to have the Web 2.0 boom. But there are differences. The first dot.com boom was public, funded by Wall Street, now we see a private one funded by venture-capital networks.

The Web 2.0 harnesses also the stupidity of crowds as well as its wisdom and constitutes a massive social experiment and like zillions of people willing to give up personal identity and join into a collective (historically that propensity has usually been bad news [10].People pay for the values they provide instant of being paid for.

But there are also stagnant fields of science where expectations were not met, or the expectation level was just too high realistic as AI (Artificial intelligence), Neural networks, Chaos theory or Fractals.

It was a period of outstanding economic growth and increase of wealth but also of increasing unequal distribution of and a widening wealth gap in 80 % of countries. Opening brought improving health, life expectancy and economic conditions to many, but also increasing inequality of distribution of income and wealth. It brought lower income groups decreasing economic influence – does this mean less democratic influence?

Coming specifically to trends in the Information technology:

In Information technology there are no “good old times”. The outlook shows that systems-level performance must meet the demands of applications, even though power dissipation is creating a fundamental problem in the development of microprocessor technology. While technology scaling has allowed us to continue to increase the number of transistors on a chip, power densities have grown with every CMOS generation as designers have pursued higher operating frequencies. Given the lack of any other low-power and high-volume technology than CMOS, in the future, the frequency of microprocessors must grow at a much lower rate than in the past decade. Even with advances in base silicon, on-chip interconnects, and cooling technologies, microprocessor performance growth rates have slowed substantially.

However, chip-level performance growth can still and will be sustained through higher levels of on-chip functional integration. The fundamental reason for this is the nonlinear relationship between power and performance. It may be possible, to decrease the power of a system tenfold with only a threefold reduction in performance. Higher performance at the chip level would then be obtained through higher levels of on-chip functional integration.

The disruption caused by power dissipation may affect all forms of computing systems. Scale-out systems represent a natural initial target for exploring solutions to this problem, given the high computational needs and the use of parallelism in their workloads. Systems management, reliability, and Amdahl's law are challenges for scale-out systems. This requires a holistic approach that considers all aspects of system design such as architecture, operating systems, compilers, and runtime systems, as well as workload characteristics and programming methodologies, in order to develop breakthrough solutions.

There is a dormant improvement potential in design changes as well as in the software and application area. The movement from 180 to 90 nm technology hardware has grown by a factor of five while the software overhead has grown by a factor of twenty; e.g. options like Linux allow for much less overhead resulting in faster and more optimized systems. Thus SOC will provide an opportunity to overlap software, hardware and relatively small development teams, resulting in 18 months time to bring new chips to the market. [17]

Many of these issues have long been recognized. The discontinuity in the development of the current microprocessor technology will oblige us to address these problems and in a holistic manner by considering all aspects of systems design before turning to fundamentally new technologies and paradigm changes.

6. References

[1] ACCENTURE Major Trends that will shape IT

[2] AGERWALA T. Systems research challenges: A scale-out perspective, IBM Journal of R&D 2006

[3] BBC, Fifty years of the Web, BBC 08/2006, How the web went worldwide, BBC Archive 2006

[4] BERNERS-LEE Weaving the Web, Harper Collins (with Mark Fisher) 1999

[5] CHROUST G. 15 years of IDIMT, 15 years of change, 2007 Synergie, Emergenz und Innovation in der IKT Industrie, SEA Univ. Linz, 2007.

[6] CNN, Top 25 Innovations, Technological Breakthroughs and Business feels technology's, influence, 2005

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

[8] FAWKES M. Highlights of the past ten years in Technology 2006

[9] GASMAN L. Foresight Nanotech Institute 2005

[10] GROSSMAN L. The Person of the year: You Making mischief on the Web and the Web Boom TIME 2.0 2006

[11] HAENSCH W, Advanced Silicon Technology, IBM Journal of R & D

[12] ISAAC R.D, The future of CMOS technology, IBM J. R & D 44, No. 3, 2000

[13] IWAI HIROSHI The future of CMOS downscaling, Frontiers Collection 2004

[14] KURZWEIL R. The Law of accelerating returns, 2001

[15] LOESCH CHR. Trends in Technology, Proceedings of Euromicro 2003.

[16] LOESCH CHR. Information Technology from Trend to Horizons IDIMT 2005

[17] MAGEE M. Clock speed will only double triple in 15 years

[18] PC World The 50 best products of all Time

[19] PLASSER E. What made the Internet work (with I. Haussteiner) SEA Univ. Linz Publ. SEA-SR-08

[20] ROWEN Chr. International Fabless 2005

[21] WIKIPEDIA Timeline of computing, 2007

[22] ZEMANEK H. Philosophie der Technik (mit R. Knoll) 2007

Cooperative Information Environments

NEXT GENERATION OF WEB-BASED TASK MANAGEMENT FOR COLLABORATIVE WORKING ENVIRONMENTS

Konrad Klöckner*

Radical changes in our industrial environment request new IT solutions for collaborative task management in distributed teams wherein team members are essentially involved in the process management and responsible for its progress. This paper presents some history aspects of workflow system development and resulting requirements for the SAGE platform, a system that provides functions to support lightweight distributed engineering processes by collaborative task management. There is a need for the development of new solutions for self-organized cooperative task management and group awareness by combining approaches from software engineering with workflow technology and CSCW methods.

1. In the Beginning, there was Work to do…

Think of the caveperson who made the first wheel. That first wheel was a creation, an invention, a reason to celebrate. The making of the second, third, fourth, fifth, etc. wheels was just work. From those cave-dwelling days, through the time when Henry Ford started producing his Ford automobiles on the assembly line, to today, we've been thinking of ways to get work done better, faster, more reliably, and for less money. Business processes are a great method for accomplishing these goals [11].

Globalisation and increasing competition force enterprises to decentralize the development of products by participating international suppliers in the engineering processes. This trend is especially due to the quantity of components used up in a product and its variety. More and more the development of software components plays a decisive role in engineering processes. Therefore enterprises build distributed teams of members with various expertise and technical

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background to handle complex engineering processes. The production processes in the automotive industry are a typical example for this.

But the decentralization of the enterprise's knowledge and business processes over organizational and institutional boundaries raise new problems. How can team members reach a common understanding of the process tasks, identify dependencies between tasks, stay informed of the current process status and results, coordinate appointments and agreements, and collaboratively develop the requested results. Usually, the knowledge is spread in the team, arrangements between members are communicated bilateral and not to the whole team, and delays are recognized often too late. A common view is missing and makes time-consuming meetings necessary to synchronize and coordinate task management in distributed engineering processes.

For this purpose, tools like email are insufficient. New solutions are required to support the coordination of engineering processes that are not completely structured right from the start. Though lightweight distributed engineering processes are rule based, only some targets like deliverables and milestones are known from the beginning. During the process progress conditions may change and in turn it may cause the adaptation of deadlines, delegation of tasks and creation of further tasks with the assignment of different responsibilities.

Our goal is to combine methods and results from the workflow management and the CSCW research area with methods to enhance and coordinate distributed engineering processes. Today, the coordination support for distributed engineering processes focuses on the administration of artefacts like source code, object code and executables, but mechanisms to plan and process system development in distributed teams are missing or only rudimentarily supported. Traditional workflow management systems support structured processes at top-level, but they are too rigid and inflexible for development processes in self-organized distributed teams. CSCW systems provide flexible tools, but the coordination and monitoring effort is left to the users themselves. Our intention is to join software engineering methods with workflow management and CSCW approaches to achieve innovative solutions for distributed software engineering in organizations and over organizational boundaries.

With the concept of user-defined workflows (UdWf) we aim to support collaborative task management in distributed teams. Flexible coordination mechanisms are provided to create, adapt, and synchronize workflow processes throughout its term depending on the current situation. All team members stay informed on process status, its progress, existing overlaps and imminent conflicts.

Today's coordination support in distributed software engineering focuses mainly on management of artefacts like source code or object files but provides less assistance for engineering processes performed by distributed teams. Workflow management systems support structured processes on top level, but they are too rigid for inter- and intra-team coordination of agile development processes. On the other hand CSCW systems offer flexible tools, however, a lot of coordination and monitoring activities are left to the user. The SAGE project [4] aims at the development of new solutions for self-organized cooperative task management and group awareness by combining approaches from software engineering with workflow technology and CSCW methods.

Three categories of activities can be identified associated with collaboration at work: communication, i.e. the exchange of information; presentation, meaning the provision of content to others; and collaboration, the simultaneous acting of a working team. There are major differences in what sorts of working environments in general, and what kinds of tools and applications in particular, are required to support these activities. Basically, collaborative working is to apply knowledge for competent action [3].

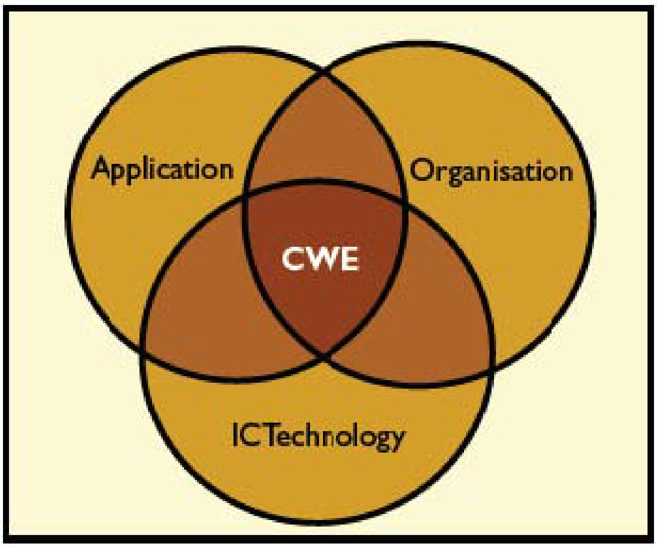

Figure 1 – Collaborative Working Environments

Collaborative acting needs to be organized according to the level of presence of workers, in terms of work, space and time. A basic approach uses three different settings: batch, meaning that workers act at different places and times; on-demand, that is people come together physically or virtually at the same time for collaborative work; and continuous, in the sense of an environment which is permanently accessible for communication, presentation or collaboration purposes. Obviously, there are many exemplifications of collaborative working which require physical and timely co-presence of workers. Others need co-presence in time, but not physically, or neither of these.

Convergence of information and communication technology has brought about tools and techniques that combine to provide the technical baseline for collaborative working. Fundamentally relevant are broadband telecom services, VoIP, 3G mobile communication, video and multimedia devices, LAN and WAN computing, desktop video conferencing and shared application software. Enhancements will arise from advanced process modelling and simulation systems. Progress in the field of human machine interaction, in areas like speech or gesture recognition, is expected to leverage breakthrough functionality of collaborative working environments.

As there is no such market segment as 'collaborative working environment solutions', any assessment of the state of the market is constrained to rather qualitative considerations and a couple of infrastructure indicators. Collaborative work in companies requires high performance technologies for bandwidth, high definition, quality of service, and reliability. For cross company collaboration, interoperability becomes an additional factor. In the societal environment, say for professional purposes for individuals, it is rather availability, accessibility, bandwidth, and compatibility which enable collaborative working.

On the IT side, collaboration tools are becoming part of the commercial offerings portfolio of major global players as well as of a growing number of SME vendors specializing in this niche market. Those primarily supporting communication, like eMail, are quite established.

Tools of the presentational type, for instance videoconferencing, and the collaborational type, e.g. for shared working on documents, are available now for desktop use. Advanced solutions for simultaneous working on shared applications, such as joint design and engineering, or modelling and simulation, seem to have only quite narrow markets as yet.

2. Workflow's Roots

Trying to define the term ‘workflow’ there is a bunch of definitions to find. Here is an easy one: “Very simply, it is the way work gets from start to finish. A workflow consists of process logic and routing rules. The process logic defines the sequence of tasks and the routing rules that must be followed, as well as deadlines and other business rules implemented by the workflow engine” [11].

And what is a workflow management system? Again an easy explanation: “A software application that stores process definitions and runs jobs based on those process definitions via its workflow engine component. The workflow engine is the runtime execution module” [11].

Workflow directions in software have come from two different originating viewpoints: *people-based business processes* and *rules-based automation processes*; the two are becoming more complementary all the time.

The roots of people-based workflow software are in workgroup tools and groupware. In workgroup tools applications (office suites like Lotus SmartSuite, Microsoft Office, and Star Office for examples, plus more specialized tools like Autodesk and Autocad), team collaboration and implicit workflow have always been strong features. Groupware is software that purposely makes it easier for people on teams or in groups to collaborate and helps their work flow more smoothly and efficiently. For people-based workflow software that has evolved from workgroup tools and groupware and now explicitly captures and manages workflows, the future is in enhancements to Web services capabilities, along with JSP and portlet support, moving them towards more and more integration within the Java environment.

The roots of workflow automation applications as expressed in Web application orchestration can be found in rules engine applications and the static, step-by-step, rules-based automation of production and manufacturing processes. This kind of workflow is now heading towards supporting people-based workflows as well.

Merging the two viewpoints means that the ability of workflow software to flexibly handle varied and unexpected circumstances becomes very important. Orchestration and choreography of Web services workflows are essential parts of ongoing standards definition work at this time.

Workflow software doesn't create business processes, but applying workflow to a business process certainly brings the details of that process into focus as you lay out the business process definition and add the required business rules definitions. A workflow can be thought of as the implementation of the answers to the questions *Who? What? When?* in a business process.

Who are the participants involved in the flow of the business process? What roles do they play? How are they organized? Are the groupings flexible and dynamic? Or more fixed and static? More entities than just people can be workflow participants. Organizations, applications, employees, Web services, and other workflows can be answers to the *Who?* question. Abstracting participants into roles makes a workflow more robust. For example, instead of risking a bottleneck in the workflow by specifying that Employee A or Employee B must do a task, or putting up with the maintenance headache of changing the list of specific employees every time there's a relocation or promotion, allowing anyone that has the Supervisor role to do the task lessens that risk and lowers that maintenance cost.

What is it that the participants do? How do they do what they do? Do they approve things? Do they perform transactions? Do they create documents? Track inventory? Call vendors for prices? Execute a campaign? Transfer information to other participants? Some workflows are completely automatic, and some consist of manual tasks that must be performed by people. More and more frequently, workflows are a combination of the two types. For example, calling a vendor for prices could be one in a series of manual tasks that a person performs, but it can become a programmatic call to a Web Service that returns prices based on the vendor and item information provided to it.

How do participants know when to start? When is the work finished? In what order do participants do their tasks? Do they do them sequentially or in parallel? If only sometimes, under what conditions? How long should each task take? Are there hard deadlines or not? If a task is not successfully completed, should it be tried again? When a business process contains tasks that are currently done by people only during the day, and examination of those tasks results in changing them to be automated and performed at any time, the people are then freed up for other tasks and the newly-automated tasks don't have to wait for a person to perform them.

3. The SAGE Project

Coordination of distributed development processes in technical domains is often complex and subject to frequent change, which makes a formal description using workflows too complicated. Even experts cannot describe in detail how they will perform and coordinate their tasks. This makes it difficult for IT-analysts to capture the necessary information for modelling a workflow. Moreover, semi-structured activities are hard to describe and cannot be determined beforehand. Advanced workflow technology like adaptive workflows [2] or emergent workflows [6] are not fully satisfactory, because team members cannot use the cooperation tools but have to employ tools from the workflow management system to change the workflows.

Furthermore, the importance of awareness for successful team work has been identified in many studies of workplaces [5]. Several models and applications have been developed and the requirement to provide awareness about activities and actions of others in a cooperative environment is part of CSCW engineering. Like in real world settings, situated action [10] requires awareness information about the working space in which the action takes place. The SAGE project aims at the development of new solutions for self-organized cooperative task management and group awareness by combining approaches from software engineering with workflow technology and CSCW methods. In SAGE both task-oriented and social awareness [9] is needed, i.e. information about the state of artefacts, e.g. tasks and deadlines, and presence and activities of people, to support coordination of development processes.

The research carried out in the SAGE project is jointly done with application partners from the automotive industry and project management consultancy. Research partners are Fraunhofer FIT and OrbiTeam.

With the adaptation of an existing process structure it is intended to optimize a workflow by the evolution in a real working situation. In our application area, the distributed software-engineering, this aspect is irrelevant. Our goal is not the adaptation and optimization of workflows for a dedicated process. We aim to realize flexible tools that can be used by team members to coordinate cooperation processes. User-defined workflows are more information-oriented than process-oriented. This aspect draws the conclusion that CSCW concepts are more relevant than concepts of production workflows.

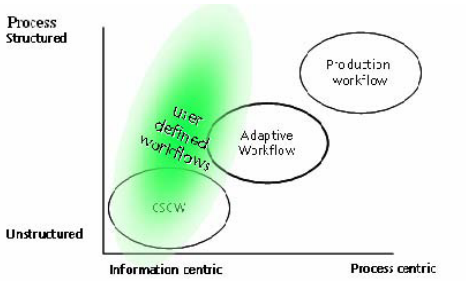

Figure 2 – User-defined Workflows in the Context of adaptive Workflows

3.1. Task Management with User-defined Workflows

SAGE supports coordination of distributed development processes with a platform that establishes a common and shared virtual information space (shared workspace), which is used by team members to create and change tasks, store and access results or agreements, to discuss and negotiate, and to stay informed about distributed development processes. The management of team membership is accomplished by the team itself (self-organized) and roles of members control their access to the shared workspaces.

The concept of user-defined workflows has been developed to allow specification of individual as well as group tasks. There are atomic tasks, deadlines, tasks with subtasks and tasks for delegation. However the type of a task can be changed during the process, i.e. users have not to describe the entire process at the beginning of the collaboration. The tasks, of course, are linked to development documents like agreements, specifications, and results.

SAGE plan to provide several services which support a high level of transparency and disburden team members from routine monitoring tasks: escalation of deadlines as well as error messages and change requests; compilation of important deadlines, documents and agreements based on relations between tasks, relations between tasks and shared workspaces, or expected results; automatic adjustment of deadlines and automatic notification about documents linked to agreements; supporting the follow-up of technical meetings. Inconsistency of development documents is avoided by using shared workspaces instead of individual folders and email exchange of documents.

A first analysis indicates that a task browser could be the main tool of the SAGE platform, which enables team members to overlook all tasks in which they are involved to easily identify upcoming tasks and to ascertain their status. Naturally, there are operations available to create, change, delete, and move tasks. The corresponding shared workspaces, discussion forums, and other tools like email or for membership management (e.g. invitation of members, account settings) can be directly accessed. Basic awareness information could be presented symbolically, e.g. the expiration of a deadline could be visualized by a red exclamation mark or modifications made to an artefact by an iconic footprint.

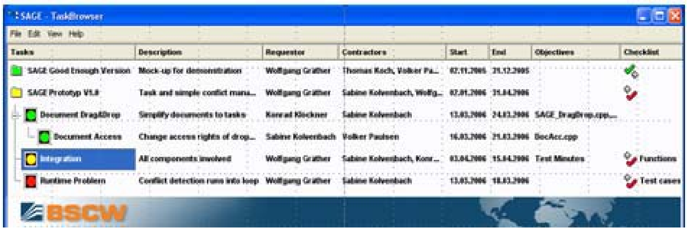

Figure 3 - Basic Awareness Information in the Task Browser

In addition to basic awareness information, team members require an overview of the current activities in their cooperative development processes [7]. Therefore, we present shortly more complex graphical space-oriented visualization tools, which serve complementary purposes: overview on group activity and overview on object specific activities.

3.2. Application Scenario and Requirements

In the SAGE project we analysed the scenario of distributed software engineering as one application area. Therefore we made interviews with software developers that are familiar with team-oriented software engineering over organizational and institutional boundaries [8].

Analyzing the scenario we identified that teams were mainly self-organized. Team members jointly accessed the same task related information, project results were distributed in and between the teams, and often problems were discussed bilateral between two members by email. To resolve conflicts and synchronize the task management the teams had to arrange joint meetings. Obviously it was important that team members were informed about modifications of documents, in order to follow these changes for their development tasks, e.g. changes in a program interface.

Based on these experiences and assumptions gained form expert interviews we observed that these kinds of engineering processes were not managed hierarchically. Personal responsibility and cooperation between team members were in demand to achieve successfully common tasks and goals. Because of the organizational and spatial distribution participants did not have the chance to meet for example on the floor or to arrange meetings spontaneously in order to stay informed on the process and to synchronize the processes as necessary. We found out that team members needed support to schedule and coordinate tasks, to manage project members and resources, and to adapt and synchronize processes depending on the current process progress.

Mostly members of collaborating developer teams did not have detailed, personalized access rights. Rather all participants were members of a team that aimed to reach a common goal. For example, in a team of developers each member had the right to create task relevant information, to read documents produced by other members, to invite further members, etc. Merely the requestor and the contractor play a certain role.

For the coordination of the involved project members and its work simple services for communication, cooperation adjustment and negotiation are needed. At any time the team members must be informed about the current status of the system development, latest changes, variations regarding the project plan and potential schedule overlaps. By this an efficient cooperation inside and in between project teams is achieved so that duplication of work can be avoided.

In order to simplify the task management and increase the efficiency its integration in the users' cooperation environment is important. In particular users must not change their current working context to coordinate their tasks.

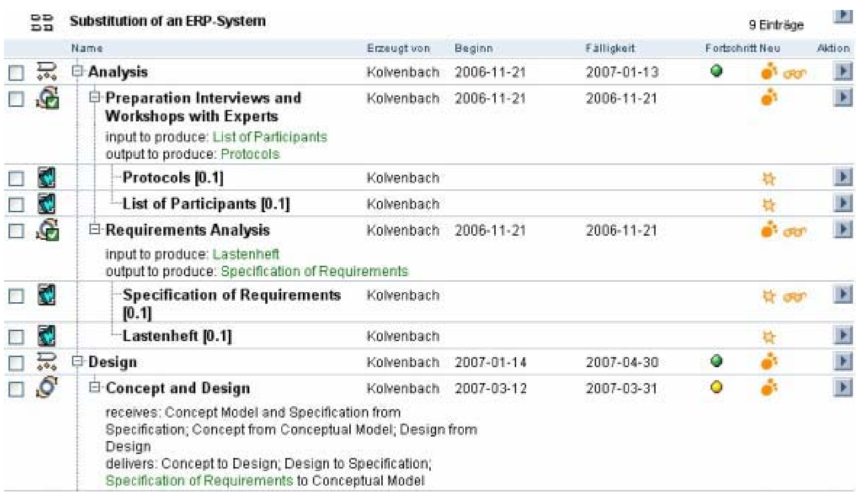

Figure 4 – Task Management in the Work Context

The SAGE developments are realized as a web-based system that allows integration by using the concept of web services. As cooperation platform we will use the web-based groupware BSCW [1] and as awareness server the web-based event and notification infrastructure ENI [9] could be integrated. The SAGE platform will be integrated with other cooperation and software engineering tools, depending on the requirements of the chosen applications.

3.3. Implementation of Task Processing and Task Coordination

Depending on the status of the task the users have various options of processing it: generating a new one, structure, coordinate, process and observe the activity. Attributes of a task like members or priority may be changed or be detailed into subtasks.

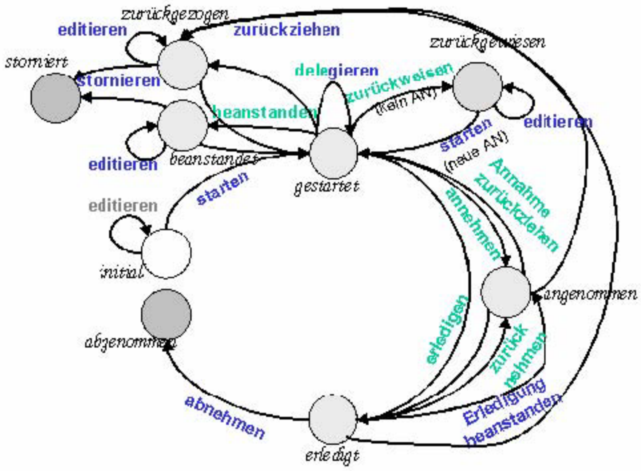

Figure 5 - State Model of Tasks

While processing a task the user may control its fulfilment, e.g. a task may be stopped or the responsible person may be changed. The concept of different task workspaces allows to exchange and administer data and results, to setup agreements and to communicate them.

Not every user is allowed to process actions during the task processing. The corresponding rights are assigned and administrated via roles. The platform offers three roles for the administration of tasks: member, initiator and contractor. The members being observers or subcontractors related to the fulfilment of the task have only restricted rights (usually read permission).

The contractor is responsible fort he fulfilment of the task and he has advanced rights. Contractors e.g. are allowed to create documents, to establish contributions in a discussion forum and to invite or exclude members from the workspace. The initiator has the most extensive rights: he is allowed to change the priority of a task or to withdraw it completely.

Normally the fulfilment of the processing steps is done by initiator and contractor in an alternating way. Initially the task is defined by the initiator and assigned to a contractor, who himself accepts this assignment, refuses it or forwards it by delegation to someone else. Various methods of dealing with exceptions allow to point out changes in the process context or to incorporate them in during further task processing. This means the in initiator may withdraw a task during its execution if preconditions for this task have changed or the task has become unnecessary.

The SAGE prototype is completely web based, this means the users directly access their task related data via their web browser. The services for cooperative task management and group awareness are described and implemented via web services. The platform allows the integration of further existing applications like communication tools that are already used by the user. The focus of the implementation was put on a most flexible realization of functionality in order to adapt the system to various application contexts. Examples are the configurable task model and roles/access rights that may change according to the individual task context.

4. Conclusion and Outlook

In SAGE we perform an iterative software design, development and evaluation process. With the evaluation of the SAGE platform at our application partners and in the SAGE project itself we will receive a lot of experiences that will be reflected in following SAGE concepts and implementations.

One important task of the SAGE project for the following months is the analysis of further application areas. Our intention is to investigate in distributed engineering processes for mechatronical systems that are typical in the automotive industry. On the one hand we will proof our concepts for collaborative task management derived from distributed software engineering processes; on the other hand we expect to get further requirements for SAGE.

A further goal is the investigation in the error and conflict management. Concerning this topic we will research for effective solutions to detect and solve conflicts. Innovative visualization tools will help users to recognize dependencies between tasks and upcoming conflicts at an early stage during the process.

5. Acknowledgement

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6. References

[1] Appelt, W., WWW Based Collaboration with the BSCW System, SOFSEM'99, Milovy, Czech Republic, Springer, 1999.

[2] Bernstein, A., C. Dellarocas and M. Klein. Towards Adaptive Workflow Systems, ACM SIGGROUP Bulletin 20(2): 54-56, 1999.

[3] European Commission, Collaboration@Work, The 2006 report on new working environments and practices, October 2006.

[4] Gräther, W., Koch, T., Lemburg, C., Manhart, P., SAGE: Self-organized cooperative task management and group awareness for the coordination of distributed software development processes, in: CCE'06 Workshop Proceedings of 'Challenges in Collaborative Engineering' Workshop, Prag, 19th-20th April, 2006.

[5] Grinter, R., From Workplace to Development: What Have We Learned So Far and Where Do We Go? In: Proceedings of GROUP'97 International ACM SIGGROUP Conference on Supporting Group Work, ACM Press, 1997, pp. 231-240, 1997.

[6] Jørgensen, H. D. and Carlsen, S., Emergent Workflow: Integrated Process Planning and Performance, Proceedings of the 1999 Workflow Management Conference: Workflow-based Applications, Münster, 1999.

[7] Klöckner, K., Collaboration based on User-defined Workflow - More than Perceiving Presence, Location and Activity, in: IDIMT-2006, Proceedings of the 13th Interdisciplinary Information Management Talks, Chroust, G., Hoyer, C. [eds.], pp. 151-158, Linz, Trauner Verlag, 2006.

[8] Kolvenbach, S., Gräther, W., Klöckner, K., With Collaborative Task Management towards Agile and Lightweight Distributed Engineering Processes, in: IEEE Proceedings of the 32nd Euromicro Conference on Software Engineering and Advanced Applications (SEAA), Cavtat, Croatia, Aug 29 - Sep 2, 2006, IEEE, Los Alamitos, p. 456-463, 2006.

[9] Prinz, W., NESSIE: An Awareness Environment for Cooperative Settings. Sixth European Conference on Computer Supported Cooperative Work, Copenhagen, Denmark, Kluwer Academic Publishers, 1999.

[10] Suchmann, L.A., Plans and situated actions: The problem of human-machine communication, Cambridge University Press, Cambridge, 1987.

[11] Virdell, Margie S., Business processes and workflow in the Web services world, IBM, 2003.

UBIQUITOUS INFORMATION INTER-FACES

Tom Gross, Thilo Paul-Stueve*

In ubiquitous environments users have pervasive access to information and communication technology. A major challenge for the concept and implementation of such environments is the adequate selection of information and communication support for users. In this paper we suggest face recognition as an approach, where the environment captures the users present in a room, detects and infers the social situation, and adapts the information and communication facilities accordingly.

1. Introduction

Ubiquitous information interfaces provide information and communication facilities that are adapted to the respective situation, and allow users to implicitly interact with the environment in a natural way. Ubiquitous information interfaces aim to be easy and simple from the users' perspective, which requires a complex internal structuring and processing.

Ubiquitous environment typically consist of *sensor* that capture information about the current situation and the users involved, *actuators* that adapt the information and communication facilities of the environment accordingly, and *processing* that analyses the captured information and infers on adequate adaptations [6, 7].

The *complexity* of the processing increases vastly with a growing number of data in a growing precision. This has several reasons:

- the growing number and spreading of sensors capturing information about the users in the digital realm, but also in the real realm provides a more and more data
- the ongoing improvement in the mechanics and electronics of the sensors leads to more fine-grained data

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- the increased availability and spreading of static and mobile computing technology creates more complex settings for which the inference and adaptation needs to function

In this paper we address these novel challenges of processing information in ubiquitous information environments. We discuss related work. We develop a general model for the hierarchical processing of data in ubiquitous environments with a categorisation of increasing complexity. We show how the model can be applied to real-world information processing challenges of ubiquitous information interfaces by describing the information processing of the face recognition in the Sens-ation Eyes prototype we developed. Finally, we summarise the paper in the conclusions.

2. Related Work

In this section we describe related work addressing issues related to information processing and inferring in ubiquitous environments. Anind Dey [2] describes several requirements of applications that aim to support context and go beyond the traditional WIMP metaphor. In particular, he emphasises that context-aware applications need to interpret and aggregate the incoming sensor data. And he also points out that these processes can include multiple layers of abstraction. Several authors have addressed this issue of interpretation and aggregation of sensor data on multiple layers.

Gross and Prinz [8] suggest a lightweight model of processing data and determining their meaning compared to a context description. Both captured event data and context descriptions consist of attribute-value-pairs. For interpreting the meaning of an event and the potential matching of an event to a context, they simply match the attributes of the events and the context descriptions.

Schmidt and Van Laerhoven [13] suggest to distinguish between: sensors that capture data, sensor cues that abstract from sensors but still depend on single sensors, contexts that describe the current situation in an abstract way, and a data representation of the context such as a context tuple space.

Kiani et al. [11] provide a middleware architecture with a sensor abstraction module providing unified access to hardware sensors, a hardware abstraction layer hiding the specifics of sensors, feature extraction agents extracting the most descriptive features, feature tuple spaces storing the results, and a feature-context mapping comparing the features to an ontology repository. Similarly, Gu et al. [9] suggest: information source layer, middle data layer, semantic integration layer, semantic access layer, and application layer.

The previous work that is closed to the model we suggest blow is from Ailisto et al. [1]. The authors suggest five layers for context processing: physical layer of data sensing, data layer of data processing, semantic layer of semantic processing, inference layer of inferring results, and application layer of action or other use of the inference results.

3. The UbiProcess Model

In this section we describe the *UbiProcess* model that is based on a thorough literature study as described in the previous section and beyond as well as our experience of developing concepts, platforms, and prototypes of ubiquitous environment over the last years.

We first start with a very simple and schematic overview of the functioning of ubiquitous computing environments (cf. Figure 1). The central feature of most ubiquitous computing environments is that they want to provide users with natural interaction—that is, to understand the situation of the users in the real world, they have to capture and store data in some model of the world. The data is then further processed—analysed and interred—in order to get insight on the users' context and situation. Based on the context and the assumed requirements that the users in their current context have, the ubiquitous computing environment then reacts and makes some adaptations in order to better support the users.

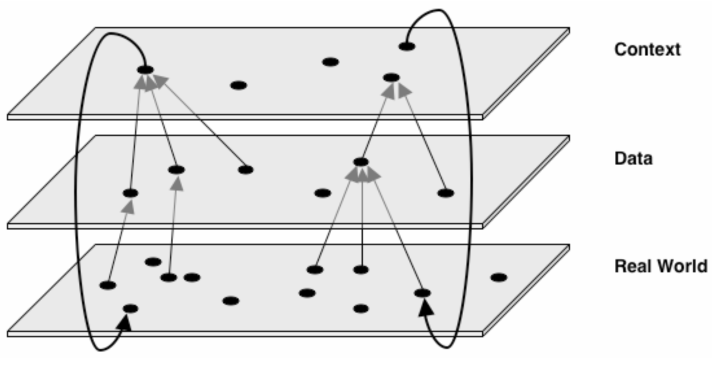

Figure 1 - Schematic overview of ubiquitous computing environments.

Already in this very simple model it becomes clear that ubiquitous computing environments face several challenges. To some extent it is obvious that paradigm shifts typically constitute progress entailing many advantages, but also bring along several disadvantages. This was already the case when moving from Computer-Supported Cooperative Work to Cooperative Web Computing, and it is similar now when moving to Ubiquitous Computing [5].

As pointed out in [4] and in [10] real-world situations often comprise explicit information, but also implicit information. It is difficult for both—humans and technical sensors—to capture all the essential data. This is particularly the case for cooperative situations, in which multiple parties are involved and bring in their tacit knowledge. Bridging this gap can become a major challenge [3].

So, ubiquitous environments gather data from the real world in order to deduce higher-level knowledge to support users through the adaptation of the environment. Each level of processing produces more complex statements about the situation in the real world. First, the samples of the real world are taken and revaluated on base of generally accepted scales and methods. Next, the samples are enriched with subjective extra information to describe the situation in the environment to finally allow the adaptation of the real world.

The *UbiProcess* model thus consists of three consecutive levels: the gathering, level representing the bridge between the real world and its data representation, the inferencing, level that transforms the data to context knowledge, and the feedback level that provides the mechanisms to adapt the real world (cf. Figure 2).

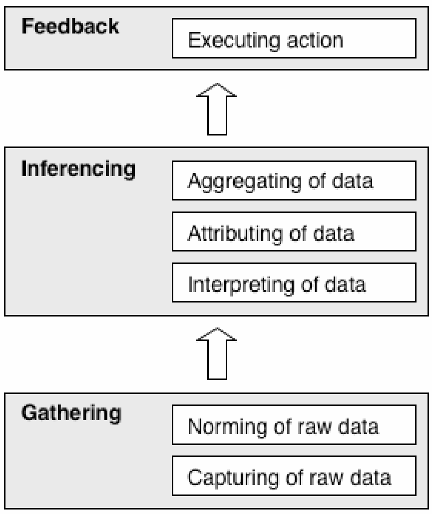

Figure 2 - UbiProcess model.

The first level is the *gathering level*. It comprises the steps capturing of raw data and the norming of the data:

- The *capturing* of data is a continuous process of taking samples of that portion of the real world that represents the environment of the users. Real world here means the world outside the model; on the one hand this might be, for instance, palpable attributes of the environment like the temperature of a room, on the other hand electronic data like users' address databases on their computer.
- If required, sampled data are standardised in a *norming* process by converting them to comparable measuring units for every type of information source. This step is important to be able to set the data in relation to each other and to subjective criteria in later processing steps.

The *inferencing level* encompasses three steps of growing abstraction in which the data is further processed on demand: the interpreting, the attributing, and the aggregating layer. Each step processes actual and historic data from the gathering level or from any layer in the inferencing level:

- In the *interpreting* layer actual and historic data of only one data source is set in relation to each other to determine statistical values like the minimum, the maximum or an average value. How to determine these values is dependent on the kind of data, which are processed, and their source. For instance, a typical location of a person is computed in a different way than the average temperature in that particular place.
- The *attributing* layer is the first layer of data processing, which adds subjective value to the data. Specialised knowledge is attributed to the data using libraries in order to obtain context information. The libraries of this layer contain knowledge in the range of common acceptation, local and cultural terms, and personal opinion. For instance, most users can call the temperature in a room of 20 degree Celsius convenient, but an individual user might have the opinion that a room temperature of 24 degree Celsius is convenient. Integrating different specialised libraries (e.g., for user groups or specific locations) result in very fine-grained reactions of the ubiquitous computing environment.
- In the *aggregating* layer data from different information sources are combined to derive complex knowledge about the state of the environment. Multiple aspects of the environment are combined using conditional operations. In combination with the

attributing layer the integration of the different needs of several users in different locations and cultures even at different times is possible. For instance, during a teleconference it might be useful that each participant's ambient light is individually adjusted to a level that is perceived as convenient formal illumination.

Finally, on the *feedback* level, the knowledge acquired in the previous levels is used *executing* actions in the real world, the environment of the users. Due to the multi-layered inferencing the reaction of the ubiquitous environment respect the specific requirements of different situations and the users. The influence of the ubiquitous environment on the real world can express directly in palpable changes or in changes inside an artefact, e.g. a computer system.

4. Inferring in the Sens-ation Eyes Prototype

In this section we want to show how the UbiProcess model can be applied to real world ubiquitous computing scenarios. In particular, we describe the individual levels and layers of the model as applied in the Sens-ation Eyes prototype. We introduce the overall design and functionality of Sens-ation Eyes from the users' perspective, sketch the software architecture of Sens-ation Eyes prototype, and describe the information processing in the Sens-ation Eyes prototype in the light of the UbiProcess model.

Sens-ation Eyes is an extension to Sens-ation. Sens-ation is a platform for the development of sensor-based infrastructures that can be used in ubiquitous computing scenarios. It consists of various sensors capturing information, inference engines processing the information, and actuators reacting upon the inference [6, 7]. Sens-ation Eyes provides an extension based on computer vision and is able to analyse video streams in order to adapt the environment. It can detect, count, track, and recognise persons in a video stream originating from a WebCams, and infer the situation on base of these and other information. It supports the users by changing the environment to their needs in the current situation detected.

Sens-ation Eyes can be used for seminar rooms, student labs, or a living rooms: It can inform students, when a seminar room is occupied by counting the persons inside, open a user's workspace on a computer, if the user is recognised nearby, start a presentation upon the sight of a tutor near and an audience in front of the projector screen, or arrange the illumination to the preferences of present people.

The data *gathering* in Sens-ation Eyes is done with the help of software sensors. Sens-ation Eyes captures data from a video stream provided by a WebCam and applies computer vision algorithms to the pictures obtained from the video stream of the camera. A motion detection algorithm, different blob-tracking algorithms, and a PCA algorithm [15] are used to provide the platform with basic data samples of the real world. For instance, such samples are the person whose face is recognised, or whether a person is detected in the picture. The captured data is translated to units like picture coordinates, radius information. Some of the values captured with the software sensors do not require a standardisation of the data, since the sensors deliver data samples in a usable format. The gathered data is transferred to the Sens-ation middleware for further processing. Sens-ation forwards the incoming data to the inferencing processes on demand and stores them in a database to provide the inferencing engines with a history of past data.

The *inferencing* level of the UbiProcess model is realised in form of inference engines in Sens-ation. Inference engines allow specifying sensors whose data are required for calculation, providing the place to implement the algorithms, and provide the platform with the results of the process on demand. The *interpreting* layer is represented by statistical calculations like the summation of the amount of persons detected in the picture, or the determination of the area where most of the persons are detected.

An inference engine on the *attributing* layer determines the occupancy of our students' lab on base of the amount of persons detected in the picture. It makes use of knowledge about the student lab provided in a library (e.g. a specific lab is 'crowded' if there are more than ten people in there), and vital coordinates in the picture can be attributed with identifiers such as Peter's Workstation.

The inference engines on the *aggregating* layer combine the information of the person detection sensor, the face recognition sensor, and the attributing layer to derive knowledge like 'Mirko is in the student lab' or 'Sue is approaching her computer'.

With the knowledge derived in the aggregating layer, the actuators of Sens-ation Eyes influence the environment. This is done with hardware that affect the environments parameter in direct, and software actuators that control the behaviour of computer systems For instance, when Christian approaches his workplace, he gets logged into his workstation, finds his digital workspace as he left it, and the desk light is adjusted to his preferences.

Sens-ation Eyes is implemented on the Java 2 Standard Edition Platform 5.0 [14] using the SensBase reference implementation of the Sens-ation infrastructure [6] and the JavaVis 3.5.1 computer vision library [12].

5. Conclusions

In this paper we have introduced a general model describing the basic capturing of data in ubiquitous computing environments, the processing of these data, and the reaction based on the inference. As we pointed out in this paper: many big challenges in ubiquitous environments concerning base technology for capturing, transferring, and processing the data have been solved to a satisfactory extent. Yet, squeezing out the semantically valuable and insightful bits about complex social situations remains a challenge.

6. Acknowledgements

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7. References

[1] Ailisto, H., Alahuhta, P., Haataja, V., Kylloenen, V. and Lindholm, M. Sturcturing Context-Aware Applications: Five-Layer Model and Example Case. Presented at Workshop on Concepts and Models for Ubiquitous Computing at the Fourth International Conference on Ubiquitous Computing - UbiComp 2002, (Sept. 29, Goeteborg, Sweden). Rodden, T., Dix, A. and Abowd, G.D., eds. 2002.

[2] Dey, A.K. Understanding and Using Context. Personal and Ubiquitous Computing 5 (2001). pp. 4-7.

[3] Gross, T. Towards Bridging the Gap Between Humans and Information Systems. In Proceedings of the Fifth International Information Management Talks - IDIMT'97 (Oct. 15-17, Zadov, Czech Republic). Oldenbourg, Vienna, 1997. pp. 147-156.

[4] Gross, T. Towards Human Interfaces: Analysing the Organisational Context. In Proceedings of the Sixth International Information Management Talks - IDIMT'98 (Oct. 21-23, Zadov, Czech Republic). Oldenbourg, Vienna, 1998. pp. 173-186.

[5] Gross, T. Towards Ubiquitous Cooperation: From CSCW to Cooperative Web Computing to Ubiquitous Computing. In Proceedings of the Eighth International Information Management Talks - IDIMT 2000 (Sept. 20-22, Zadov, Czech Republic). Universitaetsverlag Rudolf Trauner, Linz, 2000. pp. 145-162.

[6] Gross, T., Egla, T. and Marquardt, N. Sens-ation: A Service-Oriented Platform for Developing Sensor-Based Infrastructures. International Journal of Internet Protocol Technology (IJIPT) 1, 3 (2006). pp. 159-167.

[7] Gross, T., Paul-Stueve, T. and Palakarska, T. SensBution: A Rule-Based Peer-to-Peer Approach for Sensor-Based Infrastructures. In Proceedings of the 33rd EUROMICRO Conference on Software Engineering and Advanced Applications - SEAA 2007 (Aug. 27-31, Luebeck, Germany). IEEE Computer Society Press, Los Alamitos, CA, (accepted).

[8] Gross, T. and Prinz, W. Modelling Shared Contexts in Cooperative Environments: Concept, Implementation, and Evaluation. Computer Supported Cooperative Work: The Journal of Collaborative Computing 13, 3-4 (Aug. 2004). pp. 283-303.

[9] Gu, J., Chen, H., Yang, L. and Zhang, L. OBSA: Ontology-Based Semantic Information Processing Architecture. In Poceedings of the 2004 IEEE/WIC/ACM International Conference on Web Intelligence - WI 2004 (Sept. 20-24, Beijing, China). IEEE Computer Society Press, Los Alamitos, CA, 2004. pp. 607-610.

[10] Jordan, B. Ethnographic Workplace Studies in CSCW. In Shapiro, D., Tauber, M. and Traunmueller, R., eds. The Design of Computer Supported Cooperative Work and Groupware Systems. Elsevier, Amsterdam, NL, 1996. pp. 17-42.

[11] Kiani, S.L., Riaz, M., Zhung, Y., Lee, S. and Lee, Y.-K. A Distributed Middleware Solution for Context Awareness in Ubiquitous Systems. In Proceedings of the 11th IEEE International Conference on Embedded and Real-Time Computing Systems and Applications - RTCSA 2005 (Aug. 17-19, Hong Kong). IEEE Computer Society Press, Los Alamitos, CA, 2005. pp. 451-454.

[12] Pérez, J.M., Bonev, B.I., Suau, P., Viejo, D. and Cazorla, M.A. JavaVis: Open Source Code for Computer Vision Subjects. In FLOSS International Conference 2007 (Mar. 7-9, Jerez de la Frontera, Spain). Servicio de Publicaciones de la Universidad de Cádiz, Cádiz, Spain, 2007. pp. 106-115.

[13] Schmidt, A. and Van Laerhoven, K. How to Build Smart Appliances? IEEE Personal Communications 8, 4 (Aug. 2001). pp. 66-71.

[14] Sun Microsystems Inc. J2SE 5.0. http://java.sun.com/j2se/1.5.0/, 2007. (Accessed 20/06/2007).

[15] Turk, M.A. and Pentland, A.P. Face Recognition Using Eigenfaces. In Computer Society Conference on Computer Vision and Pattern Recognition (Jun 3-6, Maui, HI, USA). IEEE Computer Society, Washington, DC, USA, 1991. pp. 586-591.

ENHANCING USER-SIDE EXTENDIBILITY OF GROUPWARE

Ivan Tomek, Rick Giles, Hai Zhang, Li Di*

Technological and economic pressures make groupware ever more important and its various implementations are used by more and more work teams in a growing variety of applications domains. One must therefore ask what are the main challenges facing its successful development and application. Because issues of groupware development and its use are addressed by a variety of disciplines, groupware challenges fall under several headings. Human problems fall under cognition, ethnography, and related fields, technological problems including adoption to new software and hardware technologies and general design and implementation issues belong into computer science, and so on.

This paper is related to challenges raised by design and implementation of groupware and their relation to the needs of work teams. Design and implementation of groupware present two important problems. One is that although fundamental needs of all groupware application are the same new systems with the same basic functionality are being developed from scratch resulting in unnecessary duplication of effort. The second problem is that although fundamental needs are the same across teams and applications, specific needs vary among different groupware applications as well as within the same application domain or even within a work team because opportunities, needs, and processes continuously evolve and differ from one team to another. Because of this, it is impossible to develop groupware that will satisfy every need and will be sufficient forever. In our opinion, both of these problems – waste of effort caused by redeveloping very similar applications over and over, and impossibility to develop definitive groupware due to variations among applications in significant details - can be resolved. We advocate the development of a runtime user-modifiable and extendible modular framework (to avoid the need to re-develop each new groupware application from scratch), and building one or more well-known programming languages into the environment in such a way as to achieve user-based extendibility and thus

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allow customization and extension to satisfy various and evolving work needs. In the following, we trace the history of related efforts that led to our current work, and describe a prototypical environment called Federated Virtual Environment (FVE) that we are developing with the aim to provide the features that we advocate. We pay special attention to our novel approach to extendibility of the environment at runtime.

1. Introduction

With the spread of Internet and growing globalization of work, collaboration using electronic means is acquiring fundamental importance. The basic needs of all collaborating teams are the same – at the minimum, their members need to communicate ideas and share documents - but there are other essential requirements as well. At the same time, different work teams engaged in widely varying and continuously evolving tasks, use different work processes, and require different types of functions, supporting artifacts, and auxiliary software. As an example, a team of several thousand automotive engineers volunteers developing an open source design of the car of the future [8] uses a very different work process and very different tools than a large commercial team of software developers requiring a highly protected environment with a large software development and code versioning machinery [6], or an academic institution supporting distance education and using a variety of simulation tools, administrative software, and computer assisted learning programs.

Given the enormous need for collaboration software and the large variety of requirements, there is nothing surprising about the large number of software applications that are available or are being developed to support collaboration, and the various mixes in which software developed to support individuals and teams is used. To gain a better perspective on this multitude, a groupware classification is helpful [12]. At the coarsest level of abstraction, two types of tools are being used: opportunistic mixtures of unrelated specialized limited-purpose applications, and applications that attempt to integrate as much of the functionality required for geographically dispersed collaboration as possible into one monolithic program. We believe that tools in the first category are only stop-gap measures and that the future lies in groupware – integrated tools of the second type. Integrated groupware applications can be further divided into two subcategories. One includes those that are largely hard-coded and whose modification requires intervention by their developers. This type of groupware usually fails to keep up with user needs and is eventually abandoned. The other type of integrated groupware includes applications that provide built-in tools, which allows even users to customize or extend the application. In our opinion, applications of the second kind provide the best long-term solution because work team needs differ and evolve in time.

Applications that allow customization and extension can use several approaches. These include opening the implementation source code to the user, using a pluggable framework, or including a programming language that controls the application as a part of the environment. These approaches are not mutually exclusive and we believe that a combination of all three is the most desirable approach. This is the direction taken by our FVE groupware experiment.

In the rest of this paper, we first describe earlier products that led us to FVE, describing their general principles and main features. We then present one of FVE's most innovative features – support for user extendibility via multiple scripting languages. The last section summarizes our arguments and our plans for the future.

2. Earlier FVE predecessors

Direct ancestry of FVE can be traced to MOO applications [5], our Jersey project [11], CVW [2], and FCVW [13]. MOOs grew out of MUD networked fantasy game environments of the 1970s which provided users with a text-based interface to a virtual world of caves, castles, and other spaces inhabited by other users and 'software agents', such as various fairytale characters. Interacting with other networked players and software agents, users navigate the virtual space, and access, create, and interact with virtual objects. MUDs brought into existence the following concepts: Networked interaction with distant users that use the same application at the same or different time, virtual space divided into self-contained subspaces inhabited by participating users, virtual navigation of virtual space, portable user-instantiatable artifacts, software agents interacting with users and the environment, and persistence – autonomous uninterrupted existence of the resources of the virtual universe even in the absence of its users. MUD's persistence is based on a dynamic 'database' stored on the server machine and holding the current state of all components of the virtual universe – users, virtual spaces, and virtual objects. All these features are natural consequences of the basic metaphor of MUD as a fantasy counterpart of the real world. Besides providing an addictive immersive gaming environment, they incorporate very natural features that closely parallel physical-world affordances and are important in rich virtual human interaction.

Although MUDs were originally used only for gaming, the concepts and principles proved to be very valuable in social, work [1], and educational settings, and many variations of the original MUD were developed to serve just such needs. As this was happening, it became obvious that the hard-coded nature of original MUDs was very limiting and a new fundamental feature was added – user programmability. The most important and still enduring form of user control over the environment was provided in MOOs - MUD Object-Oriented.

MOO's functionality is implemented by a client-sever architecture. The server combines a database of code (written in a programming language called LambdaMOO [7]) that defines properties and functionality of all universe objects, and an interpreter that processes commands written in LambdaMOO and issued by clients controlled by human users and by autonomous software entities present in the universe. The interpreter is to some extent reflective (provides programming access to object definitions) because the commands that it can process include commands for creating, modifying, and deleting LambdaMOO-based commands in the code database. As a consequence, the whole environment is user programmable. In fact, MOOs are runtime programmable and can evolve without any need to interrupt and restart operation for recompilation.

Given the features inherited from MUDs and enhanced by MOO principles, new MOO-like applications for new uses need not be recreated from scratch because all usage-specific functionality can be obtained by reusing, modifying and extending the defining code and enriching the universe database. This has led to the development or cloning of many MOO-based environments among which those developed for educational uses have been most successful. An example of a lively community based on an environment of this kind is enCore [4], a MOO vigorously used by a group of educators in several universities around the world.

3. From MOO to FCVW and FVE

Over the years, only two major MUD and MOO innovations have been introduced – replacement of awkward Telnet text-based user interfaces with text-based graphical user interfaces (GUIs) thanks to window-based operating systems, and emergence of browser-based client interfaces. Although these innovations are important for user experience, they are only esthetic improvements and more serious issues have remained unresolved. One is that all MOOs use the original or slightly modified MOO server with its now antiquated technology. This server is completely undocumented, making it almost impossible to introduce other than minor changes, which is a major obstacle to significant progress. Another drawback of MOO design is that its conventional architecture is based on a single server servicing multiple clients and processing all activity happening in the virtual universe. The large load on the server, which must maintain all connections, process all incoming commands via its interpreter, maintain universe database, and broadcast all events to clients, causes limited scalability and vulnerability to server crashes. Besides these two major limitations, important features could be added or improved, such as a framework for software agents, an improved interactive development environment MOO programmers, and new types of clients, particularly for mobile computing devices, which are now a standard appliance for mobile team workers. All these limitations and possibilities led to our FCVW project, an extension of CVW (Figure 1).

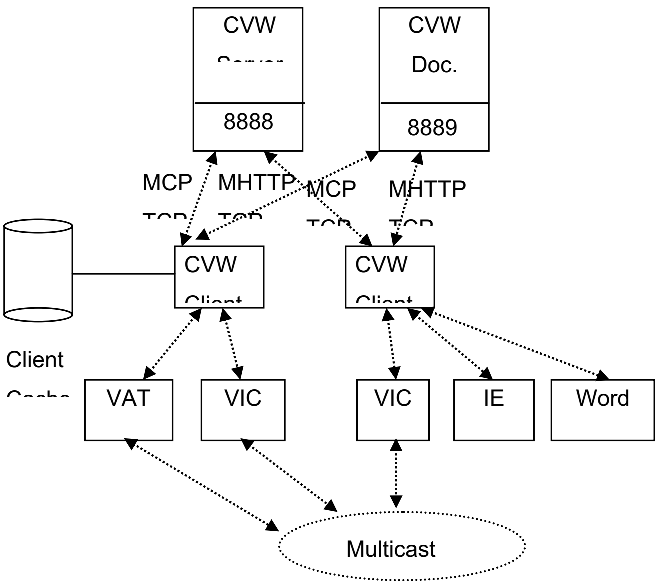

Figure 1. CVW architecture.

As the acronym suggests, FCVW is a direct successor of the CVW program (FCVW = Federated CVW), an interesting and rather sophisticated product of MITRE Corp. CVW (Collaborative Virtual Workspace) has been quite carefully designed and tested for use by office workers and includes a GUI running on desktop clients. It is based on the old MOO server augmented by a document server that provides users with an easy way to port documents from their machines to the CVW universe and share them with co-workers.

CVW's features include standard MOO functions plus multicast-based audio and video conferencing, and a multi-user real-time whiteboard. CVW also supports user groups, which facilitates various forms of document and virtual space locking as well as group communication. Besides this, CVW shares all of the above-mentioned MOO limitations and in an effort to address them, our FCVW project implemented, among others, the following features:

- *Federated servers*. FCVW adds middleware to CVW to allow an unlimited number of servers, thus extending scalability and generalizing the universe metaphor [13]. Each server runs its own part of the virtual universe (a 'building' in CVW terms) and the middleware interconnects the 'buildings' into a seamless 'campus'. The implementation of federated servers is transparent to the user who need not be aware that the virtual universe may be implemented by more than one server.
- *Mobile clients*. We implemented both a rich client for a PDA and a thin client for a BlackBerry to complement CVW's desktop clients [15].
- A LambdaMOO *IDE* for runtime server programming and code browsing, with support for code versioning [14].
- A framework for the development of *software agents* [9].

FCVW research has now been completed. It was largely an experiment that added novel features and experimented with new implementation of existing CVW features; it was not intended to become a usable groupware product. One of the main reasons for this decision was that all new features listed above were implemented by modifying the Java-based client and by adding middleware (Figure 2). We never touched the server because of its complete lack of documentation and obscure and outdated implementation.

During the development of FCVW, we became aware that further significant progress can only be achieved by modifying the server and that this requires its complete redesign and reimplementation. FVE, our current project, does exactly that and re-implements the server and the poorly designed client, both in Java. It is worth noting that both the server and the client programs are being developed using IBM's Eclipse [3]. The Eclipse framework allows modular construction and runtime module pluggability, which further enhances user modifiability.

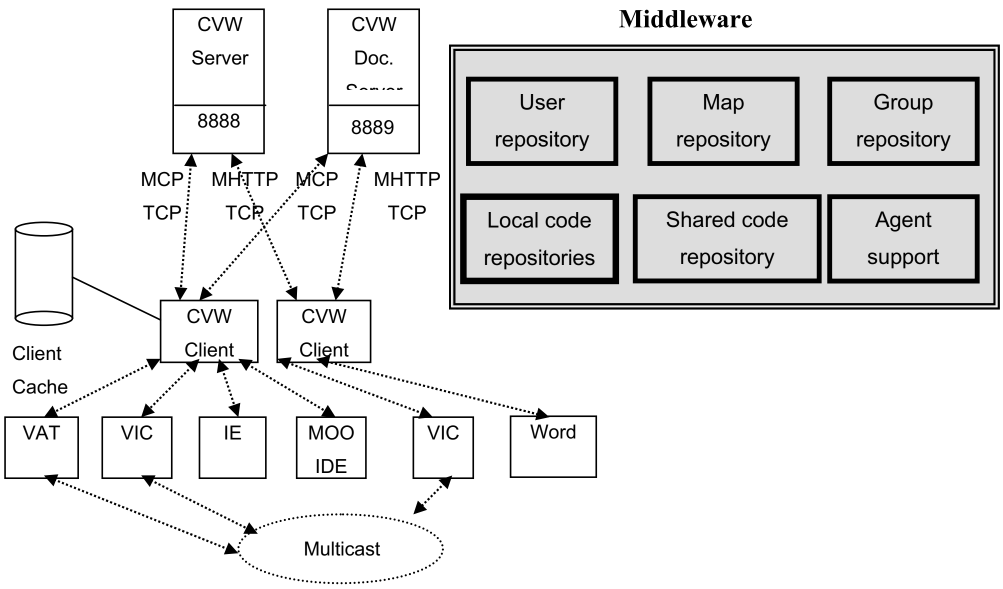

Figure 2. FCVW architecture.

4. 4. Multi-language scripting in FVE

The main goal of FVE research is to create a modularized pluggable open source groupware framework that includes features implemented in FCVW. However, several FVE innovations augment CVW further. The feature addressed more closely in this section is scripting (runtime programming) of the virtual universe via any one of a variety of several well-known programming languages. The reason why we focus on this topic is that we consider user programming of groupware to be extremely important and that although all MOOs are user programmable, the programming language through which user programming is done is problematic. The problem is that LambdaMOO was invented specifically for MOO and is completely unknown outside the MOO community. It uses an obscure combination of procedural concepts and instance-based programming, a little used variation on the now widely known object-oriented programming. As a result, although MOOs are user programmable, this feature is practically unattractive because it requires learning LambdaMOO. User programmability would become much more accessible and appealing if the scripting language was one of several better known contemporary languages such as Java or Python.

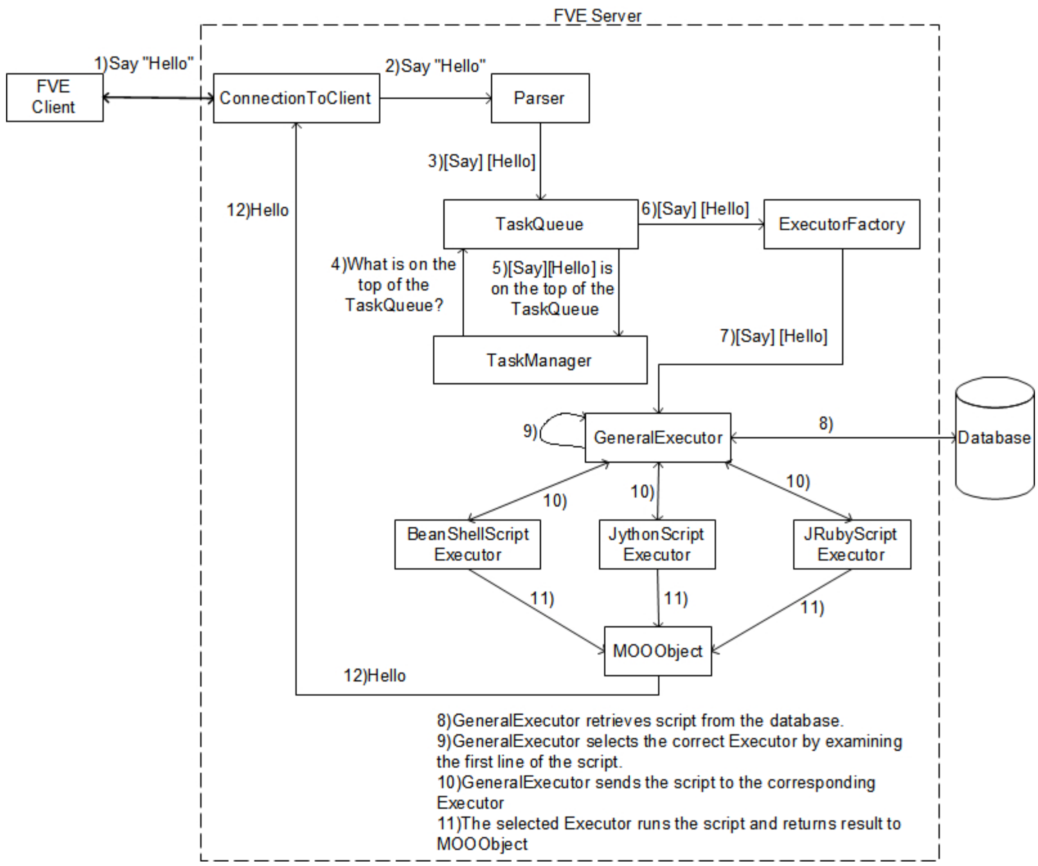

Figure 3. Example of client command processing on FVE.

One of the major innovative features of FVE is thus that it eliminates LambdaMOO as a scripting language and allows scripting in any interpreted language that uses the Java virtual machine [10]. The implementation is such that the definition of any command sent by the client machine to the server, or invoked internally by the server during the interpretation of another definition, can be written in any such language. At present, we have validated our design by writing, on a single server, commands using BeanShell (a Java-based interpreted language), Jython (a Python-based interpreted language), and JRuby (a Ruby-based interpreted language). The principle of implementation is very simple (Figure 3). Each command definition specifies, which scripting language it uses, and the interpretation of the command employs this information and the 'factory pattern' to forward the definition to an interpreter for the language in which the command is defined. This interpreter then uses JVM to execute the command.

5. Conclusion

We described the nature and the origins of FVE, an emerging multi-server groupware framework experiment. The focus of our paper was on a unique feature of FVE – the fact that it allows users to employ any combination of several well-known interpreted programming languages to extend or customize FVE operation at runtime without shutting it down. As a consequence, any programmer authorized by his team to modify the environment, and familiar with any one of several well-known modern programming allowing the programmer to choose a language that he is most familiar with, this flexibility also allows him to choose the programming language best suited for the task at hand. The expected impact of this technically interesting innovation is much greater practical extendibility of this kind of groupware, and greater appeal of this almost unlimited flexibility of the application to the user community.

On a more general level, we expect that when FVE principles are completely implemented, essentially any groupware application using its virtual universe metaphor can be built from the same well-tested and documented open source framework using a fraction of the effort required to build a new groupware program. Given the wide range of groupware needs and their continuous development, we consider the development of such a framework a very important contribution to groupware technology. Beyond this application arena, the same framework could be used to support social computing [16], a field that is currently exploding but lacks a widely accepted flexible model and platform.

Our plans for future work are as follows: We will first refine the FVE framework and complete its development, testing, and documentation. We will then start adding features supporting specific user communities, such as software developers and academic users.

6. References

[1] CHURCHILL, E., Bly S., Virtual environments at work: Ongoing use of MUDs in the workplace, Proceedings of WACC'99, 1999.

[2] CVW Overview, http://cvw.sourceforge.net/cvw/info/CVWOverview.php3

[3] Eclipse – an open development platform: http://www.eclipse.org/

[4] enCore Consortium, http://encore-consortium.org/

[5] HOLMEVIK J. N., HAYNES C., MOOniversity: A Student's Guide to Online Learning Environments, Longman, 1999.

[6] Jazz: http://domino.watson.ibm.com/cambridge/research.nsf/a1d792857da52f638525630f004e7ab8/

[7] LambdaMOO Programmer's Manual, http://magrathea.cosmic.com/pub/moo/ProgrammersManual.html.

[8] OScar: http://www.theoscarproject.org/.

[9] SHAKSHUKI E.,et al, Client Software Agents in FCVW, Proceedings of International Conference on Web and Mobile Information Systems, Taipei, Taiwan, 2005.

[10] SUN Developer Network, The Java Virtual Machine Specification, http://java.sun.com/docs/books/jvms/

[11] TOMEK I., et al, A virtual environment supporting software developers, Proceedings of CE'98, Tokyo, Japan, 1998.

[12] TOMEK I., et al, Trends in cooperative environments, Proceedings of IDIMT 2006, Ceske Budejovice, Czech Republic, 2006.

[13] TOMEK I, et al, FCVW - A Federated Collaborative Virtual Workspace, Proceedings of IADIS, Applied Computing, San Sebastian, Spain, 2006.

[14] TOMEK I, et al, End-User Programming in a Cooperative Environment, Proceedings of AusWeb 2006, Noosa Lake, Australia, 2006.

[15] TOMEK I., et al: Two mobile clients for collaboration, Proceedings of IADIS, Applied Computing, Salamanca, Spain, 2007.

[16] Social computing group, http://research.microsoft.com/scg/

Information Capacity of New Systems Theories

INFORMATION CAPACITY OF NEW SYSTEMS THEORIES

Vesna Čančer, Matjaž Mulej*

We define information as influential message, which in its turn has a semantic content and consists of data made of signs in a syntactical order. Information must hence be an attribute of systems theories for them to make sense. Their common denominator is some kind of holism. The established systems theories are able to provide many various insights, but not all of them. Making new systems theories, e.g. by synergies of several systems theories including Dialectical Systems Theory has proved fruitful. Several other attempts may exist as well and be worth learning about. In our case, 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. – This is still a work in progress.

1. Introduction: The Critical Questions Addressed

We define information as influential message, which in its turn has a semantic content and consists of data made of signs in a syntactical order. Information must hence be an attribute of systems theories for them to make sense, too. Their common denominator is some kind of holism. According to Drucker we see (in the most innovative countries) the revolution of knowledge rather than the informational one: cognition rather than electronics stands in focus (See: [17], p. 353). According to Tscherky one moves from technology to innovation leadership (ibid.). Other sources provide the same information (See: [30] and references in it). Innovation pays [13]. Being influential, innovation is a kind of information; its information capacity depends of the extent of acceptance by consumers.

The established systems theories have a big information capacity, which means that they are able to provide many various insights, although not all of them. Making new systems theories,

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e.g. by synergies of several systems theories including Dialectical Systems Theory has proved fruitful, because it develops a new information capacity. Several other attempts to make new systems theories may exist as well and be worth learning about.

There is no more one single General Systems Theory, but many of them [11]. As we can see from this Encyclopedia, their authors consider their selected parts of life from their selected viewpoint/s and try to be requisitely holistic inside their own choice of the topic and the level of holism. There are also many professions, in which their authors and users have forgotten their roots coming from systems theory and cybernetics [53], such as automation and other streams of requisitely holistic engineering, informatics (as engineering, librarianship, accountancy, controlling, marketing, etc.), management, etc. Basically, most scientific disciplines, reaching beyond the scope of the traditional description of a part of nature from a selected viewpoint, have their roots in systems thinking and cybernetics, implicitly, at least (not unavoidably in systems theory, though; systems thinking is a much older practice of holism than systems theory!). Each of them covers another part of information needs for humans to understand and master their lives and circumstances; it has therefore its own information capacity.

This paper is supposed to open the arena for new proceedings of the summarized type. We wish to contribute especially to the issue of information capacity concerning innovation management. It reports about work in process.

2. A few Cases of New Systems Theories from Maribor

A few cases of new systems theories, which have been worked on at the University of Maribor, Faculty of Economics and Business, include the following.

- The Dialectical Network Thinking resulted from a new synergy of the Network Thinking and the Dialectical Systems Theory (DST) and Project Management to provide a tool for a requisitely systemic thinking about and in the management of complex business entities such as railways (See: [43, 44] etc.).
- The Controlling Systems Theory is resulting from a new synergy of the Living Systems, Viable Systems and Dialectical Systems Theory to provide a tool for requisitely systemic thinking about and in the management of complex public service entities such as public health institutions [22, 23].

- The Business Cybernetics is resulting from a new synergy of the Kajzer's earlier work on economic cybernetics, Potočan's earlier work of decision making and its standardization on systemic and cybernetic principles, and Mulej's Dialectical Systems Theory [40].
- The Quantified Dialectical Systems Theory arises from the need for the appropriate knowledge about the basics of both systems theory and the applied computer supported methods that can help individuals or groups in researching important complex decision-making problems, which we consider necessary (but not sufficient) conditions for innovations. They should be used when intuitive decision-making is not enough for several reasons: e.g. conflicting criteria or disagreement between decision makers what criteria are relevant or more important, and what alternatives and preferences are acceptable [7, 8, 9].
- Etc.

3. Requisite Holism by Systemic Thinking in the Issue of Innovation

One of the issues related to information capacity of decision makers, who use or do not use systems thinking, tackles the contemporary issue of innovation. According to Business Week [37], even the well managed innovation projects of surveyed corporations succeed in less than five percent. To us, this means that they are complex, but also ill-prepared and one-sidedly run. Literature abounds beyond our capacity to cite it here, but success keeps remaining below expectation. Requisite holism does not seem attained sufficiently; see Figure 1. Lack of realism results in the very high failure percentage.

Fictitious holism/realism (inside a single viewpoint)	Requisite holism/realism (a dialectical system[2] of essential viewpoints)	Total = real holism/realism (a system of all viewpoints)

Figure 1 - The selected level of holism and realism of consideration of the selected topic between the fictitious, requisite, and total holism and realism

[2] A dialectical system comprises in a network all crucial viewpoints in order to help the observer attain a requisite holism, once a total, i.e. real holism with all viewpoints, synergies and attributes reaches beyond the human capacity (See: [29] etc.).

There are many more authors and contributions about different aspects of the innovation processes and their outcomes today than ever before, although there have been only nine European conferences about innovation and creativity so far [3]. Senge et al. [45] offer an interesting new approach to change and learning. Leydesdorff [19] offers an interesting new concept of modeling, measuring and simulating the knowledge-based economy. Schwartz [46] is trying to help people be more entrepreneurial (and has already sold over four million copies, which is a sign of its own how far many people are from the capacity to master their destiny in the innovative society). Lester and Piore [18] are warning – under the label of the need for capacity of interpretation – that the contemporary American education lacks education in capacity of creative interdisciplinary cooperation (which Mulej has called for in his 1979 bestseller book thinking [29]), which is a precondition for success in the innovative efforts. Nussbaum [37] raises awareness that 'despite spending huge sums on R&D, most corporations have dismally low levels of innovation productivity up to 96% of all new projects fail'; he also offers a toolbox. McGregor [21] points to attributes of the most innovative companies of today. The Economist [47] surveys attributes of the innovative organization. It publishes also its Technology Quarterly (e.g. [48, 49, 50]). Huston and Sakkab [14] are given room in Harvard Business Review to inform about their new model for innovation. Business Week [4] decided to focus on innovation for its 75th anniversary issue under the label 'The Innovation Economy' in its special report. In June 2006 Business Week published its inaugural issue of IN: Inside Innovation with its editor's words: 'We dedicate ourselves to the proposition that making innovation work is the single most important business challenge of our era. Our goal is to make a meaningful difference in the difficult journey toward building innovative business cultures.' [38]. The International Society for Knowledge and Systems Science links knowledge with holistic thinking [12]. Mulej's Dialectical Systems Theory links creativity with holistic thinking (See: [29] etc.). Conferences PODIM of which the 27th has taken place in March 2007, link entrepreneurship, innovation and management (e.g. [42]). Conferences STIQE, which have taken place eight times so far on a biannual basis since 1992, link systems thinking, innovation, quality, entrepreneurship, and environment [41]. Etc.

We could no way include all references on innovation in economic, sociological, psychological and similar literature; it is no longer a technological topic only. But IBM [15] reports on a world-wide survey finding that innovation of business is even more crucial than the technological innovation. Here, we are going to put another question: is it enough to deal with the innovation process, innovative business, and innovative society, once we want to attain the requisite holism in consideration of the contemporary life and trends; our response is clear: no, it is not, because it does not provide all requisite information. Here are two our cases aiming at requisite information.

In his contribution to the conference [31] about knowledge and innovation management Mulej used his Dialectical Systems Theory; a requisitely broad dialectical system of viewpoints results in showing requisite holism and several conclusions. He starts from OECD's definition of knowledge-based society and tries to make a synergy of (1) the process from making of knowledge, invention etc. all way to a well diffused innovation, growing into a beneficial daily practice; (2) invention/innovation typology; (3) dialectical system of preconditions for knowledge to give birth to innovation; (4) requisite holism as a way to diminishing the high risk level of the invention-innovation process (IIP); (5) application of the combined application of Mulej's USOMID and De Bono's 6 Thinking Hats methods as a tool for requisite holism in practice, to which (6) Christakis' and Bausch's co-laboratories can be added; results are put in (7) diffusion of innovation; (8) heart storming is added anew to facilitate it in order for (9) innovative business and (10) innovative society to surface and/or evolve. What should managers, researchers, and government do in order to make such approach to IIP meet its potential users' absorption capacity, is his suggestion at the end.

Mulej et al. [35] concluded their contribution about measuring the invention-innovation processes and their outcomes with requisite holism by assaying: ‘Innovation as an outcome can be attained in market only as the final phase of the invention-innovation process. IBM [15] and McGregor [21] published results of surveys saying that more managers, although too few for an innovative society, show awareness that innovation is necessary, than admit personal involvement in the invention-innovation process. Therefore it is not good enough to measure end results of this process only and leave aside the impacting factors. Here, we collected some reminders and other potential supports to invention-innovation management. Measuring can help owners, governor, managers, and government nurture champions of innovation and entrepreneurship.’

Reaction showed that both contributions were cases of requisite holism. Though, the quantitative-methods based support to the issue at stake was not included, which we will do now, briefly, of course.

4. Support to Requisitely Holistic Generating and Developing Innovations

Creation of inventions and making innovations from them requires consideration of a network of all essential and only essential viewpoints or factors; it is called a dialectical system (See: [24, 25, 26, 27, 28, 29, 32] etc.). It enables requisite holism in both individual and group thinking in order to define problems and produce creative and useful ideas by methods of creative thinking and networking in interdisciplinary co-operation (See: [33, 43, 52] etc.). We have already collected, generalized and edited main purposes of their applications, together with software products supportive of creativity [7]. Still, decision makers in enterprises have to select viewpoints to be considered and networked, including relations in networks to be considered, and to develop, choose, and verify possible solutions in order to develop inventions into innovations, leading to improvements in e.g. quality and quantity of output, its cost, quality, range offered, uniqueness, and environment friendliness, including their synergies (in a best-case scenario). They can do so by several methods, among which we emphasize the decision-making ones supported with appropriate computer programs [7, 8, 9]. It has already been demonstrated that the modern Operations Research (OR) methods can help managers much more than the traditional ones [16, 20, 39]. They can well support their requisite holism, i.e. diminish their danger of making oversights, as well as their danger of being overwhelmed by data hence losing their focus and requisite holism. Since traditional OR methods cannot satisfactorily support many complex decision-making processes, including developing creative ideas into innovations, entrepreneurs' effort to master interdisciplinary co-operation as a means of systems / systemic / holistic thinking (See: [34]) can be supported with contemporary multi-criteria decision-making (MCDM) methods.

When applying MCDM methods to several decision-making problems, we concluded that they should be approached step-by-step. We followed the phases of decision-making processes that are commonly acknowledged in literature (See: [2], p. 6): from identification of a problem, through problem structuring – model building, its use to inform and challenge thinking, to the creation and analysis of activities plan to solve a problem (e.g. to implement a specific choice, to suggest a recommendation, and to monitor performance), but we adapted and completed them up for the problem's type (See: [5, 6] etc.). Now, we extend Belton and Stewart's [2] general multiple criteria decision analysis process to the process of generating ideas and developing them to innovations as we present in Figure 2 [9].

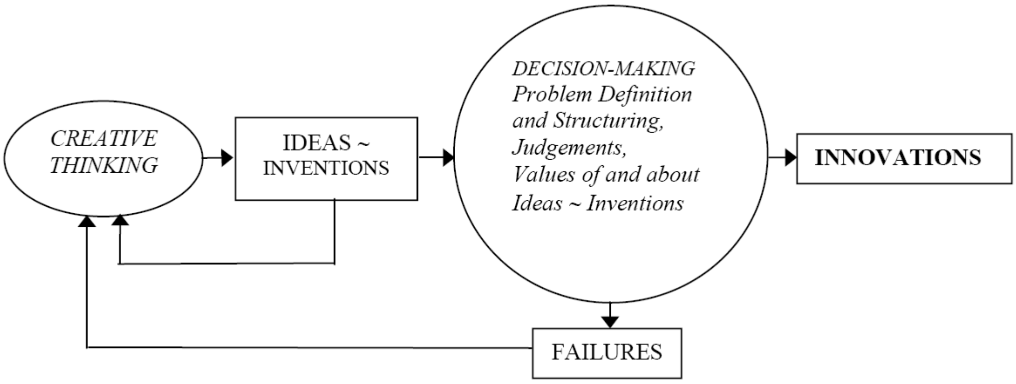

Figure 2 – The Process of Generating and Developing Innovations

MCDM 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). Therefore, DST's guidelines defining the subjective starting points (values and emotions, knowledge on contents, and knowledge on methods, as a dialectical system) can be followed when approaching problems step-by-step [3]. They are delineated in Table 1.

Since we adapted and completed these steps up for the problem's type, we have already used the guideline approach: to reach the purpose in a new way. In synthesis and sensitivity analysis another step in MCDM approaches – the DST's guideline concerning implementation of starting points - analysis is based on one synthesis and leads to another synthesis plays the major role.

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[3] On the basis of our implementing this process in real-life applications at the micro and at the macro level we concluded that it should include the following steps: problem definition, problem structuring, expressing the judgements on criteria's importance and preferences to alternatives, synthesis and sensitivity analysis.

Table 1 - DST's guidelines defining the subjective starting points in approaching problems step-by-step

Step in MCDM	DST's guidelines defining the subjective starting points
Problem definition	Purpose: in the process of generating and developing innovations, to create something new against entropy. Approach: Dialectical Systems Thinking aimed at requisite holism. A requisitely clear definition of the problem considered, objectives and alternatives. Evolution and intuition.
Problem structuring	The criteria, sub-criteria and alternatives are structured in a hierarchy / network of all important, and only important, viewpoints, as a dialectical system. Framework-type model of processes to deal with the problem.
Expressing the judgements on criteria's importance and preferences to alternatives	Capability of creative co-operation when defining the importance of the considered criteria, including the interdisciplinary one. Dialogue and organized co-operation making the requisite holism possible: ensuring the possibility of an (interdisciplinary) co-operation. Continuous up-dating: ensuring a permanent modernization of the (subjective) starting points when confronting the judgements of other participants. Interdependence of knowledge on contents and the one on methods, and emotions.

However, when using results in answer and sensitivity reports, decision makers (e.g. in enterprises) must know the basics of the applied methods [4]. Furthermore, knowledge of OR supports problem solving capacity, if decision-makers learn how to apply this knowledge in practice [5]. Especially in small and medium sized enterprises the sphere of action of one employee may combine a broader spectrum of working tasks than in large enterprises. There, each expert's knowledge base and ability to learn is of high importance when evaluating and verifying how useful are the creative ideas selected.

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[4] According to the opinion of European employers (See: [10]), the most important competencies for an employee's contribution to his or her firm's success are: capacity to learn, capacity for applying knowledge in practice, capacity for analysis and synthesis, capacity to adapt to new situations, and interpersonal skills. They are followed by capacity for generating new ideas, communication skills, and decision-making. According to the opinion of European academics, however, capacity for generating new ideas is ranked on the fourth place among seventeen considered competencies. – Dialectical systems thinking, enriched with OR method can support all of them in network, our experience says.

[5] The analysis of students' answers in the research carried out at the University's of Maribor Faculty of Economics and Business in 2003 and 2004 (See: [1]) shows that they had not sufficiently developed the capability to apply knowledge in practice. However, quantitative courses have gained very high marks from students.

Consideration of some of the other DST's guidelines concerning implementation of starting points is methodologically and computer supported, e.g. dynamism [6], and probability and risk.

5. Discussion: The Roles of Creative Thinking and Decision-Making Tools for Building Knowledge Societies

To survive in the knowledge society, attributes of the modern innovative society must be strengthened (e.g. creativity, knowledge, entrepreneurship, total/excellent quality, learning, cooperation capacity, especially the interdisciplinary one) to face serious dangers (e.g. competition with no mercy) by responsible decision-making considering (in network) all requisite dimensions of the so-called sustainable performance: economic, environmental, social, and ethical ones.

In innovative society (with information society, society of excellent quality, learning society, knowledge-based society, entrepreneurial society, … as its partial characteristics), successfulness depends on competitiveness, which depends in turn on requisitely holistic and 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 novelties, which are accepted by their users as beneficial, i.e. in innovating. And so is co-operation capacity and related methodological support for a dialectically systemic thinking by creative cooperation of different professionals.

In attempts to increase the extent to which e.g. company strategies and operating practices are committed to 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 the economic role of creativity and relationship among central invention-innovations activities, the knowledge about traditional and modern methods supportive of activating and strengthening creativity, as well as the capacity to understand and use the selected quantitative methods that support creativity and decision-making, including adequate computer programs, is often necessary. Multi-criteria decision-making methods that have already turned out to be very applicable in business practice can be used to complement intuition, and to verify ideas, and support their

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[6] System Dynamics help model and simulate system behavior over time [51]. There are several software packages designed to support quantitative system thinking modeling (See: [7]).

development into innovations. They support requisite holism without talking the systems theory language. This makes them more acceptable. Methods for the approximate specification of preferences [8] are coming into force in enterprises both because of their theoretical developments and because of failures in common-practice statistical methods. Hence, the point is in reaching the requisite holism with only requisite effort by applied systems thinking and innovation.

6. Some Conclusions

The Controlling Systems provides information to managers of public sector organizations, how to make their management style more requisitely holistic and hence successful. The Dialectical Network Thinking provides a similar information to organizations with a lot of networking, such as railways, which were the case under investigations. Business Cybernetics provides a similar information to managers of any organization as a business system. The Quantified Dialectical Systems Theory attempts to fortify the requisitely holistic thinking with quantitative methods supportive of decision making on a requisitely holistic basis, which is not a qualitative one only. This means that all three new systems theories under investigation have their specific information capacities with quite a big practical applicability and theoretical background.

7. References

[1] BASTIČ, M., The role of operations research in the innovative firm, in: Scitovski, R., Jukić, D. (eds.), Proceedings of the 10th International Conference on Operational Research – KOI 2004, Department of Mathematics, University of Osijek and Croatian Operational Research Society, Osijek 2005.

[2] BELTON, V., STEWART, T. J., Multiple Criteria Decision Analysis: An Integrated Approach, Kluwer Academic Publishers, Boston, Dordrecht, London 2002.

[3] BUIJS, J., v. d. MEER, H., Fisscher, O., Editorial, Creativity and Innovation Management, Vol. 16, No. 1, March (pp. 1-2) (2007).

[4] Business Week, The Innovative Economy. Special report. The technologies and new ideas that are changing the world, Business Week 75th Anniversary Issue, European Edition / October 11 (2004).

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[8] Decision makers can express approximate preference statements through interval judgements. Easy-to-use software has been developed to support the interval techniques (See: [36]). Preference programming describes approaches that can be helpful in group-decision making, too.

[5] ČANČER, V., The Multicriteria Method for Environmentally Oriented Business Decision-Making, Yugoslav Journal of Operations Research, Vol. 14, No. 1 (pp. 65-82) (2004).

[6] ČANČER, V., KNEZ-RIEDL, J., Why and How to Evaluate the Creditworthiness of SMEs' Business Partners, International Small Business Journal, Vol. 23, No. 2 (pp. 141-158) (2005).

[7] ČANČER, V., MULEJ, M., Creative Thinking and Decision-Making Analysis – Requisite Factors of Innovation Capacity, in: Hoyer, Ch., Chroust, G. (eds.), Proceedings of the 13th Interdisciplinary Information Management Talks IDIMT-2005, Schriftenreihe Informatik 16, Trauner Verlag Universität, Johannes-Kepler-Universität, Linz 2005.

[8] ČANČER, V., MULEJ, M., Innovations by ICT: Provision of Requisitely Holistic Information for Business to be Innovative, in: Hoyer, Ch., Chroust, G. (eds.), Proceedings of the 14th Interdisciplinary Information Management Talks IDIMT-2006, Schriftenreihe Informatik 19, Trauner Verlag Universität, Johannes-Kepler-Universität, Linz 2006.

[9] ČANČER, V., MULEJ, M., Systemic Decision Analysis Approaches - Requisite Tools for Developing Creative Ideas into Innovations, Kybernetes, Vol. 35, No. 7/8 (pp. 1059-1070) (2006).

[10] EU European Commission, University of Deusto, University of Groningen, Final Report of Tuning Educational Structures in Europe (2001-2002), Part One and Two, 2002, available: http://odur.let.rug.nl/TuningProject/doc_tuning_phase1.asp, consulted in September, 2005.

[11] FRANÇOIS, Ch. (ed.), International Encyclopedia of Systems and Cybernetics, 2nd Ed., Saur, Munich 2004.

[12] GU, J., NAKAMORI, Y.,WANG, Z. T., TANG, X. J. (eds.), Knowledge and Systems Sciences: toward Knowledge Synthesis and Creation, Proceedings of KSS2006, LNDS 8, Global Link, Hong Kong 2006.

[13] HENRY, D., Profit Margins. Creativity Pays. Here's How Much, Business Week, April 24 (p. 76) (2006).

[14] HUSTON, L., SAKKAB, N., Connect and Develop - Inside Procter & Gamble's New Model for Innovation, Harvard Business Review, March (pp. 1-9) (2006).

[15] IBM, The Global Innovation Outlook, IBM, Armonk, NY 2006.

[16] JACKSON, M., Systems Thinking. Creative Holism for Managers, Wiley, Chichester 2003.

[17] KUHELJ KRAJNOVIĆ, E., PIBERNIK, P., Razvoj inovativne organizacijske kulture z uporabo medijev internega komuniciranja (The development of the innovative organization culture with the use of the internal communication media, in Slovenian), pp. 352-361, Cimos, Koper 2006.

[18] LESTER, R. K., PIORE, M. J., Innovation – The missing Dimension, Harvard University Press, Cambridge, Ma etc. 2004.

[19] LEYDESDORFF, L., The Knowledge-based Economy: Modeled, Measured, Simulated, Universal Publishers, Boca Raton, Fla. 2006.

[20] McDONALD, G. C., Shaping Statistics for Success in the 21st Century: The Needs of Industry, available: www.misd.net/Mathematics/projects/shapingstats.htm, consulted June 2005.

[21] McGREGOR, J., The World's Most Innovative Companies, Business Week, April 24 (pp. 63-76) (2006).

[22] MLAKAR, T., Kontrolna teorija sistemov – nov model za sistemsko razmišljanje (s preveritveno aplikacijo na sistemu zdravstvenega varstva) (The Controll Systems Theory – a New Model for Systems Thinking (with the Application in the Health Care System), in Slovenian), Faculty of Economics and Business, Maribor (in process).

[23] MLAKAR, T., MULEJ, M., Complementarity of the Living Systems and the Dialectical Systems Theories - The case of Public Medical care in Slovenia, Cybernetics and Systems (forthcoming).

[24] MULEJ, M., Dialektična teorija sistemov in ljudski reki (Dialectical Systems Theory and Folk Sayings, in Slovenian), Naše gospodarstvo, Vol. 21, No. 3-4 (pp. 207-212) (1974).

[25] MULEJ, M., Dialektično sistemski pogled na gradivo za projekt Razvoj denarnega in kreditnega sistema Jugoslavije (The dialectical-systems view on the material for the project The development of the Yugoslavian monetary and credit system), in: Posvetovanje o razvoju denarno-kreditnega in bančnega sistema, Zveza ekonomistov Slovenije & Narodna banka Slovenije (multiplied) (1974).

[26] MULEJ, M., Osnove dialektične teorije sistemov (Basis of the Dialectical Systems Theory, in Slovenian), Lecture notes (Soon a few articles in Slovene journal followed) (1975).

[27] MULEJ, M., Towards the Dialectical Systems Theory, in: Trappl, R., Hanika, P., Pichler, F. (eds.), Progress in Cybernetics and Systems Research, Vol. 5, Austrian Society for Cybernetic Studies, Vienna 1976 (published 1978).

[28] MULEJ, M., A note on dialectical systems thinking, International Cybernetics Newsletter (p. 63) (1977).

[29] MULEJ, M., Ustvarjalno delo in dialektična teorija sistemov (Creative Work and Dialectical Systems Theory, in Slovenian), Razvojni center Celje, Celje 1979.

[30] MULEJ, M., Absorpcijska sposobnost tranzicijskih manjših podjetij za prenos invencij, vednosti in znanja iz univerz in inštitutov (Absorption capability of smaller enterprises in transition for the transfer of inventions, knowing and knowledge from universities and institutes, in Slovenian), University of Primorska, Faculty of Management, Koper 2006.

[31] MULEJ, M., Requisitely Holistic Management of the Invention-Innovation Process as a Specific Case of Knowledge Management, in: Gu et al., referenced here, 2006.

[32] MULEJ, M. et al., Inovacijski management. I. del: Inoviranje managementa (Innovation Management. Part I: Innovation of Management), University of Maribor, Faculty of Economics and Business, Maribor 1994 (reprinted also in 2004).

[33] MULEJ, M., KAJZER, S., Ethics of Interdependence and the Law of Requisite Holism, in: Rebernik, M., Mulej, M. (eds.), STIQE '98. Proceedings of the 4th International Conference on Linking Systems Thinking, Innovation, Quality, Entrepreneurship and Environment, Institute for Entrepreneurship and Small Business Management, at Faculty of Economics and Business, University of Maribor, and Slovenian Society for Systems Research, Maribor 1998.

[34] MULEJ, M., POTOČAN, V., ŽENKO, Z., KAJZER, Š., URŠIČ, D., KNEZ-RIEDL, J., How to Restore Bertalanffian Systems Thinking, Kybernetes, Vol. 33, No. 1 (pp. 48-61) (2004).

[35] MULEJ, M, FATUR, P., KNEZ-RIEDL, J., KOKOL, A., POTOCAN, V., ŠKAFAR, B., ŽENKO, Z., Measuring Outcomes of Nurturing Champions of Innovation and Entrepreneurship, in: Rebernik et al, referenced here, 2007.

[36] MUSTAJOKI, J., HÄMÄLÄINEN, R. P., SALO, A., Decision Support by Interval SMART/SWING – Incorporating Imprecision in the SMART and SWING Methods, Decision Sciences, Vol. 36, No. 2 (pp. 317-339) (2005).

[37] NUSSBAUM, B., Special Report. Get Creative! How to Build Innovative Companies. And: A Creative Corporation Toolbox, Business Week, August 8/15 (pp. 51-68) (2005).

[38] NUSSBAUM, B., IN Manifesto: Inside Innovation, Business Week, June 19 (p. 3) (2006).

[39] PERRIN, B., How to – and How Not to – Evaluate Innovation, Evaluation, Vol. 8, No. 1 (pp. 13-29) (2002).

[40] POTOČAN, V., MULEJ, M., KAJZER, S., Business Cybernetics, Kybernetes, Vol. 34, No. 9/10 (pp. 1496-1516) (2005).

[41] REBERNIK, M., MULEJ, M. (co-chairs and eds.), STIQE, Biannual Conference, University of Maribor, Faculty of Economics and Business, Institute for Entrepreneurship and Small Business Management, and Slovenian Society for Systems Research, Maribor 1992-2006.

[42] REBERNIK, M., MULEJ, M., RUS., M., KROŠLIN, T. (eds.), PODIM 24-27, The 24th, 25th, 26th and 27th PODIM conferences, Proceedings, University of Maribor, Faculty of Economics and Business, Institute of Entrepreneurship and Small Business Management, Maribor 2003-2007.

[43] ROSI, B., Prenova omrežnega razmišljanja z aplikacijo na procesih v železniški dejavnosti (Renewal of the Network Thinking, applied to railway processes, in Slovenian), Dr. Diss., University of Maribor, Faculty of Economics and Business, Maribor 2004.

[44] ROSI, B., MULEJ, M., The dialectical network thinking – a new systems theory concerned with management, Kybernetes, Vol. 35, No. 7/8 (pp. 1165-1178) (2006).

[45] SENGE, P., SCHARMER, C. O., JAWORSKI, J., FLOWERS, B. S., Presence - An Exploration of Profound Changes in People, Organizations, and Society, Currency Doubleday, New York etc. 2004/2005.

[46] SCHWARTZ, D. J., The Magic of Thinking Big. Set your goals high … then exceed them, Pocket Books, An imprint of Simon & Schuster, UK Ltd., London etc. 2006.

[47] The Economist, The new organisation - A survey of the company, The Economist, January 21st (pp. 1-20) (2006).

[48] The Economist, Technology Quarterly [with several contributions on technological innovation], The Economist, June 10th (pp. 1-36) (2006).

[49] The Economist, Technology Quarterly [with several contributions on technological innovation], The Economist, September 23rd (pp. 1-36) (2006).

[50] The Economist, Technology Quarterly [with several contributions on technological innovation], The Economist, December 2nd (pp. 1-36) (2006).

[51] TURINA, A., Understanding Complexity in Business Systems, Naše gospodarstvo, Vol. 49, No. 5-6, (pp. 500-514) (2003).

[52] UDOVIČIČ, K., Metode nematerialne motivacije za inoviranje managerjev v tranzicijskem podjetju: Udejanjanje intrinzičnosti v inovativnem poslovodenju človeških sposobnosti (Methods of Immaterial Motivation of Managers for Innovation in a Transitional Company: Realizing of Intrinsic Motivation in Innovative Management of Human Capabilities, in Slovenian), Dr. Diss., University of Maribor, Faculty of Economics and Business, Maribor 2004.

[53] UMPLEBY, S., A History of the Cybernetics Movement in the United States, in: Mulej, M., et al. (eds.), Proceedings of The WOSC 13th International Congress of Cybernetics and Systems (11 Symposia), 6-10 July, 2005, and The 6th International Conference of Sociocybernetics, Theme: Sociocybernetics and Innovation, 5-10 July, 2005, held in Maribor, Slovenia, WOSC – World Organisation of Systems and Cybernetics, and ISA – International Sociological Association, Research Committee on Sociocybernetics, in cooperation with SDSR – Slovenian Systems Research Society and EPF, Institute for Entrepreneurship and Small Business Management (EPF-IP), Maribor 2005.

CONTROL SYSTEMS THEORY

Tatjana Mlakar*, Matjaž Mulej**

The study behind this paper offers a new - Control Systems Theory (CoST), arising out of synergy of Living Systems (LST), Viable Systems (VST) and Dialectical Systems Theories (DTS), as well as some methods of its application. It presents a new basis for a possible innovation of social business organisational systems (SBOS) as organisations of public sectors, e.g. the medical care sector, in particular in a small transitional country, such as Slovenia. The model excludes the possibility of excessive self-organisation, chance synergies and one-sided intuitive measures; such measures are usually a result of an inappropriate preparation of implementation regardless of the model. At the same time it allows and supports professional and in particular inter-disciplinary creativity and inhibits bureaucratic rigidity. This is achieved by introducing USOMID-SREDIM procedures and novelty diffusion. An important fact, arising out of the concept of the new model, the CoST, is that it is adjusted in its possible application to the organisational scheme of medical care system in practice in Slovenia; it does not contradict or necessitate any statutory change of individual sub-systems within the overall health care system. This is in particular important as it enables the proposed model to be implemented in a relatively short period of time and without major statutory and re-organisational interventions into the system. In addition, the CoST model has no elements of work organisation, which would necessitate essential staff reorganisation in the sub-systems within the Slovenian health care system. The model transforms practice informatively and instructively into a self-controlled and self-supervised system. In this way it aims at eliminating errors and mistakes in the work process and the impact of negative emotions of humans over their work results. However, it introduces a number of essential novelties into the health system control, which could gradually become innovations.

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1. THE SELECTED PROBLEM

The organizational culture needs to be innovated, not technology only. This helps interdependence of mutually different and hence complementary specialists to become visible: ethics of interdependence may result and support co-operation. A lot of help can come from transforming the marketing-like department of the public health care institutions from a service of selling to a service of providing information, including the one about the research organizations, and thus serving as the bridge between businesses (the public health care institutions in this case) and research organizations. We do not see the problem in transfer of the health-care related knowledge, but in the managerial and organizational one. A new methodology many help.

2. THE ROLE OF GOVERNMENT IN INNOVATING OF THE PUBLIC SECTOR, E.G. PUBLIC MEDICAL SERVICES

In public sector organizations governments can support in innovation by its influence over the culture e.g. medical public sector:

- According to its role as the general coordinator and manager of the most general issues of a society, the government defines the framework conditions, including the ones related to the transfer and absorption capacity concerning novelties supposed to become innovations;
- Government can act in this role by commanding, subsidizing, enabling, allowing, but also as a rather big buyer in a buyers' market; the latter role may be the best choice in this case;
- Therefore, government can and should define in its procurement rules concerning supply to all government offices, medical, educational and other public organizations, that only the most innovative organizations may be suppliers.

To be able to succeed, government must also be a role model of innovation. Innovations related to the management style and organizational process and methods can take place in its offices, too, like everywhere else (For details see: Mulej, 2006.). To do so, a new methodology can help.

3. SUPPORT TO INNOVATION BY THE NEW CoST

To create a new methodology, we used three existing systems theories, that have never been studied together (Mlakar, in process; Mlakar, Mulej, 2007; Mlakar, Mulej, forthcoming). These are the LST, VST, and DST. We made a synergy of all of them from the viewpoint of a methodology potentially supportive of insight, checking and control in the public health care system (PHCS).

We start from the hypothesis, that the analogy with the first five of the seven hierarchic levels on which Miller (1978) has based his LST (cell, organ, organism, group, and organisation) make the potential environment of LST where PHCS processes take place directly. Miller has no such analogies. Moreover, Miller allows for them when saying, that his theory is not final (Swanson, 2005). In addition (according to LST), each of the selected five, and also all seven[1], hierarchical levels contains nineteen specific subsystems[2] which appear, subject to the content of the system being observed, in different forms. Miller studies each of the 7 systems from the viewpoints of: system structure, basic process being the reason for the system to exist, subsystems, relationship between subsystems, processes within the system, models and simulations. He never links his six viewpoints into a dialectical system as a synergy of all essential viewpoints.

VST focuses on organisations, which are one of the types of living systems, and on their ability to survive and keep their identity in complex conditions. VST therefore does not deal with description of facts from a selected viewpoint representing a living phenomenon and features common to all of them, but it covers rather an aspect of actions necessary for the organisation to survive as a VS. Among these actions it is important for the internal relationships, that the organisationally hierarchically higher subsystems of the entire VS do not exist to issue commands, but to provide information to enable the organisationally lower ones to perform their tasks as independently as possible. Therefore the lower VSs transfer to higher VSs, all the way up to the top management, only the un-mastered, hence remaining, topics dealt with by the whole organisation as a VS, to enable its existence; in this process the VS faces the problem of its requisite variety.

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[1] We do not use 'community', which Miller has added later on. We do not find it essential.

[2] We do not use 'timer', which Miller has added later on. We do not find it essential.

The supreme VS inside an organisation, if functioning in a requisitely democratic manner receives only the remaining variety and the issues associated with it rather than all of it, like a non-democratic, centralised management does. Democratic management is therefore burdened with fewer matters: others can deal with them. Hence, it has a higher degree of ability to achieve the requisite holism in the functioning of the organisation as a whole and to focus on the broader and long-term criteria.

DTS differs from LST and VST by focusing on enabling humans to attain the requisite holism in their perception, thinking, decision making and action, referring to politics, strategy, and their implementation in the daily practice. This is why DTS tries to raise humans' awareness of the permanent danger, which the law of entropy expresses as a permanent danger of everything existing to disappear by changing to something else. This danger requires humans to meet the Mulej/Kajzer law of the requisite holism and to be creative, including invention and innovation. The required humans' capacity is addressed in DTS with two dialectical systems of guidelines for humans' individual starting points: (1) to define goals, (2) to realize goals. Their impact is realized in line with Mulej's law of hierarchy of process and interdependence. With USOMID methodology DTS can be used with no word of theory backing it. (Mulej, 1975, 1979; Mulje et al, 1992; Mulej et al, 2000; Mulej, Ženko, 2004).

The three systems theories can be found complementary. This is what we profited from in development of CoST.

4. HOW WE DEVELOP CoST

If observing the external relations, i.e. the relationships between the organisation as a VS and its environments (business, social, natural), VS exists within the environment reaching outside the known area, knowledge and control of people inside an organisation. The complexity of this environment can be expressed in a wide range of unexpected events. People can only see a limited number of variables among the unlimited number of possible variables of the environment, as well as only a limited number of aspects and thus only a part of all actual attributes of any concrete variable and object. The nature of human activities is such that the complexity of the environment is much greater than the complexity of the VS (Espejo and Uršič, in Mulej et al, 2000, pp. 368-404). Therefore it is reasonable to enforce the ability of the organisation as a business system to control the environment in such a way as to reinforce its effects on the environment and diminish the effects of the environment upon itself (Schwaninger, 2006a, b).

However, the practice in SBOS within PHCS in Slovenia shows, that it is easier to strengthen the ability of the organisation as SBOS, if its internal features are known in detail. Therefore, the VST alone is not sufficient for us and therefore we will link it, within CoST, with LST and DST. In short, this new synergy is illustrated in Fig. 2.

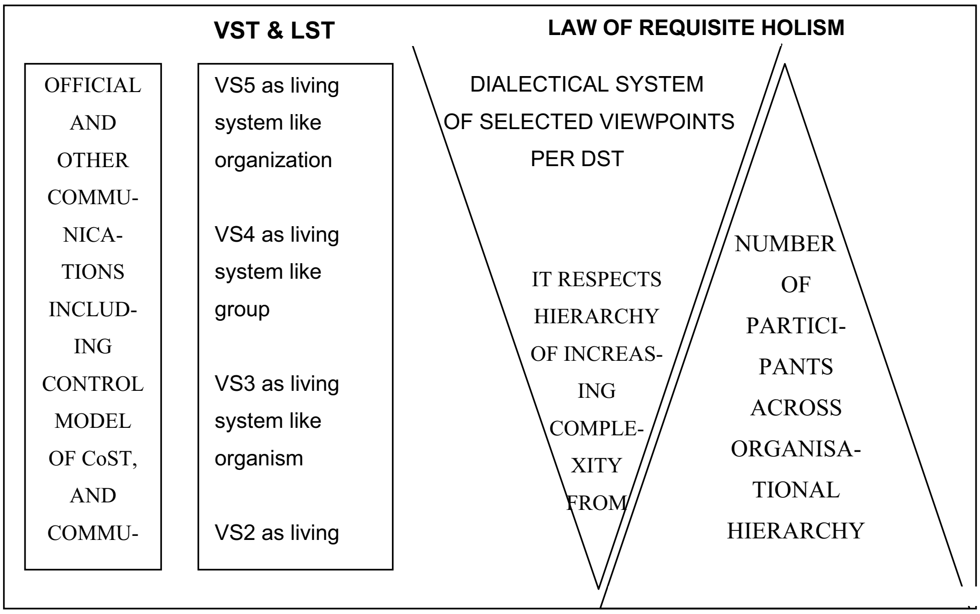

Figure 1: Summary of CoST as a new synergy of some parts of the ideas of DST, VST and LST, with the inclusion of control system.

5. ESSENTIAL ATTRIBUTES OF CoST

After illustrating the synergy in Figure 1, we now proceed to a demonstration of the essential attributes of CoST and practical aspects of its function, with cases from public health care and taking into account, that inside an organization as a VS:

1. VS1 represents the operative execution of tasks, e.g. in the outpatient clinic or another part as a basic unit of a hospital;
2. VS2 represents the functioning of a department, or division, linking the operative staff according to short-term optimisation standards, e.g. in a hospital ward with several outpatient clinics or other parts of a ward etc.;
3. VS3 represents the functioning of the organisation - the task performer linking the departments etc. according to medium-term optimisation standards, e.g. in a hospital with several wards;
4. VS4 represents the functioning of research, libraries etc. within PHCS, collecting information of various research work, for operational and politically strategic decision making; medical research work includes, e.g. concerning drugs, their national and international inspection and approval prior to use, etc.[3];
5. VS5 represents a political view of the functioning of PHCS, representing long-term guidelines and optimises the whole PHCS according to long-term standards, e.g. with decisions by the Minister of Health, Government and Parliament, including taking into account international bodies concerning medical care.

VSs 1-5 work as subsystems within PHCS in activities and cooperation of participants of different specialisations (medicine, economics, law, finance, etc.). Their shared decisions unite expert aspects and lead to the formation of protocols ensuring the general basis of quality of process implementation; they cover only the model level, as regulations or framework-type guidelines.

The number of participants decreases from VS1 towards VS5. In order to ensure creativity with successful (inter-specialist) cooperation, a method is needed, which will support and ease such efforts, and at the same time prevent uncreative arguments. We suggest using a new synergy of two well proven methods: USOMID methodology (‘creative cooperation of many

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[3] We therefore do not agree with Schwaninger (2006a) who says that VS4 represents the strategic level. Such a thesis means a deviation from Beer's original criticism - in our opinion also a fundamental one - and addition to management practice, which does not know or recognise the essential role of research, development and other forms of providing information for work operations (in VS1, 2 and 3) and business policy (in VS5). VS4 is a basis for strategy, but not equal to strategy, because the latter depends on decisions based on selected information and made in VS5 and/or VS3 to provide strategic and operational guidelines to all participants, e.g. of PHCS.

for innovative work') together with De Bono's Six Thinking Hats (M. and N. Mulej, 2006). For the implementation of created inventions in order to transform them into innovations, i.e. inventions, which have been proven as beneficial by their users, and later into a widely used practice, the findings of Rogers's theory of diffusion on innovation (Rogers, 1995 and 2003) and Jensen's heart-storming theory should be used (Jensen, 2003). Findings and conclusions derived in this way can be implemented more easily. With them it is easier to make and implement the necessary innovations in order to improve the existing practices and replace them with new, more useful/beneficial ones.

6. PARTICIPANTS AND ACTIONS SUPPOSED TO BE SUBJECTS OF CoST IN E.G. PHCS

The participants of VS1 have the function of operational performance of tasks within the competences as a PHCS basic subsystem. Specifically, we can talk about a doctor or a nurse in an outpatient clinic carrying out the programme of medical care of insured persons. They ensure medical suitability of the tasks performed and at the same time they look after the economics of their work, etc. There are many outpatient clinics having a number of different specialisations, and there are several other departments and services.

The participants of VS2 have the function of departmental heads and their staff. Their task is to ensure a continual performance of tasks, work organisation, analytical monitoring of the tasks carried out in comparison with plans, the quality of work, reducing the effects of the environment, which could cause unwanted errors, organising procedures for rectifying the effects of unwanted errors, etc. They achieve the synergetic cooperation of department units with regard to current operational work.

The participants of VS3 have the function of managers of operational staff. They ensure the achievement of planned volumes of tasks, monitor the suitability of work process relationships between departments, they ensure the constancy of cooperation in decision making of all specialist fields, they analyse business results, and make decisions regarding measures, etc. The dialectical system of the selected aspects of VS3 uses medium-term criteria, which makes it different from VS2, which uses short-term ones, while VS1 uses the case to case criteria of quality/excellence.

The participants of VS4 have the function of information providers as expert and research bodies at the hospital, country and international levels. They cooperate with subsystems VS1, VS2, VS3 and VS5. They define the scientific and specialist bases and proposals concerning the scope of rights and capabilities, which can be realised through the funds available within PHCS. In this process not only specialists of medicine are taken into account, but also other sciences and practitioners. They use analytical argumentation to form together unified bases and proposals for the scope of medical care, which can be provided in a given period of time using the designated funds. VS4 does not make decisions; it does research and gives proposals. It makes decisions only within its own sphere of work as any other VS.

The participants of VS5 work together with VS4, and they form the PHCS strategy of the country based on VS4's proposals. For this purpose, a dialectical system of criteria and aspects must be taken into account, priorities must be decided, and ethical rules respected, which means: the law of the requisite holism must be observed. The difference in decision making between VS5 on the one hand and VS2 and VS3 on the other hand is that these are long-term rather than medium and short-term decisions.

Every VS enforces insight into the observed topics/situations/processes by using all six aspects of LST (19 subsystems, etc.). However, the participants of the discussion and practice must decide, what they find requisite, and on this basis decide what reasonable targets mean for them. In this phase LST and VST are not as practical as DST. According to DST the mental activities, which must take place during the process of work-task performance originate from a number of bases, called starting points in DST:

1. OBJECTIVE BASIS IN THE FORM OF NEEDS AND POSSIBILITIES that we perceive and select those with the higher priority – the preferential needs and corresponding possibilities;
2. SUBJECTIVE BASES in the form of:
   - Values (e.g. wishes, world view),
   - Knowledge on contents (what we know about the matter),
   - Knowledge on method, or know-how (how to attain the foreseen outcome).

By their synergy we make use of dialectical system to perceive the needs and select the preferential needs, and at the same time to perceive possibilities and among these select those that relate to the selected needs.

On the basis of all these interdependent elements of the starting points we then, using the synergetic synthesis of priority needs and suitable possibilities, define the OBJECTIVES and specify related TASKS and ACTIONS. The process is CARRIED OUT according to the

USOMID principles, combined with the 6 Thinking Hats' ones. Outcomes are used to meet the preferential needs in accordance with the requirements of circumstances. Thus we achieve the requisite holism. While an innovation is being implemented into practice, we use Rogers's diffusion of innovations theory and Jensen's heart-storming, respecting the innovation proposals to ease the innovation of the old practice.

From Figure 1 we form Figure 2 representing a schematic image of a CoST model.

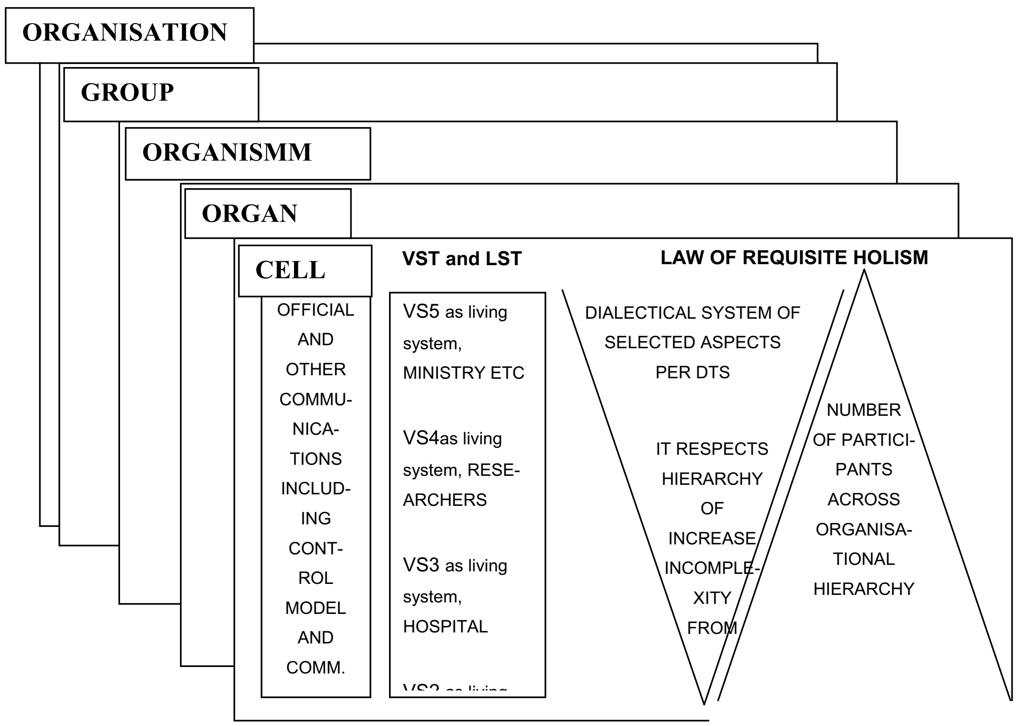

Figure 2: CoST Model applied to PHCS

7. CONCLUSION

Each of seven systems per LST contains all five systems per VST, and each of these performs all functions expressed by subsystems per LST. In order to facilitate this task, participants have attributes of their subjective starting points from DST, and use procedures from DST in the three laws in DTS.

All five VSs per VST are recursive, i.e. they are repetitive with both-way effects of all levels, including all seven systems/levels from LST. Therefore, the control can be distributed, thus divided, providing a requisite autonomy to lower VSs (according to the complexity hierarchy from LST), without causing their isolation and independence instead of co-operation and co-dependence. Neither does their relationship become commanding, but VS5, VS3 and VS2 remain rather informative superiors: occasionally there is commanding, but their order represents a rapid transfer of information in accordance with the law of requisite holism, and it is never intrusive or abusing or misusing (hopefully).

Therefore, for the preparation and implementation of decisions, it is useful or even indispensable, to avoid causing distrust instead of the ethics of interdependence. In the actual decision making, one practises, not only on paper, to use methods of organised and sufficiently uniform creative co-operation as offered by e.g. USOMID + 6 Thinking Hats. However, even such methods will not enable the inclusion of everybody in the decision preparation, as in an ideal democracy. Therefore, it is sensible to consider the decisions made as inventions, making them innovations in the practice of users, and to use the diffusion of innovations theory for their implementation. Diffusion can receive a good support from heart storming.

Details on concrete implementation of CoST in practice of PHCS cannot be addressed here due to back of room.

8. REFERENCES:

[1] De BONO E., Šest klobukov razmišljanja, New Moment 3, Ljubljana, 2005.

[2] BAILEY, K., 2003a. *About James Grieg Miller.* Oral presentation in the session commemorating the late presidents of ISSS, a part of the conference chaired by Bausch and Christakis, referenced here.

[3] BAILEY, K., 2003b. Emergence, Drop-Back, and Reductionism in Living Systems Theory. In: Wilby, Allen, editors, quoted below.

[4] ESPEJO, R., SCHUMANN, W., SCHWANINGER, M., Organizational transformation and learning: cybernetic approach to management, Management systems, Wiley, 1997.

[5] FRANDBERG T., 2005. Living Systems and its Philosophy Considered at the Level of the Earth, *Systems Research and Behavioral Science*, September-October, pp. 373-383.

[6] HAMMOND D., The Science of Synthesis. Exploring the Social Implications of General Systems Theory, University press of Colorado, 2003.

[7] JENSEN R., Viharjenje srca, New moment 3, Ljubljana, 2003.

[8] MILLER, J., Grier. Living Systems. McGraw Hill, New York, NY, ZDA, 1978.

[9] MLAKAR, T., 2000. *Zdravstveno varstvo kot organizacijski sistem v luci teorije zivih sistemov in dialekticne teorije sistemov.* University of Maribor, Faculty of Economics and Business, Maribor.

[10] MLAKAR, T., MULEJ, M., (forthcoming): Zasnova kontrolne teorije sistemov kot novega modela sistemskega razmišljanja. Naše gospodarstvo, 57.

[11] MLAKAR, T., MULEJ, M., Complementarity of the Living Systems and the Dialectical Systems Theories: The case of Public Medical care in Slovenia, 2007, Cybernetics and Systems, 38, 4, 381 – 400.

[12] MLAKAR, T., MULEJ, M., (forthcoming), On concept of the Control Systems Theory as a new model of systemic consideration. Kybernetes

[13] MULEJ M., MULEJ N., De Bonova metodologija »Šest klobukov razmišljanja« in Mulejeva metodologija ustvarjalnega sodelovanja »USOMID« v novi kombinaciji, 2005.

[14] MULEJ, M. 1974a. Dialektična teorija sistemov in ljudski reki. *Naše gospodarstvo*, 21, 3-4, pp. 207-212.

[15] MULEJ, M. 1974b. Dialektično sistemski pogled na gradivo za project Razvoj denarnega in kreditnega sistema Jugoslavije. In: *Posvetovanje o razvoju denarno-kreditnega in bančnega sistema*. Zveza ekonomistov Slovenije & Narodna banka Slovenije (multiplied).

[16] MULEJ, M. 1976. Toward the Dialectical Systems Theory. In: Trappl, R., Hanika, P., Pichler, F., eds.: *Progress in Cybernetics and Systems Research*, Vol. 5. OeSGK, Vienna (Published 1978).

[17] MULEJ, M. 1977. A note on dialectical systems thinking. *International Cybernetics Newsletter*, 63.

[18] MULEJ, M. 1979. *Ustvarjalno delo in dialekticna teorija sistemov.* (Creative Work and the Dialectical Systems Theory. In Slovenian). Celje. Razvojni center Celje.

[19] MULEJ, M. 1981. *Dialektično sistemsko programiranje delovnih procesov.* Maribor. Univerza v Mariboru, Visoka ekonomsko-komercialna šola.

[20] MULEJ, M. 1982. Dialektično sistemsko programiranje delovnih procesov – metodologija USOMID. *Naše gospodarstvo*, 28, 3, 206-209.

[21] MULEJ, M. (2006): *Absorbcijska sposobnost tranzicijskih malih in srednjih podjetij za prenos invencij, vednosti in znanja iz univerz in inštitutov.* Univerza na Primorskem, Koper

[22] MULEJ, M. et al. - partly new coauthors in every edition.(1982, 1983, 1984, 1985, 1986. *Usposabljanje za ustvarjalnost. Metodologija USOMID.* Maribor. Ekonomski center. (NB. 3rd edition was in Serbian, Radnicki univerzitet, Subotica, and Ekonomski center, Maribor); all editions reworked.

[23] MULEJ, M., ESPEJO, R., JACKSON, M., KAJZER, S., MINGERS, J., REBERNIK, M., SUOJANEN, V., URŠIČ, D., de ZEEUW, G. 1992. *Teorije sistemov.* (Systems Theories. In Slovenian). Maribor, University of Maribor, Faculty of Economics and Business.

[24] MULEJ, M., KAJZER, S. 1998. Ethics of Interdependence and the Law of Requisite Holism. In: Rebernik, M., Mulej, M., editors: *STIQE '98. – Linking Systems Thinking, Innovation, Quality, Entrepreneurship and Environment.* Maribor, The Slovenian Systems Research Society and partners, 129-140.

[25] MULEJ, M., ESPEJO, R., JACKSON, M., KAJZER, S., MINGERS, J., MLAKAR, P., MULEJ, N., POTOČAN, V., REBERNIK, M., ROSICKY, A., SCHIEMENZ, B., UMPLEBY, S., URŠIČ, D., VALLEE, R. 2000. *Dialekticna in druge mehkosistemske teorije (podlaga za celovitost in uspeh managementa).* Maribor. University of Maribor, Faculty of Economics and Business.

[26] MULEJ, M., POTOČAN, V., ZENKO, Z., KAJZER, S., IRSIC, D., KNEZ-RIEDL, J., LYNN, M., OVSENIK, J. 2004. How to restore Bertalanffian systems thinking. *Kybernetes*, 33, 1, 48-61.

[27] MULEJ, M., and co-editors. 2005. *Proceedings of the WOSC 13th International Congress of Cybernetics and Systems (11 Symposia).* In Maribor. WOSC and ISA RC51 on Sociocybernetics.

[28] MULEJ, M., KAJZER, Š., POTOČAN, V. 2005. Common sense of the uncommon sense called Systems thinking and systems theory: holism. Gu, J., Chroust, G., eds. (2005): *IFSR 2005: The New Roles of Systems Science for a Knowledge-based Society. The First World Congress of the International Federation for Systems Research*. In Kobe

[29] MULEJ, M., ŽENKO, Z. (2004): *Introduction to Systems Thinking with Application to Invention and Innovation Management.* Maribor, Management Forum.

[30] POTOČAN, V., Holistic information support for virtual business organization. *Journal of business and economics research*, 2005, Vol. 3, 11, 25-36.

[31] REBERNIK, M., MULEJ, M., eds. 1992 – biannually. *STIQE – Linking Systems Thinking, Innovation, Quality, Entrepreneurship and Environment.* Maribor, The Slovenian Systems Research Society, and partners.

[32] ROSI, B., MULEJ, M. 2006. The dialectical network thinking – a new systems theory concerned with management. *Kybernetes*, 35, 7/8, 1165-1178.

[33] SCHWANINGER M. a, Intelligent Organizations, Powerful Models for Systemic Management, Springer Berlin, Heidelberg 2006.

[34] SCHWANINGER M. b: Design for viable organizations: the diagnostic power of the viable system model. *Kybernetes*, 2006, 35, 7/8, 955-966.

[35] SWANSON G. A., The Study of Pathology and Living Systems Theory, *System Research and Behavioral Science*, September – October 2005, 22

SYSTEM THEORY AT THE POST OF SLOVENIA

Andrej Lisec*

The Post of Slovenia Ltd is the biggest bidder of postal services in Slovenia and it also has a leading position in providing parcel services. New technologies and modern organization of postal services can improve the design and logistics of postal systems. This paper presents the reorganization of parcel services between Postal Logistics Centres and Posts by introducing Regional Parcel Centres and Parcel Posts. A concrete solution, which takes into consideration the sorting out and the retaining of parcels in the Posts, Parcel Posts and Regional Parcel Centres within their individual areas, is given for the area covered by the Ljubljana Postal Logistics Centre; this is a case of innovation based on systemic thinking and the usage of the sorting out and the retaining of parcels.

1. INTRODUCTION

Extensive human activities are causing permanent changing of the world. Consequences are seen, among the others, in the continuous confrontation with different – always new *problem situations* and their solving; among the *basic features* of the both are *complexity* (= intricacy under the influence of relationships) and *dynamics*. Researching and managing such phenomenon can be supported by competence in usage of the *theory of systems.*

The quality of management depends on manager's creativity, dynamics, qualifications and on their readiness to cooperate. However, nowadays, in the world of global economy managers do not have sufficient information, which is needed for (more or less) complex problem solving and relevant decision-making, at their disposal. In the 1950s the father of the theory of systems, L. von Bertallanffy, used sensibility of the theory of systems as a basis for developing theoretical approaches (=general directions), methodologies (=knowledge about methods) and methods (=way of treatment), and for supporting practice – systemic thinking – in researching, analyzing (= recognition of the hidden essence), in preparation and decision

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implementation, taking into consideration essence of complicated phenomenon [6]. This resulted in human ability to think, make decisions, and act as holistically as possible, instead of practicing one way /unilateral and simplified thinking [6].

The sense of systemic thinking, as predicted by modern Dialectal Network Thinking (DNT), is therefore the most sufficient holistic and realistic preparation and performance of human activities, when dealing researching, development, decision making, informing or performing [7]. It is important to use DNT in each aspect of the complex problem solving. The very moment we do not consider the influence of the choice of the aspects, we can easily fall into virtual holism[1], that is think, make decisions and act/perform – or carry out, for example, management decisions. Global business conditions force us to try to be holistic in our way of thinking, decision makings and acting, as much as possible and needed.

The Post of Slovenia Ltd hereinafter referred to as The Post of Slovenia performs transport of postal parcels which includes also parcels on three levels. Each level is a finished and separate whole. All levels are connected and represent a unified and uninterrupted postal transport network. The levels of transport in The Post of Slovenia presented in picture are [1]:

- the first level of transport;
- the second level of transport;
- the third level of transport.

The first level of postal parcel transport represents the connection between Postal Logistics Centre and individual Post Offices that belong to this organising area.

For the transport of postal parcels on the first level the following means of transport are used:

- light delivery vehicles;
- medium delivery vehicles (vans);
- freight vehicles (luggage vans of different capacities).

The second level of transport is the transport of postal parcels between the both Postal Logistics Centres – PLC (PLC Ljubljana and PLC Maribor).

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[1] Because of one way thinking/one sided, which may be a consequence of extensive specialisation, we may have overlooked or neglected essence when we made a choice or even aspect of treatment of some manager's decision.

The third level of transport is performed on the international level. This is the transport of international postal consignments, including consignments leaving Slovenia and coming into Slovenia, as well as consignments crossing our country. It is performed with Austria, Italy, and Croatia and via Brnik airport.

The transport of postal parcels is performed between dispatch and arrival of parcels. The transport is carried out with almost all means of transport and it depends on the type of parcels, the length of the transport route, and the possibilities of the transport on individual routes. Own account and other motor vehicles, railway carriages, airplanes and also ships (in the international postal traffic) are used for the transport. The parcels are mostly transported by own account means of transport, freight vehicles - luggage vans. A luggage van is a closed lorry for transport of goods adjusted for transport of postal parcels.

First, postal parcels need to be transported from postal units to PLC and after performed modification and direction they need to be transported to the postal units. Transport of the postal parcels on the relation Post – PLC, as well as PLC – Post is precisely defined by postal timetable.

The existent logistics concept is based on the concentration of all received parcels in both logistics centres in Ljubljana and Maribor, where they are directed and dispatched to the addressed post offices together with letter mail.

Today all parcels received at individual post offices go to Postal Logistics Centre Ljubljana or to Postal Logistics Centre Maribor. Those accepted in business units Maribor, Celje, Murska Sobota go to PLC Maribor, and those accepted in business units Ljubljana, Kranj, Nova Gorica, Koper and Novo mesto go to PLC Ljubljana.

Parcels of bigger dimensions and pallets are delivered directly to Logistics Centres Ljubljana or Maribor - all of them to their own area.

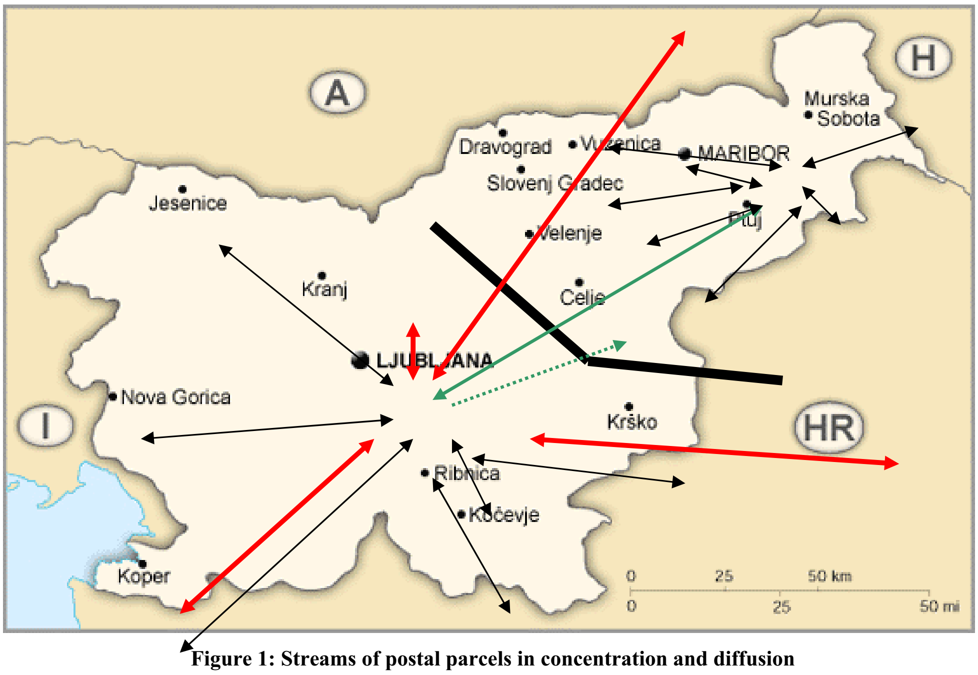

Figure 1: Streams of postal parcels in concentration and diffusion

The handing of the parcels is performed by all delivery posts that are suitably equipped for the delivery of parcels. Due to rising number of parcels from year to year (from 20 to 30 percent yearly growth in the number of parcels), it is necessary to think about different organisation of parcel transport. Therefore we will try to find a solution with the introduction of Regional Parcel Centres and Parcel Posts, which makes the parcel distribution at the Post of Slovenia better.

2. REORGANISATION OF PARCEL SERVICES

For more effective activity of the companies that are engaged in the parcel services the decision about the following is necessary [3]:

1. Location of Postal Logistics Centres (already existing PLC Ljubljana and PLC Maribor);
2. Location of Regional Parcel Centres - RPC;
3. Location of Parcel Posts - PP;
4. Allocation of posts to the service areas of Parcel Posts;

5. Definition of the transport routes that connect the Post Office, Parcel Post, Regional Parcel Centre and Postal Logistics Centre;
6. Definition of the optimal routes between the Posts Offices if the delivery to the Parcel Post is not direct.

The deciding model is based on [2]:

- the number of received parcels;
- the number of handed parcels;
- the distances between the post offices;
- time limitations;
- capacity limitations.

Tasks of Regional Parcel Centre:

7. accepting business parcels on defined area, especially parcels of bigger dimensions (also heavier parcels) and pallet parcels;
8. directing parcels to different areas (own area, Ljubljana, other areas). RPC separate parcels (all post offices keep parcels for own post office, they separate them – such parcel is a parcel for the area of own post office; Parcel Posts, Regional Parcel Centres and Postal Logistic Centres keep and separate parcels for its area, respectively) and if necessary for individual areas according to the number of parcels (Nova Gorica for Koper, Koper for Nova Gorica, Novo mesto for Celje, Maribor for Murska Sobota and vice versa);
9. the RPC needs a freight vehicle with hydraulic lifting platform for receiving and handing the parcels for the transport. Because of better use it would take the parcels also to Postal Logistics Centre and to other Post Offices. The primary activity of the RPC is to take care of uninterrupted flow of the parcels (together with the freight vehicle) on its area from receiving to handing. In the first phase it would be necessary to purchase a vehicle for individual RPC for receiving, handing and transporting parcels to and from PLC and to individual Post Offices;
10. transporting parcels to individual Post Offices and handing parcels to big users, transporting parcels of big dimensions, and transporting parcels to PLC or other

Regional Parcel Centre. At the same time the delivery of parcels after 4 pm would be performed at all Post Offices in Slovenia.

In spite of suggested changes the current concentration of parcels in PLC and diffusion of parcels from PLC is not changing substantially (delivery of parcels to individual Post Offices remains unchanged). We will improve the existing logistics system with re-arrangement of freight vehicles to RPCs for receiving and handing the parcels, with the intention of the Post of Slovenia to be able to master the higher number of parcels at the present and in the future. PLC Ljubljana does not need any new freight vehicles for the suggested concept of packet service. Light and medium delivery vehicles remain at the Post Offices for the receiving and handing out the parcels. The suggested concept demands bigger adjustment, flexibility and adaptability of all the employed who are anyhow connected to the logistics at the Post of Slovenia.

PLC Ljubljana performs the function of Regional Parcel Centre for the area of Ljubljana, besides the function of Postal Logistics Centre, and at the same time the function of the Parcel Post. The same is true for the Postal Logistics Centre Maribor. The biggest change would be in the area of the Regional Parcel Centre Novo mesto, because a direct connection with the Postal Logistics Centre Maribor would be introduced, besides the connection to the Postal Logistics Centre Ljubljana, and thus the number of performed kilometres would be lowered.

The improvement is based on the reduction of transportation costs that represent 10 percent of costs in distribution of parcels (between the start and the end post office). Other costs represent receiving, directing and handing the parcel to the addressee. In the continuation we will prove that the savings because of separating the parcels in the area covered by the Postal Logistics Centre Ljubljana can be very high.

In the Post of Slovenia parcels are transported by freight vehicles – luggage vans, medium delivery vans and light delivery vans. 6 to 24 boxes can be loaded on every luggage van. Approximately 50 parcels can be loaded in one box – transportation unit. Thus approximately 300 to 1,200 parcels can be loaded into a luggage van (Table 1). For our application freight vehicles different capacities from the biggest to the smallest will be used. The freight vehicle with trailer is only used on the relation Ljubljana – Celje – Maribor – Celje – Ljubljana. On other relations the vehicle suitable for transportation of postal parcels is used.

Table 1: Capacity of individual vehicles

Vehicle	Capacity
Light delivery vehicle	75 parcels
Medium delivery vehicle	200 parcels
Freight vehicle – 6 boxes	300 parcels
Freight vehicle – 9 boxes	450 parcels
Freight vehicle – 11 boxes	550 parcels
Freight vehicle – 13 boxes	650 parcels
Freight vehicle with trailer	1.200 parcels

Advantages of introduction of Regional Parcel Posts are:

- PLCs can separate the transport of parcels from transport of letter mail in reasonable cases (sufficient quantity of parcels);
- PLCs perform transport of parcels when they have drivers and free transport capacities at their disposal;
- number of post offices they would visit during the parcel transport would be essentially lowered;
- number of directions from PLC would be considerably lowered. That enables long-term mastering of modification of parcels in both PLCs;
- PLCs would be disburdened with delivery of parcels of bigger dimensions and pallets on its area, which is now performed, because of the size of the area, on or even under the edge of covering the costs;
- Post offices that would still perform handing out the parcels would be, without any bigger difficulties, able to ensure the service of wished time of delivery and punctual acceptance and handing out in the business places of the users;
- most of the today’s extra transports from PLC to individual post offices in the area of RPC would not have to take place (and reduction of these deliveries, respectively);
- number of kilometres covered and number of work hours get lower;
- the user is offered service and offer of higher quality (time from the reception to time of handing), which cannot be performed directly from PLC Ljubljana;

- only in this way the mastering of higher number of parcels and streams of parcels in the future is possible, because today the concentration of parcels in same limited area (PLC Ljubljana) in very short time is too high.

The results of previous researches [4] show that it is necessary to introduce regional parcel centres and parcel posts in order to lower the costs of parcel logistics. Hierarchy for the area of Postal Logistics Centre Ljubljana would be as follows:

- one postal logistics centre;
- five or fewer regional parcel centres, each of them with three to twelve parcel posts according to the number of received and handed parcels. Parcel posts cover three to most twenty post offices in its area.

Regional Parcel Centre in the area of Postal Logistics Centre Ljubljana and areas of regional parcel centres (also has the function of parcel post) and where individual parcel posts belong to were created after following criteria:

- criterion of shortest ways [3];
- the statistics of the number of received parcels for the years 2003 and 2004 at individual post offices;
- the October statistics of delivered parcels at individual post offices for the years 2003 and 2004;
- the analysis of the streams of parcels (received and handed parcels), that we performed in March 2005 (three day observation);
- on the basis of long-year experience of postal workers, including the preparing and changing the postal timetable.

It is necessary to stress that the Postal Logistics Centre Ljubljana today is not able to direct more than 25,000 parcels in one night – in few hours (during the whole day it would be able to direct more). In the past such problems already occurred, in the future they will be present many more times and this is why it is necessary to think about the changing the way of transporting parcels.

It is characteristic for Slovenia and probably for the whole world that the concentration of parcels, among them also parcels that come to Ljubljana and Maribor from the whole of Slovenia, is lower than streams in the opposite direction – from the cities to the periphery.

This is why the limitation we considered for the introduction of Regional Parcel Centre and Parcel Post is lower in the number of received parcels than they are in the number of handed parcels.

The results show that it is reasonable to introduce a new way of parcel distribution in the area of Postal Logistics Centre Ljubljana with the introduction of regional parcel centres and parcel posts, because the logistics costs are lowered by 20 percent every day, what was shown with the concrete calculations for the area covered by the Regional Parcel Centre Novo mesto by the introduction of the direct connection with Postal Logistics Centre Maribor [5].

3. Conclusions

For the finding of optimal project of logistic network in general and also for the Post of Slovenia the concrete solutions of hierarchical projects of the postal network in Switzerland, Austria, Australia and elsewhere in the world were helpful. The solutions that were performed successfully in other areas with different territorial organisation can be succeeded quickly in Slovenia because of the smallness and can be modified according to special demands of Slovenian territorial organisation, only if the management of the post is in favour of it.

We have found out that it is reasonable to improve the existent system of parcel transportation in the way that we separate the parcels for the areas of own post offices, parcel posts and for those business units where this is reasonable. This is proved by the application we performed on the example of the area of covering of Postal Logistics Centre Ljubljana that covers two thirds of Slovenia. The logistics costs are lowered by 20 percent with the new way of parcel transport with introduction of regional parcel centres and parcel posts according to present condition.

For more efficient and successful management of organizational and business systems, there are a lot of (management) theoretical and practical advice, techniques, and methods in the modern world. Without knowledge of systemic thinking and its usage, managers would not be able to integrate theories and practice into so called continuous interdependent dynamic process.

4. REFERENCES

[1] LISEC, A.: Večstopenjska prostorska optimizacija pošte. Master thesis, Portorož: Univerza v Ljubljani, Fakulteta za pomorstvo in promet, 2004.

[2] LISEC, A.: Optimizacija logistike paketov v hierarhični zasnovi poštne mreže, Ljubljana: Univerza v Ljubljani, Ekonomska Fakulteta, Doctoral dissertation, 2006.

[3] LISEC, A., BOGATAJ, M.: Travelling salesman problem at the Post of Slovenia. V: Zadnik Stirn Lidija (ur.), Drobne Samo (ur.). SOR'05 proceedings. Ljubljana: Slovenian Society Informatika (SDI), Section for Operational Research (SOR), 2005, pp. 227 - 233.

[4] LISEC, A., FERBAR, L.: Optimizacija distribucije paketov na Pošti Slovenije = Parcel distribution optimization in Post of Slovenia. V: Novaković, Aleksander (ur.), Schlamberger, Niko (ur.), Indihar Štemberger, Mojca (ur.), Poženel, Jasna (ur.), Bajec, Marko (ur.). DSI - Dnevi slovenske informatike 2005, Portorož, Slovenija, 13.-15. april. Informatika kot temelj povezovanja: zbornik posvetovanja. Ljubljana: Slovensko društvo Informatika, 2005, pp. 442 - 447.

[5] LISEC, A., FERBAR, L., BOGATAJ, M.: Regionalni vidiki optimizacije prenosa paketov na Pošti Slovenije: primer aplikacije na poslovno enoto Novo mesto. Econ. bus. rev, 2005, vol. 7, pos. št., pp. 35 – 55.

[6] MULEJ, M.: Dialektična in druge mehkosistemske teorije – podlaga za celovitost in uspeh managementa. Maribor: Univerza v Mariboru, Ekonomsko-poslovna fakulteta, 2000, pp. 22, 31-34, 84-92.

[7] ROSI, B.: Prenova omrežnega razmišljanja z aplikacijo na procesih v železniški dejavnosti. Doctoral dissertation, Maribor: Univerza v Mariboru, Ekonomsko-poslovna fakulteta, 2004.

INNOVATION POTENTIAL OF THE DIALECTICAL NETWORK THINKING

A SYSTEMS THEORY DESIGNED FOR MASTERING OF GROWINGLY COMPLEX PROBLEMATIQUES

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The Dialectical Network Thinking is a new methodology of innovation by co-operation of interdependent professionals and units. In its application the emotional part of the human personality plays a crucial role, but it used to be addressed too little. Here we are making a first step toward inclusion of the emotional intelligence in the process of thinking, decision making, and operational work on problem solving.

The selected problem and viewpoint

In our earlier contribution to IDIMT we presented basics of Rosi's methodology of systemic thinking called 'The Dialectical Network Thinking" (DNT). This time, we aim at showing how can the DNT be useful in solving the modern problems of affluence.

1. Summary of the essence of the Dialectical Network Thinking Methodology

We humans are daily exposed to problematic situations. Our perception of them depends on us. Sometimes we find them more problematic, sometimes less so, which depends on our subjective starting points as our basis to perceive and later on to master objective facts. In a perceived (potential) problem situation we try to discover how important is its impact on us and our situation, to detect potential gaps between it and our expectation/wishes, and to check

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whether or not there are ways to resolve it. If there are none of them, we are obviously facing a problem, which means that the given situation is unclear, unknown, and having no clear solution, and therefore needing clarification or solution. But, problems tend to not show up alone, hence we may expect that they may impact each other, network with each other, be interdependent, interplaying, ..., which makes the properties of the problems emerging in this way, as well as the problematiques emerging from systems/networks of these and related problems, complex in their properties. This complexity requires systemic/requisitely holistic solving. This requires a frame-work methodology of co-operative problem solving.

DNT is a new methodology able to help us in process of the complex problem solving, where we shall be capable of thinking and decision-making and also using a great potential of intelligence and emotional quality. (Rosi, 2004; Rosi, Mulej, IDIMT, 2005; Rosi, Mulej, 2006, 2006a)

Why and how does this matter in the surfacing circumstances? First: Innovative business leads more and more people in the more advanced societies, at least, toward affluence. This is the phase that humans want in order not to face problems of being poor. But after having attained this – do they still have the same motivation? Second: The growing narrow specialization requires more of networking than ever before, but very few schools teach its methodologies. Third: Both points require more holism – the requisite holism, in a best case scenario – for humans to include emotional subsystems of their personalities when entering networks.

2. After innovation and affluence – holistic creativity and social responsibility

In several contributions we discussed the problem that we are going to summarize only here (Mulej et al, 2006, 2007a, b; Mulej, 2007a, b; Mulej, Potočan, 2007; Mulej, Prosenak, 2007; Prosenak and Mulej, 2007a, b; Potočan, Mulej, 2006a, b, 2007; Vrečko, Mulej, 2007). Globalization changes rules what kind of business is acceptable for customers. Measures of excellence that used to be good enough in recent decades are no longer so. Enterprises can no longer reckon with a market with supply exceeding demand or a market that allows survival to suppliers that are better than their competitor in cost and price, in commercial and technological quality, in range offered, in uniqueness of their meeting some rather narrow systems of measures of quality; all these criteria must be met as well as the ones of environmental care. We talk about the ‘sustainable enterprises’. They burden nature less than others do, because they use more innovating and innovation that is based on meeting the law of requisite holism of observation, thinking, decision making, and action. This means that they consider the entire system of preconditions summarized in the equation of innovation.

At the same time they are not those enterprises, in which only five percent of innovation projects succeed. Sustainable enterprises succeed, because they differ from the others in the world top group by working not only on technological inventions and converting them in innovations by development, daily business of all phases and marketing, but also on innovation of values, culture, ethics and norms inside and outside their walls, therefore on innovation of their managerial style and business. They apply the ‘open innovation’ rather the older model called ‘closed innovation’. In terms of this contribution they apply more of networking, the global economy included, which makes us think that they use something like DNT in their practice. This makes their behavior more holistic, as well.

Thus, they are becoming and remaining socially responsible. All of this matters for humankind not to stop its contemporary evolution in the phase 4 foreseen by Porter. He models evolution of bases of competitiveness from the phase 1, based on natural resources, via phase 2, based on investment, and phase 3, based on innovation as the background of success, to the phase 4 – affluence. In the latter the economic laws on covering needs with scarce resources no longer fit. This kills the ambition to create in order to have. New measures of economic success are needed that some psychologists and sociologists are offering under the common denominator of ‘happiness’. The latter can result from the ambition to create and be beneficial beyond the ambition to have. Thus, maybe, a new concept of international excellence is showing up, in which innovativeness is no longer a technological or profit-oriented one only, but an attribute using and developing human creativity, co-operation capacity, and professionalism as a source of happiness reaching beyond the material content into the spiritual one, because it helps life make sense.

The DNT methodology can support humans’ transition to the ‘phase 5’ reaching beyond the current crisis of the most advanced societies. DNT supports awareness of interdependence of humans and organizations (from family to United Nations) entering networks in which they co-operate because they need each other by:

- Adding emotional intelligence to the rational one;
- Creating and maintaining the ethics of interdependence;

- Creating and maintaining organizational possibilities of a requisitely holistic creative co-operation instead of self-sufficient work from the old times with much less narrow specialization than currently;
- Creating and maintaining organizational possibilities of socially responsible behavior of humans and organizations of all kinds, not corporations only;
- Creating and maintaining organizational possibilities of practicing the 'open innovation' model.

3. Use of the emotional intelligence in problem solving processes by DNT

3.1. Basics about the emotional intelligence

Daily experience in facing various problematic and other situations points to how 'sensitively ' and differently humans may perceive them. Hence, their reaction often depends less on knowledge than on feelings, emotions, expectations, experiences, interests, circumstances etc. One faces 'inner feelings' and needs their inclusion in problem solving process to reach the requisite holism and hence to succeed.

Humans' emotional capabilities are very influential in humans' decisions how does one treat one-self and others, thereby impacting crucially humans' successes in both private and professional lives (Weisbach, Dachs, 1999). The emotional intelligence [1] is a rather new concept in humans' language, and quite unclear to many. Along with the IQ (intellectual quotient), the focus includes more and more the EQ (emotional quality). Why so?

Research has shown that the emotional intelligence (EI) adds some 80 % (!) to one's success, and IQ only the other 20 %. Success includes along with the one at work also the one in relationships, family, and daily contacts with other humans in more or less problematic situations and processes. Success means one's capacity to attain equilibrium between the emotional and rational and the physical aspects of oneself in order to requisitely holistically master the complex contemporary living.

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[1] The notion EI has been known since early 1990. It authors are US psychologists Peter Salovey (Yale University) and John Mayer (University of New Hampshire). They used it to express human attributes such as empathy, self-confidence, and control over emotions (Weisbach, Dachs, 1999).

Both the intellectual intelligence one can develop and strengthen one's EI (Weisbach, Dachs, 1999). This means that one learns to control one's emotions, i.e. to perceive, consider, and express them as well as to orient them in order to direct our emotional life aspects. One can equally influence emotions of others, e.g. the ones in our teams and networks. This can help our development and maintenance of ethics of interdependence and lead to our own and general social responsibility, thus to increasing success in solving many kinds of problems.

3.2. People with EI are more successful

Beyond a quarter of a century ago doubts showed up, whether the official measures of IQ are reliable. One namely found that a high IQ says nothing about success and does not assure it. US psychology professor Howard Gardner added to the definition of intelligence two viewpoints: capabilities in 'inter-personal relations' and 'intra-psychic.

The notion EI describes various human attributes such as character, respectfulness, sensitivity, humanism – Goethe called it 'heart culture. It is today mention in connection with success in one's professional and private life.

Success is mostly connected with chances to be influential, respected and reach. But, as we have summarized above, one should add happiness in relationships, family lives, pleasure with one's job, respectful relations with other humans, etc. They make us happy in feel more successful, which is very individual. It depends on humans, which goals should be attained for them to feel happy. What are our deeper goals, reaching beyond money, power, and recognition in our area of activity? Are we aware of circumstances in which we feel success and the way in which we contributed to it ourselves? Many are successful, who are no geniuses, but very good in networking, worm personalities, charismatic, etc.

3.3. Some aspects of EI

Intelligence, which used to be the only notion until a short while ago, includes capacities than can be measured such as the intelligence in mathematics and logics, mastering of a language, spatial presentation capacity, musical talent, body moves control capacity etc. The traditional concept of intelligence does not cover (neither value) other human capacities such as empathy, self-reliance, and emotional control – that often are crucial and specific virtues of networking and problem solving persons. Aristotle, in ancient Greek times, already expressed the need for emotional control by intelligence (Weisbach, Dachs, 1999).

The US psychologists Daniel Goleman (Weisbach, Dachs, 1999) defined EI as the capacity to understand one-self. It is expressed by empathy, consideration and attention capacities etc. This means that one knows one's interests, but is also capable of leaving them aside if necessary. This is shown by politeness, interest in others, self-discipline, feeling of responsibility, in brief: with humanism. This is exactly the precondition for humans' co-operation to be efficient and effective in teams that network to shed light on the selected problems with several viewpoints and professions to attain the requisite holism. In principle, all humans are capable of emotion, but this capability is often under-developed. In team work, like we use in DNT, in order to master complex problems, EI is exactly the human attribute, which improves mutual understanding and positive problem solving.

This results in a better chance for the requisite holism and innovative outcomes, because more human capabilities are applied.

4. DNT methodology's capacity to activate more of the (tacit) humans' potential

Ways in which humans solve problems, depend on several influential factors such as humans in charge, their resources, types of problems at stake, circumstances and time of their showing up and its periodical repetition, available time for solving them, order in the organization, organizational culture etc. Humans solve problems because they wish so, feel challenged by them, or obliged to work on them. Success in solving them makes humans happy and additionally motivates them.

DNT provides a methodology, but it should not be viewed as a deterministic sequence of steps, but as a flexible and iterative process. One starts by identification of the problematique, and keeps going be detecting links – inter-dependences, then by drafting managerial measures and problem solving possibilities, judging the possible solutions, and suggestion a selected solution to be applied. One can always return to foregoing steps. (See Rosi, 2004, and Rosi, Mulej, 2006, for some details).

Application of DNT in problem mastering depends on humans and their attributes, both rational and emotional. They find their expression in line with the law of hierarchy of succession and inter-dependence, which exposes the crucial impact of humans' subjective and objective (= outer) starting points. The concrete selection of contents of the subjective starting points (knowledge and emotions, especially values) impacts all further steps of the problem solving process, starting from the definitions of one's objectives. They should meet the law of requisite holism, and so do all further steps. Of course, they normally meet it in an inter-disciplinary use of synergy of knowledge, values and other emotions as well as possibilities along with the methodology offered by DNT.

Obviously, a requisitely holistic success of the problem solving process does not depend on IQ of team members, but EI plays and equally crucial role as well. DNT, according to experience, enable a fruitful application of both of them and their synergies. This effect of DNT is visible in successful results.

In the post-innovation times of affluence and the 5th phase this synergy will be increasingly crucial. Humans and humankind will either live on a holistic creativity with innovation included, but not the only topic, because on the basis of the fact and ethics of interdependence social responsibility will reach beyond the basic legal requirements – for humans to survive.

5. Some conclusions

Various periods of human history have provided various problems and problem solving methodologies. The growing unavoidable narrow specialization caused problem solving to become increasingly biased and inefficient, or fictitiously efficient: solving one problem and causing another one. In the times after the renaissance and industrial/entrepreneurial revolution one expected science to solve humankind's problems, and emotions should be out of scene for solutions to be rational. This expectation has proven to be an over-simplification causing many complex consequences all way to the world problems and world-wide serious problems of humankind's environmental preconditions of survival.

Therefore, requisite holism must be added to the unavoidable narrow specialization. DNT makes this demand rather easy to meet, especially if both IQ and EI/EQ are put in synergy. This requires humans of different professions to co-operate in networks, including teams, which they will – according to our experience – find easier to accept and do, if the perceive their inter-disciplinary inter-dependence and develop – as a part of their EI – their ethics of inter-dependence and social responsibility. Thus, it may easier to survive individually and as humankind. At any rate, choice of the topic of thinking depends equally of IQ and EI.

6. References:

Mulej, M., Kajzer, Š., Potočan, V., Rosi, B., Knez-Riedl, J. (2006): Interdependence of systems theories – potential innovation supporting innovation. *Kybernetes*, 35, 7/8, 942-954

Mulej, M., Potočan, V., Ženko, Z., Kajzer, Š. (2006): Etika soodvisnosti kot ozadje družbene odgovornosti. In: Hrast, A., Mulej, M., Knez-Riedl, J., editors: *Družbena odgovornost 2006. Proceedings of the 1st IRDO Conference on Social responsibility.* Maribor, IRDO Inštitut za razvoj družbene odgovornosti, June

Mulej M., Potočan, V., Prosenak, D. (2007a): Chapter for the book edited by Zhanna Belyaeva (et al.), Theme 2: Positive and Negative Trends in the Development of the Advanced Countries; Chapter Title: Innovative Culture as a Positive Economic Trend versus Complacency as a Negative Economic Trend. University of Jekaterinburg

Mulej, M., Knez-Riedl, J., Potočan, V., Hrast, A., Prosenjak, D. (2007b): Social responsibility and Requisite Holism of Thinking about the Future of the Innovative Society. In Process.

Mulej, M. (2007a): The Contemporary School and Knowledge Management

Mulej, 2007b; International Excellence and Innovativeness. In: Gabrijelčič, J. et al., editors: *19th Conference on Business excellence: International Excellence.* Otočec, Društvo ekonomistov Dolenjske in Bele krajine, Novo mesto

Mulej, M. Potočan, V. (2007): Requisite Holism – Precondition of Reliable Business Information *Kybernetes,* 36, 3-4, 319-332

Mulej, M. Prosenak, D. (2007): Society and Economy of Social Responsibility – The Fifth Phase of Socio-economic Development? In: Hrast, A., Mulej, M., Knez-Riedl, J., editors: *Družbena odgovornost 2007. Vloga menedžerjev pri razvoju družbene odgovornosti v pridobitnih in nepridobitnih dejavnostih. Proceedings of the 2nd IRDO Conference on Social responsibility.* Maribor, IRDO Inštitut za razvoj družbene odgovornosti, June

Prosenak, D. and Mulej, M. (2007a): Application of Technology to Enhancing of (Co-)creative (Co-)operation and Socially Responsible Action of All in a Society; In: Buchinger, E. et al, editors: 7th International Conference of Socio-cybernetics "Technology and Social Complexity" in Murcia**.** Book of abstracts

Prosenak, D, and Mulej, M. (2007b): How can marketing contribute to increase of well-being in transitional (and other) societies? In: Snoj, B., editor, MTC Conference. University of Maribor, Faculty of Economics and Business, Institute of Marketing, September

Potočan, V., Mulej, M. (2006a): Social responsibility of a sustainable enterprise In: Rozman, R., Kovač, J., (eds) 2006: *Družbena odgovornost in etika v organizacijah. Proceedings of the 7th scientific conference on organisation. (In Slovenian).* Univerza v Mariboru, Fakulteta za organizacijske vede, Kranj, Zveza organizatorjev Slovenije, Kranj; Univerza v Ljubljani, Ekonomska fakulteta, Ljubljana; 41-44

Potočan, V., Mulej, M. (2006b): Ethics of a sustainable enterprise and the need for it. *Systemic Practice and Action Research*, 19.

Potočan, V., Mulej, M. (2007): Socio-Cybernetics and Business Cybernetics as Approaches in Dealing with the Relation between Technology and Social Complexity in Invention-Innovation Processes. In: Buchinger, E. et al, editors: 7th International Conference of Socio-cybernetics "Technology and Social Complexity" in Murcia**.** Book of abstracts

Rosi, B. (2004). Prenova omrežnega razmišljanja z aplikacijo na procesih v železniški dejavnosti, Doktorska disertacija, Univerza v Mariboru, Ekonomsko-poslovna fakulteta, Maribor.

Rosi, B., Mulej, M. (2005). Dialectical network thinking – methodology supportive of requisitely holistic creativity. *IDIMT-2005, Proceedings*. Linz: Universitätsverlag R. Trauner.

Rosi, B., Mulej, M. (2006). The dialectical network thinking - a new systems theory concerned with management. *Kybernetes*, vol. 35, no. 7/8.

Rosi, B., Mulej, M. (2006a). Kako celoviteje prepoznavati, preprečevati in obvladovati probleme. *Organizacija (Kranj)*, letn. 39, št. 1, Kranj.

Vrečko, I., Mulej, M., (2007): Humans' Capability of Technological Adaptation to the general Technological Progress of Humankind: In: Buchinger, E. et al, editors: 7th International Conference of Socio-cybernetics "Technology and Social Complexity" in Murcia**.** Book of abstracts

Weisbach, C., Dachs, U. (1997). Mehr Erfolg durch Emotionale Intelligenz, Gräfe und Unzer Verlag GmbH, München.

BUSINESS CYBERNETICS AND ITS SUPPORT TO REQUISITE HOLISM OF INFORMATION IN BUSINESS SYSTEMS

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The business conditions require humans, enterprises and other organizations, which we understand and define as BSs, to take a new methodological approach and new methods in order to manage requisitely holistically rather than one-sidedly their holism, entanglement and dynamics. In our contribution, we discuss relations between two critically important viewpoints of research of BSs – Systems Theory and Cybernetics. This need requires consideration of interdependence and synergetic working of: the business reality, systems thinking, and cybernetics. This makes the general room for Business Cybernetics (BC). On these terms, one can formulate BC as a specification of the general and the group-specific attributes of cybernetics and management cybernetics, applied to business processes / BSs. The paper discusses two theses: 1) BC can be defined as a specialized cybernetics, and 2) BC can help the informatics aspects of business become more or even requisitely holistic.

1. The selected problem and viewpoints

We feel that there is a field needing both cybernetics and systems theory: business as one way to viability – 'business cybernetics' (BC) might have to emerge. We did not find it, although we studied quite some literature and collected quite some practical experience in business, both as employees and as consultants. It is clear that Cybernetics and (General) Systems Theory were created at about the same time by two different and interdisciplinary groups of scientists. They both dealt with complexity rather than complicatedness aspects of entities / features / processes and they both tried to stress relations between parts of reality, which used to be considered separately and one-sidedly rather than (requisitely) holistically. Later on, their "war against a too narrow specialization" did not end in their general victory, but rather

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in application of their fruitful findings inside many specialized disciplines of science and practice. This is good, but not good enough: uncovered topics remain. Business is one of them. Our first draft of Business cybernetics notion was presented in Kybernetes in 2006 [26].

To make a next step, we discuss here our understanding of Cybernetics and Cybernetics and / of business systems, definition of BC, and role and importance of BC in the process of creating (and providing) requisitely holistic information support for BSs (e.g. about connections between BC and informatics support with the viewpoint of contents of “holistic” information support for business operations, and about possible effects of BC on reliability of information).

2. Our understanding of Cybernetics

Cybernetics introduced complexity to science/practice concerning making an influence and attracting attention to relations, impacts and information, which opened human insight into the previously overseen attributes of reality. It helps humans control their own conditions of life a lot more efficiently and, hopefully, more holistically, too [See: 34, and later; 2, and later; 3, and later; 36, and later; 9, and later; 5, and later; 30, and later; 6; 31; 10; 35; 33].

On such a basis, one may conclude that Cybernetics is a science and practice of influencing / controlling / managing features, events and processes that:

1. Are complex or very complex, i.e. have multiple relations, internally and externally, and specific attributes resulting from these relations.
2. Are open, i.e. have relations, especially interdependencies, with their environment/s, including the ones between different viewpoints.
3. Are dynamic, i.e. able to change, including the observers, decision-makers and impacting actors, as well as the observation process.
4. Take inputs as well as produce outputs = impacts by information rather than by material/energy flows only.
5. Support these flows by feedback loops, e.g. stabilize and simplify them by negative ones, and reinforce them by the positive ones.
6. Are mentally, explicitly or implicitly, modeled from the selected (set or system, or dialectical system, of) viewpoint/s.

Cybernetics cannot be reduced to feedback loops or modeling alone, it takes all six attributes mentioned above as one synergetic whole, a dialectical system. The point of cybernetics is to help optimize the human impact over the human life and its circumstances, conditions and preconditions.

Thus, cybernetics is one of many specialized disciplines that need to be requisitely holistic, and can hardly be so, if left alone rather than acting in interdisciplinary cooperation with other specialized disciplines. In addition, there is a number of cybernetics applying the same basic ideas to different traditional fields of science and practice [26].

3. Cybernetics and / of business systems

Four sets of ideas are specifically stressed when one tries to understand the role of organizations or humans as BSs and their characteristics in terms of cybernetics [21; 23; 24; 25]:

1. A BS is a communication network in which its components, individuals and groups mutually exchange information (which stresses the importance of informatics and of building the information systems as partial systems rather than systems or subsystems).
2. A BS is a system / network of activities in which the sources (matter, energy and information) are transformed into outcomes (which is the topic of the modern operations research, decision support systems, and expert systems), when talking about organizations as BSs and humans in the role of BSs (trying to get employed, retire, contract out one's capabilities).
3. A BS is a societal system having certain societal tasks and responsibilities. As such, both a human and an organization as a BS is a society's subsystem (rather than a system of its own only) characterized by a network of roles and interactions, which are to be performed skillfully.
4. A human being, if considered and/or behaving as a BS, demonstrates more or less the same attributes as an organization as a BS, although in a different way.

In general, we can establish that all phenomena should be examined as cybernetic systems through the network/system of all the important viewpoints, i.e. as a dialectical system. Certainly, within the treatment, we should consider the specific starting points and characteristics of particular groups of phenomena (and the systems introduced to represent them as mental pictures of the selected parts of attributes). Therefore, different viewpoints, networks of viewpoints or dialectical systems / systems of treatment are unavoidably highlighted for different phenomena. The differences in the selection of viewpoints and their interdependence depend on the subjective selections of the authors of definitions (this is also true for the engineering / scientific laboratory experiments). The subject of our examination, here, is a BS, which represents characteristics of societal systems, i.e. illustrates social processes and events from the viewpoint of (systemic) business viewpoints.

See the important characteristics of three basic viewpoints of cybernetic treatment of phenomena selected on such basis [For details of each viewpoint of cybernetic treatment see: 31; 21; 22; 24]: An engineering observation tries to study natural events from the viewpoint of their usability for tools; 2) A biological observation tries to study natural events from the viewpoint of their given attributes with no attempt to influence them; and 3) A social observation tries to study social events from the viewpoint of the given attributes or from the viewpoint of influencing them. A dialectical system approach tries to discover their essential synergies.

We will present our view of dealing with the said dilemma on the case of cybernetics in business.

4. Business Cybernetics

The dialectical thinking, used here, includes the notion that everything has three interdependent parts or subsystems of attributes. It allows for the classification (Figure 1) into the interdependent general, special (or group-specific), and individual parts (subsystems). This means that e.g. any version of systems theory or cybernetics is useful and makes sense more or perhaps less than another one; the point is only in the difference of fields of applicability and usefulness [17; 26; 16].

<table>
<tr><td colspan="6">(1) The general part or subsystem of interdependent attributes</td></tr>
<tr><td colspan="2">(2) Group specific subsystem (1)</td><td colspan="2">(2) Group specific subsystem (n-1)</td><td colspan="2">(2) Group specific subsystem (n)</td></tr>
<tr><td>(3) Individual subsystem (1)</td><td>(3) Individual subsystem (2)</td><td>(3) Individual subsystem (3)</td><td>(3) Individual subsystem (m-2)</td><td>(3) Individual subsystem (m-1)</td><td>(3) Individual subsystem (m)</td></tr>
</table>

Figure 1: Interdependence of the general, group specific and individual part of attributes

Individuals, organizations, and countries can be seen as BSs, once this is the selected viewpoint. Doing business can namely be seen as a way toward viability in complex conditions [See: 3 and later]. Business is not the only way toward viability in complex conditions, but it differs e.g. from medical care, healthy life style, innovations to be applied in production and elsewhere, leisure, sport, culture, etc. In BC we do not mean market in other outer relations only, but also the internal ones, such as organizing, management, work processes, structures.

According to our suggestion, the difference of BC from the viable systems model by Stafford Beer, in general, lies therefore in the level of specific and individual details and depth of consideration of BSs. These details might be equally crucial as the general attributes. BC, hence, may be considered as a next step into research and application of the general cybernetics and of the viable system model in the specific, rather narrow but important, area of business.

Every topic under consideration can be seen on different levels of holism along the following lines. It takes into account the human capacity not to see the entire given, i.e. objective reality, but its selected part/s of attributes only, and to do so, on three basic levels of the unavoidable simplification (Figure 2). Thus, the attained level of holism differs a lot.

Years ago there was quite some discussion about holism [See: 2; 4], but less so lately [3; 16]. Concepts are rather different, ours is in Figure 2. Our warning resulting from Figure 2: very rarely the requisite holism can be attained without dialectical systems, requiring interdisciplinary creative co-operation.

<table>
<tr><td colspan="3">←--→</td></tr>
<tr><td>Fictitious holism/realism (inside a single viewpoint)</td><td>Requisite holism/realism (a dialectical system of essential viewpoints)</td><td>Total = real holism/realism (a system of all viewpoints)</td></tr>
</table>

Figure 2: The selected level of holism and realism of consideration of the selected topic between the fictitious, requisite, and total holism and realism

By limiting the topic and adapting the principles of cybernetics, the term BC can be applied to the cybernetic treatment of the operation (and behavior) of people and organizations as BSs. BC represents a special form of cybernetics, which can be (and should be) defined holistically based on the identification of its purpose, contents, methodology, and circumstances of use, needs and possibilities, as well as of the users. Users can utilize it as the cybernetics of the 0, 1st, 2nd or 3rd order or as the cybernetics of conceptual systems – dependent on their selected system of viewpoints, preferably the dialectical system and requisite holism [17; 16].

BC is designated for the identification, definition, analysis of BSs, and the influence on them. However, the question arises: what is business/BS and how to define it?

Business is an old term. In modern economic literature, a number of different definitions of the term business may be found, still (See: www.pangaro.com/published). For example, Webster Dictionary [8] gives 17 different definitions of business. At least nine of them are related to economic treatment and / or the definition of economic viewpoints of cybernetics.

In order to define BC, the definitions of business may be classified into two basic groups: 1) business as an activity (acting and behaving) and 2) business as an interest. Therefore, BC may be understood and requisitely holistically defined on the basis of an adequate (synergetic) understanding and use of both content definitions mentioned above.

A more detailed definition of the term BC depends on the selection and use of the methodology for its treatment (the approaches taken to the treatment, methods, and methodologies). Why? Business is an elaborate (complex and complicated), dynamic and comprehensive phenomenon, which can, in our opinion, be adequately conceived and defined only in a requisitely holistic, i.e. dialectical systemic treatment. It makes sense to analyze it within this framework as a network of all selected significant viewpoints, levels and areas of activity.

In the case of BC, we attempt to treat the activity and behavior of a (specific) group (profit-oriented) of organizations (and/or people) from a network of all the selected viewpoints (organizational, management, economic, business) holistically, which enable the requisite holism of the treatment (considering its purpose and goals) of activity and behavior. Based on the above mentioned (and presented) starting points, BC can be best defined in broadest terms as follows:

> *BC (in our definition) [21; 24; 26] is specializing in organizations and individuals as so-called BSs emphasizing the so-called business viewpoints rather than the natural and/or technical / technological viewpoints of consideration of features, events and processes in real life.*

Calling humans and organizations BSs rather than "features, events, and processes considered from the viewpoint/s of business sciences/practice," may mean that the requisite holism of consideration and action is consciously or subconsciously limited to the selected viewpoint/s, and therefore (rather) one-sided, although the expression "system" suggests holism. In this case, like in all other cases when one uses the word system, one should describe quite explicitly what viewpoint/s and content/s does one have in mind – in order to avoid mutual misunderstanding and the resulting lack of capacity and possibility to cooperate creatively on an interdisciplinary basis.

When we speak about the role and importance of Cybernetics (and/or BC) in business [2, and later; 3, and later; 30, and later; 6, and later], we must take into account that the idea of BC is close to uniting the cybernetics of the 2nd and 3rd order and cybernetics of conceptual systems into a dialectical system in order to provide for the requisite holism of management in the BSs. Thus, BC adds a new (meaning of) relation of cybernetics of conceptual systems and of cybernetics of the observation, decision-making and impacting as the phases of the same process [25; 16].

In order to implement the mentioned cognitions about BSs we also need an appropriate methodological approach for understanding the BC aspect of considering humans and their tools producing benefits for customers and themselves by three interdependent processes (basic, management, information). However, if we try to create a new requisitely holistic solution, we also need a new (requisitely holistic) approach in order to apply the exposed relation between BC and Systems Theory, the concept of interdependence. Of course, different relations cause interdependencies of different types and vice versa.

The Ludwig von Bertalanffy's concept of interdependence [4] expresses the finding / reality that all parts of the universe, in one way or another, directly or less directly, influence each other. This is because they depend on each other due to their mutual differences; they are mutually complementary. Later this finding was expressed well and documented in Gaia, when it comes to nature in general. Today, it is expressed well in literature on systems, chaos and complexity theories [5; 27; 17; 25]. Interdependence may not be seen only as a relation of elements inside en entity alone, but also as a relation between different viewpoints (which is not discussed in 4).

Interdependence of specialists is expressed and used by interdisciplinary cooperation. Thus, the relation between Business, BC, Cybernetics and Systems Theory can be defined as one of several parts of a whole / entity in a systemic consideration of the object at stake such as a BS. These parts exist and participate in different relations (internal, external), which make them create and realize a number of synergies. Hence, relation itself may be seen as a source of synergy/ies. These synergies may be used by cybernetics / cyberneticians aiming at a requisitely holistic application of the 2nd and / or 3rd order cybernetics and cybernetics of conceptual systems.

In relations between BC and the BS it can be clear, that BC can help the informatics aspect of business become more or even requisitely holistic.

5. The Contents of ("Holistic") Information Support for Business (Operations)

Business management uses information presenting important characteristics of the field dealt with, and its own and co-workers' knowledge, i.e. long-term information (from the content and methodological aspects) [19; 12; 13; 15; 14]. BC support them by improving their information capacity and reliability.

Information differs from data. Available data tend to be too many to become informative (= influential). Selection of date enables informing, which cannot be fully holistic, but requisitely holistic, hopefully. This requires an information management innovation [11; 28; 1; 7; 29; 15; 22; 24; 32]. It may result in the requisite information. In business, it surfaces in and influences the basic business and other processes supporting the entire business [19; 20].

Both non-economic and general economic information on business operation dealt with are needed in the business managers' economics-oriented decision making, and can be quantitative and/or qualitative. To run one's business operation well one, namely, needs all / requisite various information with which quantity, value, and quality (or any other important) characteristics of business are presented. Making and using information opens a variety of content and methodology issues making it adequate (= requisitely holistic, realistic, applicable, and beneficially influential).

But business operation managers need general information, too. The majority of general information can have a direct or indirect impact on economics of business operation. For this reason, this information can be also a part of the economic information in the broadest sense of the word. Beside, there is also information that can be called non-economic information for business.

With all the briefed diversity, the problem of the theory and practice of business informatics, since its beginning, has lied in the target orientation aimed at requisite economic information.

The modern business information focuses on providing more / requisitely holistic information necessary for the business operation management. This is an important trend in information management innovation.

Herein we find the increased importance of the indirect economic information. It is difficult to treat because its definition is not unified. Its content can be objective and subjective.

Thus, the information capacity of collected data and messages depends of the level of holism of the selected system of viewpoints of both the data providers and data collectors and processors. If holism is not requisite, misinformation and / or disinformation can results.

Therefore, in attempts to increase holism of information, we face two aspects of data suitability, i.e.: 1) a requisitely target-oriented information; and 2) a requisite level of generalization of information, resulting from data and messages.

For the needs of the individual business operation (different kinds, types, and forms) and business operation in the individual areas of work (e.g. per business functions, or per projects), we need the information that is suitably conceived and created in accordance with the set goals of our work. On the other hand, we need different general information for each business operation, both for it to set goals and to realize them.

Information can be created on different levels of generalization resulting from requirements of the business management. The level of generalization can be in the interval between entirely general information and completely specific information. This fact brings us again to the issue of background of attainment of a selected level of holism. It is essential for information to be reliable rather than misinformation or disinformation.

6. Reliability of Information

Failure to inform depends on more complex processes than the ones offered as their first and, of course, simplified approximation quoted by Eli B. Cohen, and aimed at provoking our thinking [7; see also 29; 32; 12; 14] in his book. His two figures say so (See Figures 3 and 4):

Data → Processing of data → Information

Figure 3: The simple three-stage framework of information delivery

Reality → Data recording → Processing of selected data → Decision maker ← context
Error types: I. Data recording, II. Process Stage, III. Decision Making

Figure 4: Expanded Framework on information delivery

We see an essential part of complexity to be added in the following facts, at least [18; 25]:

- Which part of attributes of reality does one consider? In a business case, the same business reality can provide basis for different pictures of reality, if it is watched from the viewpoints of e.g. book keeping, marketing, sales, supplies, technology for the daily routine, technology research, development, innovation (which can be of many kinds – from technology to culture and management style etc.), human resources, organizational culture, private relations along with the official ones inside the company or with its business, social or natural environments, legal situation, etc.
- Which part of possible data does one record? In a business case, they can have to do with all the above realities or some of them; they can depict their past, present, or future situations, their local, regional, national, or international situation, their situation in terms of the stage in their process of unfolding, their situation in terms of availability and eligibility of qualitative and/or quantitative data, their situation in terms of computer support to recording or another technology, etc.
- Which contents can the processing of selected data have? In a business case, data can have to do with all the above realities and possible recording types, and add to them very different levels of e.g. depth and/or breadth of insight; further routine processing or creative processing can be added, all the way to innovation, or perhaps to manipulation leading to misinformation or disinformation, which can tackle coworkers, managers, owners, or competitors, government, etc.
- Who is the decision maker? In a business case, these may be managers and/or owners. But it is not realistic enough, if one thinks of them only: everybody makes his or her decision every moment.
- Do decision makers acknowledge that complexity of business has grown and most attributes of the life reality in business have changed, while the need to make good decisions has not changed? A simplified, e.g. quantified, model of reality can hardly be realistic enough for good, i.e. requisitely holistic and realistic decisions, and resulting actions.
- Do decision makers admit that problems are to reality what atoms are to tables, and we experience tables, not atoms? Problems are abstracted from experience by analysis.

We do not experience individual problems, but complete systems (= complex entities) of those that are strongly interacting. Some authors call them messes. Defining them is the first step of real problem solving.

- How do decision makers deal with the old proverb: “What you see depends on where you sit in an organization”, i.e. the multiple and diverse viewpoints and resulting insights into the same fact, causing (very) different assessments of fact resulting in (very) different conclusions?
- How do decision makers deal with the experience that the “information asymmetry” makes you know a part of reality better than your counterparts do, while making you blind for another part / many other parts (your business partners, including your staff, many distrust you and fail to disclose their information to you).
- How do decision makers perceive, understand and assess context of their decision-making, thinking, and action? All the above varieties may enter the scene, and make a long set of very different synergies. Very different data or even information may result.
- How do decision makers consider the fact that totally holistic information (i.e. knowing everything) is impossible, and they must base their decisions on assumptions about reality and its future? How do they use imagination to make realistic strategies? How do they select the essential from the less essential data / viewpoints / information / insights / knowledge?
- How do decision makers tackle the fact that managing today includes a lot of innovation / transformation of e.g. ways of interaction with customers, ways of formulation of problems internally, ways of imaging the future – in order to make a difference, hence to survive in globalized competition? How is informing adapted to this rather new fact?

We do not say that Cohen's figures (3, 4) are not O.K. We are just following his suggestion to think more deeply about errors in informing systems to add something to his three pointed-out topics: (1) Reality and captured data are not the same, (2) Decision-making takes place within a context, and (3) Only selected data are processed.

He is right: »decision-making is only indirectly influenced by reality; there are many steps that separate reality from the decision-making process«. On this basis he wants to apply »this framework as a means to organize the types of errors that lead (information) systems to misinform their clients«.

We want to contribute by thinking in another direction: how can one tackle the data-to-information-to-decision process in order to diminish the number and weight of errors. Data recording errors follow earlier errors – data selection, and data selection basis and errors in it.

We will follow the concept depicted in Figure 5 [18; 25].

Errors to be detected, classified, and prevented or removed	
Essential errors (with critical consequences)	Non-essential errors (with unimportant consequences)
↓↑	↓↑
No over-biased / too one-sided / partial / too poorly holistic approach, but requisite holism reaching sufficient holism of decision makers in any step of the entire process from setting criteria for watching reality and collecting data all way to the final (business) decision and action – caused by no crucial lack of specialists' interdisciplinary co-operation	Biased / one-sided / partial / too poorly holistic approach reaching insufficient holism of decision makers in any step of the entire process from setting criteria for watching reality and collecting data all way to the final (business) decision and action – caused by a crucial lack of specialists' interdisciplinary co-operation
↑↓	↑↓
Selection and application of subjective starting points following the Dialectical Systems Theory and Standardized Decision-Making Model	Selection and application of subjective starting points not following the Dialectical Systems Theory and Standardized Decision-Making Model, but a one-sided / single-disciplinary approach

Figure 5: Dependence of the errors on the decision-makers' approach

BC can help BSs’ managers and operators in removing or solving the briefed information problems.

7. Some Conclusions

Cognitions that a more holistic application of cybernetics and systems theory is possible might enable more of the necessary requisite holism in consideration of BSs. This need requires consideration of interdependence and synergetic working of: (1) the business reality (i.e. working and behavior of BSs); (2) systems thinking (i.e. the methodological approach enabling the requisite holism of understanding of the business practice), and (3) cybernetics (i.e. methodology of impacting the business reality). This makes the general room for BC.

In terms of contents, BC can be defined as a specialized cybernetics on the basis of its (1) specific area to be dealt with, (2) specific methods of dealing with this area. This means application of the general cybernetics to BSs and adding to it specifics related to BSs in order to requisitely holistically deal with business-oriented organizations/humans from the selected dialectical systems of selected viewpoints. In terms of methodology, BC applies cybernetics to BSs, based on selected (dialectical systems of) viewpoints, purposes, goals, methods, methodologies, circumstances of use, and characteristics of its users. In terms of the level of closeness to reality, users can understand and apply cybernetics to their work as cybernetics of the 1st, 2nd, and 3rd order or as Cybernetics of conceptual systems.

Manager's work based on information, and information must be reliable to not be misinformation. Potential errors on the long path from data to information must hence be prevented. A one-sided approach, which belongs to the practice of narrow specialists, cannot prevent errors and misinformation, except rarely – when rather one-sided information is enough. More complex situation and processes require a more holistic approach that, in its turn, requires interdisciplinary creative co-operation of specialists of various interdependent professions. Systems thinking, supported by the Dialectical systems theory, can show a good way toward reliable information.

8. References

[1] Anderson, D. (2000). *Managing Information Systems*. Prentice Hall, New York.

[2] Ashby, R. (1956). *An Introduction to Cybernetics.* Chapman and Hall, London.

[3 Beer, S. (1959). *Cybernetics and Management.* English University Press, London.

[4] Bertalanffy, L. v. (1968, ed. 1979). *The General Systems Theory.* Braziller, New York

[5] Checkland, P. (1981). *Systems Thinking, Systems Practice.* Wiley, Chichester.

[6] Clemson, B. (1984). *Cybernetics: A New Management Tool.* Abacus Press, Kent.

[7] Vohen, E. (ed.) (2002). *Challenges of Information Technology Education in the 21st Century*. Idea Group Publishing, Harrisburg.

[8] Cove, P. (ed.) (2002). *Wester's Third New International Dictionary.* Merriam, New York.

[9] Foerster, H. (1974). *Cybernetics of Cybernetics.* Urbana, Illinois.

[10] Fancois, C. (ed.) (2004). *International Encyclopedia of Systems and Cybernetics, 2nd edition.* SAUR, Munich.

[11] Gunton, T. (1998). *Infrastructure: Building a Framework for Corporate Information Handling.* Prentice Hall, New York.

[12] Harmon, P. (2003). *Business Process Change.* Morgan Kaufmann, San Francisco.

[13] Harrison, F. (1999). *The managerial decision-making process.* Haughton Mifflin, Boston.

[14] Laudon, K., Laudon, J. (2005). *Management Information Systems.* Prentice Hall, New York.

[15] McLeod, R., Schell, G. (2003). *Management Information Systems.* Prentice Hall, New York.

[16] Mulej, M. (2007). *Inoviranje navad drzave in manjsih podjetij z invencijami iz raziskovalnih organizacij*. UM, Fakulteta za management, Koper.

[17] Mulej, M., Ženko, Z. (2004): *Introduction to Systems Thinking with Application to Invention and Innovation Management.* Maribor, Management Forum

[18] Mulej, M. (at al.) (2003). Informal systems thinking or systems theory. *Cybernetics and Systems,* Vol. 34, No. 2, pp. 71-92.

[19] Potocan, V. (1997). A New Perspectives on BDM. *Management*, Vol. 2, No. 1, pp. 13 – 24.

[20] Potocan, V. (2000). Systems of the standard DMP. *Management,* Vol. 7, No. 1, pp. 12–30.

[21] Potocan, V. (2003). *Business Organization (in Slovene).* Doba, Maribor

[22] Potocan, V., Mulej, M. (2003). On Requisitely Holistic Understanding of Sustainable Development. *SPAR,* Vol. 6, No. 16, pp. 421-436.

[23] Potocan, V. (2004). *Operations Management (In Slovene).* FEB, Maribor.

[24] Potocan, V., Mulej, M. (2004). The requisite holism of information in a virtual business organization's management. *The Journal of American Academy of Business*, Vol. 5, no. 1/2, pp. 411-417.

[25] Potocan, V. (2005). Holistic information support for virtual business organization. *Journal of business and economics research*, Vol. 3, No. 11, pp. 25-36.

[26] Potocan, V., Mulej, K., Kajzer, S. (2005). Business Cybernetics. *Kybernetes*, 34(9/10), 1496-1516.

[27] Reich, R. (1984). *The Next American Frontier.* Penguin Books, New York.

[28] Schultheis, R., Sumner, M. (1998). *Management Information System.* McGraw Hill, Boston.

[29] Tichy, N., Cohen, E. (2002). *Leadership Engine.* Harper, New York.

[30] Trappl, R. (ed.) (1983). *Cybernetics: Theory and Applications.* Hemisphere, Washington.

[31] Umpleby, S. (1990). The Science of Cybernetics and the Cybernetics of Science. *Cybernetics and Systems*, Vol. 21, No. 1, pp. 109-121.

[32] Wainright, M. (ed.) (2004). *Managing Information Technology.* Prentice Hall, New York.

[33] Vallee, R. (2003). *History of Cybernetics.* EOLSS, http://www.eolss.net.

[34] Wiener, N. (1948). C*ybernetics or Control and Communication in the Animal and the Machine.* Wiley, New York.

[35] Wood, R. (2000). *Managing Complexity.* The Economist Books, London.

[36] Zadeh, L. (1965). Fuzzy Sets. *Information and Control,* Vol. 8, pp. 338-358.

MODELING COST FUNCTIONS – MATHEMATICS AND CYBERNETICS

Tomaž Kramberger, Andreja Čurin

The similarities of mathematics and cybernetics are mostly expressed by their metatheoretical nature: they both are used for, not to describe objects and parts of the world, but to understand and model the world. That makes them both metadisciplines which means they can be applied also to themselves: they consist of models about how to build and use models: metamodels (Van Gigh, 1986), but metamodel stays a model and it can be modeled by other metamodels as well as by itself.

On the other hand there are differences between the mathematics and cybernetics: simplicity, regularity and invariance versus complexity, variety and process; the fact that systems separate into independent elements versus the fact that elements always interact; and the objective, context and value independent nature of knowledge versus the subjective, context and value dependent nature of knowledge. The cybernetics as such is reaching beyond by covering the phenomena which cannot be placed in a static, unchangeable, formal framework.

In order to present these similarities and differences we will take into consideration a problem formally defined as follows. In order to formally define the problem considered here we have to define some notions. Let $G(V,E,u)$ *be an undirected weighted graph where* $V(G)=\{v_1,v_2,....,v_n\}$ *is the set of nodes,* $E=E(G)$ *is the set of edges connecting nodes and* u *is a weight function assigning a positive cost of traversing edges. Moreover, let* $V^*(G)=\{v^*_1,v^*_2,....,v^*_n\}$ *be a sequence of priority nodes. For a walk* $W=w_0w_1w_2...w_N$ *starting at* v^*_0 *we define*

$$dw(v_j)=\min\left\{\sum_{i=1}^{k}u(w_{i-1}w_i)\,/\,w_k=w_j\right\}$$

and $\alpha,\beta_i\in R_+$. *If* W *does not meet* v_j *then the set* $dw(v_j)=\infty$. *Now the defined problem can be modeled as the Priority Constrained Chinese Postman Problem (PCCPP).*

INPUT: Undirected weighted graph $G(V,E,u)$.

TASK: The objective is to find a walk, which is the shortest walk W *that traverses each edge at least once and minimizes the cost.*

COST: The cost function defined with respect to the above mentioned demands is as follows:

$$COST(W) = \alpha \cdot \sum_{w_{i-1}w_i \in W} u(w_{i-1}w_i) + \sum_{i=1}^{k} \beta_i \cdot d_W(v_i^*)$$

In the paper we will try to show the differences and similarities mathematics versus cybernetics using this purely mathematically defined model of the real world and try to present it using the cybernetic model.

1. Introduction

Local authorities are responsible for the precautionary salting of the road network during the winter. With limited resources and treating time constraints it is imperative that salting routes are planned in advance for an efficient and effective operations. For instance in Slovenia, this has always been a manual task, reliant on local knowledge and experience of the operator. Traditionally, a `static,' often paper based, approach is used to optimize salting routes within the given constraints to enable effective use of resources (i.e. treatment vehicles, personnel and de-icing chemical material). The aim is to maintain safe road conditions, whilst minimizing financial and environmental costs. The decision about the necessary actions is based on weather forecasts.

2. Mathematics and Cybernetics

The similarities of mathematics and cybernetics are mostly expressed by their metatheoretical nature: they both are used for, not to describe objects and parts of the world, but to understand and model the world. That makes them both metadisciplines which means they can be applied also to themselves: they consist of models about how to build and use models: metamodels (Van Gigh, 1986), but metamodel stays a model and it can be modeled by other metamodels as well as by itself.

On the other hand there are differences between the mathematics and cybernetics: simplicity, regularity and invariance versus complexity, variety and process; the fact that systems separate into independent elements versus the fact that elements always interact; and the objective, context and value independent nature of knowledge versus the subjective, context and value dependent nature of knowledge. The cybernetics as such is reaching beyond by covering the phenomena which cannot be placed in a static, unchangeable, formal framework. A framework that works as a guide for building models which does not exclude any of the model but on one hand helps to avoid possible obstacles and on the other helps to find most suitable solution. As such the framework has to comprehend methods which will enable to realize its own postulates, regarding to the problem. And, unlike the mathematics, it should define more levels considering the abstract, constant and precise principles and their implementations.

3. System Theory

Most of the sciences have adopted the Systems Theory which was introduced by the biologist Ludwig von Bertalanaffy in 1940 and then further developed by cibernetician Ross Ashby in Introduction to Cybernetics in 1956. By definition it is the "… transdisciplinary study of the abstract organization of phenomena independent of their substance, type, or spatial or temporal scale of existence. It investigates both *the principles common to all complex entities, and to models, which are used to describe them*. Rather than reducing an entity to the properties of its parts or elements, systems theory focuses on the arrangement of and relations between the parts, which connect them into a whole. Thus, the same concepts and principles of organization underlie the different disciplines (physics, biology, technology, sociology, etc.), providing a basis for their unification. Systems concepts include system-environment boundary, input, output, process, state, hierarchy, goal-directedness, and information..." (Heylighen, Joslyn, 1992).

4. Principles of System Science and Cybernetics

"Principles or laws play the role of expressing the most basic ideas in a science, establishing a framework or methodology for problem-solving. The domain of General Systems and Cybernetics is in particular need of such principles, since it purports to guide thought in general, not just in a specific discipline."… (Heylighen F, 1992).

According to that and as in general it is important also for the principles of System Science and Cybernetics to adopt following attributes: primitiveness, simplicity and universality.

As for primitiveness: it is necessary for the principles to be primitive in order to give the possibility for something to follow from them, to give the beginning of thought.

As for simplicity: principles have to be simple to the point of being tautological.

As for universality: principles have to be universal to the point of being applicable in the filed of System Science and Cybernetics.

5. The Chinese Postman Problem

Several real-world problems, such as street sweeping, mail delivery, solid waste collection, salt gritting, and snow plowing can be modeled as Chinese postman problems (CPP) with some additional constraints. In the paper we present a formal definition of the special case of CPP problem that is not equivalent to those in [5], [6] or [4]. A number of different cost functions can be considered because we have two objectives that are at least partially conflicting. From the economical point of view, the traversing of every edge has to be carried out one after another using the cheapest route. Regarding the importance of the chosen nodes, delaying the service at high priority nodes can cause undesirable effects or additional costs. A practical application where priority nodes can be introduced naturally is winter road maintenance. The data provided by the variety of different methods for road ice prediction as for example HS_4 Cast method [8] or Thermal mapping [9], [10] can be used to define the priority nodes according to expected road temperature.

While the problem studied in the paper [4] deals with the cost function, where the cost of additional edges traversed is much bigger than the cost of delays and delay for the first priority node is much bigger than the cost of delay for the second node, and so on, the following paper describes a special case of CPP problem where the cost of delays are much bigger than the cost of additional edges traversed. In the paper we introduce an algorithm for finding the cheapest walk through the graph according to the defined cost function.

6. Problem Definition

The problem considered here is formally defined as follows:

Given a connected undirected weighted graph G, where V is the set of nodes, E is the set of edges and u is a weight function assigning a positive cost of traversing edges. In addition, we have a node $v_0 \in V$ called depot and a (short) sequence of priority nodes $v_1, v_2, ..., v_k$. The objective is to find a walk, which is the shortest walk that traverses each edge at least once, with respect to following demands,

(1) the walk has to visit v_1 as soon as possible,

(2) among the solutions which satisfy (1), the walk has to visit v_2 as soon as possible,

...

(k) among the solutions which satisfy $(k-1)$, the walk has to visit v_k as soon as possible.

Remark. Although the problem studied here is a variant of the Chinese postman problem which is well known to be polynomial, it seems that introducing the priority nodes may increase the time complexity. It is clear that the optimal solution will necessary use a shortest path from v_i to v_{i+1}. Note that there may be more than one shortest path from v_i to v_{i+1}. However the cost of the walk from v_k to v_0 that must meet all the unvisited edges at least once depends on the choices of shortest paths from v_i to v_{i+1}. It is not clear which choices allow optimal solution. We propose a heuristics for seemingly reasonable choices if the shortest paths.

7. The Algorithm

Our algorithm is a combination of the well-known algorithms for minimum matching, Fleury's algorithm for constructing an Eulerian walk, the Dijkstra's algorithm for computing the shortest paths and the modified Kruskals algorithm.

We have made a toy application implementing our algorithm in programming language C++. In the implementation we use some already written codes for several algorithms which are included in our algorithm. For instance for minimum matching we have used the Munkres' assignment algorithm [2], for searching the connected components in the graph we have applied the Strongly Connected Component Algorithm[13], for constructed minimum spanning tree we have used the Kruskal's algorithm code from [12]

We propose a solution which is a combination of the well-known algorithms for minimum matching, Fleury's algorithm for constructing an Eulerian walk, the Dijkstra's algorithm for computing shortest paths and the modified Kruskals algorithm. The basic versions of the algorithms can be found in any textbook of combinatorial optimization, for example [3],[1], or [11]. In short, the algorithm proceeds as follows.

- Visit priority nodes $v_1, v_2, \ldots, v_k$. Let G_1 be the graph G without edges traversed.
- Add edges to G_1 such that the resulting graph G_2 is connected.
- Add an artificial edge between depot v_0 and last priority node v_k and a minimal matching to G_3 such that the resulting graph is Eulerian.
- Remove the artificial edge such that the resulting graph G_4 is semi-Eulerian. Find Eulerian walk from last priority node v_k to the v_0 on G_4.

The input of the algorithm is:

- an undirected weighted graph $G(V, E, u)$, where V is the set of nodes, E is the set of edges and $u: E \to R$ is a weight function assigning a positive cost of traversing edges, and
- a (short) sequence of priority nodes $v_1, v_2, \ldots, v_k$.

7.1. Step 1

First, a walk P_1 from the depot to the first priority node v_1 is chosen where P_1 is one of the shortest paths from depot to the first priority node v_1 found with a modified Dijkstra's algorithm. The modified Dijkstra's algorithm finds all shortest paths between two nodes in the given graph and chooses the best one, according to the demands defined in the cost function. The best shortest path is selected as follows. If more than one shortest path P_1 exists, we choose the path which contains a higher priority node v_i. In the example on Fig. 1 there are three shortest paths from depot D to v_1: $(D,3,4)$, $(D,1,2,4)$, $(D,2,4)$. The paths $(D,1,2,4)$

and $(D,2,4)$ are better than $(D,3,4)$ because they contain v_3 which is of higher priority than v_4. Any of the two can be chosen by the modified Dijkstra's algorithm.

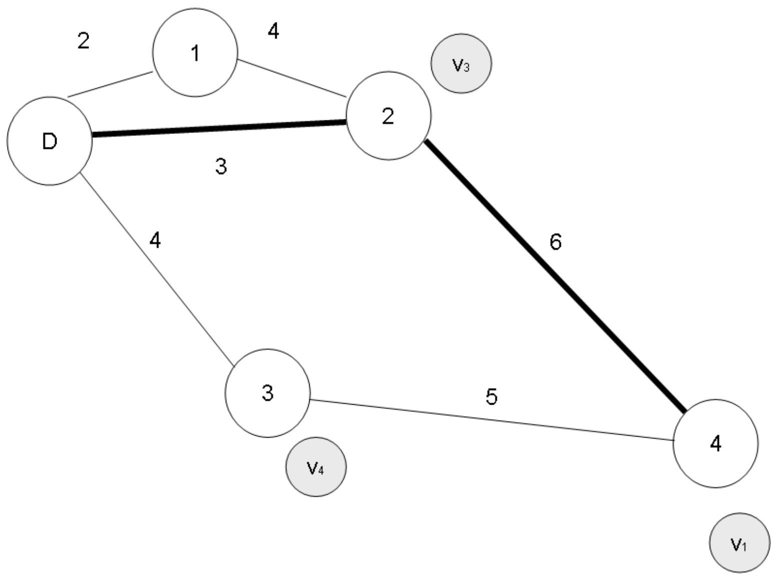

Figure 1 - Best shortest path

Next a walk P_2 is chosen in such a way that it is the shortest walk from v_1 to v_2 found with modified Dijkstra's algorithm. If v_2 has already been visited, then P_2 is empty. Otherwise, the best shortest path is selected as follows. If more than one shortest path exists, we choose the path which contains a higher priority node v_i, that was not visited before. If there is more than one shortest path containing the highest priority node that was not visited before, then P_2 is one of those which traverse more new edges (in terms of weights).

The paths P_3 ... are determined with analogous procedure as P_2.

Let E be the set edges that were used by $P_1, P_2, \ldots$, $E =' E(P_1) \cup E(P_2) \cup \ldots E(P_k)$. The resulting graph after step 1 is $G_1 = (V(G), E(G) - E)$. Clearly G_1 may not be connected.

7.2. Step 2

The task is to connect the graph G_1.

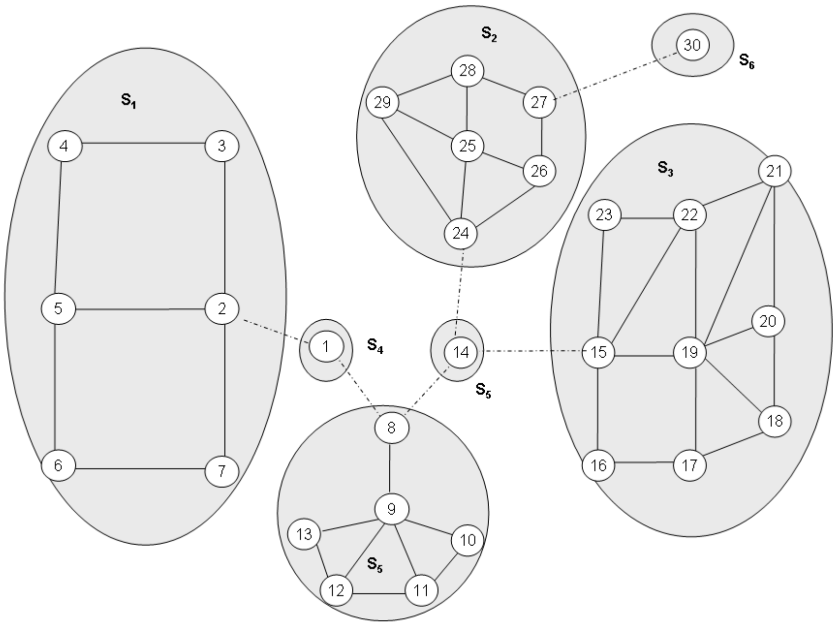

Figure 2- Graph G_1 with 7 connected components

We begin with computing the connected components of graph G_1. Now we form an auxiliary graph. The connected components of G_1 are called *supernodes*. Supernode is *active* if it contains an edge of G_1. The auxiliary graph is an edge weighted complete graph on active supernodes. The weight of superedge connecting two supernodes is the length of the shortest path in G between the two connected components of G_1.

In order to connect the graph we construct the Minimum Spanning Tree on the *active* supernodes (see Fig. 2) using the modified Kruskals Algorithm. As in the original Kruskals algorithm the unused superedge with minimal weight is considered at each step. Then the two connected supernodes are merged in a new supernode. Formally, the new supernode is $S_{12} = S_1 \cup S_2 \cup P_{12}$, a component build from the two former components and a path bittern them. In the present implementation, the first shortest path found is chosen.

Formally the result of step 2, the graph G_2, is obtained from graph G_1 by adding the set of edges on shortest paths chosen by the modified Kruskals Algorithm. Clearly G_2 is connected but may have many nodes of odd degree.

7.3. Step 3

If the graph G_2 has exactly two nodes of odd degree we proceed to step 4. Otherwise we add an artificial edge between the last priority node and the depot with infinite (i.e. very large) weight. As for the basic Chinese postman problem, the set of odd nodes is identified and the shortest paths between pairs of nodes are added to the original graph, introducing double edges if necessary. Any polynomial algorithm for minimum matching of an auxiliary graph can be used. We remove the artificial edge and we get a new graph G_3 which is half Eulerian.

7.4. Step 4

As the graph G_3 is semi-Eulerian, we can find a shortest walk from v_k to the depot using the well known Fleury's algorithm for constructing an Eulerian walk.

7.5. Summary

After step 4 we get a walk traversing all edges of the graph G with presumably near optimal value of the cost function defined in section 2. The walk consists of the paths P_1, P_2 ... P_k of step 1 and the Eulerian walk of step 4.

7.6. Example

Let us take a look to the following example. The road network which needs to be treated is modeled as a connected undirected graph G. The nodes v_1, v_2, v_3 are the priorities and n_1 is the depot. After all edges are visited the maintenance vehicle should return to the depot v_0 (Fig. 3).

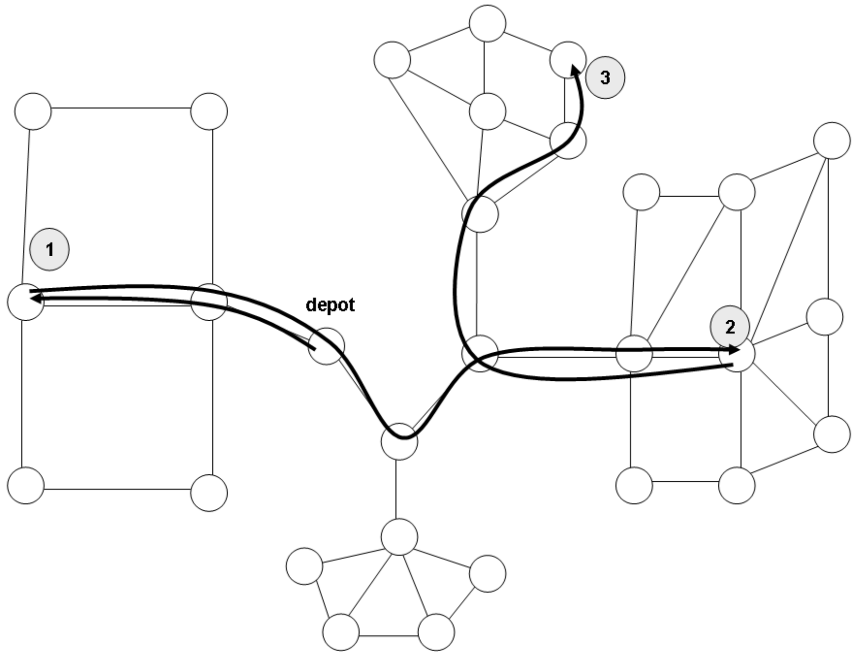

Figure 3 - Graph G with short sequence of priority nodes.

Let us consider the node n_1. Vehicles should drive all the roads and scatter them in the fastest possible way visiting priority nodes within the shortest time. The priorities are, in this order: crossing v_1, crossing v_2 and crossing v_3 using the shortest paths possible.

According to the idea of the algorithm presented in Section 2, we have to find the shortest path P_1 from depot n_1 to the first priority node v_1 using the modified Dijkstra's algorithm. Then we use the same algorithm to find the path P_2 which is the shortest path from node v_1 to v_2. In the same way we construct the path from v_2 to the v_3, as seen in Fig. 3.

The graph G_1 contains six connected components, as seen in Fig. 4, four of them being active.

The task now is to connect the graph. In general we can use Strongly Connected Component Algorithm (see, for example [1]) to determine all the disconnected components of the graph G_1, but in our case it is obvious that we have four active components as seen on the Fig. 4.

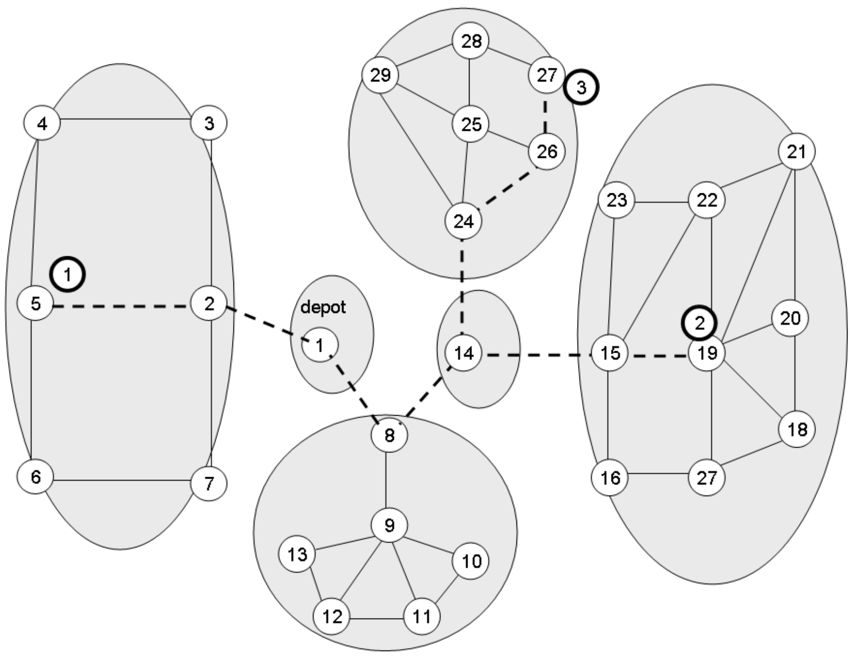

Figure. 4 - Graph G_1 with six connected components.

Now we can apply the modified Kruskals Algorithm. By adding paths $(24,14,15)$, $(8,14)$ and $(2,1,8)$ we get the connected graph G_2. According to the idea of the algorithm presented in Section 2, we have to construct an Eulerian graph (i.e. a graph with all nodes of even degree). Since the graph G_2 has more than two nodes of odd degree we add an artificial edge between the last priority node and the depot with infinite (i.e. very large) weight. Now a minimum matching has to be found, for example using the algorithm for minimum perfect matching with time complexity $O\left(n^4\right)$ (see, for example [1], [2]). In our case, the optimal solution can be found quickly even by inspecting all possible cases. Thus, we get a new graph G_3, in which all nodes have an even degree.

Since we are now in the last priority node, we have to construct the postman tour traversing all remaining edges and return to the depot. We remove the additional edge between node and the depot and get the graph G_4, which has exactly two nodes of odd degree. Now we can perform the Fleury's algorithm to find the walk through the remaining graph as seen on Fig. 5.

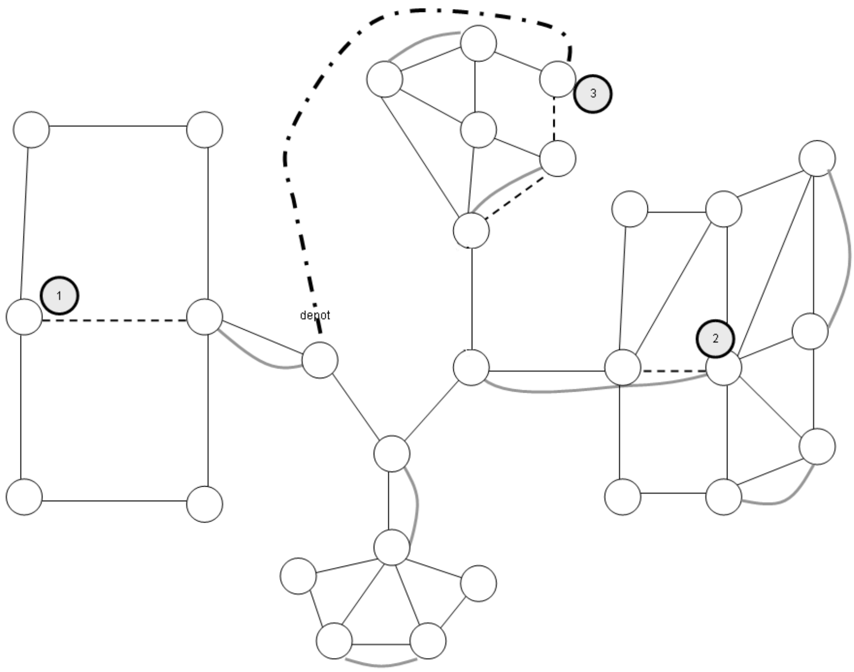

Figure 5 - Eulerian graph, with added edges to G_2.

Combining paths P_1, P_2 and P_3 in the original graph G and Eulerian walk in G_4 we get the solution of the problem defined in section 2.

8. CPP in the Aspect of System Theory

According to DaSilva et al. 1998ab, 1999 the CPP is one of the typical example of the set network analyses for which the analyzing of the models require the definition of the system of the model, its components, its subsystems, given environment, the relations between the system and environment and the modes of the changes caused by the influence of the system on environment and environment on the system.

Therefore the definition of the CPP model requires the use of principles of the system analysis which according to Heylighen and Joslyn (1992) "… the system analysis was developed independently of systems theory and applies system principles to aid a decision-maker with problems of identifying, reconstructing, optimizing, and controlling a system, taking into account multiple objectives, constraints and resources. It aims to specify possible courses of action, together with their risks, costs and benefits…"

The system analysis focuses whether on system structure or on system functionality. The analysis of the system structure requires:

- The analyses of the relations between individual system components, their character and intensity and their contribution to the stability of the system
- The analyses of the system topology, evaluation of its complexity and character of relations
- The decomposition of the system into its parts able to fulfill autonomous functions
- The composition of the system to reconstruct it from its autonomous subsystems, components and relations, including the homogenization of its heterogeneous properties. (According to Hlasny) aAnd analyses of system functionality require:
- The analyses of the system functionality as a whole, i.e. the definition of the only class of its functionality, as a result of mutual relations between functions of its parts, including system environment
- The analyses of the system processes, i.e. the definition of the all stages of the processes implemented (initial, intermediate, final), including underlying mechanisms
- The analyses of extended system functionality, i.e. the determination of qualitative and quantitative characteristics of respective processes as the parameters of functions of system components and relations. (According to Hlasny)

9. Chinese Postman Problem with Priorities in the Aspect of the Principles of System Science and Cybernetics

A problem as such is always defined by two situations, the present one or the initial state and the goal state or the desired one and the performed action is needed to change from the initial to the desired state. The problem is called solved when the needed action is found and the goal is reached.

Regarding the CPP solution as mathematically formulated in present paper we can find the formula Blind Variation and Selective Retention (BVSR) motivated by principle Occam's Razor.

Occam's Razor principle is defined as "one should not increase, beyond what is necessary, the number of entities required to explain anything" which means it is needed to cut off all the concepts, variables and constructs that are not actually important for the explanation of the phenomenon. With this the development of the model will become much easier.

Next is used BVSR formula which consists from three principles: the principle of blind variation ("At the most fundamental level variation processes "do not know" which of the variants they produce will turn out to be selected.", F. Heylighen, 1992), the principle of asymmetric transitions ("A transition from an unstable configuration to a stable one is possible, but the converse is not", F. Heylighen, 1992) and the principle of selective retention ("Stable configurations are retained, unstable ones are eliminated.", F. Heylighen, 1992). "The second principle is implicit in the "and" of "blind-variation-and- selective-retention", since it ensures that configurations produced by blind variation can make the transition to selective retention, unlike configurations in classical mechanics which remain unstable." (F. Heylighen, 1992).

10. Further Research

In our further research we will try to find better solution of CPP whether within mathematics or system theory and cybernetics.

11. References:

[1] Korte, B., Vygen J., Combinatorial optimization: Theory and algorithms, Springer, Berlin, Heidelberg, New York 2002.

[2] Black, P. E., Munkres' assignment algorithm, from Dictionary of Algorithms and Data Structures, ed., NIST. http://www.nist.gov/dads/HTML/munkresAssignment.html

[3] Papadimitrou, C. H., Steiglitz,K., Combinatorial Optimization, Algorithms and Complexity, Dover publications inc., New York 1998

[4] Kramberger T., Žerovnik J., Chinese Postman Problem With Priorities, Proceedings SOR'05, Nova Gorica, Slovenia (2005), 357-362.

[5] Guan, M., Graphic Programming using odd and even points, Chinese Mathematics 1, (1962) 273-277.

[6] Thimbleby,H., The directed Chinese Postman Problem, Software Practice & Exp., 33(11), (2003), 1081-1096.

[7] Drossos N., Papagelis A., Papaioannou P., Choosing from a forbiddingly big number of solutions, http://students.ceid.upatras.gr/126papagel/project/kef5_7_2.htm

[8] Schaffar G., Hertl S., Major developments for the autonomous forecast model HS^4 Cast, Proceedings of the 8th International Road Weather Conference (SIRWEC) University of Birmingham, U.K.(April 1996).

[9] Shao, J., Application of an artificial neural network to improve short term road ice forecast, Expert Systems with Applications 14 (1998) 471-428.

[10] Shao, J., Lister P.J., Hart G.D., Pearson H.B., Thermal mapping: reliability and repeatability, Meteorological Applications 4, (1997) 131-137.

[11] Wilson, R.J., Watkins, J.J., Graphs, An introductionary approach, John Wiley, New York, 1990. (Slovene translation: Uvod v teorijo grafov, DMFA Ljubljana 1997.)

[12] http://www.personal.kent.edu/126rmuhamma/Algorithms/ MyAlgorithms/GraphAlgor/kruskalAlgor.htm

[13] http://www.ics.uci.edu/126eppstein/161/960220.html

[14] Ashby, R., 1956: Introduction to Cybernetics, 1956

[15] Bertalanffy L., 1968: General Systems Theory

[16] Da Silva, A. N. R.; R. S. Lima, A. A. Raia Jr and P. Van der Waerden, 1998: Urban Transportation Accessibility and Social Inequity in a Developing Country. In: Freeman, P. and C. Jamet (eds.) Urban Transport Policy: A Sustainable Development Tool. Proceedings of the International Conference CODATU VIII, 709-714, Cape Town, South Africa.

[17] Da Silva, A. N. R.; R. S. Lima and P. Van der Waerden, 1999: The Evaluation of Urban Network Patterns with a Global Accessibility Index in a GIS Environment. Paper accepted for the 6th International Conference on Computers in Urban Planning and Urban Management, Venice, Italy.

[18] Da Silva, A. N. R.; P. Van der Waerden and H. Timmermans, 1998: Intra-Urban Accessibility and Land Values in Developing Countries. Paper presented at the 8th World Conference on Transportation Research, Antwerp, Belgium. Davidson, K. B. (1977) Accessibility inTransport

[19] Heylighen, F., 1992: "Principles of Systems and Cybernetics: an evolutionary perspective", in: Cybernetics and Systems '92, R. Trappl (ed.), (World Science, Singapore), p. 3-10

[20] Heylighen, F., Joslyn, C., 1992: What is System Theory, Principia Cybernetica Web, http://pespmc1.vub.ac.be/ SYSTHEOR.html

[21] Hlasny, T., 2005: Spatio-temporal modeling and simulation in GIS – The principles

Amarel S. (1968) : On Representations of Problems of Reasoning about Actions, in : Machine Intelligence 3, D. Michie (ed.) (American Elsevier, New York).

Heylighen F. (1988): Formulating the Problem of Problem-Formulation, in: Cybernetics and Systems 88, Trappl R. (ed.), (Kluwer Academic Publishers, Dordrecht), p. 949-957.

Korf R.E. (1980) : Toward a Model of Representation Changes, Artificial Intelligence 14, p. 41.

Simon H.A. (1986) et al.: Decision Making and Problem Solving .

Heylighen F. (1992): Principles of Systems and Cybernetics: an evolutionary perspective, in: Cybernetics and Systems 92, R. Trappl (ed.), (World Science, Singapore), p. 3-10.

Heylighen F. & Joslyn C. (2001): Cybernetics and Second Order Cybernetics, in: R.A. Meyers (ed.), Encyclopedia of Physical Science & Technology , Vol. 4 (3rd ed.), (Academic Press, New York), p. 155-170.

Ghiani, G. & Improta, G. (2000) An algorithm for the Hierarchical Chinese Postman Problem, Operations Research Letters 26, 27-32.

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SYSTEMIC MEANING OF INFORMATION IN SOCIAL SYSTEMS (COMPANIES AND SOCIETY)

Antonín Rosický, Eva Švarcová*

This paper deals with different attitudes of data, information and knowledge that influence our understanding of the world. The never-ending circular process of transforming data into information and information into knowledge changes understanding of organization in management and business accenting the role of human and his/her knowledge.

1. Changing understood informatics

An advancement of professional discipline(s) oriented towards dealing with information makes for changing concepts and appropriate names. Particular concepts accent appropriate methods and tools of this dealing as well as reasonable aspect of management or business. These concepts (and appropriate tools) very often promise inadequate solution…

Let us compare a few major concepts that approve oneself in used designation of whole discipline. Most famous are informatics, information systems and information or knowledge management. Informatics is often associated with strong aspect of information and communication technology and therefore criticized at the same time. In contrast to the area of information systems considered in context of management and/or business is growing. Practice is admittedly oriented towards creating, purchase and customization of computer systems. Strawman curricula that distinguish five informatics-oriented branches, is important contribution. Computer Engineering, Computer Science and Software engineering head towards technical field, Information Technology and Information systems head towards field of management and business. There is an obvious shift in their definition: Information technology is understand in wider concept transcending common idea of computing and is oriented towards support of information needs. Authors say verbatim (Strawman Curriculum) [33, p. 18]: *Information Systems focuses on the 'information' aspects of 'information technology'. Information Technology is the complement of that perspective: its emphasis is on*

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the technology itself more than on the information it conveys. From this point of view information systems are characterized through focus of IS professionals as follows: *Professionals in this(IS) discipline are primarily concerned with the information that computer systems can provide to aid an enterprise in defining and achieving its goals…*

Despite proclaimed importance of information and/or knowledge both concepts are misty understood in many varied denotations and some of them contrast in important characteristics. Probably three most important ideas connected with information[1)] are deeply rooted in the community:

- Thing and/or commodity that can be acquired (incl. purchased) stored and manipulated;
- Concernment (of its amount) decreasing uncertainty and improving decision in this way;
- Intricate causal relation converts data into information (information into knowledge).

2. Cognitive nature of information

An acceptance of the fact that information is 'influential message' includes far-reaching consequences. Checkland a Scholes [8] observe other conception: *An important minority strand in the IS debate has come from an alternative perspective, from those whose fundamental response to information is to see it as symbol rather than signal. Such a school of thought is humanistic, and treats IS as a cultural rather than technical phenomenon.* In this sense information is rather cognitive category than single impetus initiating deterministic response (behaviour) of its receiver. On the contrary of common or general sense such information is described as semantic and/or conceptual having rather nature of interpreted symbols than signals with determined response.

This enunciation calls our attention towards notion of information again. Let us just briefly remember linkage relation data – information – knowledge in linear chain, which ignores manners of transformation data into information and information into knowledge. The origin, importance and use of data and knowledge are disregarded. However advanced systems theory and namely cybernetics provide quite different conception which emphasize circular

[1] We stem from personal experiences and study of various sources as well as from research in these days (its first results will be known in July and will be presented on the conference).

relations between information and knowledge (see bellow). Moreover in this conception is disdained actual (and dynamic) nature of knowledge emerging from human cognition and it is replaced by set of static '*pieces of* knowledge' i.e. represented facts, methods, expertise(s), lessons etc. On the other hand advanced system theory and second order cybernetics explain two topics being important for better understanding:

- The first one is the dynamic nature knowledge being consistent with human cognition
- The second is the disposition of circularity having an essential significance within real world.

In this meaning we can demonstrate relationships mentioned above in new way which is tally with the concept of hermeneutic circle well known from philosophy (epistemology).

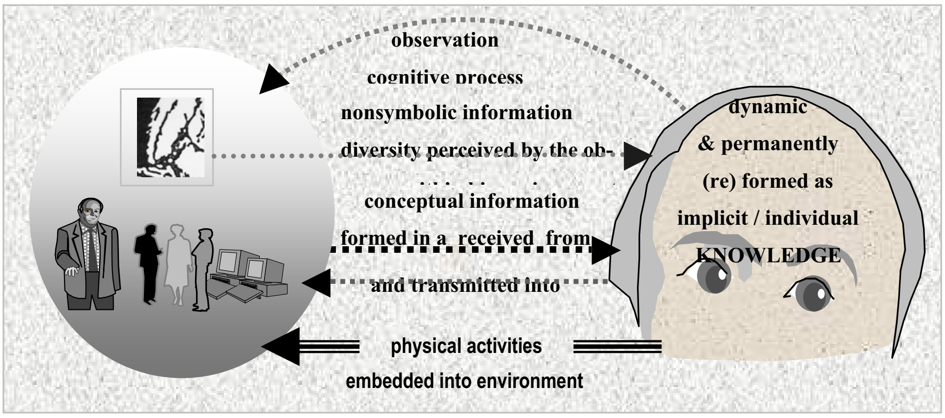

Figure 1 - Active role of the observer within social and material environment point out two kinds of information and mediated nature of conceptual information.

This picture describes two types of information received by the observer: The first one is empirically distinguished in environment, the other is semantic or conceptual information. These explanations fairly come up to idea of tacit knowledge well known from philosophy and now namely from knowledge management area. Simultaneously they accent some consequential (and not exactly evaluated) aspects of (the affair denoted) knowledge:

- Individual inside of it emerging primarily from individual's interaction within an environment;

- Dynamic nature of knowing changed that is continuously re-created (rather than created);
- Intentional nature of knowledge and knowing tied up with (i) emotions on individual level and with (ii) ethical norms emerging on social level;
- Two ways of knowledge (re)creation through: (1) learning (from experiences) and (2) teaching (sharing of knowledge and experiences of others people);
- Conjunction of implicit knowledge with symbols through that is presented externalized knowledge, usually denoted as (conceptual) information;
- Socially aspects of knowledge (such us power, media, technology etc.) influencing emergence of knowledge frameworks (theories, paradigms, ideology…);
- Circular nature of knowing in which origin knowledge participate on interpretation of meaning of receiving information (strongly tied up with natural language);
- An essential and ignored fact of validity, verity and credibility of knowledge and information.

Concisely sketched facts influence human and social information processes as well as proactive human participation in (co)evolution. Human knowing is limited and emerges from two kinds of generalization (a) individual's level as empirical perception (physical interaction) and (b) social communication (symbolic interaction). As result human knowledge has a character of (diversely) 'justified true belief' and form two types of contrasts – among various (culturally shared) social realities on the one side and social and material reality on the other side. Just these gaps constitute new aspects of complexity emerging within social systems.

Adequate awareness changes some common thought as well as activities. Information technology (ICT and/or IS/IT) really manipulate only with meaningless symbols (data structures). Their meaning emerges one and only from individual's knowledge and particular context and fluctuate among socially shared patterns. Dramatically growing amount of information (data) brings increasing (1) dependence on (usually anonymous) expertise on the one hand and (2) amount of fluctuations on the other side. In the first case we (can) lost flexibility and adaptability and the possible for emergent (and often unwelcome) change increase in the second case.

The mentioned nature of information and knowledge brings forward necessity of new ways of thinking and/or knowledge creation and use. The first is a topic of that credibility based on critical thinking and 'scientific ways' of cognition. The second focus on new ways of systems analysis as a way of receiving real knowledge applying to systems. Both cases are the question far of traditional ideas (objective, natural, rational, systemic) science and refer to actual meaning of systemic thinking and responsibility of human (as observer).

3. Engineering: Information (and) systems as artefacts

The ideas excerpted above cover a tendency to consider new framework of our (business) behaviour in a turbulent environment. Theory of complexity got a considerable notice during last year including managerial theory but substantial difficulties go along with understanding and application of it just from the necessity to overcome one's own orthodoxy deeply rooted within the positivistic rudiment of common shared knowledge and language. One of the more important and most hardly acceptable principles for the comprehension of system's complexity is self-reflection. From the Enlightenment times human perceives himself out of system' and elated by the idea of objectivity he behaves as governor and/or creator[2)] from appropriate anthropic position. In order to he substitutes concept of evolution by notion of design or progress and just the second notion frames the nature of industrial society. In other words humane belief to have situation (world) and making firmly in their hands…

Only limited influence on approach to IS/IT conception, design and use probably has wider roots. Whole process of computing is principally deterministic as well as technological dealing with information and IS/IT. To make some artificial features of systems that are obvious result of engineering design we can point out few aspects:

- The objective of designed system results from human intention that is proverbial in advance and remains constant all the while of its existence. Its definition results from discussion of users and designers, which is a complicate social process. On the ground of clear purpose the question of 'effectiveness – efficiency' is reducing to such effect as speed, price etc.

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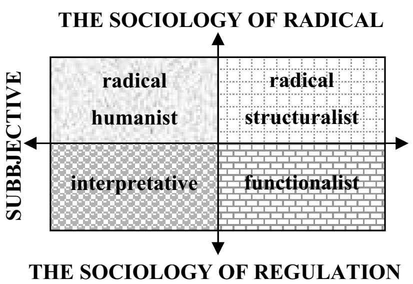
[2] In Scientific American [Czech edition, February 2002] Michael Shermer points out antagonism of two opinions 'theory of evolution' and 'creationism'. He presents huge influence of creationism (in USA) and refers to its non-religious form, that is based on the existence of 'intelligent purpose' narrowly connected with artifacts.

- An environment of used artefact regarded as invariable, known and well specified by its attributes or function and often established together with designed system. Artificial system is implemented into its environment and mutual interaction covering changes in the environment is disdained.
- The human stays outside of designed system and the function of the ‘user’ or ‘service’ is trusted with him. The attention focused on human-system interface and its ergonomic parameters and facility of a command.
- The system is arranged systematically and prevailing hierarchically aligned system structure is based on the fixed dependence of components with known and constant attributes and functions. Running processes have determined character and they are asynchronous; optional parallel processes are synchronised effectively.
- System’s arrangement, organization and/or order are derived from the knowledge of system’s designers - such knowledge forms an order that is embedded into artefact. Traditional engineering methods (technical applications) are derived from the legality of physical laws and have a character of fixed rules.

Note: these principles are successful in a construction of machines and other technical systems and also in technologies [3] that process matter. However designed IS differ from information processes within social systems.



Horizontal axis discerns two dimensions concerning both basic conceptions of world’s recognition

Vertical axis desribes opposite conecptions regarding the nature of society and pertinent aspiration to govern it that connects with notion of social engineering and its deprecation (F.A. Hayek) or advocacy (K. Popper).

Lets us remind two facts: The nature of regulation lies in an

Figure 2- Different concepts of organisation as social systems eked out Burrell and Morgan’s

Let us stress that the distinction between both mentioned agendas lies namely in the used name and in the attention given to the purpose and following activities of designers. Nobody doubts that both agendas influence dealing with information within social systems -

[3] Only few ‘highbred’ technologies (like production of beer or whisky) use natural character of biological systems and trust spontaneous order of living organisms (germs).

organizations and consequently also in whole society - and changes their character as well. Redefinition of original purposes and functions or secondary a readjustment of sophisticated information system constitutes essential arduous redesign or new design at least. Rigidity of computer based IS and its flexible accommodation to changing environment seems to be one of the essential problems. Moreover information strategy constituting framework that associates also deliberation about purposes and use of IS/IT depends on the notion of the organization itself. Relevant reference of IS to organizations is often connected with four paradigm's originally suggested by sociologists Burrel and Morgan. To stress some thoughts in context of this paper it seems to be useful to put in remembrance these paradigms and theories that make for their resolution.

Both types of organization that authors connect with a 'sociology of regulation' do not change concept and design of IS/IT in a fundamental way. Though the appropriate type of IS/IT influences clearly two types of organizations that answer to concept of information. Traditional type and use of information system (based on structured database and applied software) correspond to traditional vision of functionally arranged organization of industrial era. Interpretive notion of organization is representing soft approach to social system and stress communication information within organization and better cooperation of activities in this way. Mentioned concepts of organization (founded in information systems area) form together conceptual prevailing background of information systems. Both ideas also wrestle with nature of information: Functionalist concept does not muse on a meaning of information and concentrates on 'hard data'. On the contrary the interpretative approach focuses on the meaning or its best denotation resulting from communication of participants and focuses also on textual information. In spite of the debated connection among data, information and newly also knowledge (and sometimes also 'capta' and 'wisdom') the notion of information remains foggy. Shared point of view remains static and concatenates all mentioned concepts in a linear chain that relegate information as well as knowledge to data.

4. Conclusion putting tacit question

There are also natural problems of interpretive approaches successful in the case of normative processes and systems (typically book keeping incorrectly called 'accounting systems') there. Let us remember two important issues: The first of them relates to credibility of used knowledge and information coupled with (derived from) it. In spite of the fact that it is not issue of verity in the traditional sense the four main theory of truth can be useful for better understanding From the actual business position the first proves as best. Its troubles crop out with two aspects: The first results an operational rationality that create and/or select purposeful agency activities regarding actual situation (and corresponding information/knowledge). The second opens problem of knowledge forming in the past while business decision and its results are oriented to future and/or its insufficiency increasing herewith changing complexity of (emerging within) the environment. Regarding these facts we should ponder on knowledge and information appropriate for actual situation and systemic nature of the environment. Next query appertains to the nature and individuality of knowledge participating on generating of meaning and various differences. The first is difference of knowledge (and intention) of its designers and users. The first knowledge – anticipates relevant problems as well as (best) ways of their solutions – and is (rather more than less rigidly) embedded info designed IS. Data produced through this system are interpreted in new way through actual (i.e. implicitly adopted) knowledge of particular (individual) users… The concept of the 'universal user' essential for engineering approach approves to be misleading and fails. User without corresponding knowledge stalemates and has to act suitably. It is solved through different norms standards and directions (being shared/embedded knowledge). However such solution (this trend seems to be increasing latterly) readily reduces flexibility of agenda and organization… This fact needs not only competent and creative people ('knowing workers') as well as freedom granted by organization. Accepting suggested theory we should put such tacit questions within wider context of actual situation. Simple framework of such questions with possible results is apparent from the Figure No. 3 presented bellow.

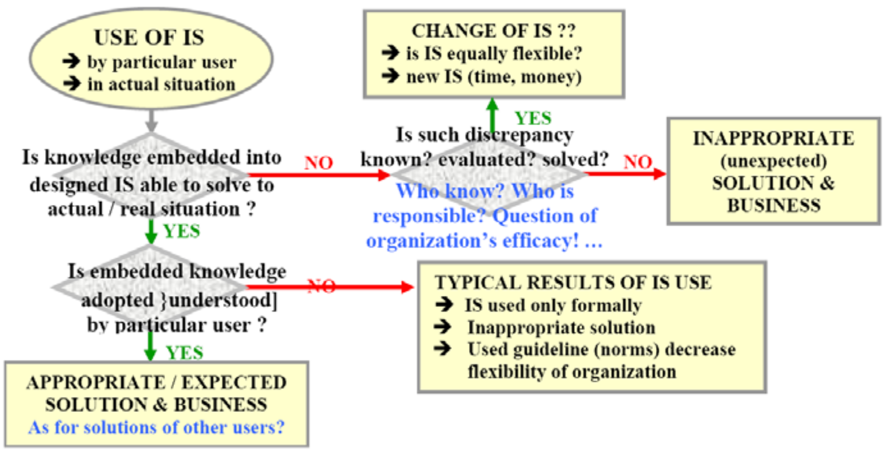


Figure 3 Social, cognitive and organizational contingency of information systems (success)

Although the specialists ignored the fact for a long time, the situation has changed as the result of technical potential, e.g. issue of Service Oriented Architecture that cannot fulfil the expectation without the comprehension of information and/or knowledge in context of management.

5. Cyberspace of globalization and knowledge society

Using communication technology (not only digital) we are overloaded by data (incorrectly by information) but without an appropriate individual knowledge we are not able to interpret them creatively and flexible as an act. On the contrary knowledge embedded into IS/IT have rigorous (and anonymous as well) character and it is often far from actual problems emerging from evolving user's environment increasing complexity. These issues makes demand on us to focus on social systems – as well business organizations or entire society – and raise an issue how to deal with arising complex situations where society evolves towards cyberspace. Beyond an appearing attention paid to higher flexibility of designed IS [12] and/or to DSS (needing a participation of user's knowledge for success). Other possible advancement lies in information and/or knowledge management based on human notion of both concepts explained in this article. Traditional thought stands for some misunderstanding: Information management is commuted into management of IT and knowledge management is restricted to use of IT (for example data mining). The second stream of KM oriented towards (learning) organization common concept is based on misguided of *organizational knowledge* that is only danger metaphor. Unfortunately both deals with knowledge as an item that is '*objectively defined*' in first case and '*socially constructed'* in the other. Our dealings with information and its mutual metamorphosis with (implicit) knowledge that covers such processes as '*abstraction*' or '*adoption*' [7] are penetrated with designed structures and influence nature and evolution of social systems.

With this conception of knowledge – of the nature of information, knowledge and technology - we would be aware of our responsibility to participate in extremely complex domain of information system. The design of IS/IT is the engineering process producing artefacts of its implementation and thus embedding standard knowledge into the organization and bounding its flexibility (diversity of actions). Similarly also the usage of ICT increases an amount of shared data that often go together with a lack of receiver's individual knowledge. The necessity to embody technologically oriented design within human based information/knowledge management appears more and more clearly. An emerging 'global brain' and flexibility of appropriate knowledge results from individuals and social structures (institutions incl. educational systems or managed science) as well as from the ways of IS/IT design and use. Maybe better familiarity with concepts of information and knowledge can explain our responsibility in this co-evolutionary and self-organizing process.

Above outlined nature of conceptual information - knowledge frames their emergent and unique character and constitutes quite new (social) phenomena as cooperation, management and government... Actual and informal power comes from individual knowledge and depends also on the ways of their communication within information environment, influenced by information technology in an essential way. Presented ideas of advanced systems theory gives information (and knowledge) into less known relationship with evolution. Bela Banathy [3] describes this substantiality through the next sentences:

> *... difficulties arise from a theoretical and methodological design framework that rests upon an underconceptualised notion of information.*
>
> *... in living systems in general, and social systems in particular, evolution and information are so tightly interrelated that it is not appropriate to discuss one without the other.*

Understanding and evaluation these words need adoption of principles of self-organization as well as the difference of both realities. To use another quotation from Maturana and Varela [20, p. 27] works - *All doing is knowing and all knowing is doing* – can illustrate their actual unity. At the same time points actual (non anthropic) nature of (conceptual) information that consist in human interaction within the (material) environment an/or communication within social systems. To accept that, we can disuse many familiarly known problems newly and/or we can discover some other that were not reflected by then. Let us mention just two of them: Due to dramatic growth of shared data (communicated as information) fluctuations within system of global world increase dramatically and change its complexity including uncertainty... Possibility of changes escalates especially on the boundary of cultures, where fluctuations are bigger. Cultural boundaries do not lie only between Western civilization and Islam, we can find them inside European Union. The problem of virtual reality outreaches commonly meditated problem of computer games and involves problems of ecology. Also decreasing sense of (material) reality approves oneself in many problems of socially rich states and/or in dilemma concerning ways how to prevent construction and potential use of NBC. Giddens [15] warns against another problem - strengthening dependence on external expertise that influences our everyday life. Accepting this idea Beck [5] points out the fact of existence and often inconsistency of various expertise(s) and calls our environment 'risk society'. According to these problems and to the character of shared information a discourse comes forward as a problem of fundamental importance. Thus shared discourses influence information environment and various information systems, services and institutions.

6. Conclusion

Mentioned ideas are recently accepted in systems theory that accents also other important concepts as fluctuation, complexity and self-organization. Information generally (in the sense of *unified theory of information*) plays in these evolutionary processes essential role. Some aspects of human knowledge outlined above enable understand the meaning of semantic information and its role from social systems including different organization and/or societies. With such knowledge – of the nature of information, knowledge and technology - we would be aware of our responsibility in extremely complex domain of information system. The design of IS/IT is the engineering process producing artefacts of its implementation embedding standard knowledge into the organization and bounding its flexibility (diversity of actions). Similarly also the usage of ICT increases an amount of shared data that often go together with a lack of receiver's individual knowledge. The necessity to embody technologically oriented design with human based information/knowledge management appears more and more clearly. In this way we are able to make the best account of IS/IT and to cut down undesirable incidence of embedded standards. Human nature of the conceptual information, as well as purposeful (and designed) ways of dealing with it, aims (cultural) evolution at globalization. An emerging 'global brain' and flexibility of appropriate knowledge results from individuals and social structures (institutions incl. educational systems or managed science) as well as from the ways of IS/IT design and use. Maybe better familiarity with information and knowledge can explain our responsibility in this co-evolutionary and self-organizing process. And for those who still believe in absolute power of information technology let us remind words of Vanda Orlikowski (prominent author taking interest in application IS/IT in management and organization) that argues distinctly [23]: *We are purposeful, knowledgeable, adaptive and inventive agents who engage with technology to accomplish various and changing ends.*

7. References

[1] Alter, S., Sidestepping the IT Artefact, Scrapping The is Silo, and Laying Claim to Systems, in: Organizations' Communication with the ACM, Vol. 1, article 30, 2003. www.aisnet.org/news/news2.shtml.

[2] Avgerau, Ch., Ciborra, C., Land, F., The Social Study of Information and Communication Technology, Oxford University publisher, 2004.

[3] Banathy, B., Information-based Design of Social Systems, in: Behavioural Science, Vol. 41, pp. 104, 1996.

[4] Bateson, G., Steps to ecology of Mind, Northvale, Jason Aronson Inc, 1972.

[5] Beck, U., Risk Society - Towards a New Modernity, Sage Publication, 1992.

[6] Berger, P., Luckman, T., The Social Construction of Reality. A Treatise in the Sociology of Knowledge, Doubleday, New York, 1966.

[7] Boisot, H., Knowledge Assets: Securing Competitive Advantage in the Information Economy, Oxford University Press, 1999.

[8] Checkland P., Scholes, Soft Systems Methodology in Action, J. Wiley, Chichester, London, 1990.

[9] Checkland, P., Holwell, S., Information, Systems and Information Systems, Wiley, Chichester 1998.

[10] Cilliers, P., Why We Cannot Knot Komplex Things Completely, in: Emergence, Vol. 4, No ½.

[11] CAIS Communication of the Association for Information system, Vol 12; 2003.

[12] Ciborra, C., A Theory of Information Systems Based on Improvization, in: Rethinking Management Information Systems (Currie & Galliers eds.) Oxford University Press, New York, 1999.

[13] Foerster von, H., (ed.) Cybernetic of Cybernetic, 2nd ed., Futue Systems, Inc. Minneapolies, 1974.

[14] Gershenson, C., Heylighen, F., How can we think the complex?, http://www.vub.ac.be/CLEA, 2004.

[15] Giddens, A, The consequences of modernity, Polity Press, Cambridge, 1990.

[16] Hofkirchner, W., The Quest for a Unified Theory of Information, Gordon & Brecich, 1990.

[17] JAIS Journal of the Association for Information system, Vol 1, 2003.

[18] Krogh von, G., Ichijo, K., Nonaka, I., Enabling Knowledge Creation, Oxford UP, London, 2000.

[19] Lévy, P., Rapport au Conseil de l'Europe, Éditions Odile Jakob; Paris, 1977.

[20] Maturana, H., Varela, U., The Tree of Knowledge, Shamhala, Boston, 1998.

[21] Mingers. J., Social Theory and Philosophy for Information systems, Plenum, New York, 2004.

[22] Nonaka, I., A Dynamic Theory of Organizational Knowledge Creation, in: California Management Review 5, 1995.

[23] Orlikowski, W., Using Technology and Constituting Structures: A Practice Lens for Studying Technology, in: Organizations, Organization Science, 11. 4. 2000.

[24] Prigogine, I., From Being to Becoming: Time And Complexity in the Physical Sciences, Freeman, San Francisco, 1980.

[25] Polanyi, M., The Tacit Dimension, Garden city, New York, 2000.

[26] Rosický, A., Information within the (Human) System: Considerations Of Freedom, Power and Order, in: Synergy Matter, Plenum New York, 1999.

[27] Rosický, A., Information generating system: Towards concept of information generating social systems, EMCSR, Vienna, 2002.

[28] Salthe, S., The Natural Philosophy of Ecology: Developmental Systems Ecology (Infodynamics), 2002, http://www.nbi.dk/~natphil/salthe/natphilecol.2001.html

[29] Senge, P., Through the Eye of the Needle, in: Gibson, R. (ed.) Rethinking the Future, Nikolas Breadley Pub., London, 1996.

[30] C. P. Snow Science and Government, The Godkin Lectures at Harvard University, New York, 1962.

[31] Stanford Encyclopedia of Philosophy [2005] http://plato.stanford.edu/contents.html#k (15. 09. 2005).

[32] Strawman, S., Computing Curricula 2004 - Overview Report, http://as.nida.ac.th/resource/pdf/ Overview_ Draft_11-22-04.pdf (15. 07. 2005).

[33] Stonier, T., Information and the Internal Structure of the Universe, Springer, London, 1990.

[34] UKAIS [1996]: UKAIS Newsletter.2(1), 1996.

[35] Weaver, W., Science and Complexity, in: American Scientist, vol. 36, p. 536-544, 1948.

[36] Weinberg, G., An introduction to general Systems Theory, Dorset House, Pub. New York, 2000.

[37] Winograd, T., Flores, F., Understanding Computers and Cognition, Ablex Pub. Norwood, 1986.

SYSTEMIC APPROACH TO INFORMATION ALIAS A PAPER TOWARDS THE HUMAN PERSPECTIVE IN INFORMATION PROCESSING

Tomáš Sigmund*

In the system thinking the human perspective on things has been somehow neglected. This text is trying to show some differences between mechanistic processing information by machines and human perspective on information processing. It deals with rule following, pattern recognition, social character of man and the way he perceives the world.

1. Introduction

System sciences as a transdisciplinary, interdisciplinary and multiperspectival domain equally bring together principles and concepts from ontology, philosophy in general, philosophy of science, physics, biology and engineering as well as geography, sociology, political science, psychotherapy (within family systems therapy) and economics among others. In my paper I'd like to discuss the perspective from which human beings perceive information. This perspective is of course phenomenological, but represents a necessary point of view from which the world and information about it give itself. Another point of view is the cosmological or objective perspective represented by positive sciences. Both these perspectives are somehow interrelated as we perceive the world as a unity.

Prof. W. Hofkirchner tries in his unified theory of information to unify both these perspectives. Holding just one perspective amounts to either reductionism or projectionism (identity without difference) or dualism (difference without identity). The only true perspective for him is the dialectical one (identity in line with difference). I consider this dialectical approach to be very illuminating as it stresses both sides of the complex problem equally. However I think some of the system sciences confine themselves to one, usually the scientific side. That is the reason why I would like to mention the phenomenological side. I

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also think it can tell us more than it seems. The reflection of our perceptions can learn us a lot about the way humans exist in the world and perceive and process information. The important fact however is, it is not the only way the world gives itself to us. As Merlau Ponty points out:

“If I touch with my left hand my right hand while it touches an object, the right hand - object is not the right hand touching: the first is an intertwining of bones, muscles and flesh bearing down on a point in space, the second traverses space as a rocket in order to discover the exterior object in its place.” [6]

“I can identify the hand touched in the same one which will in a moment be touching … In this bundle of bones and muscles which my right hand presents to my left, I can anticipate for an instant the incarnation of the other right hand, alive and mobile, which I thrust towards things in order to explore them. The body tries to touch itself while being touched and initiates a kind of reversible reaction.” [7]

I can see two connected ways how to dialectically interweave the two perspectives. The first is the human action and the second one is narration. Our body lives and acts in both these worlds and its action can then be represented in the narration.

2. The human perspective

Now let’s turn to the notified area of human world as a phenomenon. If possible, I’ll try to differentiate the human perspective from the technical or mechanical one a little. A very nice analysis of this topic can be found in books of H. Dreyfus. [3] [4]

Given the nature of computers as formal symbol processors artificial intelligence presupposes understanding consists in forming and using appropriate symbolic representations. It uses the old Cartesian idea representations consist of simple ideas (inborn or perceived), the Kantian idea concepts are rules for relating these ideas and Frege’s proof such rules could be formalized and manipulated without intuition and interpretation. Artificial intelligence looks for primitive and formal rules to capture the human knowledge. It tried to represent human understanding in the form of huge data structure comprised of facts and rules for relating these facts.

3. Rule following

It turned out however that in order to grasp human understanding we have to understand the common sense background helping us to understand what is really relevant together with the feelings, emotions, motivations and bodily capacities. Our background knowledge consists of skills for dealing with things and people rather than rules and facts about them. When we do something we usually don't follow any rules. Following rules may be quite helpful at the beginning, but will be disturbing when somebody tries to master an activity. After one understands the domain, one sees meaningful aspects, not context free features. At the next stage the learner learns to set goals and perceive the situation in terms of what is relevant for achieving these goals. A further stage is achieved when a player is able to see a situation as having a certain significance and tending toward a certain outcome. E.g.: In chess masters would observe after a few seconds that to win white must attack the king side. After even more experience one reaches a level where he sees immediately what must be done.

We are not only able to cope with changing events and motivations; we are to project our understanding into new situations. One can sometimes do what has not so far counted as appropriate and can it recognize in retrospect as having been just the right thing to do. I can give three more examples: swimming, combat sports and yawning. We don't think on any rules when we swim. And to use the example of H. Dreyfus [5], we use training wheels when we learn how to ride a bicycle, but we don't use invisible wheels after we have learnt it. Even metaphors cannot be simply said to contain any similarity to the objects they stand for. As Searle points out if I say Sally is as a block of ice, no distinctive quality of a block of ice would be true for Sally. Searle thinks there are whole classes of metaphors that function without any underlying principle of similarity. It seems to be a fact about our mental capacities that we are able to interpret certain sorts of metaphor without the application of any underlying rules or principles other than the sheer ability to make certain associations [8].

Whenever human behavior is analyzed in terms of rules these rules must contain a "ceteris paribus" condition and what "anything else being equal" means in any specific situation can never be fully spelled out without a regress. The "ceteris paribus" points to a background of practices which is the condition of the possibility of all rule-like practices.

4. Situation

Our position in the world does not consist of objects; it is more than a sum of objects and may be called a situation referring to other situations and to the world. The situation consists of possibly relevant facts, actually relevant facts and essential facts. Open-structure problems, unlike games and tests, raise three sorts difficulties related to these types of facts. One has to decide which facts are possibly relevant; which are actually relevant; and among these which are essential and which are inessential. In a given situation not all facts belong into the realm of possible relevancy. In the context of a chess game the weight of the pieces is irrelevant. It can never be important let alone essential or inessential for deciding on a specific move. What counts as essential depends on what counts as inessential and vice versa and the distinction cannot be decided in advance, independently of some particular problem. In real world the list of possibly relevant facts is infinite. Two questions remain: 1) how to restrict the class of possibly relevant facts while preserving generality; 2) how to choose among possibly relevant facts those which are actually relevant.

It is not quite clear what it is that enables people to orientate in their world. Human beings are somehow already situated in such a way that what they need in order to cope with things is distributed around them where they need it, not packed away like a trunk or even indexed in a filing cabinet. This system of relations which makes it possible to discover objects when they are needed is our home or world. Some facts of our natural history are taken for granted in our use of language and in structuring our everyday activities. But these aspects of things that are most important for us are hidden because of their simplicity and familiarity. (One is unable to see something because it is always before one's eyes.)

Facts are not relevant or irrelevant in a fixed way but only in terms of human purposes. There are no neutral and brute facts. The human world is prestructured in terms of human purposes and concerns in such a way that whatever is significant is a function of that concern. Freedom from concern leads to nihilism.

Our body and perceiving the world through it is also crucial in:

- Being able to make sense of things (to see what is relevant)
- Being able to let things matter to us and so acquire skills
- Our sense of the reality of things

- Our trust in other people
- Our capacity for making the unconditional commitments that give meaning to our lives

The bodily skills enable us to recognize objects in each single sense of modality (e.g. as Melrau Ponty says to learn to feel silk, one must learn to move or be prepared to move one's hand in a certain way and to have certain expectations) and through them we can see and touch the same object.

5. Pattern recognition

When people recognize a face they don't measure any proportions, they don't search through any lists of traits, they just know whose face it is. An important role in this recognition play two horizons, background or outer horizon which is never determinate, is ignored but not excluded, and the inner horizon which means we are aware of more than the perceived facts and that past plays an important role in our perceptions. Machines come from detail to the whole we go the other way round. When the expected process breaks down we are disoriented, we don't know which context is valid.

What counts as a part is defined in terms of the whole, the principle of organization cannot be separated from the elements it organizes. The body confers meaning, responds to rhythm, recognizes patterns etc. In our perceiving the anticipation of future aspects is very important. The anticipation is transferable to other contexts. What we have learnt in one context is transferred to another.

As I have mentioned in our perceptions two forms of awareness are involved. First there is the basic figure-ground phenomenon, necessary for the existence of the perception. Whatever appears in our experience and draws our attention appears on a horizon which remains more or less indeterminate. This background which needn't be determinate affects the appearance by letting it appear as a unified, bounded figure. This is the outer or ground horizon. This horizon is indeterminate and yet provides a specific context so that one has always a sense of the relevance of some facts. For a computer any information must be as determinate as the figure itself. This horizon describes how some information is ignored without being excluded.

There is a second horizon, however, explaining the way background provides information for the perceiver. This second horizon is inner and is not as indeterminate as the outer horizon. It is something-more-than-the-figure as H. Dreyfus puts it. When we perceive an object we are aware it has more aspects than we are at the moment considering. Once we have experienced these further aspects they will be experienced as copresent, as covered by directly presented phenomenon. This process of referring from horizons to the object and the whole situation can be best noticed when it breaks down. If one thinks he will be drinking water but is actually drinking milk by mistake, his reaction is disorientation. He doesn't taste neither water nor milk. A computer could be at best programmed to try some hypotheses and pick the one suiting the data. But it is far from the human interaction.

6. Bodily presence and virtual existence

Tools we work with form part of ourselves, they are similar to our bodies and are not part of objective space and time.

The idea that we can live without our bodies in the virtual space of internet is not plausible. There is always a trade-off between what the internet offers and what it takes away:

- Relevance x scope of information
- Quality x quantity of information
- Real x virtual in our relation to things and people
- Commitment x anonymity
- Efficacy x economy
- Mastery, Expertise, Skills x competence
    - less involvement - taking risks, accepting approval or criticism in front of others is missing
- Telepresence is parasitical on real presence
- Disembodied nihilism x embodied meaning (commitment, vulnerability, embodied finitude)

As for the virtual space of the internet H. Dreyfus [1] suggests some hints and how to use it reasonably and what the future trends may be:

[1] See his book On the Internet

- New group of professional (in specific area) intermediaries may soon arise who respond to meaning
- Combination of distance learning with bodily presence. Only emotional, involved, embodied human beings can become experts. Teachers must contain and encourage involvement.
- Machines cannot behave like humans and that's why people will have to learn to behave like robots (telepresence). The sense of our power and vulnerability related to our bodily presence is indispensable.
- Net may lead to isolation, loneliness and depression (Japan). It can also foster cooperation.
- Athenian agora is the opposite of the virtual public space where anonymous kibitzers from all over the world risk nothing.
- Aesthetic people live in a world of intense feeling and lively communication, but the drama is like a game, it has no real world consequences and risks. People can enter and leave the virtual community easily. Experience turns into a play. The danger comes up when game becomes more attractive than dangerous real life.

7. Public realm

The horizons of things are related to public realm. Objectivity means publicity. As H. Arendt puts it:

The term public signifies two closely interrelated meanings:

1. "It means first that everything that appears in public can be seen and heard by everybody and has the widest possible publicity. For us, appearance - something that can be seen and heard by others - constitutes reality. Compared with the reality which comes from being seen and heard, even the greatest forces of intimate life lead an uncertain, shadowy kind of existence unless and until they are transformed, deprivatized and deindividualized, as it were into a shape to fit them for public appearance. The most current of such transformations occurs in storytelling" [1].
   So the term refers to public institutions like town hall meeting, parliament assembly and to some extent even to business affairs.

2. “Second the term public signifies according to Arendt the world itself, in so far as it is common to all of us and distinguished from our privately owned place in it. To live together in the world means essentially that a world of things is between those who have it in common as a table is located between those who sit around it; the world as every in-between relates and separates men at the same time” [2].

It means human being in the world is always being with others. Man is a social being and when he is alone it is the aspect of his social existence. Private life is only derived from the public one.

8. Conclusion

In these few remarks I attempted to highlight some features of the human perspective on the world. This perspective should be included in a wider dialectical perspective and should serve as a base for a comprehensive system thinking taking into account the human phenomenological aspect of world perception and understanding and processing information. Because management and managers deal with people they should understand their complex nature. We saw three dialectical relations at work in this text. Cosmological perspective of machines and phenomenological human perspective; partial mechanistic perspective and holistic human view; private and public space. It is very difficult to unify them and to find one comprehensive description. They are interrelated but cannot be reduced to one aspect only. In order to formulate a credible theory of information we have to be aware of the complexity of the world.

9. References

[1] ARENDT, H., Vita activa oder Vom tätigen Leben, W. Kohlhammer GmbH, Stuttgart, 1960, page 49-50

[2] Ibid, p. 52

[3] DREYFUS, H., On the Internet, Routledge, New York 2001

[4] DREYFUS, H., What computers still can’t do: a critique of artificial reason, MIT Press, Cambridge, Massachusetts, 1992

[5] Ibid, p. xiii

[6] MERLEAU-PONTY, Phenomenology of Perception, Routledge, New York, 2002, page 92

[7] Ibid, p. 93

[8] SEARLE J., Intentionality: An essay in the philosophy of mind, Cambridge University Press, Cambridge, 1983, p. 149

Enterprise Application Integration

ENTERPRISE APPLICATION INTEGRATION, A METAMODEL APPROACH

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The focus responsibility of the IT-specialists in the last decades was to develop applications that support different business functions and processes. For today the enterprises are well equipped with IT-devices and applications but in most cases these run separately: in various business units, on different platforms and also they are working with data formed on other ways and stored in different media and places. Beside the force to integrate systems and to fulfill the on-line needs of entrepreneurs, customers, citizens etc. there is an urgent need for inter-organizational cooperation. Although in the last years the participants of the IDIMT discussed already problems and solutions of EI/EAI there are several highlights worth to mention. This year we plan to focus not only the present technologies but also effective principles and solutions, such as for example the Enterprise Integration MetaModel

1. Introduction

The Enterprise Application Integration (EAI) is a conceptual IT category, which unites methods, techniques and tools, integrates applications within the enterprise environment in real-time. In order to benefit from the integration of the legacy systems and the new applications, the CEO and the CIO are forced to utilize the advantages of the EI technology. The targets, the functionality of the systems are described in different forms; the features are expressed from different point of view depending on the specification scopes. The integration process can relate on several components of the organization, so it is possible and in most cases desirable to integrate

- business units of the inter-organizational enterprises,
- functions and processes enterprise wide or partial by subsystems,

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- requirements of the entrepreneurs, managers and/or employees,
- investments and costs of different business units,
- business components with or without IT,
- products, technology, resources, infrastructure,
- IT systems: infrastructure, applications, data,
- the corporate knowledge etc.

Having the enterprise integration in sight and focusing on applications it is important to restrict the definitions. The Gartner's definition seems to be the most appropriate one: *The enterprise integration is an emerging category of products that provides messaging, data transformation, process flow and other capabilities to simplify the integration of enterprise resource planning, legacy and other applications* [1]. It means that the EAI is the creation of new strategic business solutions by combining functionality of an enterprise's existing applications, commercial packaged applications and new code using a common middleware [9]. For today the integration is not a technical issue anymore; it is not only an efficient tool to solve the communication problems between different subsystems, but it is interpreted as the usage of the architectural software and computer systems principles to integrate a set of enterprise computer applications.

But the developers managing integration projects have to face problems, because 70% of all EAI projects fail. Most of *the failures* are not due to the software itself or technical difficulties, but due to *business and management issues*. As the situation is not changed for today considerably, the European Chairman of EAIIC has outlined seven main pitfalls undertaken by companies using EAI systems and explains solutions to these problems [11].

- *Constant change:* The dynamic nature of EAI requires dynamic project managers.
- *EAI is a paradigm:* EAI is not a tool, but rather a system that should be implemented.
- *Lack of EAI experts:* EAI requires knowledge of many issues and technical aspects.
- *Competing standards:* It is paradox that EAI standards themselves are not universal.
- *Building interfaces is an art:* It is not sufficient to engineer the solution; it is needed to cooperate with user departments to reach a common consensus on the final outcome. A lack of consensus on interface designs leads to excessive effort to map between various systems data requirements.

- *Loss of details:* Information that seemed unimportant at an earlier stage may become crucial later, e.g. in the final phase.
- *Accountability:* Since so many departments have many conflicting requirements, there should be clear accountability for the system's final structure.

Other potential problems may arise in the areas of:

- *Emerging Requirements:* EAI implementations should be extensible and modular to allow for future changes.
- *Protectionism:* The applications whose data is being integrated often belong to different departments which have technical, cultural and political reasons for not wanting to share their data with other departments.

As the requirements can be satisfied only by effective methods and tools the IT-professionals are responsible for reorganizing the existing computing systems in order to save the information assets. Making efforts to improve efficient solutions for EI, it is useful to apply modeling paradigm as a proven and well-accepted engineering approach. Disregarding the detailed analysis of the modeling concept I would like to focus only to the key factor of the effective EAI process.

2. Paradigms for EAI Process

2.1. Enterprise Modeling

An enterprise model is a computational independent representation of the structure, activities, processes, information, resources, people, behavior, goals and constraints of a business, government or enterprises. By NAYLOR's definition a model is "... an attempt to describe the interrelationships among a corporation's financial, marketing and production activities in terms of a set of mathematical and logical relationships which are programmed into the computer." [4] These interrelationships should represent in detail all aspects of the firm including "... the physical operations of the company, the accounting and financial practices followed, and the response to investment in key areas" [2]. Enterprise modeling is the process of improving the enterprise performance through the creation of enterprise models. This includes modeling both of business processes and IT.

The modeling of the enterprise network could facilitate the creation of enhanced understanding of every business processes and the relations that extend across the boundaries of the enterprise. In this way a fast understanding can be achieved about how business functions are working throughout the enterprise and how they depend upon other functions of the organization. There are several techniques for modeling the enterprise such as active knowledge modeling, process modeling (CIMOSA, PERA, LOVEM and DYA etc.), object-oriented modeling and/or modeling the enterprise with multi-agent systems. Summarizing the most important features of the enterprise mapping process it is desired to state, that this concept is not a new idea, but it is an accepted architecture

- for integrating what you have built with what you are building and/or what you are going to build,
- for declaring the implementation of one or more platform-specific models (PSM) based on the platform-independent model (PIM),
- for remaining flexible in the face of constantly changing infrastructure,
- for lengthening the usable lifetime of the software, lowering maintenance costs and raising ROI (Return of Investment), and
- for having much more important role than ever before.

2.2. Model Driven Engineering

The Model Driven Engineering (MDE) refers to the systematic use of models as primary engineering artifacts throughout the whole engineering lifecycle. MDE can be applied to software, system and data engineering. In order to solve the integration problems effectively there appeared already attempts to give proposals for model driven development process. The leading companies are pressed to define and work out general frameworks. The OMG (Object Management Group) Task Force –being responsible for the standardization– elaborated and in 2005 accepted the MDA as a framework for realizing the model driven engineering concept. The Model-Driven Architecture is an innovative approach to construct enterprise architecture by abstracting and visualizing business requirements in the form of platform- and technology independent models with separating implementation details from business functions [3], and giving a chance for Rapid Enterprise Integration [8].

2.3. The Metamodel Concept

Before creating a metamodel, we have to make the term of metamodel clear. The word meta is a prefix used in order to indicate a concept which is an abstraction from another concept for completing or adding to the latter. The Greek word *meta* is equivalent to the Latin word *post*. In epistemology, the prefix meta**-** is used to mean something *about its own category*. For example, metadata are data about data (who has produced it, when was it produced, what format the data are in and so on).

Most general, metamodeling is the analysis, construction and development of the frames, rules, constraints, models and theories applicable and useful for the modeling in a predefined class of problems. This concept is composed with the notions of the terms meta- and modeling. *A metamodel is a precise definition of the constructs and rules needed for creating semantic models.* Metamodeling is the construction of a collection of concepts (things, terms etc.) within a certain domain. As a model is an abstraction of phenomena of the real world, a metamodel is yet another abstraction, highlighting properties of the model itself. It is the abstract language for defining different kinds of metadata. From computational perspective, this concept is used practically in computer science and also in computer/software engineering process. From another approach the metamodels are closely related to ontology, as both are often used to describe and analyze the relations between concepts [10]; consequently a valid metamodel is an ontology, but we must make absolutely clear that not all ontology are modeled explicitly as metamodels. The metamodel can also be considered as an explicit description (constructs and rules) of how a domain-specific model is built. In particular, this comprises a formalized specification of the domain-specific notations.

Accordingly let us put the question: *what are the metamodels good for?* We can give several answers depending on the purpose for which any given metamodel was developed. In most cases the common purpose is (1) to give a *schema* for semantic data that needs to be exchanged and/or stored in a repository, and (2) to define a *language* that supports a particular methodology or process. In this sense the *metadata* is a general term for data that *describes information about models and their data (features)*. The model gets here broader meaning as usual, in computer science the model means any collection of metadata that is related in the following ways:

- The metadata describes information that is related with itself in some way.

- The metadata fully conforms to rules governing its structure and consistency; that is, it has a common abstract syntax.
- The metadata has real meaning in a common semantic framework.

In the last years I was working on developing a generally usable metamodel that has all information about the enterprise models let they express semantics of the enterprise features (business units, relations, processes, behavior) or the information and IT-domain.

3. The Enterprise Integration MetaModel

An Enterprise Integration MetaModel (EIMM) has to involve information about models created on different mapping levels. In my research work I focus on developing a metamodel that describes the components, architecture and characteristics of all models reflecting to the corporate features from different views, and that supports the enterprise integration process. Designing a generally applicable metamodel it is important to use the standards, modeling and transformation tools that help to realize the enterprise wide integration. The first step for defining a metamodel is to distinguish the different enterprise models (see Table 1) and than to define the metamodel architecture itself.

Table 1. Model Classification Viewpoints and the Categories

Model Classification	Model Categories
modeling aims	the target of the mapping/modeling process
model creation	defined by creation date, mapping methods
model types	depending on modeling subject: industrial, trade, healthcare etc. models
mapping approach	the general concept and philosophy (paradigms) used during the mapping process
model views	*from actors' point of view:* users, owners, developers view
	from system approach: components, architectural, process, actor, control, methods, behavior, business units, devices etc. views
model details	specification levels differentiating in details of model definitions
mapping levels/layers	domain, business, platform-independent, platform-specific, implementation, deployment, operation etc. levels
used modeling tools	process mapping tools, standards, modeling languages, executable transformation tools,
model interfaces	*interface issues:* generated, received etc.
	interface form: paper, electronic, etc.
data models	data forms, management systems
transformability	platform identity, common interfaces, transformation tools

3.1. The Metamodel Architecture

The Enterprise Integration MetaModel is a framework for defining metadata, representing the integration process currently underway in the areas of object repositories, object modeling tools and a meta-data management in distributed business environments. Since there are many possible kinds of metadata in a system, the EIMM has to contain information about many different business models, which are integrated by defining a common abstract syntax specified for metamodels [5].

Although a model represents the functionality, the structure or behavior of a system, the models can perform its purpose only if we separate the domain specific information from the business details, and the relevant business-specific information from the technical details and the complexity of its implementation. In order to meet every demand of integration needs the EIMM has to be developed for solving these requirements. A *three layered architecture* of the enterprise metamodel logically follows the mapping process: business domain, business and design (object) models. These models satisfy the needs for generating clear understandable models that are already cleaned from the elements and features not relevant to the developing purposes. The EIMM is a generally applicable model that involves all information necessary to the integration process.

3.1.1. The Business Domain Layer

The first level of the abstraction is *the business domain layer,* which reflects the main characteristics of the business processes, the process and organizational elements and their relations. This model is often called *Computational Independent Model* (CIM), because it focuses on the real processes, the system features, the functionality and the nature of the modeled system. The components of the domain model appear in different forms, and are handled and stored in different business units. Some of them are described verbally, some are expressed graphically; they can be expressed in different forms, are found in different documents, and on different workplaces.

3.1.2. The Business Model Layer

In order to have a correct base for enterprise wide and inter-organizational integration it is necessary to separate the unimportant components and features, and to map the domain model to business model. This abstraction process results another set of models that relates to different part of the system and reflects it from different views [6]. The Business Model Layer (problem domain, business logic, different views of business and analysis model) plays definitive role in creating a correct enterprise metamodel, not only because it constitutes the basis of the enterprise-wide integrated system, but also because it identifies and controls the deployment, maintenance and the software quality assurance.

3.1.3. The Design Model Layer

Going on the mapping process the developers have already information about the analyzed organization. The model set that shows the internal features and also the external relations of the given organization can be expressed as a number of classes. These classes represent both the static and the dynamic approach of the system. As the main purpose of the abstraction process is to have information for integration, it is necessary to have unambiguous specification about all subsystems let it be manual operated, fully/partly computer aided, stand alone and/or partly integrated. The object model is the right one for mapping the system and for expressing the relations and the static/dynamic features. It is also destined for being the starting point of the next integration process steps. The different model views that reflect the functionality and the nature of the system on a higher abstraction level have to base on the object model. The classes represent metadata information about the business models, and express the relations and characteristics of these models.

Each class in the EIMM object model represents a special view of the business domain model, and involves data about these models. In this metamodel it is practical to separate the classes into three packages.

1. The business package (businessPackage) involves all the corporate models that are described in different forms and languages (e.g. textual, diagram, matrix, graph form). This package contains 6 classes with information about business units, processes, resources, strategy and programs, rules and laws and the organizational environment models.
2. As the IT plays special role in the organization with providing different services it is necessary to distinguish their components from the business elements. The computer system can be analyzed also from different views. From integration point of view it is required to separate the infrastructure from the running system. The system package (systemPackage) contains two classes involving metadata about the information infrastructure and the information system models.

3. The modeling language package is to fulfill the requirements that are suitable for automated interpretation. This package contains a metalanguage class and a transformation rules class

4. Conclusions

The EIMM containing information about the different enterprise models is a powerful base to start the integration process. Filling the repository with model information up, the developers are able to design and create integrated systems of high level by knitting the preexisting islands, the manual operated and the computer aided systems together. This is an effective way to satisfy user's requirements rather than to develop and/or buy new integrated enterprise systems. But under the pressure of need to reach low production cost, high quality of enterprise-centric computing, the software industry and the professionals have to face more and more increasing challenges. Anyway the enterprise integration architecture with EIMM provides an efficient framework in which the effective legacy systems in cooperation with the newly developed software can continue their function on a very competitive way with only a few losses of human, material and technological resources. Summarizing the essence of the enterprise metamodel concept we have to consider both the advantages and the disadvantages:

1. Advantages:
   - The EIMM realizes the real time information access among systems.
   - Business processes can operate streamline and raise organizational efficiency.
   - The maintainability of information integrity across multiple systems is increasing.
   - EAI implementation period can shorten, the required resources reduce.
   - It helps to save information and IT assets making enterprise performance much more effective.
2. Disadvantages
   - The small businesses cannot undertake the high costs of the integration process or event the purchase of an integrated system.
   - Using the EIMM metamodel require a fair amount of up front design, which many managers are not able to envision and/or not willing to invest in.

The model driven EAI technologies are still being developed and there isn't a consensus on the ideal approach or on the appropriate technology sets a company should use. With developing enterprise integration metamodel I intended to give a generally applicable framework for the developers contributing to the efforts that many institutes and professionals make in order to increase the effectiveness of the enterprise integration.

5. References

[1] GartnerGroup Inc. Glossary: www.gartner.com

[2] Gershefski, G. (1971) "What's happening in the world of corporate models?", *Interfaces*, Vol 1, No 4.

[3] J. Bézivin (2001): *From Object Composition to Model Transformation with MDA* – Conference IEEE-Tools-39, Santa Barbara, USA

[4] Naylor, T. (1970): *Corporate simulation models and the economic theory of the firm*, in Schrieber, A. (editor) "Corporate simulation models", University of Washington Press, Seattle, pp 1-35.

[5] *OMG Meta Object Facility V 1.4* – http://www.omg.org/ ; OMG April, 2002

[6] Raffai, M. (2002): *Increasing IS Requirements and New Engineering Technologies* – 10th Interdisciplinary Information Management Talks Conference, Zadov; Schriftreihe Informatik, Universitätsverlag Rudolf Trauner; Pages: 257-275.

[7] Raffai, M. (2003): *The UML-based Transformation of the Domain Model - Modeling Strategy for the Enterprise Application Integration* – Conference on Business Information Systems, Gyor

[8] Raim, M. (2002): *Implementation Infrastructure: Enablers for Rapid Enterprise Integration* – OMG Information Day

[9] Ruh, W.A.–Maginnis, F.X.–Brown, W.J.(2001): Enterprise Application Integration: a Wiley Tech Brief – John Wiley & Sons.

[10] Söderström, E.B. – Andersson, P. – Johannesson, E. – Wangler. B. (2001): Towards a Framework for Comparing Process Modeling Languages – Lecture Notes In Computer Science; Vol. 2348. Proceedings of the 14th International Conference on Advanced Information Systems Engineering. Pages: 600 – 611.

[11] Trotta, G. (2006): Dancing Around EAI 'Bear Traps'. Retrieved on 2006-06-27

BUSINESS PROCESS MANAGEMENT (BPM)

Vlasta Svatá

BPM, in various forms has been around for the last 10 to 15 years. It consolidates objectives and methodologies, which have been proposed in a number of approaches including Business Process Reengineering, Process Innovation, Business process Modelling and Business Process Automation/Workflow Management. Each of this term represents different stage of business process understanding. The current realization of this term is strongly influenced by the new information systems architecture, which is called SOA (Service Oriented Architecture). The main aim of this paper is to present different views over this subject which can help bring more understanding of future challenges in the area of systems management.

1. BPM as a Management Approach

What is the relation between the BPM a management theory itself? Answering this question we have to define and relate at least three next terms: management, process, system. Different authors define the term of management differently. They even cannot agree on whether to apply the term management or leadership[1]. There exist many definitions of management. Great majority of them exploits the term process, e.g. management is

- the organizational process that includes strategic planning, setting; objectives, managing resources, deploying the human and financial assets needed to achieve objectives, and measuring results,
- the process of getting activities completed efficiently with and through other people,
- the process of setting and achieving goals through the execution of five basic management functions: planning, organizing, staffing, directing, and controlling; that utilize human, financial, and material resources,
- the process by which conservation is made possible, etc.

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[1] Peter Drucker didn’t admire leadership per se, remarking once, „The three greatest leaders of the 20th century were Hitler, Stalin and Mao. If that’s leadership, I want no part of it“.

The goal of management is to provide desired results effectively and efficiently. This is done through the use of resources in specific applications or context. Michael Klimesh[2] developed a 3-dimensional view of management [5], shown below. It illustrates that management *activities* are applied to *resources* in a *context*.

There are five management *activities*:

- Planning – identifying and deciding what to do and how to do it. Planning activities provide goals and expectations.
- Implementing – consisting of the following three sub-activities.
  - Arranging – deciding on the proper organization and relationship of resources and processes to achieve the desired results or outcomes most efficiently and effectively, i.e.,
  - Sourcing – locating and getting all the resources and processes needed to achieve the
  - Orchestrating – directing, coordinating, synchronizing, and symphonizing resources in changing and dynamic environments.
- Control – measuring and monitoring actual performance, comparing it to expectations, evaluating differences, and providing direction for adjusting arranging, sourcing, and orchestrating activities or changes to the plan.

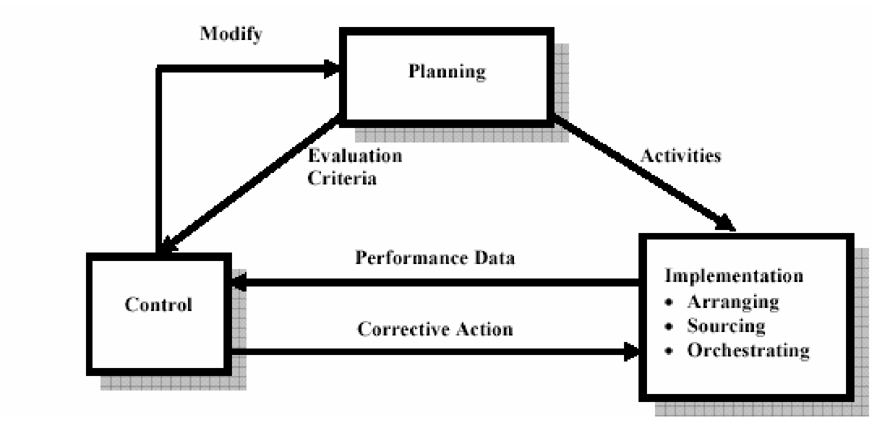

Figure 1 -The 5 primary management activities and their relationships [5]

[2] Michael Klimesh, visiting Assistant Professor, Department of Economics and Management, Gustavus Adolphus College

Resources include people, money or capital, machines, facilities, materials, energy, information, time, proximity, intellectual property, technology, and a whole lot more.

Systems (applications or context) are almost limitless. Here are a few: business, personal, domestic, civic, leisure, technical, manufacturing, marketing, sales, distribution, medical, and promotion. You can get very specific systems; for example Skoda Mlada Boleslav instead of manufacturing.

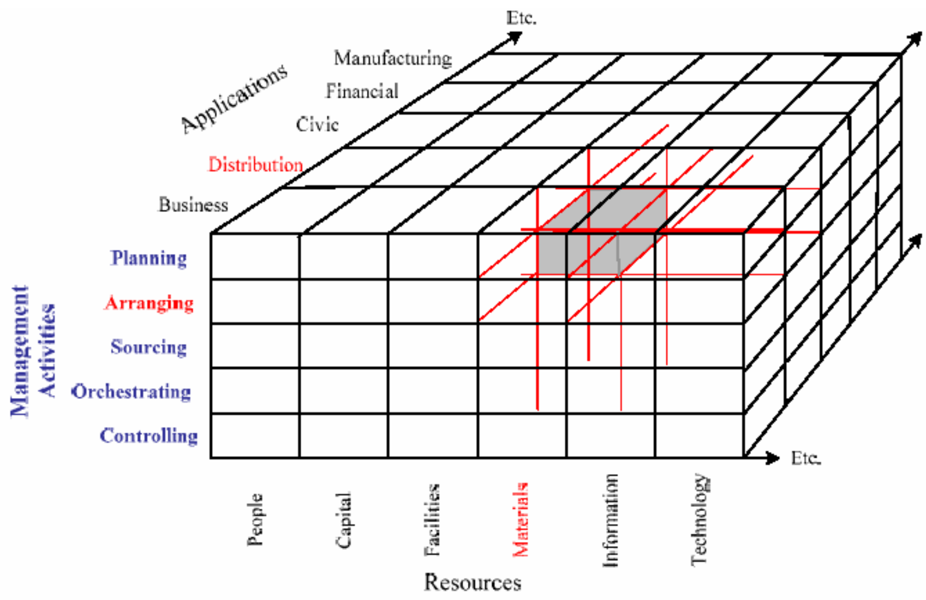

Figure 2: Arranging materials for a new distribution centre [5]

The small cube (see Figure 2) represents one of the cubes that could be in the interior of the graphic – arranging facilities for a new distribution centre. The differences in the sets of *resources* applied and the *applications* or *contexts* in which they are applied make kinds or forms of management different from one another. And so, marketing management is different from production management because it uses a different set of resources than production management and applies them in a different context. There are many different kinds of management, including people management, time management, financial management, information management, asset management, sales management, outsourcing management, energy management, leisure management, risk management, administrative management, systems management, and more.

Each of these types of management is in the same time business process. Processes and systems (applications, context) are essential to the definition of management. Without processes, management activities would be random and would not work together as a whole.

But for the true effectiveness, management processes must themselves be managed. Having a documented, structured process makes it easier to improve and tailor it to different situations.

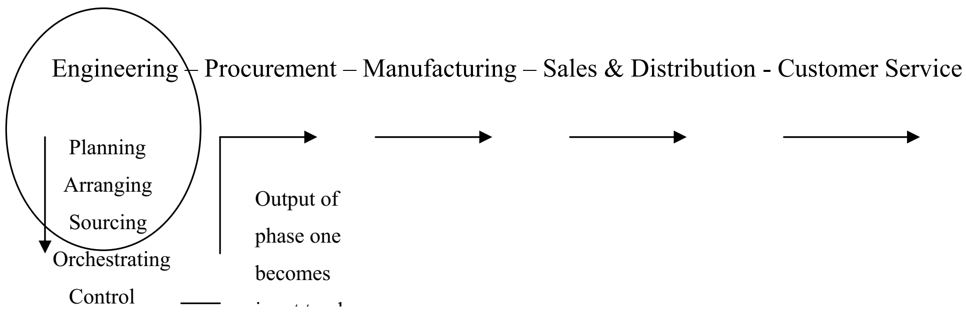

Figure 3 - Relation between management activities and business processes

The traditional definition of business process says: process is a set of logically related activities or tasks and is aimed at achieving a certain result. In relation to management theory presented above, **the business process can be defined as a set of management activities (planning, implementation, controlling) that differ in resources applied and systems (applications, context).**

Management process activities represent general model (metamodel) for each business process and consists of basic three classes of management activities: planning, implementation, controlling. Business process consists of activities, that are in the same time either planning, implementation or controlling ones and specific (differ in resources applied and systems). This characteristic of business process activities makes them less flexible. When we try to manage business processes, we have to develop their models and automate (orchestrate) them. Then in case any resources or systems changed, there is the problem of changing business processes.

2. BPM as an Inherent Part of SOA

Traditional business process management systems are using formal process models which are used to govern the execution of business processes. These systems act as a centralized control hub, and invoke functions in ERP systems and business applications based on a formal plan given by the process model. BPM provides a wonderful abstraction for building business systems. But all too often we can see BPM being used to build higher level, more efficient, but nonetheless silo applications rather than contributing to an overall flexible, agile enterprise. This is where SOA (Service Oriented Architecture) comes in. SOA provides the application platform that bridges the business processes and the operational resources. At the business process level, it provides interfaces that directly support executing process tasks, but it defines those interfaces within an enterprise context to support consistency and reuse. At the operational resource level, SOA exposes existing capabilities as integration services. But it doesn't do this by directly mapping existing applications as services. Rather, it provides new service interfaces based on enterprise semantic and functional requirements, and maps them to the existing systems. Finally, it joins these top and bottom layers together through service composition to create the application platform layer.

Together, BPM and SOA provide a perfect combination for enterprise computing. BPM provides the higher-level abstraction for defining businesses processes, as well as other important capabilities of monitoring and managing those processes. Services provide the functions that support those processes. SOA provides the capabilities for services to be combined together and to support and create an agile, flexible enterprise. BPM without SOA is useful for building applications, but difficult to extend to the enterprise. SOA without BPM is useful for creating reusable and consistent services, but lacks the ability to turn those services into an agile, competitive enterprise.

3. BPM as an Object for Modelling

Processes previously existed only in the minds of reengineering consultants or ERP system implementators. Today they are far more than abstract drivers of change. Processes are now formal digital models of how information systems can be directly aligned to the objectives of business executives.

The classis approach to IS development was based on top-down approach: business requirements defined by users were expressed in languages so vague that technicians had to interpret and then complete, specifications, often introducing errors along the way. End users and IT specialists have spoken different languages: one of work and process and one of systems architecture and software logic. The divide was so great that software methodologist had to build sophisticated bridges between the two communities (CASE tools, prototyping etc.) The most recent manifestation of this trend is called the Model Driven Architecture (MDA). MDA represents the single language between business and IT at the level of software development and cannot be thus the basis for BPM (even if MDA could be used by a software vendor to develop BPMS). Therefore there exists another technique called DDA – Design Driven Architecture, which is overlapping the gap between process and supporting software. While modelling process we are in the same time developing the system. The tools that enable this technique are called Business Process Management Systems (BPMS, see next topic).

The basic characteristics of processes are:

1. processes need to be understandable for IT specialists, managers, end-users, etc.
2. they are set of activities (functions)
3. activities are interrelated
4. activities within the processes can be provided by different business entities (collaborative B2B processes)
5. activities within internal business process can be provided by different departments (roles)
6. there exist different levels o processes (process breakdown structure) (they are nesting,)
7. processes should be automated /executed.

These process characteristics must be in the same time the core principles (goals) of any modelling technique. Let me introduce you one of the standard for process modelling called BPMN - Business Process Modelling Notation and show you, how this standard enables the above seven basic process characteristics.

BPMN was developed within the OMG/BPMI (Object Management Group/ Business Process Management Initiative). Currently BPMN 1.0 version is available[3]. The primary goal of this modelling technique is to provide a notation that is readily understandable by all business users, from the business analysts that create the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes. Models should be also supported with an internal model that will enable the generation of executable language (e.g.BPEL4WS). Thus, nowadays the model creates a standardized bridge for the gap between the business process design and process implementation (see characteristics No1).

BPMN defines a Business Process Diagram (BPD), which is based on a flowcharting technique tailored for creating graphical models of business process operations. A Business Process Model, then, is a network of graphical objects, which are activities (i.e., work) and the flow controls that define their order of performance. A BPD is made up of a set of graphical elements. These elements enable the easy development of simple diagrams that will look familiar to most business analysts (e.g., a flowchart diagram). The elements were chosen to be distinguishable from each other and to utilize shapes that are familiar to most modellers. For example, activities are rectangles and decisions are diamonds. The four basic categories of elements are

- **Flow Objects** – represents activities (functions). There exist basically three types of flow objects: event, activity and gateway (see characteristic No2)
- **Connecting Objects** – enable to describe the relations (flow) between objects (see characteristic No3). This flow can be either
  - sequence flow (shows the order (the sequence) that activities will be performed in a process)
  - message flow (show the flow of messages between two separate process participants (business entities or business roles) that send and receive them.
  - association (associates data, text, and other Artifacts with flow objects).

[3] BPMN 1.0 Final Adopted Specification, which has been approved by the OMG board and technical plenaries, is currently in the finalization phase

- **Swimlanes** is a mechanism to organize activities into separate visual categories in order to illustrate different functional capabilities or responsibilities. BPMN supports swimlanes with two main constructs:
  - Pool represents a participant in a process (see characteristic No4).
  - Lane is a sub-partition within the Pool (see characteristic No5) .
- **Artifacts** are tools supporting some flexibility in extending the basic notation and in providing the ability to additional context appropriate to a specific modelling situation, such as for a vertical market (e.g., insurance or banking).The current version of the BPMN specification pre-defines only three types of BPD Artifacts, which are:
  - *Data Objects* are a mechanism to show how data is required or produced by activities.
  - A *Group* is represented by a rounded corner rectangle drawn with a dashed line. The grouping can be used for documentation or analysis purposes, but does not affect the Sequence Flow.
  - *Annotations* are a mechanism for a modeller to provide additional text information for the reader of a BPMN Diagram.

The modelling of business processes often starts with capturing high-level activities and then drilling down to lower levels of detail within separate diagrams. There may be multiple levels of diagrams, depending on the methodology used for model development. However, BPMN is independent of any specific process modelling methodology (see characteristic No6)

The graphical objects of BPMN, supported by a rich set of object attributes, have been mapped to the Business Process Execution Language for Web Services (BPEL4WS v1.1), the defacto standard for process execution. Figure 4 provides an example of a segment of a business process and marks the mapping to the BPEL4WS execution elements (see characteristic No7).

4. BPM as an Object for Automation

The basic tool supporting business process modelling and execution is BPMS. BPMS enables companies to model, deploy and manage mission-critical business processes that span multiple enterprise applications, corporate departments and business partners behind the firewall and internet. BPMS is a new category of software and opens a new era of IT infrastructure. It is to the process designer what a design workstation (CAD/CAM) is to the automobile designer. In general, it is a digital simulation of the real "thing". BPMS are in the same time process models and systems. They cannot be understood as a compiler or translator that takes process diagrams and generates software code. A BPMS is a software system not the beginning of the software development process.

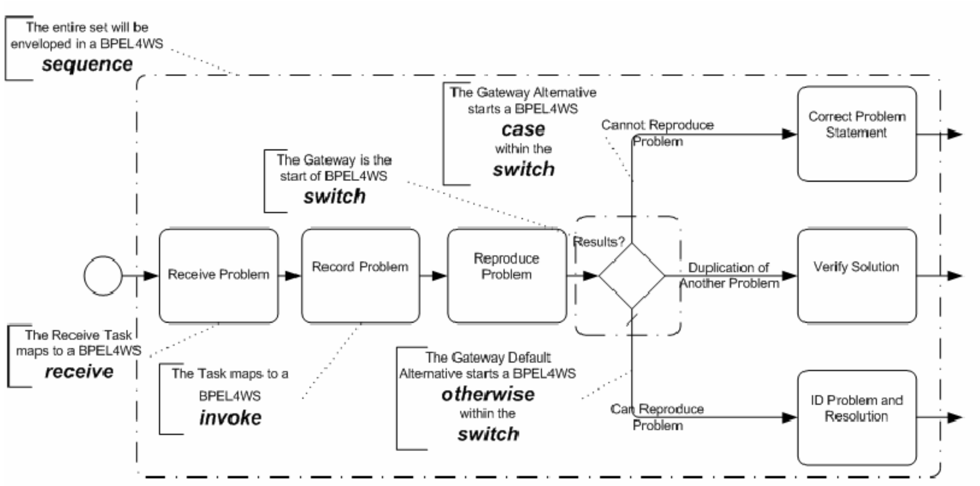

Figure 4 - An example of BPD with annotation to show the mapping to BPEL4WS [10]

The BPMS - often called "suites" – are one of the hottest areas in BPM. They do not replace existing applications although its ability easily define and execute new processes will be used to replace some application development. Existing heritage systems, however, remain valuable for internal and external process-based development (DDA), because their functionality, currently ingrained and embedded, can be tapped and encapsulated by the BPMS as software components that contribute to new or improved business process design. This is valid for both a standard applications like ERP systems and newly invented "best of breed" applications. This type of process based integration is desirable not only from the point of view of end-users but also from that of software suppliers that want to build a repository of application components from other vendors, which they can use to develop processes that meet the needs of particular industries or individual customers.

At the moment, about two dozen companies offer BPM suites. The arena is complicated by several factors:

- BPMS is one of the most growing marketplace. More and more vendors enter this place so it is difficult to provide any comparisons.

- There exist vendors of separate suites (BEA, Sun SeeBeyond, webMethods). In the same time the market is facing the growing presence of business process management server vendors like Microsoft, IBM and SAP, whose products link closely to BPM suites.
- We are at the beginning of the BPMS evolution. BPM vendors can only project their own ideas of what companies need and want in their suites. Some confusion is natural. As marketplace evolves, vendors will get a clearer picture of what features and tools business need.

5. BPM as an Object for Evaluation

It used to be that proprietary technologies, priced at a minimum, provided the main source of competitive advantage. But as the information industry continues to mature and software companies in it become more fully developed, the software product differentiation, while still important, will become much harder to achieve. Dell and Freedman (2000) say: "It will give way to process innovation as the fundamental source of competitive advantage". In the same time it is stressed, that the project of implementing BPM and SOA (as a best practice design approach to developing and deploying a BPM initiative) is a iterative continuous process. Thus organizations can differ in the level of BPM maturity. Therefore it is very important to be able to evaluate this maturity levels.

Recently, a number of models to measure the maturity of BPM have been proposed. The basis for the majority of these maturity models has been the Capability Maturity Model developed by the Software Engineering Institute at Carnegie Mellon University. This model was originally developed to assess the maturity of software development process. Later on it was applied to other types of IT processes, too. A good example of this application can be seen in Cobit. The CMM introduces the concept of five maturity levels defined by special requirements that are cumulative. When we try to apply the CMM model for business process assessment, we can recognize, that the main shortcoming is simplifying on only one dimension for measuring and the lack of actual applications of these models. Smith and Finglar (2004) argue that a CMM-based maturity model which postulates well-organized and repeatable processes cannot capture the need for business process innovation. The BPM maturity definitions however differ greatly from those used in CMM. (see Figure 5)

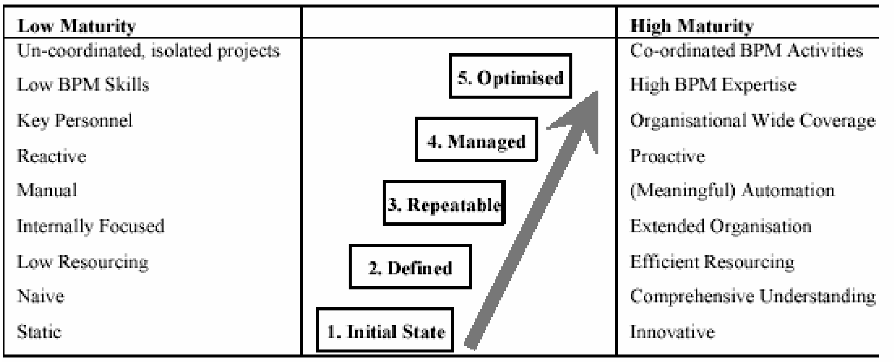

Figure 5 -: Comparison of low and high maturity [7]

More comprehensive definitions have been used in order to better reflect the specific requirements of BPM maturity on a factor basis. The example of such a model can be The holistic model presented in [7] . This model is based on three dimensions. The dimensions are:

1. **Factors**: specific, measurable and independent element, which reflects a fundamental and distinct characteristics of BPM. These are: IT/IS, Methods, Governance, People, Culture, Strategic Alignment. Model depicts “coverage” and “proficiency” for each factor[4]

2. **Maturity stages**: high-level repeatable phase that applies to BPM in general as well as to individual business processes. The phases are: 1. Initial, 2. Defined. 3. Repeated, 4. Managed, 5. Sustained.

3. **Organization scope and time**: organization scope is defined as the entity to which the model is applied. The entity can be the entire organization or a sub-set of an organization (division, geographical location etc.) Time refers to then actual point in time at which the model is applied. Thus this dimension will enable the assessment of the relative success of the selected strategies.

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[4] Knowing levels of „coverage“ and „proficiency“ within each factor enables organizations to determine priorities by asking „Do we want to do this more broadly?“ or „ Do we want to do this better?“

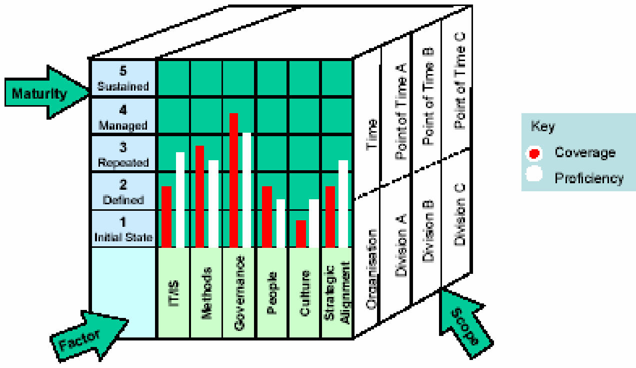

Figure 6 -: BPM Maturity Model [7]

6. Conclusions

The story about BPM is not new one. The first ideas dealing with BPM appeared in literature during 90´s in last century (e.g. [1], [2] , [3]). But it was only theory. Presently many analysts' reports are stressing the fact, that one of the strongest revenue growths can be seen in the BPM market just in the last year. Leading software companies are working hard to keep up with BPM wave. But unfortunately there is a lack of knowledge people and methodologies, which can help users to implement it in practice. And just business people and their ability to accept this BPM initiative is the key condition. I hope my article will make it easier.

7. References:

[1] DE TORO, I., McCabe, T. (1997): How to Stay Flexible and Elude Fads. Quality Progress

[2] ELZINGA, D., J. HORAK, T.LEE, C., BRUNNER, C. (1995): Business Process Management: survey and Methodology. IEEE Transactions on Engineering Management

[3] HARMON, P.(2003): Business Process Change: A Manager's Guide To Improving, Redesigning, and Automating Process. Amsterdam Boston: Morgan Kaufmann.

[4] Issues and Best Practices for the BPM and SOA Journey, http://www.waria.com/Documents/Issues_and_Best_Practices_for_the_BPM_and_SOA_Journey.pdf , May 2006

[5] KLIMESH, M.: Management and Leadership for 21st Century Leaders. Business conference in Athens, 2003

[6] MICHAEL W. LODATO, Management, The Process, 2006, www.bptrends.com

[7] ROSEMANN, M., TONIA DE BRUIN. 2005. Application of Holistic Model for Determining BPM Maturity, BPTrends,. February 2005, www.bptrends.com

[8] SMITH, H., FINGLAR, P. (2004). Process Management Maturity Models. Business Process Trends, July 2004

[9] SMITH, H.,FINGAR, P. Business Process Management: The Third Wave, , 2003. www.bpm3.com

[10] WHITE, S., CHOBANTOV, P.,MARIN, M.. BPMN Fundamentals, OMG, www.bpmn.org

AN INTERNET-BASED METHOD FOR MACHINE TRANSLATION EVALUATION

Ágnes Varga

Abstract

Machine translation would be very useful in cooperative information environments or integrated into enterprise application IF it was reliable, understandable and acceptable enough. Unfortunately it is not any of these, but to find out where it stands it has to be evaluated. The current research would like to try out an experimental evaluation method based on the internet and focussing on acceptability. It would like to find out whether this evaluation method can be valid, reliable and effective. The method uses the internet as a reference corpus and measures to what extent can sentences and sections of sentences be found in this reference.

The findings show that although the methods may have to be refined and human evaluation also has to be carried out, the method justified our hypothesis and gave reliable results.

1. Introduction

Let us imagine an international project or a multinational company with participants/employees from several countries. Let us suppose that they have the most modern and absolutely complete technical support for their cooperation. They have all the necessary equipment for communication, data transfer, etc. The situation seems ideal, but even the most modern technology will not be able to make communication possible if they do not overcome the language barrier. If the participants speak each others' language or have a common language they all speak this is not such a serious problem. If they do not, they can employ a translator, but this method can be complicated, time consuming and most importantly expensive, though in many cases more reliable than the others.

But in a technologically ideal situation, we would like to solve the problem with modern technology without extra human effort. The solution can be an 'ideal' machine translation software that can cope with all the necessary languages, that is reliable and that produces easily readable and understandable texts. With the help of such a software the problem of written communication is very easily solved. (In the ideal world there would also be a completely reliable speech recognition and production software that could also solve the problem of oral multilingual communication.)

BUT we have to admit that this solution is not available at the moment. Machine translation is not reliable and it is not easily readable, especially not in Hungary and in Hungarian, where foreign language knowledge is a very serious problem. [8] In a working environment very high quality, reliability and precision would be needed especially if there is no supervision of the translations. The final goal of machine translation development is of course to achieve all these, but in the meantime, machine translated texts and machine translation systems have to evaluated either to set the direction of further development, to compare the systems to each other, and also to inform the audience about the current situation.

2. MT evaluation

Machine translation can be evaluated by humans, but this method is expensive and relatively slow. Automatic evaluation can be much faster and more objective. Automatic evaluation methods can be divided into two main categories: those that evaluate the text in itself, using parsers, feature vectors, etc., for example [4], and those that evaluate by comparing the translated text to other (either human translated or original) texts.

There are several MT evaluation methods of the latter kind from which Bleu and NIST are the earliest. I would like to explain the methodology of the Bleu, which uses human translation as a basis of comparison. [3], [7]

2.1. The Bleu method

The Bleu score is a number in the interval of [0;1] expressing the quality of a candidate translation. The quality is based on closeness to 3 reference texts, which are the translations of the same text made by 3 different human translators.

First the paragraphs of the candidate text are segmented into words (unigrams), then into word-pairs (next to each other), then into segments of 3 words following each other, and so on. These segments are called *n-grams*. In every step of segmentation (words, word-pairs, etc.) the algorithm compares the n-grams of each paragraph to the n-grams of the corresponding paragraph of the reference texts, and gives the evaluation according to similarity. [7] 0 means that the translation is completely different, and 1 means complete sameness, which is practically impossible, even in the case of human translators.

In the Bleu methodology it was found that the best correlation with monolingual human judgments was achieved by using sequences of maximum 4 words. It takes sequence-length into consideration by giving weights, thus the longer the n-gram is, the more it counts in the final result. [7]

If human translations are evaluated with the Bleu method (by comparing them with 3 other human translations of the same text), their result is usually under 0,6. The Bleu score of the English-Hungarian translation of MetaMorpho was 0.4101 in an evaluation. Just for the sake of illustration and comparison I would like to mention that the average Bleu score of the English-German translation programs available on the web was 0.428.

The current research methodology has some common characteristics with the Bleu method, but the reference texts and the calculations differ considerably.

3. The research

3.1. Aim of research

The aim of the present research is to find out whether an evaluation method based on the internet can be reliable, valid and effective. [6]

A software was implemented to evaluate machine translated texts. Its evaluation method is similar to that of the Bleu, but it uses the whole (Hungarian) internet as a reference, and it is not paragraph, but sentence-based. The main difference is that in our method the references are NOT translations of the same text. This evaluation method focuses on the acceptability of the texts, and only examines translations made by the MetaMorpho MT system (English–Hungarian).

According to de Beaugrande a text has to be cohesive, coherent, intentional, acceptable, informative, situational and intertextual. [1] We can see that acceptability is only one aspect of a text. A translation always has to be accurate as well (ie. having the same 'meaning' as the source text), but the current research does not aim to examine accuracy.

A former research has shown that more than 50% of the texts produced by this system could be understood by the readers, but 90% still considered the translations unacceptable or had a bad opinion about machine translation. [9] This means that understandability does not equal acceptability. Thus a translation does not need to be a 'text' in the linguistic sense to be acceptable, but at the same time understandability is a necessary but not sufficient condition for a machine translated text.

In the research it is assumed that the more similar the translations are to the texts produced by the reader-community, the more acceptable they are by that community. One aspect of the research is also based on the assumption that the more frequently a text or a phrase occurs on the web, the more readers find it acceptable.

3.2. Methodology

3.2.1. Reference corpus

Based on the assumption above, all the Hungarian texts on the internet are used as a reference corpus to carry out the evaluation. The internet is a suitable corpus because of its size, its availability (everyone can be an author and a reader) and it can be easily searched. It does not contain only ideal or correct texts, but it is assumed that the authors publishing their texts consider their products acceptable. This fact is also the main reason for not using the Hungarian National Corpus, which contains mostly 'standardized' texts, ie. from the press, literature, science and official documents, and the 'uncontrolled', personal texts only make up its 10 %. [5]

3.2.2. Method

The evaluating algorithm works in the following way. The software creates n-grams from the sentences of the text to be evaluated, and then with the help of several search engines it searches for these expressions on the internet. Each sequence has a result from the number of found pages. Naturally, finding a longer sequence of words on the internet has more significance than finding one word, and it also suggests a higher degree of fluency, thus the longer the n-gram the more weight its result will get. Fluency is also a very important feature of a text and it also contributes to acceptability.

The search engines used are Google, Yahoo and AllTheWeb. I carried out some experiments and found that the results of these three engines do not differ so considerably as others do (eg. MSN, Tangó, Kurzor), and all the three allows defining the language of the search.

In the research language is a key issue. If the language of search cannot be specified, the results found can be misleading. Due to the unique features of Hungarian language searches for already sequences of 2 real Hungarian words will quite reliably give only results from Hungarian texts. For this reason I carried out separate researches using n-grams of n between 1 and 5, and also using n-grams of n between 2 and 5. I chose 5 as the maximum length of a sequence after carrying out several experimental searches, where I found that while sequences of 5 can give results, 6-grams are almost never found.

For the sake of safety I excluded words consisting of only 1 or 2 letters from the list of unigrams, and also many of the 3-letter words, as they might be abbreviations, or can occur in other languages with high frequency. Unfortunately the language settings of search engines cannot always be trusted.

3.2.3. Calculation of the results

The final result will be the average of the results of the individual n-grams, a number between [0;1] denoting the quality (acceptability and fluency) of the translated text.

As the search results for a sequence are in an interval whose upper boundary is virtually undetermined, the results have to be mapped into an interval, otherwise the final result can also be virtually any number that can only have any meaning in a comparison situation. I chose this interval to be between 0 and 1.

I used two kinds of mapping and examined which will give more reliable results. One method does not take frequency into account, which means that independently from the number of pages found the sequence gets 1 as a result, and if no pages were found the result is 0 for the sequence. These results were also weighted according to the length of n-grams. Let Q_1 denote the final result for the text, r_s the result of a sequence, S the total number of sequences in the text, and let w_n be the weights of n-grams. n is the length of the sequences, and N = 5 is the maximum length of the sequences. Thus

$$Q_1 = \frac{\sum_{i=1}^{S}(r_s \cdot w_n)}{\sum_{i=1}^{S} w_n} \qquad n = 1, .., 5$$

Two kinds of analysis were used: Q_{1A} uses only n = 2, ..., 5, and Q_{1B} uses also unigrams, ie. n = 1, .., 5

The other method takes frequency into consideration, as well. The mapping is done in the following way: a frequency number F_{ij} (i = 1, .., 5, j =1, .. 3) was determined for each search engine and for each n, and the results were divided by this number.

$$Q_2 = \frac{\sum_{i=1}^{S}\left(\frac{r_s \cdot w_n}{F_{ij}}\right)}{\sum_{i=1}^{S} w_n} \qquad n = 1, .., 5$$

Here Q_{2A} with n = 2, .., 5 and Q_{1A} with n = 1, .., 5 were also calculated.

Where $\frac{r_s \cdot w_n}{F_{ij}}$ is more than 1, the result of the sequence is 1, since it is considered very frequent.

For finding F_{ij} I did some experimental searches with all the search engines I used, and for each search engine determined the highest number of results for n-grams using the most frequent Hungarian words and meaningful sequences of these words. [5] These numbers would represent a fictional upper limit of the search results. After finding these numbers I tried them for the evaluation, and found that they are far too large, and the results will be under 0.4 even for the very good text. Thus they had to be diminished by half and even by fourth, and the results were still below 0.6, and the fairly good machine translated trial text gave a result of 0,036, consequently different F numbers had to be found. I considered frequencies, and decided that if a word is found 10000 times, a word-pair 200 times, a 3-gram 100 times, a 4-gram 10 times, and a 5-gram even once on the web, that can be considered frequent and commonly used. In the case of some search engines these numbers had to be slightly adjusted, but it was found that they generally work well.

The weights were also determined empirically. The Bleu method calculates a result (modified n-gram precision) for the text for each sequence-length (4 results), and then calculates their logarithms, thus giving weight to the sequences. The method of this research is different from that of Bleu in the fact that there is no exact match, and 100 % sameness, since there are several reference texts, and the reference texts are not the translations of the candidate text to be evaluated. Thus the weights were determined by experimenting and it was found that the weights of 100 for a complete sentence, 0.1 for words, 1 for 2-grams, 5 for 3-grams, 10 for 4-grams and 50 for 5-grams proved to give a fairly reliable result.

The calculations were also refined by assigning the weight of 1 to n-grams (n = 3, .., 5) if they do not occur even once, and assigning a 100 times larger weight to words that cannot be found.

Let us see an example for a sentence of a good text with method Q_{2B}:

Sequence	**Results found**	**Weighted result**
Vajon	686000	1
lesz	12500000	1
eredmény	756000	1
Vajon mi	53900	2
mi lesz	1180000	2
lesz az	1820000	2
az eredmény	234000	2
Vajon mi lesz	1470	5
mi lesz az	51500	5
lesz az eredmény	8090	5
Vajon mi lesz az	164	10
mi lesz az eredmény	390	10
Vajon mi lesz az eredmény	15	100
Final result:		**1**

3.3. Practical problems

Time factor is a serious issue in the evaluation. Due to the several page downloads, the running time of the program can be considerable. The other major problem is that search engines allow only for a limited number of searches a day, which also increases the time of research.

3.4. Results

In order to give the evaluation results a basis of comparison, 'good' and 'bad' texts also had to be analysed.

What is a good text? I considered good (or completely acceptable) those texts that can be found in newspapers, literature, science and any other coherent texts found on the internet. In the research I used (printed and internet) newspaper articles and texts from internet forums and blogs as 'good' reference texts. Bad texts are much harder to define, and even harder to find or create. Of course in a language a text written in any other language is considered bad. But in the case of internet search it would not be safe to use a good text in any language (especially if it is a text according to de Beaugrande's principles), even if the language of the search is given, because it might still give misleading results.

I created three kinds of 'bad' texts. One was a sequence of random letters, with spaces and punctuation marks so that it would look like a text. The second was a Hungarian text where I permutated the words. The third was also a Hungarian newspaper article where I inserted a meaningless sequence of random letters after each word. The hypothesis was that MT will have a score between good and bad texts.

To determine the weights and frequency numbers several preliminary tests had to be carried out. For these tests 2-3-sentence-long sections of texts were taken, from a good text – with very common words and sentences –, from two bad texts and two machine translated texts. (The texts can be read in the appendix.) All these sample texts were analysed by the program with several weights and frequency numbers. The main results of the preliminary tests can be seen in Table 1.

Table 1. Results of preliminary tests

Test 1	large weights (0.1, 10, 100, 1000, 10000, 10000), large frequency numbers			
	Q_{1A}	Q_{1B}	Q_{2A}	Q_{2B}
G	0.95	0.999	0.56	0.38
B1	0.51	0.11	0.016	0.01
B2	0	0.0064	0	0.0000024
MT1	0.98	0.97	0.57	0.0026
MT2	0.87	0.92	0.035	0.032
Test 2	large weights (0.1, 10, 100, 1000, 10000, 10000), smaller frequency numbers			
	Q_{1A}	Q_{1B}	Q_{2A}	Q_{2B}
G	0.95	0.999	0.91	0.91
B1	0.51	0.11	0.36	0.051
B2	0	0.0064	0	0.0029
MT1	0.93	0.97	0.56	0.47
MT2	0.87	0.92	0.66	0.3
Test 3	final numbers: smaller weights (0.1,2,5,10,50,100), smaller frequency numbers (10000,200,100,10,1)			
	Q_{1A}	Q_{1B}	Q_{2A}	Q_{2B}
G	0.98	0.98	0.91	0.92
B1	0.08	0.052	0.079	0.012
B2	0	0.061	0	0.0047
MT1	0.75	0.79	0.49	0.45
MT2	0.36	0.33	0.26	0.25

The first set (test 1) shows the results with weights having orders of magnitude difference for n-grams (0.1 for unigrams, 10 for 2-grams, 100 for 3-grams, 1000 for 4-grams 10000 for 5-grams and sentences) and large frequency numbers (roughly 25 % of the occurrences of the most frequent words, 2-grams, etc., different for each search engine). It can be seen that the machine translations achieved far too good a result, and the Q_2 results do not use the top half of the interval.

The second set of rows (test 2) are the results with still the same weights but relatively low frequency numbers (10000 for unigrams, 200 for 2-grams, 100 for 3-grams, 10 for 4-grams 1 for 5-grams and sentences). Here the results take up the interval more evenly, but the two machine translations are too close to each other while they considerably differ in grammatical accuracy, acceptability and understandability.

The third set (test 3) is the result of the weights and frequency numbers I finally used, with the frequency numbers above, and weights mentioned earlier in section 3.2.3. Here the results correspond with the initial criteria and also with (my) human judgement of the texts.

The research was carried out both with and without unigrams taken into account because both points of view can be defended.

Since a language is determined by its grammar rather than its vocabulary (just think about foreign words borrowed so easily), and a jumble of words will not be accepted as a text, only sequences longer than 1 word should be taken into account. But there can also be completely strange and unusual, but at the same time completely acceptable and understandable word combinations in a language that will not be frequently used, and this fact should not decrease the result considerably. Considering this point of view words should also be counted, especially in the case of Hungarian, which is an agglutinative language – sticking affixes (eg. endings) to words to express case, person, number, etc. But where unigrams are taken into account they naturally count with very low weigh if they can be found, and with very high weight if they cannot.

The numbers in the different columns are calculated with different algorithms thus the results should only be compared within columns. The aim of these preliminary tests were to determine weights and frequency numbers to produce results where the result of the good text is relatively close to 1, the result of the bad text is close to 0, and MT1 text should be considerably below the good text, and MT2 even lower. These results would indicate a correspondence with human judgement.

After the trials I evaluated 3 original Hungarian articles, 3 bad texts and 6 machine translated texts, each of about 100-150 words. The average results of the candidate texts are the following:

Table 2. Results of the automatic evaluation

	Q_{1A}	Q_{1B}	Q_{2A}	Q_{2B}
Good texts	0,87	0,87	0,63	0,65
Bad texts	0,11	0,156	0,089	0,085
Machine translation	0,54	0,58	0,4	0,4

In the first method the machine translated are roughly in the middle between good and bad texts – slightly closer to good texts, though -, while in the second they are far closer to good texts. It would be interesting where they would stand according to human judgement.

The same values are only a coincidence, the individual texts did not get the same value in any case with the different methods. It can also be seen that unigrams have such a low weight that their presence or absence in the list of sequences does not cause significant differences in the results.

4. Conclusions

The results of the evaluation showed that the machine translated texts are indeed between the good and bad texts. The results indicate that this evaluation method can be a reliable one, but it could only be proved by evaluating the texts with a different method, and position them between 'good' and 'bad' texts. A constraint to the research is that it does not measure understandability and accuracy. To determine whether the evaluation method indicates the acceptability of the texts human evaluations also have to be carried out and compared with the results of the automatic evaluation. I would like to carry out this survey in the future. If human evaluation based on understandability also supported the results achieved by the automatic evaluation, it would also prove the reliability of the method. For the final method one of the above mentioned 4 methods will have to be chosen.

It would also be interesting to see whether the results were considerably different if the Hungarian National Corpus was used.

I assume that the evaluation method can be used with any languages with slight modifications, and this would also be worth to try.

5. References

[1] BEAUGRANDE, R. de, DRESSLER, W., *Introduction to Text Linguistics*, Longman, London, 1981.

[2] Comparison of MetaMorpho with On-Line MT-Systems, http://www.morphologic.hu/index.php?option=com_content&sectionid=24&task=view&id=517&Itemid=225&lang=en

[3] DODDINGTON, G., *Automatic Evaluation of Machine Translation Quality using N-gram Cooccurrence Statistics*. In Proceedings of 2nd Human Language Technologies Conference (H LT-02). San Diego, CA. 2002. pp. 128-132.

[4] GAMON, M., ANTHONY AUE, A., SMETSL, M. *Sentence-level MT evaluation without reference translations: Beyond language modeling*, EAMT, Budapest, 2005

[5] Hungarian Academy of Sciences – Research Institute for Linguistics – Hungarian National Corpus, http://corpus.nytud.hu/mnsz/index_eng.html

[6] NEMETHNE HOCK, I: *Idegen nyelvi mérés és vizsgatechnika*. Veszpremi Egyetem, Veszprem, 1993.

[7] Papineni K., Roukos S., Ward T., Zhu w.-J. *BLEU: a Method for Automatic Evaluation of Machine Translation*, Research Report, Computer Science IBM Research Division, T.J.Watson Research Center, RC22176 (W0109-022), 17 September 2001.

[8] Special Eurobarometer 2005 – Europeans and their languages, published in 2006– http://ec.europa.eu/public_opinion/archives/ebs/ebs_243_en.pdf, 2006.

[9] VARGA, A., *Understanding Machine Translation*. In: Schriftenreihe Informatik Vol. 19. IDIMT-2006. Trauner Verlag Universität, Linz. 2006. pp. 285-297.

6. Appendix

Sample texts for preliminary tests:

6.1. Good text (G)

Ez egy teljesen jó szöveg. Vajon mi lesz az eredmény? Hát, majd meglátjuk.

6.2. Bad text 1 (B1)

Rcikörlg eöühk cd8fscle coé. deqciegg coleűyie. egole dokekk folef spléeoi fibkeáx coydfopr viehgfil vole gxv dllgeo y ole a oáw gűeeer driekhgáa ovleg!

6.3. Bad text 2 (B2)

Nem dpágne fogadta ehare kamerák wgár kereszttüze üekf a éjw9jg pécsi dikgée Sz. giweö9 I.-t dkigkg februári bűvnáe szabadulásakor.

6.4. MT text 1 (MT1)

Ez túlzottan unalmas neki, és túl lassú. Miért csinálja az erőfeszítést? Inkább otthon dolgoznék, mondja.

6.5. MT text 2 (MT2)

A téli havak korábban szertefoszlanak, mondják miközben rárontanak egy kiszámíthatatlan évszakra a közeli síüdülőhelynél, a sokéves lakosok, a legtöbb déli a nemzetben.
A ragadozó rovarok légiói menekültek el az erdőbe az köpenyek a felső hegy, az ölő fák, amiket gyengített rekord, melegednek.

European Projects

EUROPEAN PROJECTS

Markus Helfert[*], Petr Doucek[**]

The term "Integration of Europe" is indeed one of the most frequently used terms in today's media, newspapers and journals. However, scientific research and developments suffer by the use of these integration tendencies. The advantage of this type of work is that new ideas are envisage and realized as an integration process. A useful mean for integration that is used frequently in projects that result in team collaboration internationally is the use of this term as above. Two projects that are presented in this contribution are as follows – one is a Czech project realized by the University of Economics, Prague - Competitiveness of the Czech Republic ICT Graduates and finally the second is the international project carried out at Dublin City University - Curriculum Development Project in Ireland.

1. Introduction

Small projects do not exist.

The Information and Communication Technology (ICT) industry is increasingly important to the 21st century to the development of information and to its economies as well. An OECD study [OECD_06] estimates that the ICT sector contributed approximately 9 per cent of the GDP in OECD countries in 2005 and employed over 14.5 million people in OECD countries [OECD_06]. Typical feature of the existing world is the important differences in the demand for ICT specialists in different countries and regions. ICT experts and specialists are increasingly required in countries with emerging economies in contrast to stabile and very well developed countries, in which the demand on these professions is lower. In some regions (for example in Australia) a permanent increasing rate of unemployment in these professions exists [VOR_06].

The development of ICT always implies that the requirements of persons coming into this area constantly changes. Indeed, ICT skills are increasingly a workplace requirement. Up to 5

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% of total employment is estimated to ICT specialist occupations and around 20 % regarding occupations using ICT. Job definitions of ICT specialist appear to be evolving. They require some combination of ICT specialist skills with other, traditional skills – e.g. marketing, business etc. ICT skills are supplied in different ways for different peoples and requirements. Basic ICT skills are increasingly filled “naturally” through diffusion of ICTs and the use of ICTs in schools and at the workplace. Efforts are being made to improve the access of older workers to ICT skills through training programmes. Because ICT specialist skills needs are likely to change rapidly as technology changes, the formal education system may offer less flexibility for adapting curricula than private-sector subjects usually set up as multi-stakeholders partnership [OECD_06].

One way how to obtain the relevant knowledge for ICT experts and specialists is through a direct education process, which produces implicit knowledge. Another process, the process of practical experience creates tacit knowledge. Ideal source for this kind of knowledge and practical experience are common projects in the frame of the EU or also with EU external partners.

2. International Projects

International Projects aim at improving the competitiveness of European industry and enabling Europe to master and shape future developments in ICT so that the demands of its society and economy are met. ICT is at the core of the knowledge-based society. Activities will strengthen Europe's scientific and technology base and ensure its global leadership in ICT, help drive and stimulate product, service and process innovation and creativity through ICT use and ensure that ICT progress is rapidly transformed into benefits for Europe's citizens, businesses, industry and governments. These activities will also help reduce the digital divide and social exclusion [EC_06]. Challenges for the Framework Program 7 (FP 7) are following:

- Pervasive and Trusted Network and Service Infrastructures.
- Cognitive Systems, Interaction, Robotics.
- Components, systems, engineering.
- Digital Libraries and Content.
- Towards sustainable and personalized healthcare.

- ICT for Mobility, Environmental Sustainability and Energy Efficiency.
- ICT for Independent Living and Inclusion.

Topics have multi and transdimensional character so they represent excellent opportunities for new groups of experts in more then in one area.

At present the operations of the University of Economics, Prague and the Faculty of informatics and statistics for one FP 7 project with international business partners and universities is starting. The theme of the project is Information Security Management System.

3. Local Projects

(1) Czech Experience

We waited at the Faculty of informatics and statistics for the call for FP7 in the last year and we realized a local project during this free time. This project is briefly described in the following part of the contribution.

3.1. Project: Competitiveness of the Czech Republic ICT Graduates[1]

Three organizations active in informatics in the Czech Republic:

- The CSSI (Czech Society for Systems Integration),
- SPIS (Association for Information Society),
- CACIO (Czech Association of Information Technology Managers)

by the support of Ministry of Education of the Czech Republic and in cooperation with University of Economics, Prague, Faculty of Informatics and statistics and CzechInvest Agency have started a project aimed at improving the ICT labor market situation and increasing cooperation of universities with employers of ICT graduates. First phase of the project will focus on the precise definition of ICT professions and the basic structure of their knowledge and skills. During the second phase we are collecting data on the demand and supply of ICT professions. We expect results of these studies in the middle of 2007.

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[1] This project is supported by Ministry of Education, Youth and Sports of the Czech Republic in the frame of development project „Transition of the Best Experience Between Universities and Practice“ and evaluation of data sources was realized in the frame of the project MSM61384398910 – “Methods of Knowledge Acquisition from Data and Their Use in Economical Decision-making“.

This project is unique by its orientation on detailed qualification of ICT skills (ICT Graduate/Employee skill profile). This qualification allows us to compare (on detailed skill level structure) different ICT professions provided by universities with ICT oriented programs and these demanded by labor market. The project results will be supplied back to the universities (in order to improve their study programs) and also to potential investors in ICT area (showing the university graduates skills and potential of the current and future workforce).

3.1.1. Roles in ICT

As a base for the skills profile and core ICT profession definitions we have used the following classification having particular criteria, ranging from economic characteristics, through managerial consequences, to the level and type of knowledge. Our project prefers classification underlining the competitive ability of graduates based on their knowledge potential. ICT specialist in this context is educated and qualified to use his/her knowledge potential mainly in the design, implementation and operation of ICT and their practical application – see the qualities listed below:

- Designs and develops ICT.
- Designs and develops ICT applications.
- Implements, customizes and integrates ICT applications within enterprise or other economic subject, thus changing and modifying working procedures and effectiveness of staff.
- Implements and manages ICT operation including user application support.
- Manages ICT projects.
- Manages information services and knowledge provision.
- Provides and purchases ICT services and products – using professional skills regarding detailed knowledge and effective methods of their use.

End users of ICT are not considered as ICT specialists, as most of the current graduates (medical doctors, financiers, architects) are by definition active in data processing and computer aided operations. For example, advanced user of SAP is according to our nomenclature not an ICT specialist, unlike the methodology designer responsible for the overall SAP architecture.

Due to fast developments and relatively high specialization of students we define ICT specialists at two levels – the first level consists of five basic ICT roles with corresponding key knowledge and activities, the second level lists ICT professions included in the basic roles as shown in Table 1.

Basic ICT roles and ICT professions	Knowledge / Activity of basic ICT role
	Obligatory knowledge for all roles: • High level of creativity • Fluent English • Team work ability • Communication competence
Business Process Analyst/Designer ***Profession*:** *analyst, knowledge engineer, business consultant, Standard SW implementator, information broker, competitive intelligence specialist*	**Key knowledge:** • Modeling of enterprise processes change to make them rapid, more effective and less costly in order to produce quality products/services • Optimum use of knowledge and competence of employees and business partners • Which ICT services/applications are advantageous to use for business processes support **Key activities:** • Analysis, design, standardization and optimization of enterprise processes and organizational structures (financing, trade, production etc.) • Analysis and planning of business effects resulting from IS/ICT • Analysis and design of knowledge management at organization • IS/ICT risk analysis, business continuity • Proposal of ICT services supporting enterprise processes • Implementation and customization of standard software • Proposal, design and search of information content (information services, portal, web) needed for management support **Note:** Knowledge of global best practices, local conditions and enterprise culture is required (offshore outsourcing is not expected).
IS/ICT development and operation manager (ICT Manager)	**Key knowledge:** • Business/ICT relations management – the role of ICT in supporting business goals • ICT services, processes and resources organization and management • Management and coordination of ICT projects

Basic ICT roles and ICT professions	Knowledge / Activity of basic ICT role
Profession: *CIO, project manager operation manager, security manager*	**Key activities:** • ICT project management • Information strategy working-out • Sourcing strategy working-out • ICT services delivery management • IS/ICT enterprise operation management • Problem and change management • Risk management • Security management • IS/ICT economics management • Quality control and IS audit **Note:** This profession is not recommended for outsourcing
Businessman in ICT products and services (ICT Salesman, ICT Relationship Manager) ***Professions:*** *salesman in ICT products and services, supplies manager of external products and services, account manager, relationship manager*	**Key knowledge:** • Knowledge of global and local ICT markets • Knowledge of existing/potential partners/customers • Legal aspects of ICT trading • Negotiation strategy and tactics **Key activities:** • Marketing of ICT products and services • ICT products and services sales • ICT products and services purchase • Preparation of agreements on supply of ICT products and services (SLA) • Management of relations between supplier and customer (sourcing strategy principles) • Negotiation with partners (respecting different national and cultural environment) **Note:** This profession is not suitable for outsourcing
Developer / IS Architect ***Professions:*** *developer, programmer, tester, system integrator, ICT architect, systems development manager*	**Key knowledge:** • Technologies and procedures needed for design, integration and operation of applications • Design and development of user friendly applications with simplified operational requirements • Design of suitable technological and application architecture of IS/ICT organization • Management of the team of designers and developers **Key activities:** • Analysis and design of ICT applications (on-line services, BI, effectiveness of business processes, personal/tailored application. entertainment) • Database design

Basic ICT roles and ICT professions	Knowledge / Activity of basic ICT role
	• Data mining • Programming of client, server, database and web applications • Grid programming • Application testing • Application documentation (design, program, operational, users) • Maintenance and administration of application versions • Integration of applications • Design of hardware, software and data architectures **Note:** Due to easy outsourcing these professions might be transferred to countries with low labor costs – except analysts and designers of applications
Administrator of applications and of ICT infrastructure (ICT Administrator) ***Professions:*** *application administrator, database administrator, network administrator*	**Key knowledge:** • How to acquire, maintain, operate and terminate ICT infrastructure components • How to scale up and down the ICT infrastructure • How to support users of IS/ICT **Key activities:** • Application administration, training and support of users • Database administration • Administration of data content • Administration of computer network and of basic SW • Administration of configurations • Web administration **Note:** Suitable for outsourcing – these professions might be transferred to countries with low labor costs

Table 1 List of ICT Professions

3.1.2. Education Levels

Initially we have developed the survey questionnaires for universities and for the businesses in the Czech Republic. We have been concentrating on the 18 skill categories (selected based on the respected IT curricula) and their weight in the university graduate or employee profile. This weight was expressed by the number of ECTS credits (universities) or on the following scale (companies and institutions):

- Level 0 - No knowledge.
- Level 1 - Overview (relevant to **1-3 ECTS** credits).
- Level 2 - Basic orientation and terminology (relevant to **4-8 ECTS** credits).

- Level 3 - Good orientation and basic practical skills (relevant to **9-32 ECTS** credits).
- Level 4 - Good orientation and good practical skills (relevant to **33-64 ECTS** credits).
- Level 5 - Highest knowledge quality and advanced practical skills (relevant to **65 and more ECTS** credits).

3.1.3. Results Overview

We have tested these questionnaires at the pilot project among small number of universities and businesses. Then we have distributed these questionnaires among relevant universities and secondary education institutions in the Czech Republic and we have received 202 answers - profiles of the graduates of different IT related study programs together with the total number of their students, number graduates and number of students enrolled to study the program. We have also received 1002 answers from the Czech Republic companies and governmental institutions – skill profiles of different IT roles in the company or institution together with the average salary and number of employees in each of the roles (also with the prediction to next years). Then we have analyzed these data using different analysis and data mining methods.

3.1.4. Results for Bachelor level education

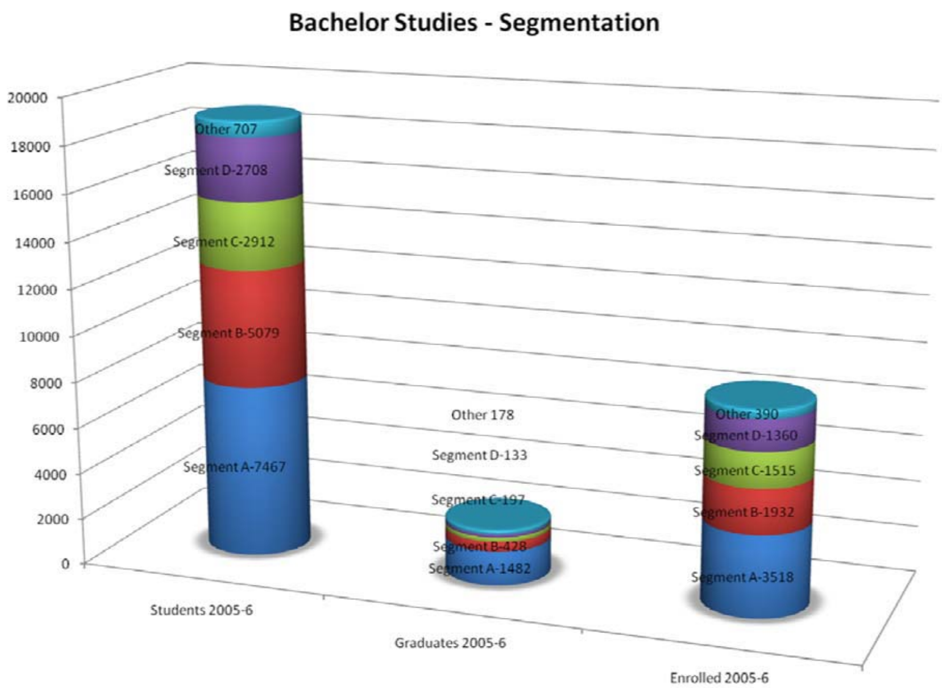

Figure 1 - Bachelor Studies Segmentation

Segment A – indicates characteristics with **very low level of ICT education** (work hypothesis is that ICT education is "additional" to another ones). This low level could be followed in two dimensions. The first dimension is the variety of the ICT courses, which are focused mainly on software engineering, data engineering and ICT infrastructure without any other knowledge for students. This selected parts of ICT gives to graduate students only briefly overview of the whole problematic and general information. The second dimension is the deepness of the education in selected course. The level three is very low for teaching so low variety of courses. The level is under the average of the whole ICT education level through all investigated segments.

Segment B – **offers harmonic education in "exact sciences"**. Education is focused on ICT area presentation with added value of the statistics, marketing and enterprise finance and economics. This specialization gives perspective to a graduate either to be a lower ICT manager to go to farther master study level.

Segment C – gives common education in classic ICT. This kind of education represents knowledge in areas of ICT services, software engineering, data engineering and ICT infrastructure, operational excellence, communications and team leadership. Additional is taught statistics – part of "exact science". These graduates have potential for being successful ICT managers especially the top ICT managers on the CIO level.

Segment D – **the most complex knowledge** with accent not only to ICT education, but it releases also general education in economics, organization and enterprise knowledge. The D segment with whole scope of taught knowledge offers potential for future graduates to enter into the level of upper management and perhaps to the top management level. Knowledge here presented must be, of course, supported by very strong motivation, further education in master level (perhaps in doctor stage) and hard work in business.

3.1.5. Results for Master level education

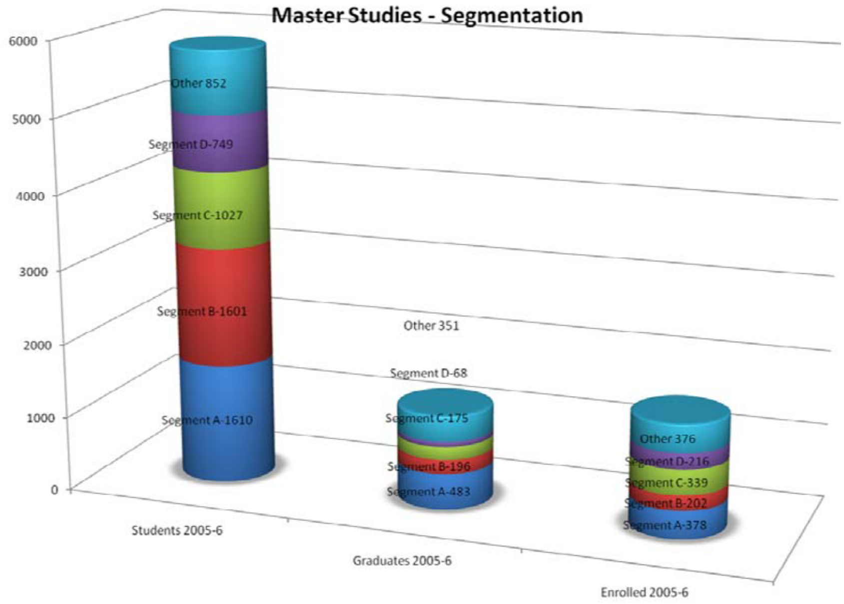

Figure 2 - Master Studies Segmentation

Segment A - ICT Additional (ICT overview) gives only general partial knowledge level in the ICT area. The ICT level is only additional to other non informatics education and it is question why are these master programs taught in the community of ICT specializations. Graduates are expected to continue in ICT education. Working hypothesis is that these persons could participate in ICT business in following roles **Businessman in ICT products and services** (ICT Salesman, ICT Relationship Manager).

Segment B – offers **comprehensive** basic **education** in ICT. For graduates is working hypothesis that they have opportunity to, of course after further business – non university – education, enter successful into ICT business in all in Table 1 specified roles.

Segment C – prepares graduates with accent to Architecture Analysis and Design, Software Engineering and management skills– Communication and presentation, Organizational Management Methods. Working hypothesis is that graduates are ideal for leading positions in ICT branch. It could be the large spectrum of professions starting from project managers to the CIO. This expectation corresponds to the role **IS/ICT development and operation manager** (ICT Manager).

Segment D – gives more detail knowledge in areas of Process Modeling, ICT Infrastructure and Software engineering. Work hypothesis is that graduates in this segment are oriented towards following roles - **Business Process Analyst Designer or Developer/IS Architect**.

Role **Administrator of applications and of ICT infrastructure** (ICT Administrator) is the position to what are prepared graduates of lower of education. It does mean that graduates from specialized middle schools or bachelor study level are optimal educated to this position.

More detail results of this research project will be presented live in České Budějovice during this session.

3.2. Project: Curriculum Development Project in Ireland

(2) Irish Experience

The curriculum for a Master programme in Business Informatics was developed over the last two years, with the valuable support of an international accreditation board. The board included four international experts in the field of business informatics from Ireland, UK and Austria. Representing the interdisciplinary character of the programme, we aimed to include members from different backgrounds representing a thematically well-balanced accreditation board. Members of the board presented particular expertise in

- Knowledge and Data Engineering and Process Modeling.
- Strategic Information Systems.
- Information Systems Management.
- Practical approaches in the banking sector.

Between the first proposal for the programme in 2004 and the final recommendation for accreditation in May 2005, the accreditation board met and discussed the curriculum three times at Dublin City University [HEL_06]. Our initial programme proposal was revised in order to include recommendation from the board. However, the diversity of different viewpoints among the members made it difficult to maintain the characteristics of business informatics throughout the programme. It seems the curriculum should include many related subjects ranging from Business and Information System Strategy to Mathematics, Statistics and Programming.

The discussions indicated that the controversy is often due to two complementary but fundamentally different streams in Information Systems, with on the one hand a technology-, engineering- and method-orientated perspective and on the other a business- and management-orientated focus. A different emphasis in Information Systems-related degrees was observed, with an emphasis on management aspects on the one hand, and the business informatics and information systems engineering perspective on the other. In order to structure the different backgrounds and viewpoints we propose a framework that is illustrated in Table 2. This framework will be used in our further research to structure the diversity of Information Systems degrees.

Table 2: Information Systems' viewpoints

		Perspective		
		Informatics / Computing	Information Systems	Business and Management
Aspect	Subjects / Topics to be included			
	Teaching mode			

3.2.1. Programme Layout

The central focus of the proposed curriculum for business informatics is to qualify individuals to lead IS-related transformations, enabling them to apply technological solutions and develop information system architectures to solve business problems of organizations. With this goal in mind the curriculum focuses on an engineering perspective and the integration of cultural studies. The programme is intended for students who have achieved a primary degree in Computing, Computer Science, Software Engineering or a comparable discipline. The programme is designed to be completed in one calendar year of full-time study and consists of two taught semesters followed by a practical project.

3.2.2. Curriculum Structure

The curriculum has an emphasis on engineering principles, and includes a module on Structural Science, which encompasses Management Science and Data Engineering and Data Mining. It also has a strong modeling component, and includes modules on IS Architecture, and Business Process Management. The integrative perspective is provided by the Supply Chain Management module. The programme also covers the more traditional Information Systems disciplines like for instance in the Strategic Management of Information Technology module. An overview of the general programme structure is provided in Table 3. Three complementary strands can be identified in the programme, which can be related to our business informatics framework; Business and Consulting Skills, Information Technology / Information Systems in Business, and Informatics in Action.

Table 3: Curriculum Overview

Semester 1	• Research Skills / Seminar Topics • Information System Architecture • Structural Science	• Business Process Management • Strategic Management of Information Technology • Business Studies
Semester 2	• Supply Chain Management • Managing and Working in an Intercultural Environment	• Sectoral applications of Information Systems • Regulation in Information Systems • Project Management • Managing Change
Summer	Dissertation / Practicum	

3.2.3. Transferable skills

In addition to the emphasis on engineering principles and core subjects of business informatics, the study programme also supports the building of capabilities for managing transformations by aiming to expand transferable skills. In essence, transferable skills are those skills which, having been learned in one context, can then be applied in another. A summary of transferable skills by module is provided in the appendix. Typically these skills are based on modern teaching, learning and assessment methods that include

- guided independent study and activity, with specialist input when appropriate,
- recent or current case studies,
- essay and report writing,

- collaborative group work and discussions,
- presentation of findings to the group as a whole.

3.2.4. Practicum

In the final semester, from May to August, students work on a practicum or major project of a practical nature. The general objective of the practicum is to allow students to draw on the theoretical knowledge gained over the taught element and to apply it in a practical setting in a European environment. The practicum gives students the opportunity to demonstrate their ability to analyse problems in the field of business informatics and draw conclusions according to scientific methods within a given timeframe.

3.2.5. A survey to evaluate curricula in Business Informatics

At present we carry out a survey, which aims to evaluate topics in business informatics and information systems study programmes. An initial analysis of information provided on institutional web pages shows that even in the context of the Bologna agreement study programmes nationally and internationally are still very diverse. Our explorative results indicate that the difference is often due to two related but fundamentally diverse streams, with on the one hand a technology- and engineering-orientated focus and on the other a business- and management-orientated focus. This is the core theme of the survey. The survey intends to evaluate selected information systems and business informatics study programmes in Europe and aims to identify differences between them.

The main part of the survey consists of a Framework of 20 topics that represent some aspects taught in business informatics and information systems degrees (see Figure 3). Participants are asked to indicate the relative importance of the topics by distributing 100 available points among the sliders. The initial responses are interesting and show the diversity and various opinions in Business Informatics and Information Systems. Detailed results will be presented and discussed in České Budějovice during this session.

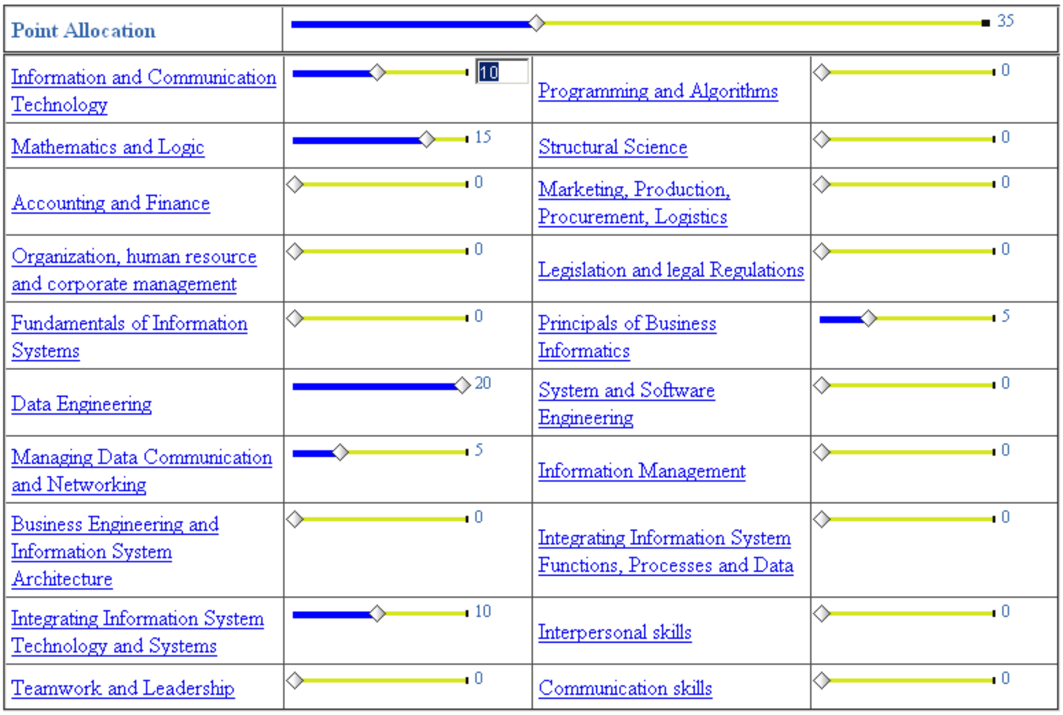

Figure 3: Framework to evaluate topics in Business Informatics

4. Conclusions

International projects represent very good opportunity for experience exchange between members of the work team. There are interchanged not only professional skills, but also cultural aspects and habits of everyday life. Common projects have important influence on building up of the new future European community of researchers, developers and scientists. Our paper presented two projects, one from Czech Republic and one from Ireland. The results illustrate that ICT education is diverse, but ICT offers also many opportunities. The presented focus on Business Informatics approach appears to us not only to be innovative with regard to its interdisciplinary character, but moreover the engineering perspective and the integration of cultural studies and practical experiences in an international setting equips graduates with required transformation capabilities. Further evaluation and discussions are required and intended for the session in České Budějovice. Also, an evaluation of the changing or required capabilities and skills of ICT graduates would be interesting.

5. To Potential Participants and Contributors

Only by practice could everyone get some skills. What are main effects of co-operation in Research and Development (R&D) projects? Our main topics for this session are:

- transfer of methodology of the scientific (research and development) work,
- contacts between participations with large potential to the future co-operation and it development,
- co-operation in working teams, team leadership and project management,
- sharing of knowledge, combining several schools and approaches to the problem solving,
- building up of new social networks especially for young research people and PhD students,
- increasing R&D potential in Europe and by this way growing economics effectiveness and efficiency.

We know that projects are not only successful activities. Sometime it comes thru that bad result appears in a project. Do not hesitate present in our session; your negative experience from projects or from projects that you have heard about. The analysis of the reasons of troubles will be very useful for other conference participants. Mistakes and bugs are also one of the sources of experience.

6. References

[EC_06] European Commision: ICT - INFORMATION AND COMMUNICATION TECHNOLOGIES A Theme for research and development under the specific programme “Cooperation” implementing the Seventh Framework Programme (2007-2013) of the European Community for research, technological development and demonstration activities. Work Programme 2007-08

[HEL_06] Helfert, M., Duncan, H. 2006. Aspects on Information System Curriculum: A Study Program in Business Informatics, in International Federation for Information Processing (IFIP), Volume 206, The Transfer and Diffusion of Information Technology for Organisational Resilience, eds. B. Donnellan, Larsen T., Levine L., DeGross J. (Boston: Springer): 229-237.

[OECD_06] OECD 2006: Information and Communication Technology, OECD Information Technology Outlook, ISBN 92-64-02643-6, 2006

[NOV_07] NOVOTNÝ, Ota, DOUCEK, Petr: Competitiveness of the Czech ICT Graduates. Portorož 28.03.2007 – 30.03.2007. In: *Ustvarjalna organizacija – Creative Organization [CD-ROM].* Maribor : Universita v Mariboru, 2007, s. 1380–1386. ISBN 978-961-232-200-7.

[VOR_06] VOŘÍŠEK, Jiří, FEUERLICHT, George. The Impact of Global ICT Trends on Demand Characteristics for ICT Profesionals. Martinique 05.11.2006 – 10.11.2006. In: Proceedings of the 5th Conference Europe. Paris : IUT Pari Jussieu, 2006, s. 151–164.

[VOR_07] VOŘÍŠEK, Jiří, NOVOTNÝ, Ota, DOUCEK, Petr: Competitiveness of the Czech ICT Graduates (In Czech), Praha : ČSSI; VŠE FIS, 2007. 49 s. URL: http://www.cssi.cz/publ_si_clanek.asp?typ=1&kod=1024.

Summary of Transferable Skills

Module	Critical thinking	Problem management and solving	Research skills and methods	Communica-tion	Group-work and interpersonal skills	Intercultural, social and community awareness	Planning, organizing and resource management
Research Skills/Seminar Topics	●	○	●	◖			◖
Information System Architecture	○	○					
Structural Science	○	●					◖
Business Process Management	○	●	◖				◖
Regulation in IS	○	○				◖	
Business Studies	○			○		◖	◖
Strategic Management of Information Technology	○	◖		●	◖		●
Supply Chain Management	○	●		◖	○		◖
Sectoral applications of Information Systems	○	◖			◖	○	◖
Project Management	◖		●	◖	◖	○	●
Managing Change		◖		●	●		
Managing and Working in an Intercultural Environment	○	○		●	●	●	
Practicum	●	●	●	●	●	●	●

Legend:
● Considerable development
◖ Moderate development
○ Some development
Negligible development

REFLECTIONS ON THE EVALUATION OF EUROPEAN FUNDED PROJECTS

Josie P. H. Huang , Julian Newman

This paper addresses two related difficulties in conducting effective evaluation: the problem of evaluating collaborative European research projects as such, and the problem of evaluating collaboration support for virtual organisations. These problems are closely connected, because most EC-funded research projects involve international teams drawn from different partner companies and universities across several member states, and thus inevitably have to operate as a form of virtual organisation. The authors have undertaken evaluation tasks within two EC "Framework" projects, within the context of a broader research programme in collaborative systems evaluation, and the current paper seeks to draw some of the main lessons from these case studies with the purpose of showing different perspectives on evaluation issues and processes.

1. Introduction

Evaluation has acquired increasing importance in IT with the growth of international e-commerce and the spread of virtual enterprises, which are supported by collaborative systems. With the cost of IT investments growing and the desire for better deployment of organisational resources, companies increasingly require a deeper understanding of the performance and the impacts of IT investments.

In order for an effective evaluation to take place, a background study provides the essential theoretical context. Farbey et al. [5] argue that evaluation is likely to be dismissed as 'counter-cultural', unless it takes fundamental organisational values on board. Such considerations are leading to a growing recognition of the importance of involving multiple stakeholders in evaluations.

The authors have undertaken evaluation tasks within two EC "Framework" projects, within the context of a broader research programme in collaborative systems evaluation. This programme aims to contribute to the understanding of the problems of evaluation of collaborative systems to support virtual enterprises by means of an investigation into contextual and social perceptions. In order to carry out such research, to find a way of understanding social activities and organisational context, both individually and in groups, an interpretive epistemology is adopted. To meet the identified need of evaluators for support in applying an appropriate evaluation instrument, a lifecycle and stakeholder-oriented approach was proposed [8,9,10].

The current paper seeks to draw some of the main lessons from these case studies with the purpose of showing different perspectives on evaluation issues and processes.

2. The European Research project as a Virtual Enterprise

At the present time, there are many research projects conducted with European Union funding, both under the Framework programmes and under the European Social Fund, etc. This paper concentrates on projects funded under the Framework Programmes, which involve multiple partners who may be from industry, academia or research institutions within different countries. These projects operate as a type of virtual enterprise, in the sense of being a temporary network of organisations with a specific goal or interest which cooperatively forms a coherent entity and performs collaborative work amongst group members [11]. Given different reasons and backgrounds, a virtual enterprise is formed with different patterns. VE formed patterns that have been previously identified include strategic alliance, equal partner, ongoing coalition, and outsourcing agreement [18, 25].

The patterns used to form a virtual enterprise are important elements in identifying the stakeholders as different VE patterns are comprised of different groups of people. A strategic alliance is usually formed for exploring new market opportunities and the alliance is across different industries corresponding to each partner's expertise. An equal partnership often occurs between competitors in the same industry with the purpose of getting into different geographical marketplaces and to increase their proficiencies. Ongoing coalition involves customers and suppliers in terms of value chain and supply chain. Outsourcing agreement takes place to support companies in focusing on their core competency and outsourcing the work to experts.

Research projects often can not be grouped into the other VE formed patterns. With regard to the numbers of research projects under European Community, the form of research project therefore can not be neglected and can be recognised as a pattern of forming a virtual enterprise. The relationship between collaborative systems and virtual enterprises is presented at Figure 1 shown below.

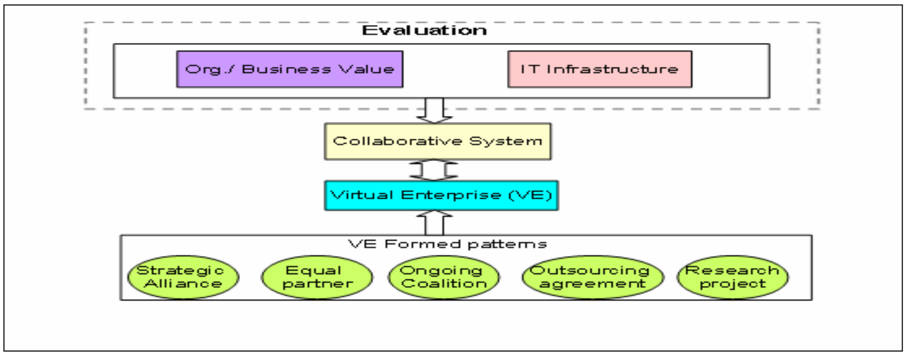

Figure 1 - Relationship between collaborative systems and virtual enterprises

Virtual enterprises, i.e. research projects, which involve collaborative systems in multi-site and multi-partner projects, may pose more problems for the evaluators because more knowledge and information are required than when evaluating normal organisations. For example, the information is often limited and not able to be assessed, especially in financial aspects due to confidentiality in participating organisations. In addition, because of the different organisational context, and the interaction and social activities between people, such evaluation of European Union funded projects therefore requires organisational integration, cooperation, and coordination with the organisational environment, the actors/stakeholders and the researchers. In order to provide a better understanding of the evaluation of collaborative systems to support a virtual enterprise, two case studies were carried out.

3. Background of Case studies

The first case study was a European Framework V project, named as Project D in this paper. This project aimed to address a need in both the European aerospace and automotive industries to model, validate and provide tool support for cross-organisational product configuration management (PCM). Participants in this project came from different organisations distributed across multiple sites in four European countries, with different responsibilities, specialities and experience. By the nature of Project D, its pattern of forming a virtual enterprise is categorised as research project. There was a dedicated evaluation work package in Project D, and the researcher (first author) participated in this project by planning evaluation activities, proposing the evaluation instruments and then implementing them. With the project's support, the researcher was allowed to observe the development progress throughout the entire project and therefore was able to report the findings to contribute to other projects as critical success factors. Project D went through a development lifecycle from capturing requirements, feasibility analysis, design and then implementation. With one of Project D partner's support, the author was able to assess the results of Project D within an organisation. Therefore, the framework along with lifecycle based stakeholder oriented approach was evaluated within the Project D which could be considered as a whole development lifecycle.

The second case study was carried out with a European Framework Six Programme project (named as Project C in this paper). Participants in this study came from different geographically distributed organisations with different responsibilities, specialities and experience. Three project partners participating in this project are from different organisations, but are all in the automotive industry. Based on the nature of Project C, its pattern for forming a virtual enterprise is categorised both as research project and as equal partner within virtual enterprise. In this study, the researcher contributed to the formation of the validation/evaluation strategy but owing to time constraints was not able to follow the complete evaluation cycle.

4. Outcomes from the case studies

The following section highlights the major findings from the two case studies. The problems experienced, and the potential risks identified in each case study are then summarised.

4.1. Project D

According to the features and the formed pattern for virtual enterprise, Project D is placed into the category of a research project. It formed a network and learning organisation in order to develop a collaborative system relating to configuration management across heterogeneous tools and domains.

During the process of using the Lifecycle-based Stakeholder-oriented approach for selecting appropriate evaluation instruments, stakeholders were identified along with the Project D context and content. In the case of applied research projects with part-public finding, such as Project D, the "outsider" stakeholder group are significant. As a result, both the funding body and the external users of those results that will be placed in the public domain were considered as Project D stakeholders. With the characteristics of network and learning organisation along with the nature of Project D and stakeholders perspectives, the evaluation instruments, scoreboard and questionnaire were designed.

A Scoreboard was defined and used to validate the functionality in terms of its technical aspects within different industrial scenarios. The use of a Scoreboard performed a function of formative evaluation. In other words, it assisted project management in monitoring progress towards the achievement of milestones. The outcomes generated from the scoreboard were taken into account for gap analysis between the requirements and implementation. The result was analysed and identified actions/ activities for further improvement.

A questionnaire approach was adopted to perform a summative evaluation of the non-functional aspects in terms of business and organisational added value. There were also various attempts to evaluate the cost benefit in terms of final business revenues. However, the financial impact of the Project D results is confidential to each organisation and it was realised that it is difficult to get the accurate financial figures, in the short term, in the framework of the Project D. Consequently, cost effectiveness evaluation which emphasises intermediate outcomes over a short term was adopted to valuate the non-functional aspect. Along with the Project D conditions and the concerns as previously mentioned, the Synthesised model [16] was modified and proposed with a new form.

With the evaluation outcomes, it was apparent that the Lifecycle-based Stakeholder-oriented approach needed further improvement. As a result, a justification of the method used was included to enhance the approach. The lessons learned from the empirical study indicated that a follow up action needed to be carried out. A further evaluation was performed with one of the Project D partners. However, due to organisational restrictions, the author was only allowed to access the department which had been directly involved in Project D (the company research department). As a result, evidence from stakeholders was limited.

The result of the case study shows how the Lifecycle-based Stakeholder-oriented approach contributes in monitoring the progression of the project. However, it also presents the ongoing nature of a number of problems within the development of collaboration environments for virtual enterprise. In Project D, the potential issues are identified in terms of communication, project management, time/cost/quality and organisation and culture. A few issues appeared during the evaluation processes which deserve further discussion, for example on effective knowledge management to enable the organisation to derive maximum benefit from involvement in collaborative research projects.

4.2. Project C

This research project consortium contained different organisations spread across Europe with different levels and types of expertise and experience. Three project partners participating in this project were all from the automotive industry. The Project C pattern of virtual organisation is therefore grouped into the category of research project and equal partner to form as a network organisation. As it has the characteristics of a network organisation within a virtual enterprise, some issues need to be addressed as mentioned in the previous section.

The evaluation approach focuses on the user requirements in terms of stakeholders' perspectives, on the political/strategic/economical impact, on organisational added value, and on the technical aspect with the consideration of context, content and process. A 'Gentleman's Agreement' was signed to validate the technical functionality within different scenarios. Questionnaires were designed to evaluate user acceptance, regulated services, impact assessment, and financial effect, i.e. cost saving, ROI, and organisation added value.

Some potential issues were identified through participant observation. They are recognised as user satisfaction, communication, clear goals and objectives, project management, time/cost/quality, trust and lack of agreed evaluation criteria.

4.3. Summary of case studies outcomes

In summary, both studies experienced success and faced problems, to a different degree, across different organisations and different types of virtual enterprise. In both studies, some follow up activities were required because the summative evaluation was incomplete within the timeframe of the projects. However, a major difficulty faced was the lack of resources for carrying out follow-up activities. Due to the fact that the context was changing constantly, some attempt was made to negotiate the budget and resource. The main problem in Project D was the limitations on access to the stakeholders. As a result, the follow up activities were either performed under constraints or not carried out at all.

5. Discussions of the research findings

Reflecting on the research findings and the nature of the case studies introduced above, further discussions are undertaken along with the relevant literature in this section. According to the type of virtual enterprise within both case studies carried out in this research, there is an indication that the issues associated with network organisation and learning organisation need to be addressed. These issues include knowledge management, trust, organisational culture, and collaboration between stakeholders and their performance. Referring to the findings and potential risks discovered in this research, several common problems emerge more than once among the case studies. The frequent problems are communication, project management, and time/cost/quality. As a result, attention is paid to the common issues which result in the problems identified within each study in this section.

5.1. Communication

Communication is recognised in much research as the core of a virtual team process and has given rise to a lot of discussion on the need for effective communication, facilitating communication by using ICT technologies, and the communication difficulties encountered within a virtual team [1, 14, 19]. In order to achieve objectives and accomplish tasks successfully within a virtual team, information must be swapped and communicated between members effectively.

Effective communication is reliant on effective information sharing in terms of knowledge exchange, helpful discussion and negotiation about issues with members, and efficient ICT tools use. Some problems within each study associated with communication are discussed below.

- Information exchange

  Information exchange is complex when team members are dispersed in different locations within a virtual team. The issue of effective communication in terms of information exchange emerged in Project C. An intended result of Project C was to provide a certification service. In order to provide a certification service to the public, especially for other sub-projects, the test platform needs to be designed to be as generic as possible. However, due to the huge scope of the project, the sub-projects did not really communicate with each other. As a result, the definitions of specific items for testing were different in each project, in such respects as security and privacy. The ineffective communication generated an issue during the design of the context of testing for certification due to the various definitions given within different sub-projects. Consequently, time and budget were unnecessarily spent on clarifying the validation criteria and jargon. Furthermore, this lack of communication may result in driving the development into the wrong direction or into not covering the full scope. Moreover, the integration between different protocols/ applications in order to perform validation may also become an issue.

- Helpful discussion and negotiation

  Along with sharing information, Krumpel [13] suggests that all perspectives of an issue within a virtual team needed to be brought to attention and discussed for the team to be effective. In the Project D study, different opinions regarding the pilot implementation were raised. For instance, IT vendor partners only addressed highly prioritised scenarios because of the time limitations. In contrast, industry partners wanted to implement all scenarios. With different perspectives in each participant, the priorities of implementation therefore needed to be negotiated. This issue also reflects time allocation and management and it echoes the need for considering time constraints more carefully while submitting the proposal. Moreover, different perspectives from group members need to be addressed and negotiated [17] but in this project strong characters within some companies had dominant influence in directing the project to their interests.

5.2. Project management

A virtual team often encounters difficulties in coordinating across time zones, cultural diversity, temporal structure, and different mental models to perform the highly interdependent project tasks [12,21]. Saker et al. [20] suggest it is necessary to develop collaboration models/mechanisms for the team to manage team members' contributions consistently and coherently.

In a virtual team, face-to-face communication enhances positively the relationship between internal collaboration and team performance, innovativeness, and member satisfaction. In addition, it provides an opportunity which allows full discussion and eliminates the arguments after a critical decision has been made. Successful project managers therefore plan and arrange formal communication and coordination processes to achieve the common goal within the teams. Periodic face to face meetings along with clear objectives for the delivery of expected results enhance coordination activities and push a project forward [6,15]. Townsend et al. [23] suggest managerial control in virtual teams and that “clear schedules must be established of when the team will provide reports, interim deliverables and final product”.

In Project D, schedules in terms of milestones, deliverable deadlines, implementation and activities were established. Periodic face to face meetings were also arranged and provided opportunities to team members for discussions. The project held management (steering) meetings and technical meetings regularly. However, discussion at technical meetings sometimes covered both purposes instead of having separate management meetings. The people who attended technical meetings were usually in more junior positions and not authorised to make decisions. The risks of having technical meetings discussing management issues resulted in bringing out disagreement about project management because of different industries having different concerns and priorities. Due to this unclear meeting purpose, some meetings were held ineffectively and caused conflict between members. As a result, the project was considered by several participants to have poor project management. The re-scheduling of activities which led to the exclusion of true end-users from the demonstrator trials may be seen as one result of these management problems. However problems of this kind are seldom reported in formal project outputs and publications.

A virtual team is usually established to perform complex tasks or develop a complicated system. Due to the huge and complex nature of the system, the project is usually implemented in several stages. Strategies such as prototyping and early integration, and defining project reporting mechanisms have been suggested as methods of monitoring remote workers successfully in virtual teams [7]. In order to implement the prototype, it is necessary to prioritise project tasks and define the scope to put into practice.

Project C was considered as a complex project. Currently, there are no mature/applicable standards or service level agreement. Consequently, there is not much experience with certification processes and services. Project C was trying to eliminate this gap for a group of services. However, the intention of covering the complete chain of certification, including components, products, systems within different branches, was not realistically achievable, neither in a national nor in a European context.

As a solution, it would be more realistic to start with one specific service to ensure the essential elements were covered and considered. With the success of the small scale of certification scheme as a prototype, then the project can be expended to a broader scope.

5.3. Time/cost/quality

IT projects are often delayed, over budget and result in poor quality outcomes [4]. In Project D, an essential comment from different partners was “this is a huge project and we need more time” as there were many opinions and different requirements from industry partners. Moreover, the replacement of one of the project partners was also a reason for the project being delayed.

In Project C, training material had been produced at an early stage in order to promote the certification concept to other sub-projects which will be the end users of Project C. While the training material was produced, a lot of uncertainties and controversies remained between Project C partners, e.g. concerning the certification process. However, the training material was published 18 months before the project end. Due to the remaining undefined process, it implies that there is a high probability that the produced training material will not match the final certification process. This means that the training material will not be used as it does not reflect the reality of what needed to be reproduced. It is arguable that the project resource was wasted which could have been avoided by postponing the time to publish the material. However, the budget of Project C was cut down to about one third of the initial requested budget. A comment from different partners is “this is a complex project and we need more resources”. As a result, it is unlikely to reproduce the training material in the future.

There are many reasons which could result in a lack of time in any project. Cost and time can be deliberately understated in terms of size of IT budget in order to increase the likelihood of the proposal being accepted. Moreover, not fully investigating the resource which is required in a project will also result in failure to estimate/ predict time scales. In addition, a virtual enterprise usually involves multiple partners from different organisations and it is time consuming to reach a compromise with each other and build a level of trust to work on the project.

6. Reflection on the case studies

6.1. Justification for the choice of stakeholders

In this research, stakeholders were identified and their perspectives about evaluation methodologies were addressed in each case study. Through the methods of observation and participation during the evaluation process, the stakeholders' opinions about project results and organisational operations were collected in depth.

In Project D, the internal stakeholders were identified and grouped as users, managers, developers, and other departments in the organisations. In the case of applied research projects with part-public funding, the "outsider" stakeholder groups are highly significant, including both the funding body and the external users of those results that will be placed in the public domain. Thus one of the tasks of summative evaluation is to demonstrate to those external stakeholders the contribution that the project has made to scientific and technological knowledge. Based on the above theories, in Project D, the external stakeholders which were identified included customers, suppliers, developers, other European Research projects, the European R&D community and the European public, as represented by the Commission, Council, Parliament etc.

In order to investigate how the organisation used the results of these research projects and see if there is any difference between the stakeholders' perspectives and the reality, the author therefore cooperated closely with one of project partners, Company A. In Company A, the purposes of joining Project D were to reduce the time and costs of the development and deployment of their products whilst increasing their quality. Moreover, they intended to implement a proof-of-concept demonstrator of Project D innovations inside the organisation, use the concept and experience for organisation process re-engineering, and improve the knowledge for future innovation.

In reality, the results of Project D have been demonstrated many times to different groups within Company A, culminating in the creation of a committee in charge of the transfer of results to engineering teams for future vehicle programmes. However, knowledge transfer within Company A is heavily reliant on tacit knowledge. Consequently, the knowledge gained from research projects is embodied in and transmitted by the employees who participated in the project. The participants involved in Project D were mainly in the R&D department. Therefore, the knowledge and experience obtained from Project D were stored in the R&D department and then distributed to other departments. As a result, it is reasonable to revise the groups of stakeholders within Project D by adding the R&D department into the groups. The revised Project D stakeholders are shown below: *Figure 2: Amended Project D stakeholders*.

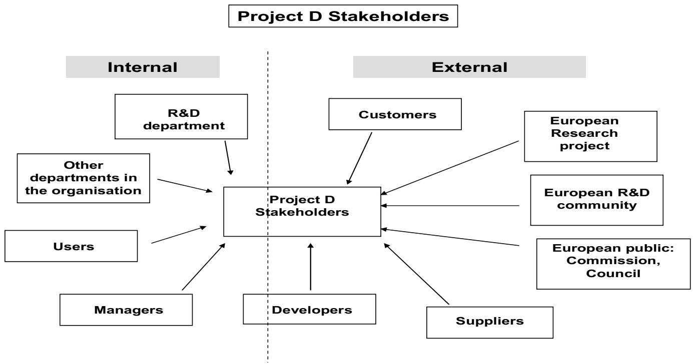

Figure 2 - Amended Project D stakeholders

A similar situation also existed in Project C that most participants were from the R&D department in each organisation. As a result, a R&D department shall be added into the Project C stakeholders as well. With this revised concept of stakeholders, it brings out the questions what the degree of relationship and collaboration are between other departments and R&D department, and what the gap between research and practice is and how the knowledge can be transferred from R&D department to other departments.

Furthermore, there was an underlying theme connecting stakeholders with Power/Resources/Politics within case studies. In Project D, due to a political reason, i.e. nationality, the author was only allowed to access some project partners' organisations with permission. In addition, while performing the follow up activities in Company A, the author was permitted to collaborate with R&D department only due to restrictions within Company A. As a result, the evaluation activities were limited and carried out within designated departments and it was not possible to evaluate the project performance with the end users.

These facts introduced above highlight that Power, Resources and Politics have a huge impact on evaluation activities. Berghout et al. [2] state that politics in decision-making is inevitable. With the power, the decision maker can authorise and control the resources in terms of time, budget, manpower, and influence the level of participation by empowering others. With the experience of this research, it demonstrates that Power-Politics controls the level of accessibility, resources and information within organisations. It also influences the degree of input/participation in evaluation activities. As a result, some stakeholders may be identified and taken into account during an evaluation plan, yet their perspectives cannot be collected in practice because of political restrictions. Subsequently, the opinions collected from the limited group of stakeholders can not represent the others' perspectives as a whole. In addition, the evaluation activities may also be affected by the Power-Politics, e.g. time and budget for carrying out evaluations, and selection of evaluation instruments. This echoes Blackler's [3] position that evaluation needs to shift attention from the participants or stakeholders in IS development to a better understanding of the importance of organisational politics.

The Power-Politics implicate the issue of assessing the political issues associated with capital budgeting and decision making. This theme therefore needs to be highlighted and systematically addressed throughout evaluation.

6.2. Emerging issues in research

The European Union (EU) has been conducting research and technological development based on multi-annual framework programmes since 1984. The research activities under EU funding have contributed one third of the world's scientific knowledge. Currently, the Seventh Framework Programme (FP7) is at the stage of its first call, while the Sixth Framework Programme (FP6) lasted for four years from 1 January 2003 to 31 December 2006. According to the FP6 web site (http://europa.eu.int/comm/research/fp6/projects.cfm), there were more than 188 projects. Actions under previous Framework Programmes continued in FP6, such as the active participation of small/medium enterprises. These activities in FP6 were intended to mark a decisive step towards the involvement of Europe's research and scientific networks. The transformation of the European Union is then expected to impact the most dynamic and competitive knowledge based economy in the world. From these perspectives, it can be seen that the European Research Community, the European public institutions, and other EC-funded projects, must all be considered as essential stakeholders when evaluating any EC-funded collaborative project; but the results of the research reported in this paper raise doubts about the practical involvement of these wider stakeholders in project evaluation.

Whitley [24] identifies the value of new knowledge is which is produced beyond and is an improvement on previous work and suggests that "research is valued to the extent that is affects, influences, and is essential for other's work to be successfully accomplished". This emphasises the importance of reusing results in later research and brings out the question how many of the research results are then used or re-used in organisations or other research projects. In this research, both projects were unable to use the summative evaluation results for further improvement due to project time constraints. This raises the questions, how many projects are able to carry out an evaluation; how many of them are able to carry out a summative evaluation within their time constraints and therefore provide secure results as basis for further improvement. With these questions in mind the author therefore carried out a secondary research through the Internet, i.e. visited Community Research & Development Information Service (CORDIS) website (www.cordis.lu), Information Society Technologies (IST) website (http://cordis.europa.eu/ist/). The results of EU research projects are only available within the designated website of each project and unfortunately, there is no evidence that any such research has been carried out to answer the above questions with respect to FP6. In addition, each funded project has been reviewed by designated reviewers who should deliver the review results. However, there is no evidence that such document is available for public use in terms of knowledge reuse.

This is a vital area for future research if valuable data is not to be lost. These research results can then contribute to the further framework programme design. With clear guidelines generated from the research, the budget under the framework programme can be allocated effectively to those research areas which most need to be addressed. In addition, there is close connection in this programme level of evaluation that needs effective knowledge management in the organisations.

6.3. Knowledge management

Knowledge is often distinguished into two forms: codified or explicit knowledge and tacit or implicit knowledge. Explicit knowledge is well documented, formalised and easy to share with others. Tacit knowledge is fuzzy and exists in people's mind and can be transferred through communication and sharing, however, it is not easy to formalise. Knowledge can be transferred through socialisation and formalisation into the format that can be distributed and understood and subsequently contributes to the invention of new knowledge.

Sutcliffe [22] introduces specific design knowledge as "Claims" and presents it by a scenario of use and example artefact. Claims can be reused by illuminating the design information and converting the associated artefact. The process of claims reuse from one project with its related information can put claims into a reality test and thus lead to claims evolution. Knowledge and experience obtained from participating in research projects, such as Project D and Project C, require participants to transmit them to others. Therefore, it is important to manage how the knowledge is transferred. As a result, knowledge management becomes important in an organisation as transferring the new knowledge into products and services performs as an essential function in maintaining a competitive edge in business.

The findings of Project D show that the project partner which the author had maximum access, i.e. Company A, is heavily reliant on tacit knowledge management. Moreover, 70 percent of the employees in their R&D department are contractors from external consultant companies. However, some consultant companies do not wish their employees to stay in the same company too long, e.g. more than 3 years. Therefore, it can be foreseen that the employees who embody this tacit knowledge may turnover every three years. These observations imply some concerns emerging: how a partner in an applied European-funded project can maintain and manage research manpower more effectively, and also keep and manage the knowledge from their research projects. Knowledge transfer/reuse is heavily associated with organisational learning. Organisational learning requires a culture of acceptance to be developed and can be promoted by management structures, such as establishing guidance to gather knowledge and encourage its transfer [22].

Furthermore, in Section 6.it was mentioned that previous EU research results can contribute to further research programme design. The outputs of research are often generated and influence within two domains: dissemination in public and organisational learning. Dissemination is presented in the form of codified documents as explicit knowledge and available to be accessed by public. Organisational learning however is knowledge transfer either through codified documents or communication and sharing between employees as tacit knowledge management, e.g. the knowledge management in Company A. Referring to the concept of stakeholder, different types of knowledge management will have impacts on different stakeholders. For example, in Project D, the organisational learning will affect the internal stakeholders, i.e. R&D department, users, managers, developers, and other departments in the organisation. On the other hand, the dissemination/ public knowledge will influence external stakeholders, i.e. developers, customers, suppliers, other European research projects, European R&D community, and European public bodies: Commission, Council.

However, in the previous section we highlight the difficulty of collecting some stakeholders' perspectives as a result of Power and Politics. Consequently, it is impossible to find out how the knowledge is transferred and managed between these stakeholders. This points to a need for future evaluations to address how knowledge management impacts on different stakeholders.

In addition, there is no evidence to show how many of the EU research results are then used or re-used in organisations or other research projects. The emerging issue in research highlights that there is a need to address the knowledge management in the European Union in order to allocate resources effectively to those research areas which most need to be addressed in the future.

7. Conclusion

The transformation of the European Union is expected to impact the most dynamic and competitive knowledge based economy in the world. From these perspectives, it can be seen that the European Research Community, the European public institutions, and other EC-funded projects, must all be considered as essential stakeholders when evaluating any EC-funded collaborative project; but the results of the research reported in this research raise doubts about the practical involvement of these wider stakeholders in project evaluation. In addition, the theme of Power/Politics/Resources is highlighted during carrying out the case studies that some stakeholders' perspectives can not be collected for reasons of Power and Politics. Consequently, it is difficult to find out how the knowledge is transferred and managed between these stakeholders. This points to a need for future evaluations to address how knowledge management impacts on different stakeholders.

With the experience gained from the case studies, it suggests that both projects encountered the same difficulty during the process of evaluation. Reflection on the case studies brings to attention some subjects that need to be addressed while conducting an evaluation, such as the influence of power and politics on evaluation activities and resources, e.g. time, budget, and accessible stakeholders. With the outcomes of the case studies, further research could be directed towards knowledge management. This could include knowledge management and transfer within an organisation, and the re-use of knowledge in European funded and other research projects or in the public domain.

8. Reference

[1] Alexander, S., Virtual teams going global, InfoWorld, Vol. 22 (46), pp.55-56, 2000.

[2] Berghout, E., Nijland, M. and Grant, K., Seven ways to get your favoured IT project accepted – politics in IT evaluation, Electronic Journal of Information Systems Evaluation, Vol. 8 (1), pp. 31-40, 2005.

[3] Blackler, F., Information technologies and organisations: lessons from the 1980s and issues for the 1990s, Journal of occupational psychology, Vol. 61, pp.113-127, 1988.

[4] Bounds, The last word on project management, IEE Solutions, Vol. 30, No.11, pp. 41-44, 1998.

[5] Farbey, B., Land, F. and Targett, D., How to assess your IT investment: a study of methods and practice, Oxford: Butterworth Heinemann, 1993.

[6] Geber, B., Virtual team, Training, Vol. 32 (4), pp.36-40, 1995.

[7] Haywood, M., Managing Virtual Teams: Practical Techniques for High-Technology Project Managers, Boston: Artech House, 1998.

[8] Huang, J. P. H., An Evaluation Framework to Support Development of Virtual Enterprises, in the previous section Electronic Journal of Information Systems Evaluation, 2003.

[9] Huang, J. P. H., An Enhanced Approach to Support Collaborative Systems Evaluation, in 13th IEEE International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises, Los Alamitos, CA: IEEE Computer Society, pp161-166, 2004.

[10] Huang, J. P. H., A conceptual framework for understanding collaborative systems evaluation, in 14th IEEE International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises, Los Alamitos, CA: IEEE Computer Society, pp. 215-220, 2005.

[11] Huang, P. H., Evaluation of collaborative system to support a virtual enterprise, PhD thesis, Glasgow Caledonian University, 2007.

[12] Kayworth, T. R. and Leidner, D. E., The global virtual manager: a prescription for success, European Management Journal, Vol.18 (2), pp. 183-194, 2000.

[13] Krumpel, K., Making the right (interactive) moves for knowledge-producing tasks in computer mediated groups, IEEE Transaction on Professional Communication, Vol.43 (2), pp. 185-195, 2000.

[14] Mark, G., Meeting current challenges for virtually collocated teams: participation, culture, and integration, in Chidambaram, L., and Zigures, I. (Eds.), Our virtual world: the transformation of work, play and life via technology, Hershey, PA: Idea Group Publishing, pp. 74-93, 2001.

[15] Maznevski, M. and Chudoba, K., Bridging space over time: global virtual team dynamics and effectiveness, Organisation Science, Vol. 11 (5), pp. 473-492, 2001.

[16] McKeen, J. D., Smith, H. A. and Parent, M., An integrative research approach to assess the business value of information technology, in M. A. Mahmood and E.J. Szewczak (Eds.), Measuring Information Technology Investment Payoff: Contemporary Approaches, Hershey, PA: Idea Group publishing, 1999.

[17] Newman, J., Raybourn, E.M and Huang, P. H., WETICE 2003 Evaluating Collaborative Enterprises Workshop Report, in Proceedings of the 12th IEEE International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises*,* Los Alamitos, CA: IEEE Computer Society, pp. 131-136, 2003.

[18] Palmer, J. W., Supporting the virtual organization through information technology in a new venture: the RETEX experience, in Proceedings of the 1996 ACM SIGCPR/SIGMIS conference on Computer personnel research, New York: ACM Press, pp. 223-233, 1996.

[19] Powell, A., Piccoli, G. and Lves, B., Virtual teams: a review of current literature and directions for future research, The DATABASE for advance in Information Systems, Vol.35 (1), pp 6-36, 2004.

[20] Saker, S., Lau, F., Sahay, S., Using an adapted grounded theory approach for inductive theory building about virtual team development, Database for Advances in Information Systems, Vol. 32(1), pp. 38-56, 2001.

[21] Saker, S. and Sahay, S., Information systems development by US-Norwegian virtual teams: implications of time and space, in Proceedings of the Thirty-Fifth Annual Hawai Internal Conference on System Sciences, Hawaii, pp. 1-10, 2002.

[22] Sutcliffe, A., The domain theory: patterns for knowledge and software reuse, Lawarence Erlbaum Associates, Mahwah, New Jersey, 2002.

[23] Townsend, A., DeMarie, S. and Hendrickson, A., Virtual teams: technology and the workplace of the future, Academy of Management Executive, Vol. 12(3), pp. 17-29, 1998.

[24] Whitley, R., The intellectual and social organisation of the sciences (2nd edition), Clarendon Press, Oxford, 2000.

[25] Yen, D. C., Chou, D. C., Chen, T. and Chen, H., Becoming a virtual organisation: a strategic approach, International Journal of Networking and Virtual Organisations, Vol.1(2), pp.184-198, 2002.

EUROPEAN RESEARCH ON VIRTUAL ORGANIZATION

Jan Klas*

The aim of this contribution is to briefly introduce research on the topic of virtual organization performed in the frame of framework programmes (FP) of European Commission, with concentration on 6th FP and priority IST (Information Society Technology). In this contribution virtual organization is understood as a special collaborative relationship among organizations. There are briefly described research efforts performed under the 5th FP and 6th FP of European Commission and projected research areas under the 7th FP. There are also described some concepts relating to the topic of virtual organization in the framework programmes, like Smart Organization, Virtual Breeding Environment and Collaborative Networks.

1. Introduction

The topic of virtual organization is very broad one and in the theory of virtual organization, there is no unified approach not only to the topic of virtual organization but also to the basic terms, like the term "virtual organization". In this contribution, virtual organization is understood as a specific relationship among organizations, similar to networked organization.

Virtual organization was not and is not special research target in research performed under the framework programmes of European Commission (further only European research), but the virtual organization topic has been quite extensively researched in broader research of networked enterprises, often with concentration on IS/ICT dimension of the networked enterprises.

Virtual organization was researched in various projects of the 5th FP, which has been synthesized in the frame of the VOSTER project. Further more, interesting research on virtual

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organization is now in progress in the projects of the 6th FP. These projects are running from 2004 and are intended to conclude in 2008 – like the projects ECOLEAD, ATHENA or DBE. 7th FP also counts with virtual organization, in broader topic of ICT support of the networked enterprise.

There are many concepts in the theory of virtual organization. European research deals with some interesting ones, which are briefly described further in this contribution: Smart organization, Virtual breeding environment, Collaborative networks, Digital business ecosystem.

The aim of this contribution is to give quick orientation on the topic of virtual organization in the research performed under framework programmes of European Commission.

2. Framework programmes of the European Commission and selected research projects

2.1. 5th framework programme

In the 5th FP the virtual organization topic was researched under the Smart organisation priority. Results of various project were synthesised in the frame of the VOSTER project, launched in 2001 and concluded in 2004, under priority „New methods of work and electronic commerce“ and sub priority „Smart Organizations“ with budget of 1,35 mil. EUR financed by European Commission. Projects covered by the VOSTER project are depicted on Figure 1. The VOSTER project results from state of the mentioned projects to the beginning of 2003.

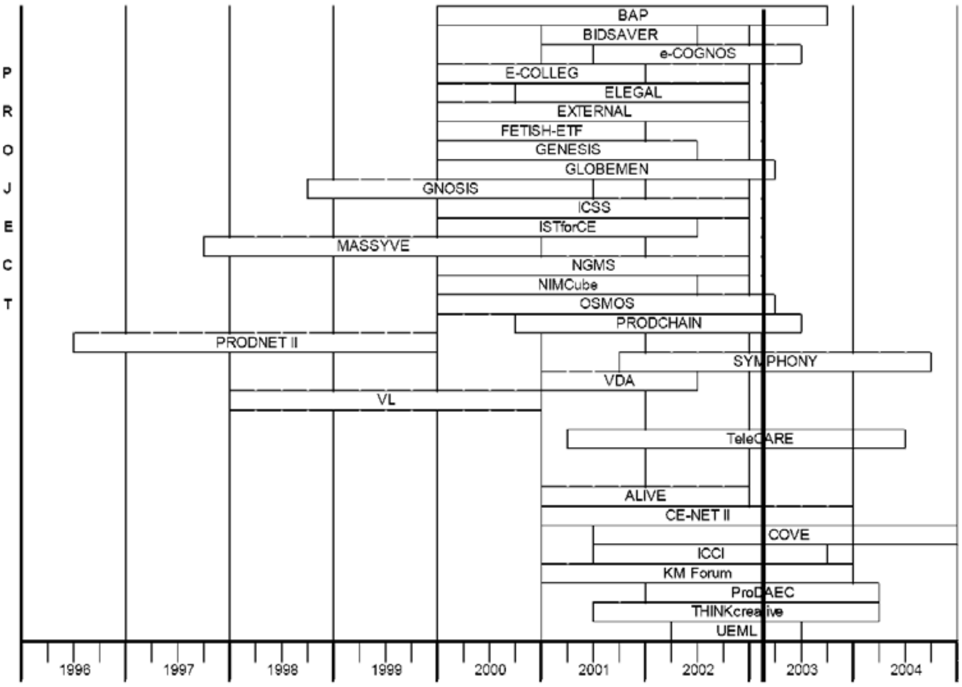

Figure 1 – Projects covered by the VOSTER project [13]

Among outputs of the VOSTER project belong:

- Guidelines for VO [11] – introductory material to the topic of virtual organization, containing in my opinion rather simplifying assumptions and short case studies with business targets.
- ICT support infrastructures and VO interoperability [13] – synthesizing material dealing with ICT infrastructures of virtual organization, containing timeline with basic projects (see Figure 1), evaluation of description of each project to the topic of ICT infrastructures of virtual organization (not provided here because of space constraints), basic types of infrastructures for virtual organization (see Figure 2), described in more depth, and technologies for VO (in sense when to use videoconferencing equipment and which one, when to use ergonomic furniture, ...).

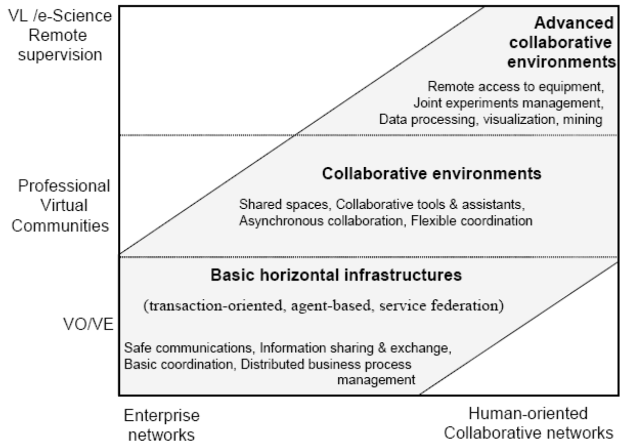

Figure 2 – Basic types of virtual organization and infrastructures [13]

2.2. 6th framework programme

In the 6th FP, most of the research regarding the virtual organization topic is done under the topic of ICT in networked enterprises. Projects and their types in this area are depicted on Figure 3, contents of the projects is described on Figure 4. In my opinion, among most important integrated projects in area of virtual organization belong projects ECOLEAD, ATHENA and DBE, which are described later in this article.

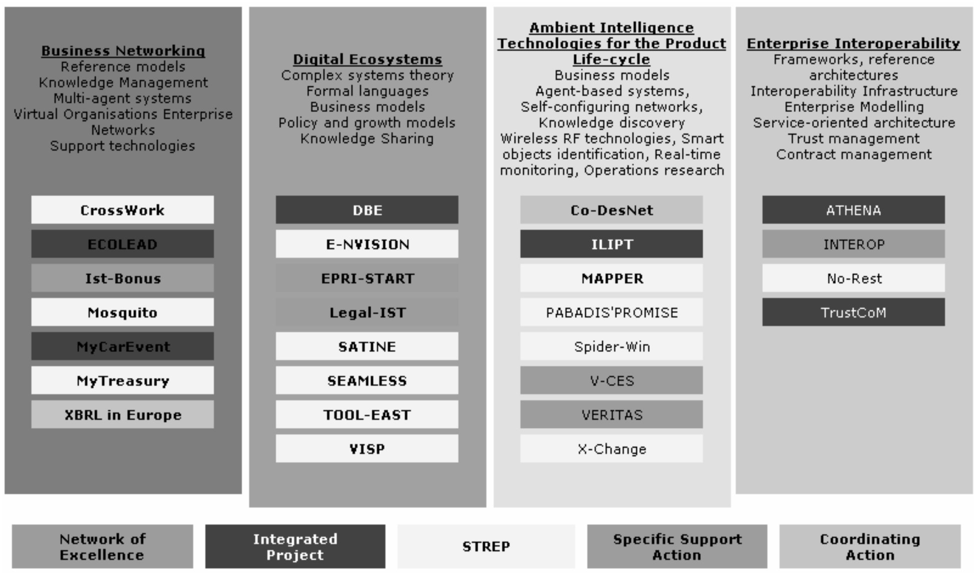

Figure 3 – Projects of 6th FP in area of organizational networking [12]

ATHENA project [1] concentrates on interoperability of heterogeneous business networks. Among desired research results belong: framework for interoperability on business level, requirements on applications from the point of view of interoperability, model for interoperability impacts analysis, referential model a best practice experience.

DBE project (DBE stands for Digital business ecosystem) [6] aims for creation of special internet-based software, enabling SMEs to collaborate on the basis of digital ecosystems. Via this platform it will be possible for them to find both their partners and customers. General scheme of digital business ecosystem in the view of the DBE project can be seen on [6].

ECOLEAD project aims for creating solid basis of the concept of collaborative networked organization, based on contributions in five main areas – three vertical ones (virtual breeding environment), dynamic virtual organization, virtual professional communities) and two horizontal ones (theoretical backgrounds of collaborative networked organizations and ICT infrastructures).

Project	Type	Target
ATHENA	IP	interoperability of heterogeneous business networks
CrossWork	STREP	workflow in automobile industry
DBE	IP	digital business ecosystem
ECOLEAD	IP	collaborative networks and their ICT infrastructures
E-NVISION	STREP	creation of Europe-wide technological platform for e-business
ILIPT	IP	agent approaches in automobile industry supply chains
MAPPER	STREP	flexible production management and SME inclusion into production networks
Mosquito	STREP	teleworking
MyCarEvent	IP	mobile services for automobile aftermarket
MyTreasury	STREP	cash management; creation of single market for cash management
No-Rest	STREP	applicability and dynamics of e-business standards
PADABIS'PROMISE	STREP	creation of new architecture for production management, based on real-time agents and distributed intelligence
SATINE	STREP	integration of web services in peer to peer networks
SEAMLESS	STREP	integrated computer models in forestry and environment

Project	Type	Target
SPIDER-WIN	STREP	creation of ASP platform for communication management of SME supply chains without necessity of implementation of standard ERP
TOLL-EAST	STREP	creation of open source ERP for collaborating SMEs
TrustCoM	IP	trust and contract management framework enabling the definition and secure enactment of collaborative business processes
VISP	STREP	creation of single software platform for SME clusters, in order to operate like single enterprise
X-CHANGE	STREP	change management in factories

Figure 4 – IPs and STREPs in 6th FP in Enterprise Networking [compilation]

2.3. 7th framework programme

In the 7th FP research, virtual organization (networked organization respectively) will be supported especial via target ICT-2007-1.3: ICT in support of the networked enterprise in the Challenge 1: Pervasive and Trusted Network and Service Infrastructures, with funding of 30 million EUR total (with 11 million EUR intended for IP and 11 million EUR intended for STREP) – based on document "ICT – Work programme for years 2007 – 2008" (topic ICT, FP Cooperation).

The amount of funding intended for the target ICT-2007-1.3 is definitely substantial; however with these funds the target ICT-2007-1.3 belongs to smaller ones; there are several targets with total funding around 100 million EUR (more than three times higher than the target ICT-2007-1.3).

3. Selected concepts in research of virtual organization

In this part of the contribution, there are described selected concepts relating to the research of virtual organization topic in FP of European Commission. The selected concepts are:

- Smart organization – concept used in 5th FP.
- Virtual breeding environment – concept for establishing virtual organization, researched in 5th and 6th FP.
- Digital business ecosystem – concept of SME interaction and network formation via electronic networks (internet), researched in 6th FP (DBE project).

- Collaborative networks – wider topic containing also various types of virtual organizations researched in 6th FP (ECOLEAD project).

3.1. Smart organization

In the 5th FP the virtual organization topic was researched mostly under the sub priority Smart Organization. According to [10], smart organization is knowledge driven, internetworked organization, which dynamically adapts new organizational forms and ways of work and is able to create and exploit opportunities offered by digital age.

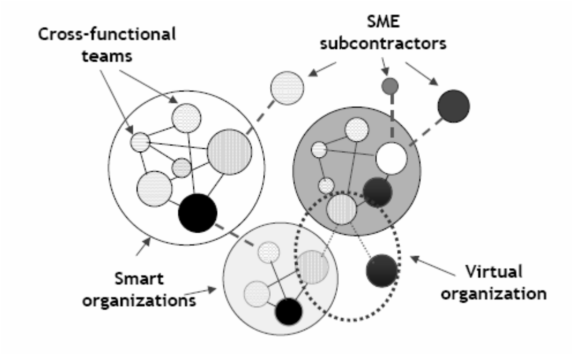

Figure 5 – Smart organization and virtual organization [10]

Relationship among smart organization and virtual organization is apparent from Figure 5 and Figure 6. Smart organization is wider concept, in which virtual organization plays its role, mainly as way of collaboration of smart organizations.

Organizational form	Organizational structure	Type of collaboration
Corporate, Co-located	Functional units and cross functional teams in the same location	Intraorganizational
Extended enterprise	Functional units and virtual teams	Supply chain integration
Virtual enterprise	Organizational „projects“ and virtual teams	Strategic alliance, cooperation agreement, joint venture
Value network / e-business community	Organization network of competences and virtual teams	Economic web

Figure 6 – Organizational forms and types of collaboration in Smart organization [9]

3.2. Virtual breeding environment

The concept of virtual breeding environment belongs among concepts of virtual organization based on relatively permanent network of organization; from this permanent network member organizations form dynamic ad-hoc coalitions in order to exploit single business opportunities. In this concept the permanent network is called virtual breeding environment, which role is to support creation of dynamic ad-hoc coalitions, so called dynamic virtual organizations. Brief scheme of this concept can be seen on Figure 7. The virtual breeding environment was researched under the 5th FP and is more in depth developed also in the 6th FP, under the ECOLEAD project.

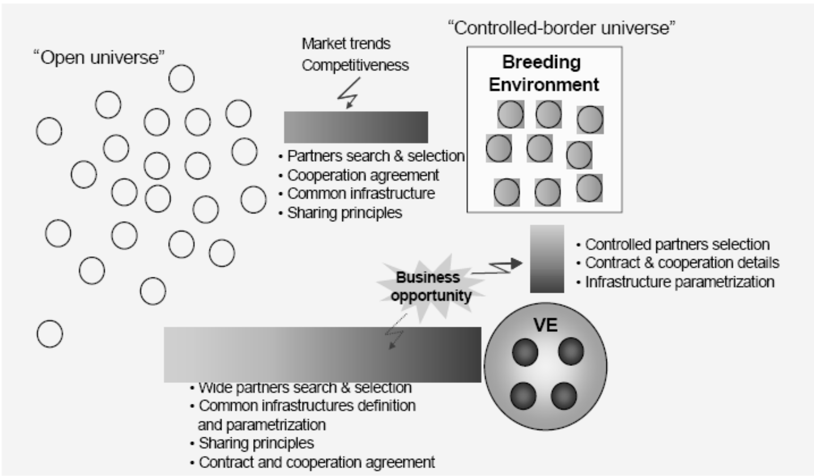

Figure 7 – Formation of virtual organization and breeding environment [13]

Following the ECOLEAD project [4], roles of organization in virtual breeding environment can be as follows:

- member – organization registered in breeding environment,
- administrator – organization responsible for breeding environment,
- broker – organization looking for new business opportunities,
- planner and business integrator – organization forming the ad-hoc coalition for the business opportunity – identification of capacities and competencies, ...,
- virtual organization coordinator – organization coordinating formed and operating ad-hoc coalition – the dynamic virtual organization,
- and many others.

Personally I consider the concept of virtual breeding environment as one of the most important concepts of virtual organization based on "permanent" networks.

3.3. Collaborative networks

Collaborative networks are a concept, which in my opinion substantially overlaps with concept of virtual organization. Relative position of virtual organization and collaborative networks, according to the authors can be seen on Figure 8.

Collaborative networks are defined as "alliances formed by various entities, which are mostly autonomous, geographically distributed and heterogeneous in the sense of their operational environment, culture, social capital and goals, but which collaborates in order to better achievement of joint or compatible goals and which interactions are supported by computer networks" [7].

These collaborative networks have joint characteristics [2]:

- network of autonomous entities (organizations, people, resources, ...) located in different locations,
- management through joint goals/intentions achieved by mutual collaboration,
- heterogeneity is coped with operating on the basis of shared principles and interoperable infrastructures.

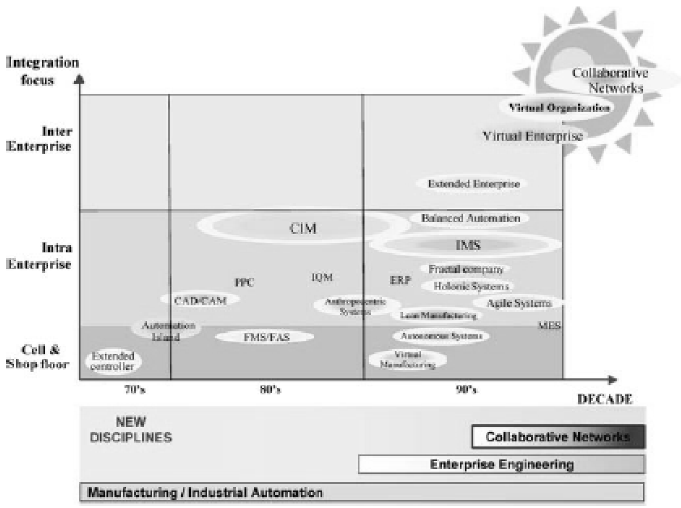

Figure 8 – Historical perspectives of collaborative networks [3]

Among collaborative networks belong many other concepts, like dynamic virtual organization, virtual breeding environments, digital ecosystems, clusters etc. See Figure 9.

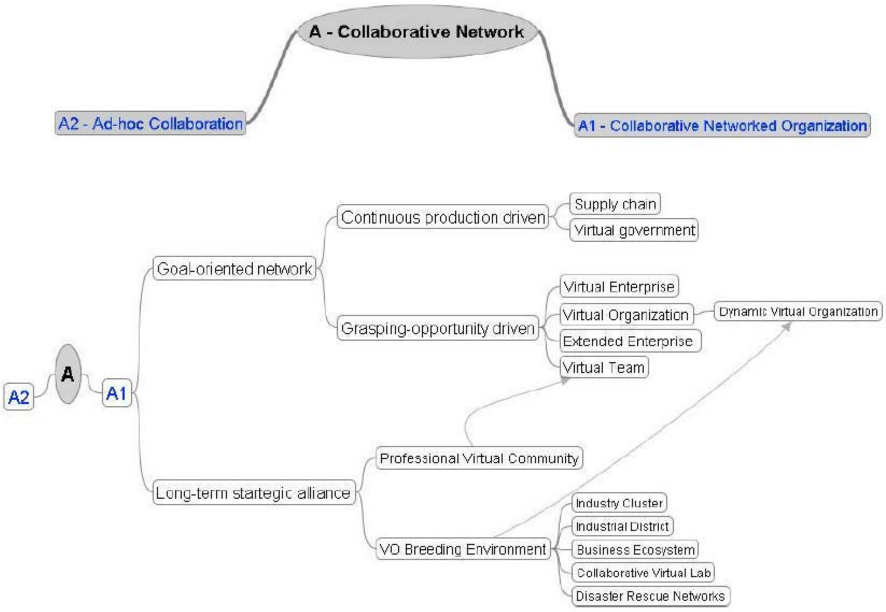

Figure 9 – Concepts inside collaborative networks concept [7]

Relationship among concepts of virtual organization and collaborative networks depends on understanding the virtual organization. In narrow sense, virtual organization understood as virtual organization, virtual enterprise, dynamic virtual organization and virtual organization breeding environment, the virtual organization is part of the collaborative networks concept. In wide sense, virtual organization understood as organization of relationships supported with IS/ICT, collaborative networks belongs into the virtual organization concept.

4. Summary and conclusion

The aim of this contribution was to give short overview of research on the topic of virtual organization performed in the framework programmes of European Commission. The virtual organization topic has been researched in the 5th FP, in the 6th FP and is going to be researched also in the 7th FP, usually not as a topic itself, but as a part of wider topics (Smart organization or Organizational networking supported with IS/ICT). In the second part of the contribution were briefly introduced in my opinion most significant concept in relation to virtual organization in the European research: the concept of Smart Organization, the Virtual Breeding Environment concept and the Collaborative Networks concept.

To conclude, in European research the virtual organization topic is part of wider concept of organizational networking and is mostly researched in connection with support by IS/ICT. Virtual organization is actual topic, which will be also researched in the future, in the 7th FP with substantial funding (30 mil. EUR in 2007-2008).

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6. References

[1] ATHENA – Objectives [online]. [Cited on 31. January 2007]. Available from WWW: <http://www.athena-ip.org/index.php?option=content&task=view&id=22&Itemid=57>.

[2] Camarinha-Matos, L. M.; Afsarmanesh, H. The Emerging Discipline of Collaborative Networks. In: CAMARINHA-MATOS, L. M. (Ed.). Virtual Enterprises and Collaborative Networks (IFIP International Federation for Information Processing). Springer, 2004. ISBN 1402081383.

[3] Camarinha-Matos, L. M.; Afsarmanesh, H. Collaborative networks: a new scientific discipline. Journal of Intelligent Manufacturing. 2005. Vol. 16, Iss. 4-5, p. 439. ISSN 0956-5515.

[4] Camarinha-Matos, L. M.; Afsarmanesh, H.; OLLUS, M. Ecolead: A Holistic Approach to Creation and Management of Dynamic Virtual Organizations. In: Camarinha-Matos, L. M.; Afsarmanesh, H.; ORTIZ, A. (Eds.) Collaborative Networks and Their Breeding Environments: IFIP TC 5 WG 5. 5 Sixth IFIP Working Conference on VIRTUAL ENTERPRISES, 26-28 September 2005, Valencia, Spain (IFIP International Federation for Information Processing). Springer, 2005. ISBN 0387282599.

[5] DBE: Graphical Overview of the DBE [online]. [Cited on 31. January 2007]. Available from WWW: <http://www.digital-ecosystem.org/downloadfiles/DBE%20Overview_Final.pdf>

[6] DBE: Welcome To DBE – Digital Business Eco-System [online]. [Cited on 31. January 2007]. Available from WWW: <http://www.digital-ecosystem.org>.

[7] ECOLEAD : Deliverable D52.2 Rough Reference Models of Collaborative Networks [online]. [Cited on 1. February 2007]. Available from WWW: <http://www.ve-forum.org/projects/284/Deliverables/D52.2_Final.pdf>.

[8] ECOLEAD :: European Collaborative Networked Leadership Initiative [online]. [Cited on 28. January 2007]. Available from WWW: <http://www.ecolead.org>.

[9] Filos, E.; Banahan, E. Towards the smart organization: An emerging organizational paradigm and the contribution of the European RTD programs. Journal of Intelligent Manufacturing. 2001. Vol. 12, iss. 2; p. 101. ISSN 0952-8091.

[10] Filos, E. Smart organization in digital age [online]. [Cited on 10. September 2006]. (Note: Author works for European Commission – DG Information society and media). Available from WWW: <http://www.ve-forum.org/Projects/Articles/54_Smart_Orgs_in_Dig_Age_Filos_14Jul2005.pdf>.

[11] Hannus, M.; Anastasiou, M.; Bifulco, A.; Findeisen, P.; Karvonen, I.; Löh, H.; Plüss, A.; Ollus, M.; Weidemann, M. Guidlines for Virtual Organizations [online]. VTT Technical Research Centre of Finland. Espoo, Finland. [Cited on 5. February 2007]. Available from WWW: <http://www.ve-forum.org/Projects/275/
vo_guideline_20050527.pdf>.

[12] VE-Forum: European Research in Enterprise Networking [online]. [Cited on 5. March 2007]. Available from WWW: <http://www.ve-forum.org/apps/comm.asp?$1=402>.

[13] VOSTER: Deliverable D44: ICT support infrastructures and interoperability for VOs [online]. [Cited on 5. February 2007]. Available from WWW: <http://www.ve-forum.org/Projects/275/voster_d44.pdf>.

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