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New knowledge society creation, which is characterized by the national economy rich in knowledge and saturated with high technologies, and rapid information circulation require specialists, whose basic skills are versatile. Nowadays social science specialist should be able to use modern ICTE technologies and active research methods in order to carefully model and forecast processes that take place in the society. Accordingly, for an ICTE specialist it is not enough to have only the knowledge in his own field of specialization, in order to fully fit in the modern labour market.

These requirements for comprehensive knowledge are especially important in the regions because complex task solution is more characteristic there.

Neither successful new specialists’ preparation, nor regional balanced development is possible without a research. Annual Proceedings of Vidzeme University College serve for experience generalization in ICTE technologies and research methods use in the different regional development aspects. An aim of the publisher is to encourage regional science and research development, granting free publication possibilities mainly to the young scientists, doctoral students, graduates, and industry specialists.

The Editor is truly thankful to the article writers and technical personnel for the successful cooperation in creation of the proceedings. The Editors would like to pay special thank to “Latvian Intelligent Systems, Ltd.” for financial contribution.

Editors
CHALLENGES FOR THE EUROPEAN ENERGY POLICY OF THE NEXT YEARS

by EU Energy Commissioner Andris Piebalgs

INTRODUCTION

Energy markets are changing rapidly, therefore, our energy policies must also evolve. The Energy sector is crucial to competitiveness, sustainable development, growth, and employment. It directly concerns all citizens in terms of access to energy at a reasonable price wherever they live.

Current trends are obvious: we are going to see higher oil and gas prices. Domestic EU energy resources are on a clear downward trend. At the same time, demand is raising across all sectors, at a steady 1-2% per year. Much of the developing world, and notably China and India, will continue to grow explosively.

The EU will become increasingly dependent on external energy supplies if nothing is done. At current trends, the EU import share will grow from 50% today to 70% in 2030. By then, the EU will be 90% dependent from oil imports and 70% from gas imports.

Against this background, the next five years will be a “watershed period” for energy policy. Three main objectives have to be targeted:

- To ensure our energy supply – in the context of high oil prices and increasing energy demand;
- To make the internal market in energy work and be competitive which should lead to competitive prices for consumers and businesses;
- And to contribute to sustainable development – meet our Kyoto commitment notably in terms of reduction of CO2 emissions.

To meet these objectives, European Commission has identified six priorities:

- Reduce energy demand through energy efficiency;
- Ensure the proper functioning of the internal markets for gas and electricity for the benefit of all our citizens;
- Promote renewable energy sources;
- Create a better linkage between energy policies and environmental and research policies;
- Strengthen nuclear safety and security, and
- Further develop external energy policy relations.

The whole point of a coherent energy policy is to develop a package of mutually reinforcing policies that – together – achieve the three core objectives: security of supply, competitiveness, and sustainable development. Indeed, each action should contribute not only to its core objective but to all three.

ENERGY EFFICIENCY IS OUR FIRST FOCUS

A key priority for the Commission is energy demand management. Unless we have a truly sustainable approach to energy, we cannot have a stable economy and secure society. Despite the good record of the EU regarding energy efficiency, it is estimated that one fifth of our energy is wasted. Simple changes in behaviour (such as switching off lights, computers and machines on stand-by) or small investments (such as in energy saving light bulbs, insulation or thermostats) can make a big difference to Europe’s total energy demand bill.

Energy savings also can serve multiple political objectives. It can:

- Save money for individuals and industry alike,
- Save on imported fuels and improve our trade balance,
- Save on the need for new infrastructure,
- Create jobs in new energy-efficient technology and service sectors,
- Reduce the environmental impact of energy, particularly CO2 emissions,
- Create export opportunities.
A High-level group with Member States has already been established. The Commission adopts in June a Green Paper on “Energy Efficiency”. This Paper is setting the frame and broadening the consultation process. It is outlining what measures might need to be taken to mitigate the continuing 1-2% growth in energy demand referred to earlier and to stabilise energy at present levels or even reduce it.

Implementation measures of the energy efficiency policy deserve to be looked at more closely.

Since the 1970s, improved energy efficiency has contributed more to our energy balance than any other single energy source. These so-called “negawatts”, megawatts NOT being consumed thanks to energy efficiency, have been every bit as valuable in economic terms as the “produced watts” of energy they replaced.

With today’s energy prices, a megawatt of energy savings costs about half of what it costs to produce the same amount of energy. The cheapest, most competitive, cleanest, and most secure form of energy for the European Union thus remains saved energy.

It is generally accepted that because of new energy-efficient technology, Europe can still improve its energy use in a cost-effective way by some 20% in the coming 15 years. This savings potential lies in all the end-use consumption sectors, including industry and transport.

In order to realise this saving potential, we need a comprehensive strategy.

First, we must ensure that new EU legislation on energy efficiency in buildings and cogeneration is fully implemented in all Member States.

- The Directive to promote combined heat and power (CHP) is of particular importance.
- The Directive to improve the energy performance of buildings uses revised Member State building codes for new and larger renovated buildings, energy performance certification, and inspection of heating and cooling systems. Systematic use of, for example, passive heating, cooling, and daylighting on new and renovated buildings, can reduce energy demand by approximately 30%.
- Very recently an agreement was reached in Parliament and Council on the “Eco-design Directive” that will allow the Commission, assisted by a Committee, to set minimum efficiency requirements on a wide range of energy-using appliances and equipment. It is worth noting that voluntary agreements with the manufacturing industry, which have earlier proved to be very successful, may also be used to meet minimum efficiency requirements, if they are approved. We are also preparing to broaden the scope of the EU energy performance-labelling scheme for appliances to cover a larger range of appliances and equipment.

Secondly, the proposed legislation on energy services and end-use efficiency that sets forth binding savings targets of at least 1% per year for all Member States should be adopted as soon as possible. The legislation requires Member States to place savings obligations in particular on the public sector (1.5 % savings target per year) and also on energy retailers and distributors to provide their customers with energy services and energy efficiency measures.

There are requirements for energy audits, improved financing and financial instruments, billing, metering, tariff structures and consumer information and incentives. The legislation also promotes energy service companies, building on the fact that what consumers really want is not energy but the services that energy provides.

EU energy efficiency legislation will now cover over 450 million inhabitants. This means a very large market for the appliances and equipment covered by EU minimum efficiency requirements, performance labels, and other standards. Some non-EU countries with significant trade with the EU have adopted and are already applying domestically the EU minimum requirements and labels. We welcome more such initiatives.

In transport, we have mandatory labelling of fuel efficiency for new cars and are now considering a proposal for a Directive on public procurement requirements for clean and energy-efficient vehicles.

Thirdly, we need to go further and be imaginative if we want to achieve the full 20% saving potential. A Green Paper on Energy Efficiency that is published in June will propose a number of ways to further improve the market for energy efficiency and launch a broad public debate and stakeholder consultation on the subject. The results of this debate will provide information that can be used to draw conclusions and to prepare future initiatives in the field.
POTENTIAL IN NEW MEMBER STATES

Cogeneration and district heating deserves a special attention in the context of energy efficiency debate, especially due to its enormous energy efficiency potential in new Member States.

Most Member States in the EU-25 have applications of cogeneration in industry and in district heating systems. In some new Member States in Central Europe, it is a very important way of providing heat, especially to households.

District heating, if managed well, can be environmentally friendly. It is estimated that existing district heating and cogeneration facilities, including industrial applications, may save 3-4 % in CO₂ emissions and primary energy use compared to separate production. This is due to a large enough heat load to allow cogeneration, which improves overall energy efficiency, to the efficiencies of economy of scale and to the possibility of energy use from many sources including waste and biomass. The latter also increases the flexibility and the security of supply for the EU-25.

High efficiency cogeneration is supported by the Combined Heat & Power (CHP) Directive, which will be transposed into national legislation by 21 February 2006. Though the CHP Directive has no targets, there is an informal EU target in the Commission’s strategy document adopted in 1997 on cogeneration to have 18 % of electricity from cogeneration by 2010. Currently this is about 11 %.

Cogeneration wills not only benefit from harmonised rules and definitions, improved grid access and the removal of barriers in the Combined Heat and Power Directive but also from the support schemes that Member States may now develop for high efficiency Combined Heat and Power. Regarding the update of old Combined Heat and Power installations or the construction of new ones as well as the improvement of distribution networks for district heating, positive developments can be noted in some new Member States like Latvia and Poland with support from the EU regional and structural funds, not only contributing to energy efficiency and the environment but also to the economic development of those regions.

At the same time, the Commission is aware of some remaining problems.

- In most countries there is hardly a coherent long-term policy regarding heat specifically. This may harm the development of district heating and sometimes even reduce existing cogeneration capacity.
- District heating also touches on a great many aspects in society. Economic, environmental, social, and even cultural policies are relevant. This makes it complex for Member States to develop long-term policies that may benefit quality district heating.
- In some new Member States, there is a growing imbalance between the heat capacity and the declining demand. This may lead to more problems for district heating making it less appealing in a competitive heat market. Declining population in some areas of Europe may add to this problem.
- In many EU countries there is an aversion towards any collectivistic scheme, especially if experience from the past has created the image of providing bad service and being rather unreliable with the new risk of being submitted to a monopolist pricing power in the future. Market forces in the heat market should be able to function and policies and measures by regulators should reflect this.
- Policies and tariffs should reflect investment and cost recovery and energy efficiency. In this context, it is important that competition in the heat market should be fair.
- Another important aspect is the need for raising awareness with the end-consumer for his consumption and resulting energy costs. Accurate metering at a reasonable price and informative billing is crucial for this goal.
- District heating in itself is no guarantee for energy efficiency and emission savings. Installations may be old and poorly maintained and distribution networks can be inefficient resulting in heat losses. To this end standards need to be introduced for quality district heating. Energy Service Companies, which derive their profits from energy efficiency gains, could deliver large cost savings and better efficiency, especially in new Member States.

RENEWABLE ENERGY

Coming back to the issue of energy supply, we have to think of diversifying energy sources. One of the priorities of this Commissioner is promoting renewable energy sources as an important part of the energy mix. Europe is the world’s leader, especially in wind energy.
However, there is still some potential to be realised. Consequently, the Commission will maintain pressure on Member States to achieve promises on Renewables. Currently the EU is on course to achieve an 18% share of Renewables in electricity consumption by 2010, compared to the 22% target in the Renewables directive.

Clear action is necessary to continue this trend. It is obvious that direct support measures will remain essential in the future to ensure sufficient penetration of green electricity in the market and to meet our agreed targets.

The Commission’s Communication on the financing of renewable energy sources to be published by the end of this year will therefore concentrate on evaluating the many different support schemes, which actually exist in Europe.

At this stage, I believe that it is premature to propose a harmonised European support scheme. We first have to do a thorough analysis of the current divergent national systems and experiences in Member States. What are the current best practices? What are the implications on the internal market? Only after having a clear picture, it will be possible to indicate a direction for a necessary long-term strategy.

We also seek to give a fresh priority to biomass including both biofuels for transport and biomass in electricity generation, including cogeneration. In a new action plan we will identify how the potential of biomass available in Europe can be further developed in order to reach the targets on Renewables for 2010.

Further developing Renewable Energy is one example for the integrated approach to energy policy described earlier. It is of importance not only to reduce our import dependency. It as well contributes to both our Kyoto and Lisbon objectives, as it helps reducing greenhouse emissions and creates jobs.

INTERNAL MARKET OF ENERGY

One of the three objectives, the delivery of a competitive single market for energy is, of course, an area where the Commission sees its own role as very important. Fair competition clearly requires a level playing field and the need for Community legislation in this respect have proved to be important.

The Commission is closely pursuing Member States, which have not yet transposed the gas and electricity Directives into national laws. There are now infringement procedures against 10 Member States ongoing for not transposing one or both Directives.

Significant progress can be expected once the new Directives are fully effective in all Member States, especially regarding the introduction of regulatory authorities with a full set of competences and the reinforcement of unbundling of the transmission and distribution system operators. The internal market relies on strong and effective regulation at national level to ensure proper implementation.

Competition will allow EU citizens to benefit of the freedom of choice between the different suppliers and spread the benefits of competition, which are already experienced by larger commercial customers.

The Commission will, at the end of 2005, issue a report, which will examine progress to date in constructing the internal market for electricity and gas. This will be an important milestone since it will reflect around five years experience with competitive markets and set the scene for opening of the market to all customers in July 2007. Such an opportunity to take stock will allow us to examine again the balance between national and European measures.

There is, therefore, no shortage of activity at European level to address the ongoing issues in the electricity and gas markets. We also expect Member States to play their role, particularly the national energy regulators and competition authorities.

It is not my intention at this stage to draw definitive conclusions on any additional legislative measures that might need to be taken. The reports should be the basis of a detailed, wide-ranging debate, enabling us to draw conclusions later in 2006.

RESEARCH

A better linkage between energy policies and environmental and research policies is yet another priority of this Commission. There will be an increased budget for the 7th Framework Programme, with large-impact projects; a strengthened Intelligent Energy programme as part of the Competitiveness and Innovation Framework Programme. The EU already has a lead in climate and energy technologies and this should be reinforced.
Research and technology can surely help develop a more sustainable energy future through “clean coal” technologies, carbon sequestration, hydrogen and fuel cells, new technologies for energy efficiency and renewables.

For example, it is important in terms of security and diversity of supplies that coal retains an important position in Europe’s energy mix. It will therefore be proposed that during this Commission, Member States, Commission, and industry work together to develop a coherent and ambitious European Clean Coal Partnership.

NUCLEAR SAFETY

Finally, the need to strengthened nuclear safety and security needs to be underlined. Where nuclear energy does form a component of any Member States’ energy portfolio – and this is up to the Member States to decide - it is crucial that it does so in a totally safe and secure manner.

EU EXTERNAL ENERGY RELATIONS

As mentioned before, Europe’s possibilities in the energy supply side are limited. Therefore, we need to strengthen the EU external energy relations with our major partners both producers and consumers. The EU will continue to deepen its bilateral cooperation with the main producer countries on which it depends, notably through the dialogue with Russia and through relations with the countries of the Caspian Basin, of the Mediterranean as well as with Norway. Possibilities for a new dialogue with OPEC are being explored and the first high-level meeting is scheduled for June. As the Commission has always stressed, a dialogue is necessary both when prices are high as well as when they are low.

In order to diversify the oil and gas supply networks, the European Union is also currently reinforcing its cooperation with key transit countries. Furthermore, a South East Europe Energy Community, extending the EU internal energy market to the Balkan countries, has been agreed.

It goes without saying that the discussions between the EU and the main energy consuming countries (United States, Japan, China, and India) will also be enhanced.

There is also a need to improve data transparency and accuracy on the oil markets including stocks in order to reduce speculation and price volatility.

CONCLUSION

Having outlined the priorities for the future EU energy policy and aiming at security of supply, a competitive market, and sustainable development, it becomes clear that we need to have a balanced energy mix with full use of available energy sources.

We all want functioning sustainable markets that will deliver what customers want – a stable and reliable supply with clear signals about the real costs of energy use both direct and indirect. The Commission is committed to these objectives and will take whatever measures are necessary to help deliver the required results.

BIOGRAPHY

Andris Piebalgs. I took up the post of Energy Commissioner in November 2004. Since the EU enlargement on 1st of May 2004, when the Commissioners of the new Member States came into the European Commission, I was heading the Cabinet of Latvian Commissioner Mrs. Sandra Kalniete. Before joining the European Commission, I worked for almost a decade in diplomacy. I started my diplomatic career in 1995 when I became the ambassador of Latvia in Estonia. During five years – between 1998 and 2003 – I was the Ambassador of Latvia to the European Union, later – Undersecretary of State for EU affairs at the Ministry of Foreign Affairs of Latvia.

Six years of my career, I have spent being active in Latvian politics. From 1990 until 1993 I was Minister of Education, in 1993 and 1994 I was chairing the Budget and finance committee of the Parliament of Latvia (Saeima). In 1994, I became Finance minister of Latvia and held this post for two years.

I was born in Valmiera (Latvia) on 17th September 1957, and in 1980, I obtained my degree in Physics from University of Latvia. During the eight years time after my university studies I worked as a teacher, later Headmaster of the 1st Secondary School of Valmiera. My career in the education system continued when I started to work as Director of the Department in the Ministry of Education of Latvia.
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LACK OF INTEGRATED COMPETENCES IN REGIONAL AND LOCAL PLANNING

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KEYWORDS
Regional and local planning, financial support, quality and evaluation system

ABSTRACT

These are means to facilitate growth of local economies and temper negative social economical dissimilarities among them. The new approach of development planning builds on interdisciplinary model with substantial role of IT and software technologies, to ensure public participation and long term and foreseeable planning in time and place.

In the article, there is government support policy of territory development planning in the period of 1996 - 2002 assessed. Results shows major financial support among planning measures has been in the field of development programs, spatial plans elaboration and acquisition of computers and software.

Author has analysed quality of elaborated territory development programs using 16 different factors. A quality control result shows the weakest ascent of process is implementation and assessment that is connected with competences of involved staff in planning.

IDENTIFICATION OF PROBLEMS IN REGIONAL AND LOCAL PLANNING AND EVALUATION
There are two levels of self-governments in Latvia- local self-governments and district self-governments. Citizens elect the local self-governments directly, and their task is to ensure provision of functions defined by the law, considering the interests of state and citizens of the particular self-government. Among several autonomous functions of self-governments, Law on Self-governments emphasizes territorial development planning.

The second self-government level is district self-governments, delegated by local self-governments to implement the functions stated by the Law and entrusted by the local self-governments.

Law on Territorial Development Planning states that the district and local self-governments must elaborate the territorial development program of the particular territory.

Simultaneously with the administrative territory regional planning (district and local self-governments), the development is promoted also on the level of planning regions. Since 2002, there are five planning regions in Latvia, whose borders differ from European Union NUTS\(^1\) III level regions.

The main goals of the planning regions are to promote the development of the region and attract investments to the social and economical development of the region. Table 1 reflects comparison of the main characterizing indices of the planning regions.

There exist significant negative economic development differences among the planning regions. Vidzeme planning region, which is the largest by the territory, is the least populated, which can be partially explained by the historical development of the population structure-single farmsteads. The most rapid economic growth takes place in Riga region, which has the highest density of population- 105.2 people per 1km\(^2\) which promotes rapid development of services.

The most unfavorable and slowest development is characteristic in Latgale region. The development is limited by the poor availability of information and telecommunications, which is essential in e-marketing development. Territorial development index, calculated from 8 indicators is negative for all planning regions, except Riga.

Thus, the planning of development is essential in the regions of Latvia, in order to promote the development of local economy.

The author of the research for the purposes of planning evaluation has selected local self-governments of one district, which have analyzed the elaboration of spatial

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\(^1\) Nomenclature of Territorial Units for Statistics (NUTS)
development programs and planning documents, from each planning region except Riga.

Legislation of Latvia entitles the self-governments to elaborate the spatial development programs, but does not determine or recommend methodology or guidelines in elaboration of quality territorial development program, which is later implemented in the local self-government and their evaluation order. During the period from 1996-1999 every Cabinet of Ministers elaborated new regulations about the order of assigning state earmarked financing for the local self-government development planning, which burdened and complicated the planning procedure for self-governments, as they changed every year. In 1999, the Cabinet of Ministers elaborated general regulations, which were not refined every year, which can be evaluated positively.

In 2003, new regulations were adopted in accordance with the Law on Territorial Development Planning. The regulations determine that the earmarked financing can be spent exclusively on elaboration of territorial planning and detail planning, training of planning specialists, purchasing of cartographic material and geographic information system software, but not other software, and ordering research. Until 2002, the target financing for territorial development planning was allocated also to elaboration of self-government territorial development programs, therefore the paper analyses the quality of territorial development programs of the period 1996-2002.

The new planning approach emphasizes involvement of society in early stages of planning in order the local society was informed and involved in the decision-making process. Information technologies and global network play significant role in society involvement and information process, as they allow fast and cheap dissemination of information, as well as to receive feedback, information and assessment; elaboration of visual materials (posters, maps, work-sheets); e-mail provision for planning specialists for fast information circulation among those involved in planning process, employment of specialized software, compatibility and updating of various databases (population register, land cadastre).

However, the opportunities offered by the information technologies are not fully employed in the planning process due to lack of knowledge and skills.

Elaboration of territorial development programs in self-governments is supported by the state since 1996, assigning target financing to self-governments and district self-governments based on application principle reviewing them in turn with separate priorities. Initially in 1996, the main beneficiaries were district councils.

District council development planning departments together with information technology specialists worked together on development and implementation of the Unified Municipal Information Technology System, which is very significant and important for each local self-government, as well as for entrepreneurs and inhabitants, as it allows working and learning the newest information more operatively.

In 2003, Saldus district was the pioneer district in Latvia, which practically implemented Unified Municipal Information Technology System (every self-government of Saldus district possesses e-mail, Internet, data transmission network in certain spheres).

At the same time during the period 1996-2002 Saldus district showed the lowest territorial development activity in the

<table>
<thead>
<tr>
<th>Planning region</th>
<th>Population percentage 2004</th>
<th>Area percentage</th>
<th>GDP per inhabitant 2002, % of the national average</th>
<th>Use of computers in enterprises, at the beginning of the year 2003, %</th>
<th>Enterprises with access to the internet, at the beginning of the year 2003, %</th>
<th>Territorial Development index, 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riga Region</td>
<td>47.4</td>
<td>16.2</td>
<td>143.8</td>
<td>54.0</td>
<td>36.3</td>
<td>1.540</td>
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<td>Latgale Region</td>
<td>15.9</td>
<td>22.5</td>
<td>48.4</td>
<td>35.1</td>
<td>16.1</td>
<td>-1.396</td>
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<td>Kurzeme Region</td>
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<td>21.1</td>
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<td>43.6</td>
<td>26.8</td>
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<td>16.6</td>
<td>55.7</td>
<td>40.6</td>
<td>25.0</td>
<td>-0.541</td>
</tr>
<tr>
<td>Vidzeme Region</td>
<td>10.7</td>
<td>23.6</td>
<td>57.8</td>
<td>42.2</td>
<td>25.7</td>
<td>-1.046</td>
</tr>
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Source: Latvia’s regions in figures 2004; Development of Regions in Latvia 2004.
country, in terms of applications for state earmarked financing, elaborated territorial development programs.

ANALYSIS OF FINANCIAL DISTRIBUTION AMONG PLANNING ACTIVITIES

One must note that the state support to territorial development planning in self-governments did not begin with elaboration of methodology for self-government development planning and support for elaboration of training programs for self-government specialists. The author maintains that the initial error has considerably harmed the development of self-governments:

- Irrational waste of financial resources;
- Optimum results of development planning are not achieved;
- Delayed attraction of different projects and European Union structural funding to self-governments.

Initially the target financing was assigned for elaboration of various projects, which affect and promote the economic development of the territory (e.g., water supply, heating, cross-border cooperation, education), as well as to self-governments, which corresponded to the priorities stated by the Cabinet of Ministers:

- Self-governments, which had created development planning department;
- Self-governments facing rapid development;
- Self-governments, which are located in special development regime regions defined by the Cabinet of Ministers.

Successful and timely development planning was negatively affected by the regular changes in the Cabinet of Ministers regulations about the order of assigning the state earmarked financing for planning until 1999, when general regulation without time constraints were elaborated.

Before 1999, self-governments could initiate development planning only in the middle of the calendar year for the state earmarked financing means, as the order of promotion, approval and coordination of regulations of the Cabinet of Ministers occupied a certain period of time.

Distribution of the total financing is as follows: state earmarked subsidy investment 76.57% and self-government co-financing for planning activities 23.43%. It is the average indicator per one self-government. The total number of self-governments having attracted the state earmarked subsidies is 511, from which 26 are district self-governments.

The largest financial investment during the 6 years’ period of development planning process has been in the elaboration of territorial development programs and planning — 1.4 million Lats for each activity separately and software purchasing 1.3 million Lats (see Figure 1.). During 1996-2002 the local and district self-governments have allocated 5 527 952 Lats for territory/spatial development planning process (see Figure 1). The above-mentioned 5.5 million Lats include the state earmarked subsidy share, the money invested by self-governments and received from projects and donations for territorial

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Figure 1. Finance distribution among involved parties in territorial development planning
Source: Ministry of Environmental Protection and Regional Development, 2002.

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development planning. During a six-years’ period a single self-government has spent for territorial development planning 10817.90 Lats on the average. A single self-government has spent on the average 2588 Lats from the means allocated for territorial development planning on purchasing computers and software. Computers and software in the development planning process are employed as basic tools, in order to perform the assignments. Nearly all self-governments, submitting the first application for receiving the state earmarked subsidy mentioned purchasing the computers and software as one of the planning activities. It was the first computer equipment ever acquired and therefore it was employed for general needs of the self-governments (office work, accounting, photocopying) and not for the territorial development planning, as it was initially intended, because during 1996-1999 many self-governments did not employ the planning specialists. The author has performed research of Krāslava and Bauska district local self-governments in 2000 within the framework of the territorial reform, emphasizing the technical provision of self-government operations, which essentially affect the work of the planning specialist work. In 2000, from 26 local self-governments of Krāslava district 9 did not possess any computers and printing facilities, 5 self-governments had 1 computer, and 3 self-governments had 4 computers. The biggest number of computers was in Krāslava town (17) and Dagda town (7). The whole district was in critical situation with global network provision, as only Krāslava town self-government was connected to the global network. All 26 self-governments were provided with fax apparatuses, 9 self-governments possessed scanners. Scanners were purchased mainly in the self-governments, which had received the state earmarked financing for the development planning. Only Dagda town council owned a codoscope, therefore the planning work-groups and seminars could not employ the presentations prepared in advance, or the consultants brought the necessary equipment with them from the capital. Photocopying machines were in all local self-governments, which were mainly used for multiplying the survey questionnaires for planning needs. 11 self-governments were provided with mobile connections. In 1999 ten local self-governments employed planning specialists, several of them were temporarily contracted for elaboration of the territorial development plan or it was their second job. Two self-governments employed a planning specialist in a part-time position. From 17 local self-governments in Bauska district in 2000 all were provided with computer equipment. Dāvini rural territory was the last to receive the computer in 2000. Rundāle rural territory had 2 computers with Internet connection and partial Internet connection in Skailstkalne rural territory, and Bauska town. 13 self-governments had fax apparatuses, 5 self-governments had scanners and 2 self-governments – codoscopes. All self-governments in Bauska district were equipped with copying machines, 11 self-governments had mobile connection.

The author of the research has surveyed all 43 self-governments mentioned above and met the employees of the self-governments, which provided the opportunity to assess qualitatively the employees’ computer skills and work with geographic information system software, in order to prepare and elaborate databases and cartographic material. The results of the survey indicated that majority of the self-government specialists could not work with computer, prepare documents, and store them in the computer or other carrier (floppy). Majority of the self-governments, but not all, had an employee, who possessed minimal skills of employing the purchased equipment (log on, open a document, write, format, save, store and log off). Thus many of the additional options of the computer equipment purchased for the self-government money were not used. Information technologies rapidly outdate and become cheaper. Scanners were not employed for the development planning, and the author considers it was not a priority in order to initiate the local self-government development planning. Scanners provided the opportunity to supplement the development program with visual pictures, as in 2000-2002 digital cameras were not fairly common. Specialists employing the geographical information systems, among them ArcView, were in few municipalities, where the specialist was also the district planner or land surveyor. Land surveyors mainly worked with MicroStation software, as it is widely used by Latvia State Land Service.

Computer and software equipment are territory/spatial development planning tools, which do not operate by themselves. They require a specialist skilled in new technologies in order to achieve the goal-plan the territorial development in accordance with its advantages and preventing the obstacles of territory development. Thus the means invested in support activity “computers and software” were not fully effectively employed due to the lack of information technology skills.

Territorial development program is the initial document in territorial development planning, as territorial development program defines the territorial development goals, tasks, and vision of the particular self-government development in future. Consequently, most of the financing is allocated to this activity, as all self-governments applying for the first state earmarked financing for planning, included the territorial development program (see table 2).

1 473 724 Lats were allocated for territorial planning elaboration until 2002, including the financing for the elaboration of the territorial planning chapter, elaboration of the 1st edition, elaboration of the final version, corrections of the territory/spatial plan. The many versions explain the fact that in 2005 only 1/3 of self-governments in Latvia have adopted territorial plans, as until 2002 mainly the 1st edition of the territorial plan was elaborated. Total sum of 124 747 lats is spent on training of self-government planning specialists. Dividing the sum among the self-governments, which have received state earmarked
financing for development planning, a single self-government during a six-year period has allocated for training planning specialists 246 Lats per self-government. A very small sum - 41 Lats - has been spent for training one specialist per year, which contradicts the national and international documents, which emphasize continuing education and training as a priority.

Table 2. Self-government co financing and state earmarked financing for planning activities from 1996–2002, LVL

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Source: Ministry of Environmental Protection and Regional Development, 2002.

EVALUATION OF TERRITORIAL DEVELOPMENT PROGRAM QUALITY

Good evaluation is a significant component of a good program. Improving evaluation is especially important in local self-governments, where the development planning documents are elaborated and adopted at the end of 1990ies and since then have not been reviewed and improved. Kinsley emphasized that territory/spatial development program is the reviver of the local self-government economy. He also indicates that the leaders of self-governments experience necessity of the growth of knowledge amount, as the number of the decisions to be made in various spheres, including technologies and innovations, is rapidly increasing.

The author performed the qualitative analysis of Gulbene, Krāslava, Bauska and Saldus district local self-governments’ territorial development programs, available in the archives of Ministry of Regional Development and Local Government.

The surveyed districts were selected according to the territorial principle- one district from one planning region, in order to evaluate the regional differences in territorial development planning in Latvia. Riga planning region was not included in the research, as it is a highly urbanized region and therefore Riga region and the other four planning region self-governments are not comparable in development planning. The author has observed 75 local self-governments in the research territory, but comparative and generalized decision-making analysis was evaluated in 120 self-governments.

16 factors were determined and qualitatively evaluated, considering the expert board (representatives of Ministry of Regional Development and Local government, State Regional Development Agency, district and local self-governments, planners- practitioners, author of the research) recommendations:

1. Description of the current situation.
2. Evaluation of the current situation.
3. Problem identification.
4. SWOT\textsuperscript{2}, PEST\textsuperscript{3}, factor analysis application.
5. Program based on logical framework.
7. Surveying and interviewing of entrepreneurs.
10. Statement of mechanisms of achieving the stated goals.
11. Specified time limit for the tasks/activities.
12. Specified financing for the tasks/activities.
13. Responsible person for implementing the tasks/activities.
14. Responsible institution for implementing the tasks/activities.
15. Defined control, evaluation, or monitoring tools for the program implementation.
16. Technical implementation of the document.

The author initially evaluated each of the 16 above-mentioned factors according to the 7-point scale:

\begin{itemize}
  \item 1- very poor
  \item 2- poor
  \item 3- fairly poor
  \item 4- average
  \item 5- fairly good
  \item 6- good
  \item 7- very good.
\end{itemize}

In order to evaluate correspondences among the evaluated factors and regions/districts, the author converted the initially created 7 point scale into nominal scale, distinguishing three grades of assessment: poor, average and high.

The author employed ($\chi^2$) Chi-test criteria, in order to determine the significance of region (district) influence upon the factor quality.

The author proposed the following hypotheses for each factor:

\begin{align*}
  H_0 : n_{0i} &= n_{ei} & & \text{Factor quality and region are not dependent} \\
  H_1 : n_{0i} &\neq n_{ei} & & \text{Factor quality and region are dependent}
\end{align*}

Factor 1 “Description of the current situation” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 4.69 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 2 “Evaluation of the current situation” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 4.82 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 3 “Problem identification” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 4.57 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 4 “SWOT, PEST, factor analysis application” quality and region are dependent features, as $\chi^2_{\text{fakt}} = 17.30 > 12.59$, $H_0$ hypothesis is rejected with the probability 95%.

Factor 5 “Program based on logical scheme” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 7.59 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 6 “Surveying of inhabitants” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 5.47 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 7 “Surveying and interviewing of entrepreneurs” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 5.34 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 8 “Statement of the self-government development vision” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 4.94 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 9 “Statement of the self-government short-term and long-term goals” quality and region are dependent features, as $\chi^2_{\text{fakt}} = 18.49 > 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 10 “Statement of mechanisms of achieving the stated goals” quality and region are dependent features, as $\chi^2_{\text{fakt}} = 13.75 > 12.59$, $H_0$ hypothesis is rejected with the probability 95%.

Factor 11 “Specified time limit for the tasks/activities” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 8.44 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 12 “Specified financing for the tasks/activities” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 7.51 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 13 “Responsible person for implementing the tasks/activities” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 8.69 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 14 “Responsible institution for implementing the tasks/activities” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 3.29 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 15 “Defined control, evaluation or monitoring tools for the program implementation” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 2.47 < 12.59$, $H_1$ hypothesis is rejected with the probability 95%.

Factor 16 “Technical implementation of the document” quality and region are not dependent features, as $\chi^2_{\text{fakt}} = 5.26 < 12.59$, $H_1$ hypothesis is rejected with the probability.

From the 16 analyzed factors, three essentially affected the region/district (SWOT, PEST, factor analysis application, statement of the self-government short-term and long-term goals, statement of mechanisms of achieving the stated goals), which confirm that the territorial development

\textsuperscript{2} Strengthens, Weakness, Opportunity and Threats (SWOT)
\textsuperscript{3} External factors of Politics, Economics, Social and Technologies (PEST)
program quality cannot be mainly related to the territorial location of region/district. The location does not essentially affect the quality of the elaborated documents.

After the programme quality evaluation the author calculated the average program quality evaluation and ranked the elaborated territorial development programs, which indicated the correlation among the qualification and experience of the development planning specialist and the quality of the elaborated territorial development plan.

The average indicator of the elaborated territorial development program quality is 4.25 (maximum 7), which is average evaluation. Quality of more than half of the elaborated territorial development programs is below the average quality indicator, which highlights essential problems in elaboration of territorial development programs in Latvia.

Analyzing the territorial development program quality according to the 16 selected factors, the data provide even more exact information about the main problems in elaboration of the development programs, directly aimed at the elaboration of the planning perspective chapter. The factor “Defined control, evaluation or monitoring tools for the program implementation” has received the lowest quality assessment. It emphasizes the question about the sustainability of the program, its necessity in the self-government, if it is not envisaged for implementation, evaluation, and improvement.

On the local self-government level, the evaluation of territorial development planning is the most essential, as quality planning is decision-making infrastructure. If the self-government planning process results in stating the development priorities and ways to achieve them, then reasonable decisions can be made. On the local self-government level, it is essential to understand the significance of territorial development planning evaluation and the ways in which the achieved results, observations will be employed.

The main goal of the evaluation is to enhance the planning quality, to change the planning procedure if necessary, to promote the capacity of the territorial spatial development program implementation, to determine the weak points in all stages of planning and prevent them. For the local level evaluation, it is essential to involve the creators, implementators of the territorial development program, decision-makers, depending on the specific territory also representatives from the regional development agency.

CONCLUSIONS

Financing procedure of territorial development planning from 1996-2002 with the existing order of state earmarked/target financing, did not promote qualitative development planning in a local self-government, as the territorial development was started only after allocating the financing from the state means.

Before allocating financing for elaboration of the territorial development program, it is necessary to train the planning specialists, if they do not command corresponding qualification or experience.

In order to achieve higher results, it is necessary to train a specialist to work with the information technology solutions. Shortage of development planning specialists is especially vivid in rural local self-governments, due to the lack of financing, qualified specialists and lack of understanding among the politicians.

The poorest and insufficient chapters of the elaborated territorial development programs are related to perspective planning, ways of achieving the goals and mechanisms of implementation. Territorial development program was essentially influenced by the self-government planning specialists’ competence in social and economic issues, involvement of society, ability to adjust themselves to the information circulation, computer skills, and knowledge of planning software.

Evaluation and monitoring chapters are not present in the local self-government territorial development programs elaborated until 2002; the newest programs contain drafts of evaluation and monitoring steps, although showing understanding of evaluation and monitoring only as lists of indicators with measuring units.

As the local self-government territorial development planning quality is directly affected by the planning specialist, his/her qualification and competence in planning, as well as information technology skills. Developing new study programs one must create integrated approaches, which combine the socio-economical issues with information technology solutions in time and space. The most essential information technology skills for planning specialist are related to modeling and simulation methods, in order to find solutions to sustainable development of the territory, balanced with the economic and natural environment.

REFERENCES

Latvia`s regions in figures 2004. Central Statistical Bureau of Latvia, Riga, 2004

BIOGRAPHY

Agita Šļara received a Master Diploma in Geography, regional planning, from the University of Latvia (1996). Currently doctoral student of Regional Economics in the University of Agriculture of Latvia. Since 2001 lecturer, professor assistant in Tourism Management and Planning Department in Vidzeme University College, Valmiera, Latvia.
THE RURAL SCHOOL AND ITS TEACHING STAFF FACING THE CHALLENGE OF THE ADVANCING INFORMATION AND COMMUNICATION TECHNOLOGIES

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KEYWORDS
Rural educational framework, Information and Communication Technologies (ICT), curricular integration.

ABSTRACT
Within the present rural educational framework can be seen a continuing acquisition of the New Information and Communication Technologies (ICT). Slowly schools are becoming computerised, pursuing generally a double objective: on the one hand to avoid isolation of the children of the new Information Society from ICT and to promote its use to learn and transmit knowledge, and on the other hand, to avoid isolation of the teaching staff in their role as active members in collaborative projects, training and research.

Now we see rural education centres that in the future will be able to develop important organisational and operational changes, but will also have to accept great teaching challenges. Particularly, these centres will adopt a new concept for the rural school, revision of early and permanent training plans for the teaching staff, and the role of families and institutions related to the school.

A positive predisposition towards the introduction and use of the new ICT in the classroom on the part of the education community, and a stable staff, are only some of the conditions the rural school needs to be able to put itself in a state of continuous critical and constructive innovation towards the integration of ICT.

A NEW PERSPECTIVE: THE NEW RURALITY AND ITS INFLUENCE IN THE RURAL SCHOOL

Society is heading towards a world of general urbanisation; not only because most of the population of the planet already lives in urban areas, but because rural areas will form a part of the economic, political, cultural and communication structure organised from urban centres (Elboj 2000, 60). Nevertheless, although ICT and globalisation of the economy exist, as can be seen on the television screen, the reality is that there remain regions of our country where social structures, production relations, habits, attitudes and values of the people who live there are characteristically rural. Furthermore these regions run the risk of being left on the margins of globalisation and the new Information Society, which is forming. This is the “possible danger” identified by Castells (1994), which ceases to be noticed, and becomes ignored by the mass media as if it did not exist.

One cannot talk of the rural school using its old image because rusticity, in its old sense, simply does not exist. The spirit of capitalism and the Information Society have penetrated to such an extent into those supposed rural spaces that nowadays it is not easy to perceive significant differences in habits, attitudes and values, and even less so if one considers social structures and production relations. We live in a global city, in which voids act exactly the same as do, in micro-urbanism terms, the parks and green zones of the industrial city. It would be more logical to speak of the world countryman, who, in fact, does not exist; actually he is a non-central urbanite – an extension of the capitalist and industrialist of the 19th and 20th centuries in the whole of Spain.

Rural norms are changing: traditional ways disappear or preserve themselves, almost as an exclusive right, like a cultural legacy or manifestation of folklore. This leads to single parent families and work subject to schedules; in some places there is a significant number of immigrants, in others sector services etc. dominate. To illustrate this transformation, García Jiménez (2001) gives an example: - “I see a shepherd with his mobile phone, a well known ice cream wafer company using the internet, a single mother or a couple together, but unmarried, and, meanwhile, occasional tourists pass unnoticed”.

The development of ICT is spreading the same culture in urban and rural areas so that the global Information Society is emerging in such a way that, although rural villages are served badly from the point of view of public transport, it is not a great disadvantage to their inhabitants, since television and cinema provide a broad perspective of the world which largely compensates for the lack of nearby metro or air services in their surroundings. ICT is providing the diverse rural and...
urban populations with a culture. This unites them as far as ideas, values, expectations, habits of consumption, opinions etc. are concerned.

There is no doubt that pupils are receiving the median culture of the masses, similar in countryside and urban environments, and despite the former criticism from many scholastic sources, that it was unsuitable for rural purposes, this is now far from daily reality, and has resulted in thinking about rural culture in the urban context.

Inhabitants of rural regions have been exposed predominantly to the television with its new view of life, but there are other changes, perhaps not so explicit, much in harmony with rural life prospects and the means to achieve them and turn them into accomplishments (Garcia Jiménez 2001). Now ICT is integrated like a wind of change to the traditional ways and shapes reality.

THE DOUBLE FACE OF THE ICT IN THE RURAL SCHOOL: POSSIBILITIES AND RISKS

Elboj (20000, 61) emphasises two of the most important consequences the Information Society is generating:

1. The cause of the new inequalities is in the transformation of the Industrial Society into the Information Society. A society that prioritises material, that considers that material resources favour success or failure of countries or people, becomes an Information Society where it not only prioritises control of material resources but intellectual capacity and the selection and processing of information. Rural areas are one of the groups that suffer these inequalities more, since they rely on little material and human resources to be able to acquire and develop the capacity for selection and processing of information so necessary in the present society. It not only serves to have great tracts of land or great cattle ranches, but it is necessary to develop a series of production techniques and new innovative ideas so that the resulting products are competitive in the market. This would ensure that the countryside is not excluded from the Information Society and even prevent many regions from disappearing.

2. The Information Society generates a process of social duality. On the one hand there are social sectors, groups and social classes that are developing this capacity for information selection, as is the case for the academic urban means families, that is those in which there is a person with a university title who lives in the city. We learn, not only in school, but also in other activities associated with a school or outside it. This process of duality we are forming is exactly that, for there are people who obtain employment and succeed.

Centres located in the countryside must allot a high priority to the objective of educational administration and access to the Internet for the advantages that ensue for their special situation and configuration. These advantages can be summarised in four parts (Martin-Moreno Cerrillo 2002, 63 & 64):

1. The virtual communication centres. The educational administration will have to make an effort to provide technological assignments to the rural education centres, and simultaneously specify training for their staff. In this manner, rural classrooms will not be locked up within their walls but will expand into the Web.

2. Access to remote learning aids. Use of the computer in rural education centres is still very limited, but a future change is foreseen with the birth of a new type of school, in which it is possible to access online resources of prestigious organisations. The teaching staff will have to become familiar with access to remote information and to train their pupils in its use. Extensive use of different remote resources of learning will expand the educational opportunities of the pupils.

3. Establishment of professional communities online. The establishment of professional communities online can substantially reduce the classical isolation of teaching staff that works in rural areas. It has been noted that, in a real sense, professional interaction between rural staff has been difficult and minimal. Across the Internet all teachers have to be able to receive information, directions, courses online, etc.

4. Rural staff “going public.” In all these cases which refer to the virtual communication centre, such as publication of educational practice and establishment of a professional community online and which concern access to remote learning material, it is necessary to pay special attention to the risk of habitual access to the Internet in the education centre concerning virtual navigation, file downloading, received E mails etc. This constitutes activity that can consume much of the teaching staff’s and the pupil’s time and is the reason why it is necessary to take precautions continually to ensure the opportunity for each teacher to work with his pupils.

ICT in rural schools can offer the possibility for their survival and even notably contribute to an improvement in the quality of life in their environment and avoid sociocultural isolation. Many rural centres have tried integration of ICT in their scholastic life, valuing the positive, taking advantage of everything good it offers...
(even registering), and initiating local and/or regional competition. In addition, in certain rural areas, the use of ICT in the school environment has evoked an increasing interest on the part of the population towards its use as a tool to access different areas of knowledge (Boix 2004).

However, use of ICT can involve some risks. On the one hand, a society with elitist services can be created, only beneficial to a limited number of people, instead of creating an access sufficiently generalised and common to enable the organisation of an open and democratic society around this information; and, on the other hand, mere access to technological information does not ensure opportunities for all. Modern technology is expensive and can be counterproductive if it is only in reach of a few privileged people.

Rural areas can be excluded from the Information Society. Access to the new technologies is much more difficult in these areas than in urban ones, firstly because depressed areas do not have suitable telephone lines to access the Internet and secondly do not have qualified personnel able to teach the use of and handling of these new technologies to the rural population. This situation brings as a consequence the impossibility of rural staff and pupils taking advantage of the greater benefits that the Information Society can offer these regions, since they could be offered access to an ample supply of foundation courses with the possibility of being able to mount their own virtual companies, having access to international markets, without leaving their locality.

Many social sectors do not achieve the minimum capacity demanded by the Information Society to select and process information, and consequently, they stay at the margin of the work market, which could leave them excluded from the Information Society. Access to the new technologies is much more difficult in these zones than in the urban world because they lack infrastructure and qualified personnel to teach the use and handling of these new technologies to the rural population. The consequence is the impossibility of taking advantage of the greater benefits that the Information Society can offer to these depressed zones.

Corchón Alvarez (2002, 78) warns that in the Information Society, restricted use of the new technologies can lead to great masses of population being ignorant of much knowledge, giving rise to social differences. Further, access to technological information does not provide equality of opportunity, this resulting only from each department, such as social institution and public service, preventing those problems. In addition, the public service must make it possible for all school staffs to have the minimum requirements to protect themselves in the postmodern society. And within the school it is the teacher who, with technical and due intellectual preparation as well as necessary perception, must strive so that no student is excluded from the society that is going to affect his life. The Information Society demands renovation of the scholastic institutions of the future in order that they prepare their students to coexist with their new pressures, this task being the responsibility of the professionals of the education department, for which a very good preparation is needed in the diverse fields of education.

**REQUIREMENTS FOR A SUITABLE TRANSFORMATION OF THE ENVIRONMENT**

If we start with the school of the just arrived twenty first century, it must provide the basic needs of the citizens of the future, who will find themselves in the so called Information Society, developing their critical judgement and their capacity for self learning. Hence we understand that the responsibility that the education institutions must accept, is to educate for life, and specifically disproportional for the rural school (Mérida Serrano 2002, 653).

It is a condition of the Information Society that certain types of knowledge and data circulate quickly, breaking the barriers of the deprived cultures, the limitation of distance, as well as the limits of storage capacity and information processing. Facing this new society, Gimeno Sacristan (1999, 8 – 11) demands of the education department a suitable answer if it does not want to be left on the margins of the disciplines of knowledge, culture, and communication. For this to be so, he considers that education and curriculum are very important challenges, not new, although more intense:

The first challenge lies in finding suitable criteria for selection of contents: “the impossibility of whether the curricular text containing the methods of learning, reproduces what it had produced in the past, or what takes place right now, is a subject for debate, i.e. what is essential and what is worthwhile to dedicate itself to, which is not an easy subject”.

The second challenge is that the school, a place of formal and systematic education, has been left with, so to speak, a well known competitor like a parallel school with its parallel curriculum that competes with the academic one, which is anchored in the old educational traditions. The school curriculum is devalued for the simple reason that it no longer monopolises the function of culture transmission it had in the scholastic system.

The third challenge is that because of cultural devaluation of the curriculum, we must rethink it and consider the urgent necessity of harnessing the cultural potential of teachers overtaken by these other diffusers of culture. The curricular reforms would have to consider that there are no important changes of culture in the
classrooms, and less so in the education community, that do not take place through the intellectual promotion of the teachers.

It is necessary that the teacher is adequately trained in the correct use of ICT; one needs training and scientific instruction for the rural teachers which, not only enables them to look for, select and organise information for later processing with their pupils, but which must familiarise them with the variety, multiplicity and multifaceted nature of the services that ICT puts at their disposal.

Data provided by ICT can be used to improve educational methodologies based on heterogeneous groups, types of educational co-ordination and proprietary organisation of these centres and associations of rural schools. Furthermore, the necessary infrastructure to increase the achievement of these computerised schools will become a big information storehouse.

According to Flecha and Oliver (2000, 46) state that, “learning and knowledge are the basic materials of the new economy”, such that the proposals that ensure the development of the rural school within the Information Society will be those which prioritise connection to the networks of information and shared knowledge. That show how to access, select and process data cost effectively to increase productivity; that are themselves based on flexibility and constant change in a fluid organisation; that consider working in teams taking autonomous decisions; that are interconnected and that recognise a profession is not for a lifetime but that continual training is essential.

Opinion is universal concerning the importance of the role of ICT in making knowledge accessible to those who are in permanent employment (Berlanga Quintero 2003). We live in an Information Society in which city dwellers who expect to remain permanently cannot stay on the periphery where the majority sees itself obliged to emigrate to. For this a new approach is essential to end the duality of the rural world against the urban and, equally to drive forward in the direction of knowledge to create new objectives, and new proposals for expansion of the rural environment.

REFERENCES


BIOGRAPHY

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INTERNATIONAL BALTIC UNIVERSITY FOR ENVIRONMENTAL BALTIC SEA REGION STUDIES IN LATVIA

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KEYWORDS
Baltic Sea region studies, Baltic University, Environmental studies, Sustainable Development, Regional Development, Environmental Management, Water Management, Information and Communication Technologies

ABSTRACT
Role of the International Baltic University with secretariat at Uppsala University in Sweden and with participation of universities from all countries situated in the Baltic Sea drainage basin, in the Baltic Sea region studies is analyzed. Contribution of the Baltic University for Baltic Sea Region studies in Latvia is described.

Given overview of the international courses for the Baltic Sea region studies: for environmental studies, for regional development studies, for studies of cultures, politics, societies.

Integrative approaches for environmental studies and concepts for studies of principles of sustainable development of the Baltic Sea region are analyzed.

Use of information and communication technologies, ICT, in the Baltic Sea region studies is described.

THE BALTIC UNIVERSITY COURSES AND LATVIA

Important contribution for the Baltic Sea region studies in Latvia gives international courses of the Baltic University.

Latvia participates at the activities of the International Baltic University since it’s creating in 1991.

The Baltic University, in which more than 180 universities from Central and Eastern Europe participate, is established as a Programme at Uppsala University, under an international board.

The International Baltic University is coordinated by a secretariat at Uppsala University.

The Baltic University Programme is a network of universities and other institutions of higher learning in 14 countries within or partly within the Baltic Sea drainage basin: Belarus, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden, and more marginally Czech Republic, Norway, Slovakia and Ukraine.

The Baltic University cooperates also with public and educational TV companies, with research institutions and municipalities in the Baltic region.

The Baltic University national centres develop and coordinate the Programme in their respective areas.

Activities of the International Baltic University in Latvia are coordinated by the Centre for Baltic Studies of the University of Latvia (Spricis 2001).

There are several universities in Latvia participating at the Baltic University Programme:

- University of Latvia,
- Riga Technical University,
- Latvian University of Agriculture,
- Latvian Academy of Culture,
- Latvian Academy of Medicine,
- Daugavpils University,
- Liepaja Academy of Pedagogy,
- Rezekne Higher Education Institution,
- Riga Economic and Culture Higher Education Institution,
- Latvian Sea Academy.
The Baltic University has produced several international university courses with relevance for the countries in the Baltic Sea region.

Special emphasis at the Baltic Sea region studies is put on issues of sustainable development and regional development.

Main part of the courses is dealing with environmental issues of the Baltic Sea region with high priority for the countries of the region.

The courses are interdisciplinary, problem oriented and based on ongoing research at the participating universities:

- The course *Environmental Science* is concentrated on understanding, managing, and protection of the environment in the Baltic Sea region (Ryden et al. 2003). The course deals with important issues of what we need to do to develop a society that lives in harmony with nature and with the world resources.

- The course *The Baltic Sea Environment* focuses on the environmental situation of the Baltic Sea region.

- The course *A Sustainable Baltic Region* deals with sustainable use and management of natural resources, with the long-term protection of our environment and with the sustainable organizations of human societies from the level of households to those of municipalities, cities, and countries.

- The course *Sustainable Water Management* focuses on problems important for all people living in the Baltic Sea region - water quality problems. The course focuses on sustainable water management, with special emphasis on the conditions in the Baltic Sea Basin. The course intends to convey knowledge of water management at the municipal, regional, and national levels.

- The course *Sustainable Community Development and Urban Planning* focuses on sustainable community development with special emphasis on the conditions in the Baltic Sea region. This interdisciplinary course covers social science, architectural and cultural aspects of community development and intends to convey practical knowledge.

- The course *Environmental Management* consists of four parts and focuses on environmental management approaches in industries and other organizations with great importance for developing a good environment in the Baltic Sea region.

- The course *English for Environmental Science* deals with education of specific English language skills important for the Baltic Sea region.

The aim of the course is to develop the language skills for all specialists and students interested in the Baltic Sea region ecology, environmental sciences and neighbouring fields. The course contains both highly technical material and texts introducing the reader into the field of environmental issues. (*Korsuk et al. 2003*).

- The course *Peoples of the Baltic* concentrates on questions of our common culture, history, human rights, democracy and security in the Baltic Sea region. The course content includes following topics:
  - Description of the region and its countries, resources, economies;
  - History of the region;
  - Cultures, religions, languages;
  - Majorities, minorities and their relationships;
  - Multicultural societies, minority rights and human rights;
  - Democracy and democratic developments;
  - Internationalisation and region building, peace and security (*Maciejewski et al. 2002*).

- The new course *Regional Development and the Baltic Seas region* is aimed to get a general understanding of the problems of regional development, to get knowledge about development of the Baltic Sea region, about its countries, peoples, and history. Course is giving students a tool for dealing with problems of peaceful coexistence and sustainable development.

The Baltic University course materials in English and TV series for courses are widely used for studies.

**INFORMATION AND COMMUNICATION TECHNOLOGIES**

When International Baltic University Programme started in 1991 the technical facilities, possibilities and infrastructure that allowed easy contacts within a network were limited. Satellite TV became an important mean of contact, as still seen in the logotype of the Baltic University. Today the situation is very different.
Modern information technologies, in particular Internet, computer-, video- and audio- conferences are used to strengthen network learning.

The computerized telephone network (ISDN) has expanded rapidly in the Baltic Sea region and is used for digital communication and interactive video conferencing. The main purpose using this technology is to carry common student seminars, as well as lectures by experts from one site to all participants.

Regular contacts between course groups and universities in general using ICT are developed as an important profile of the International Baltic University Programme. The Baltic University Programme web page (http://www.balticuniv.uu.se) is primarily intended to be a resource for students and teachers.

**INTEGRATIVE APPROACHES FOR ENVIRONMENTAL STUDIES OF THE BALTIC SEA REGION**

One of the basic courses of the International Baltic University is *The Baltic Sea Environment*. On it’s bases new course *Environmental Science for the Baltic Sea basin* was created.

New book *Environmental Science – Understanding, Protecting and Managing the Environment in the Baltic Sea Region* was prepared by Baltic University Press (Ryden et.al. 2003)

The book is extensive treatment of environmental issues with a focus on the Baltic Sea region. This book addresses the specific environmental problems faced in the Baltic Sea region, and that need to be solved in the region. The extraordinary natural beauty and resources in the region, which should be protected, are also described.

This book is the result of the efforts of a large number of individuals active within the Baltic University Programme, and a number of experts.

Book describes that environmental science is the interface between society and nature, between people and their physical, chemical, and biological surroundings. All these aspects are included in an interdisciplinary manner.

There are descriptions about natural environment and its changes, and how society reacts to the challenges posed by these changes, in economics, law, ethics, politics, etc.

A key objective has been to find ways to protect the extraordinary nature in the region. Considerable effort has been made, in each case or for each environmental threat, to point out how to improve and manage environmental situation. Final part of the book deals with environmental management.

Sustainability is also introduced in more detail as a basic strategy to deal with the environmental dilemma.

Environmental science is described as dealing with the interface between society and nature. The course as well as the chapters in the book is divided into four parts.

First part provides background on environmental studies. A description is given on how environment works in terms of material flows, energy flows, and geology, i.e. the physical and chemical world. Background is given from an ecological perspective, i.e. the biological world and how ecosystems work. This part contains background on the region studied.

Second part treats all major categories of environmental impacts by the man: on landscape, biology, nutrient flows, atmosphere and chemistry.

Third part covers how society deals with environmental impact. Technology, economics, law and ethics constitute major responses by society.

Fourth part addresses the environmental management and sustainable development.

The Baltic University Programme through teacher conferences, student conferences, and possibilities to arrange audio, video and computer conferences using information and communications technologies supports the courses.

Knowledge transfer from the Baltic university gave possibility to introduce new approaches for environmental studies for the Baltic Sea region at several universities in Latvia.

**CONCEPTS FOR SUSTAINABILITY STUDIES OF THE BALTIC SEA REGION**

It has become evident, that environmental problems have indigenous ability to spread and to convert the originally local problems to regional, national, and global challenges.
Therefore, today the people of all societies of the world face a new task of promoting a sustainable development (Ryden et.al. 2003).

Important area of Baltic studies is issue of environmental Baltic studies with particular attention to concepts of sustainable development of the Baltic Sea region (Spricis 2001).

Therefore the course Sustainable Development of the Baltic Sea region is included at the programme of Baltic studies at the University of Latvia.

The aim of interdisciplinary course of environmental Baltic studies is to familiarise with theoretical principles and practical approaches of sustainable development of the Baltic Sea Region, with environmental problems and policy in Latvia.

The course is linked with the International Baltic University and it covers several topics: historical perspective and theoretical principles of sustainability; energy production and environment; sustainable energy resources; human activity and materials flows, sustainable materials management; sustainable agriculture and forestry; sustainable industrial production; sustainable mobility; community development, sustainable cities and habitation; links of sustainable development with economy, ethics, law and policy.

Sustainable development focuses on good management and effective use of (renewable) resources, reduction of environmental impact to sustainable levels and good economic and social developments (Ryden 1997).

Basic concepts of sustainable development:

- **Natural resources and limited carrying capacity.** The available resources are in the long term sufficient only for a limited population and certain life-style. There is a limited carrying capacity.

- **Return flows to nature and maximum critical load.** All wastes from society constitute a return flow to nature. This return flow may not destroy its productive capacity. For all substances there is a maximum critical load. The returned material needs to be processed in such way that it can be included in the natural cycles. Recycling is a basic sustainability requirement.

- **Environmental impact and Environmental Utilization Space (EUS).** Sustainable development requires that society’s impact on nature is such that it does not in the long run devastate its productive capacity and the living conditions for man and other life forms. This requirement is detailed in the Environment Utilization Space, EUS, and concept.

- **Materials flows.** While the carrying capacity focuses on the extraction or harvest of resources from nature and the critical loads concerns the return of materials to nature, the materials flows concept considers these two simultaneously. Sustainable development requires that the materials flows caused by man-made activities do not change the natural material flows.

- **Systems requirements.** From the physical point of view all the conditions for sustainable development may be summarized by some principles, which in themselves embody the aspects of resource availability, environmental impact and those of materials flows. The systems principles define conditions for the long-term productivity of the biosphere needed for the survival of man and other life forms.

- **Economical.** Economists classically estimate the wealth of a nation as a Gross National Product, GNP. Economists may, however, in principle make up a special budget that also includes natural resources and deduct environmental damage, called environmental debts. This is called net national income, or sometimes a Green Budget.

- **Ethical.** Sustainability demands that the living conditions of future generations do not deteriorate. This essentially a question of justice, of distribution of resources between generations. Distribution of natural resources need not only be considered over time- so-called inter-generation equity, but also over space, that is between us now living here on Earth – intra-generational equity.

- **Political.** Sustainable development as a political goal was prepared by the Brundtland UN Commission in its 1987 report and agreed on as a goal for development at the Rio conference in 1992. One of the Rio documents, Agenda 21, describes in detail in 40 chapters how sustainable development should be implemented in the member nations. Agenda 21 is negotiated document. Since the 1992 agreement, Local and National Agendas 21 are being worked out. The proposal agreed by heads of states, to produce the first regional Agenda 21, concerns the Baltic region.
- **Cultural.**
  Sustainable development may in this perspective be seen as a programme for a new, a post-modern development, which does not rely on increased material turnover. In fact it instead addresses in a more fundamental way the questions of what is development, what is good human life and what constitutes a human culture in harmony with nature.

- **Issues of sustainable development are much linked with economy, ethics, law, and policy.** Environmental issues today are not just a matter of “protection”, but also a matter of long-term strategies.

- **Intergenerational equity** is an important issue in economies, which are undergoing substantial social security reforms.

- **The task of environmental ethics** is to study systematically and critically the values and attitudes that govern our treatment of the natural world.

- **Very important for the region are problems of the value of a clean Baltic Sea.**

Education in sustainable development at universities in Latvia is provided in partnership with International Baltic University.

Materials for studies of sustainable development of the Baltic Sea Region prepared by the international Baltic University are widely used at several universities and institutions of higher education in Latvia.

Many teachers of universities in Latvia participated at the regular Baltic University teachers’ conferences for competence development.

**CONCEPTS OF WATER MANAGEMENT STUDIES FOR THE BALTIC SEA REGION**

Very important issue for the Baltic Sea region is water management sector influencing quality of life for people in all countries of the region.

The Baltic University course *Sustainable water management* in Latvia was offered for the first time in spring of 1999, with student participation at the international videoconferences and videolectures.

The course *Sustainable water management* is a master level course to promote sustainable water management in the Baltic Sea region.

The aim of the course is to give knowledge on the state of the water resources in the Baltic region, their present use and management, and the challenge of creating sustainable water-use practices in the different countries and regions in the Baltic Sea drainage area.

This master level course covers three parts:

- The Waterscape;
- Water Use and Management;
- River Basin Management;

and focuses on questions of sustainable use of water and water resources in the Baltic Sea region (Lundin 2000).

These three parts could be studied either as three separate courses or as one large course.

Sustainability is introduced in more detail as a basic strategy to deal with water management.

The course treats:

- The waterscape with wetlands, lakes, rivers, coasts and the Baltic Sea,
- Water resources,
- Hydrology of natural waters and hydrological models,
- Sustainable water use in agriculture, urban areas and industries,
- River basin management with emphasis on comprehensive planning and resolution of water use conflicts.

The course *Sustainable Water Management* and it’s parts are organized as an international cooperative programme among universities in the Baltic Sea region.

A curriculum for the course or its parts is established independently at each participating university.

About 40 universities in the Baltic University network in Sweden, Finland, Estonia, Latvia, Lithuania, NW Russia, the Kaliningrad region, Belarus, Poland and Slovakia offer the course.

In Latvia the course *Sustainable water management* is offered by three universities: University of Latvia, Riga
Technical University and Latvian University of Agriculture with support of the Baltic University’.

By the wide use of video-, audio- and data conference systems the participating students engage in common seminars. The course consists of lectures, seminars, excursions, and case studies; accompanied by a series of three textbooks.

The sustainable water management course and it’s parts are also offered as distance courses.

Since 2003 there is also an Internet based learning course at Uppsala University. This Internet based course is open to students from Latvia universities and to all students anywhere in the world.

All material for the courses including literature, Internet links and project tasks are available in the public domain (http://www.balticuniv.uu.se/swm/).

CONCLUSIONS

International Baltic University courses are giving excellent possibility for Universities in Latvia for transfer of knowledge in the Baltic Sea region studies, for regional development studies and for identification of common concepts for the Baltic Sea region studies.

The Baltic University courses are giving special opportunity for Universities in Latvia to introduce regional approaches and concepts in environmental studies and in sustainability studies.

Activities of the International Baltic University are giving possibility for universities of the Baltic Sea region and for Universities in Latvia to participate at network learning.

Moreover, to get experience in practical implementation at the study processes of modern information technologies, in particular Internet, computer-, video- and audio-conferences.

REFERENCES


BIOGRAPHY

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INFORMATION SYSTEM OF PROFESSIONAL EDUCATION PROGRAMS – BASIS FOR THE EVALUATION OF THE CONTENTS AND QUALITY OF EDUCATION

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KEYWORDS
Information System, Module, Professional education, Life-long learning.

INTRODUCTION

A new, up-to-date program of professional education can shortly be described as an optimal composition of acquiring theoretical knowledge and practical use of latest technologies. Taking into consideration the insufficient material technical and methodological covering in the sphere of high technologies, the author sees a way of more rapid modernization of education programs in a closer cooperation among educational establishments and in involving employers into the process of education. In this respect, participation of the state is essential by ensuring legislative basis to foster cooperation. Interconnection with employers would ensure that the new technologies used in production come into the educational establishment.

The cooperation of educational establishments would prevent doubling in the education programs and in the development of methodologies, would ensure consolidation of material technical and methodological resources for the modernisation of the study contents and would create a synergic effect.

Step One in the acceleration of the pace of modernization in professional education – forming a Web-based information system of study contents.

Step Two – forming a modular system of education programs and courses, which would make the contents of courses more precise and would prevent from doubling in the education programs.

Step Three – adapting the contents of the education programs into the environment of e-tuition, as a pre-condition for cooperation, exchange of program contents and methodologies.

The state, in this respect, should ensure the legislative basis by defining the education programs, materials of courses and methodological materials developed with the financing from the state and European funds as state property and making them accessible to all educational establishments.

ABSTRACT

Globalisation, as well as the united European space, have in fact taken down borders of states and opened a way for new technologies to enter Latvia. The rapidly changing technologies, especially information technologies in electronics, mechatronics and other knowledge capacious branches set new demands for the qualification, further education and re-qualification of the personnel. The existing system of education is inert, it has a weak link with the producer - employer, cooperation among educational establishments is unsatisfactory, there is no common information system. To reduce the effects of the negative factors mentioned above, development of modular content of studies is being suggested, introduction of a unified form of the study content description, as well as use of information technologies in the analysis of the study content and quality.

The comparatively scarce density of inhabitants in the regions (outside Riga) makes the services of education, especially further education, economically unprofitable and managerially complicated. Therefore, regional educational establishments devote a special attention to the development of e-tuition, which would allow for a successful competition as well as for cooperation among educational establishments of different regions. Due to the insufficient financing the development of e-tuition course is too slow. In addition, the pace of the renewal of the program contents offered by educational establishments and development of new methodologies is not satisfactory.

As a result, not all the education programs correspond the demands of the labour market, however, each educational establishment has some competitive education program, or separate courses, which it could offer in its region or the whole state. Hereby a solution is being suggested to foster the cooperation among the educational establishments, which would lead to a synergic effect in the modernisation of the system of education.
The author has analysed the accessible information (published in the Internet), offered by different structural units of the Latvian system of education, both governmental and non-governmental, and has come to the following conclusion:

- By content, the information is superficial, mostly general, which does not allow to judge about the content of the respective education program and its importance;

- By form, the information is presented by using very different designs and different formats of data (texts, PDF files, web-pages, etc.), which makes it more difficult to perceive and analyse the information.

Development of an information system on the contents of professional education would foster:

- More active and closer cooperation among the educational establishments;
- Computerised analysis of professional standards and prognosis of actualisation;
- Formation of the current demand from employers;
- Objective information for people about the offers for education and further education in the region;
- Objective evaluation of the contents of informal further education;
- Opportunity to see and analyse the link between the initial professional education and courses and seminars for professional perfection;
- Recognition of skills acquired in an informal way and development of methodologies for their evaluation.

To make the information system successful, the situation of the professional education and the situation of the labour market must be acknowledged.

PROFESSIONAL EDUCATION AND LABOUR MARKET

INITIAL PROFESSIONAL EDUCATION

The Law on Professional Education, accepted in 1999, regulates the system of initial professional education. There are three stages in the professional education:

- Professional basic education;
- Professional secondary education;
- Professional higher education, which is divided into:
  - First level professional higher education;
  - Second level professional higher education.

Latvian system of education sets out five levels of professional qualification:

- The first level of qualification is to be acquired in the professional basic education programs;
- The second – vocational,
- The third – professional secondary,
- The fourth – first level professional higher,
- The fourth – second level professional higher education programs. The Law on Higher Educational Establishments regulates the implementation of the Second level of professional higher education.

In 2000 the State Standard of Vocational Education and the State Standard of Secondary Professional Education, but in 2001 the State Standard on the First Level Higher Professional Education were adopted. They envisage the division of the obligatory contents of the education program, final testing, and demands in the acquisition of the program.

LIFE-LONG LEARNING

Unfortunately, there are no adjustments concerning the legislation on further education and life-long learning in Latvia. However, the importance of further education grows with every year, because people need to acquire new technologies, adjust themselves to the changing labour market. It is possible to keep one’s competitiveness only by improving one’s professional knowledge and skills, therefore the importance of further education is still growing. In the European context, having the principle of life-long learning, the state must ensure the access to education to all inhabitants in their place of residence, independent of their age, sex, profession, and type of employment (National programm, 2004).

Further education may be formal and informal. As a result of formal further education, a qualification recognised by the state is awarded. Informal further education includes different courses, which do not end with acquisition of an official qualification, but which give a chance of acquiring latest technologies, achievements of science, methods of work, etc.

ESTABLISHING THE SITUATION

The initial professional education can be acquired at accredited establishments of professional education (mostly state-owned) by mastering licensed and accredited education programs. It means that the content and realisation of these programs is regulated by the standard of the profession and other normative acts. The quality of the acquired education can be compared due to the system of centralised exams. This system is bureaucratic and it is not able to react to rapid changes in the labour market, because:
• The procedure of working out standards of a profession is prolonged, so they haven’t been worked out yet for a range of new professions;

• Prolonged and bureaucratic procedure of licensing and accrediting of education programs – which, in the author’s opinion, is necessary, but does not foster development and accrediting of education programs oriented to the demands of the labour market.

Formal further education mostly consists of training the unemployed. To assign an official qualification, the educational establishment and the program have to be accredited. It means that shortcomings of formal further education are the same as in initial professional education mentioned above.

Informal further education has a greater role in maintaining a person’s competitiveness in the labour market than the formal one. It has become essentially necessary to develop a system to evaluate the quality of the courses of informal further education and distant learning. (Latvian National Observatory, 2002)

As the results of the research (Lesiņš M.M., 2005) show, informal further education, despite its doubtless advantages, still does not receive support from the state and meets severe difficulties, especially in the regions where it also does not gain a proper popularity.

MODULAR PROGRAMS OF PROFESSIONAL EDUCATION

The pilot project in the frame of Leonardo da Vinci program, called “Module – a link between the initial and further vocational education” (1998-2001) worked out the methodology of developing a program for module education. It envisages the following basic principles in developing modules:

• The module has to be like an independent education program,
• The structure of the module includes: The aim and tasks of teaching, starting conditions, term of acquisition, form of studies (day, evening, correspondence), contents in the form of study themes, methods and contents of evaluation, sources of information.

The author holds the opinion that it is useful to work out modules the volume of which corresponds with a nominal value from the following scale (see Table 1):

<table>
<thead>
<tr>
<th>Lessons:</th>
<th>8</th>
<th>12</th>
<th>16</th>
<th>24</th>
<th>32</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit points:</td>
<td>0,2</td>
<td>0,3</td>
<td>0,4</td>
<td>0,6</td>
<td>0,8</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table1. Relationships.**

**WHY MODULAR PROGRAMS?**

Further on several considerations are given on why it would be useful to form a modular system when developing the content of education programs and courses.

The fact that the education program is licensed and accredited would allow to legalise the modules included into the contents of the program and not to subject them to repeated bureaucratic procedures in the process of state recognition of informal further education.

The improvement of the contents of accredited programs would be possible without essential changes in their content, but by changing separate modules.

The opportunity of combining various modules to form various programs and courses of professional education and life-long learning, adapted to a specific target group.

The use of a precisely defined Template, which allows to:

• Do a wide and many-sided computerised analysis of the information in the module
• Do the indexation of modules.

The basis for the systematisation of the courses and modules of professional education programs is taken from the Multiple intelligences (intellectual abilities) by Howard Gardner, Ph.D. (Teacher Tap) They are as follows:

1. Naturalistic
2. Bodily kinesthetic
3. Visual spatial
4. Verbal linguistic
5. Logical mathematical
6. Musical rhythmic
7. Interpersonal
8. Intra- personal

By dividing the content of education into 8 big groups it is easier to define the aim of the module, as well as to control the correspondence of the education program contents.

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1 Credit point - study registration unit, that corresponds to the amount of 40 academic lessons of work for the students (one study week), where up to 50% of lessons are in contact.
INFORMATION SYSTEM OF THE PROFESSIONAL EDUCATION CONTENTS

The author suggests developing an information system based on Web and database technologies, which would contain the following information fields:

- Education programs corresponding to profession standards, their division into courses and modules
- Formal further education - state order for training the job hunters
- Informal further education – contents of the seminars and courses offered by producers and service providers, designed according to the demands of module development
- Employer’s information field – job descriptions, descriptions of qualification competences, etc.
- Guidelines for the state strategic development plans and programs – visions of future interpreted under the context of education
- Catalogue of key-words, which would allow for actualisation of program contents, checking the presence of new key-words in the content of respective education program
- Contents of education programs and courses, divided into modules. The module includes the following information:
  - Header of the module; contents (in the form of theme titles), methods of evaluation, keywords
  - Header includes the following information – the aim of the module, tasks, study language, starting conditions, length of studies (lessons, credit points), study form (full-time, correspondence, self-education), level of taxonomy, succession (what modules can be mastered after the respective one)

This system will give additional opportunities:

- Generating a digital profile for each profession
- Using the information from the data base – generating a digital profile of each person’s education and qualification (considering the initial professional education, further education, practice and work experience)
- To make the range of programs / courses / modules offered by an educational establishment more “transparent”, more foreseeable, thereby fostering the cooperation and exchange programs of educational establishments.

CONCLUSIONS

The offer for modern professional education is hindered by several factors:

- Insufficient financing for the development;
- Bureaucratic barriers and lack of legislative basis;
- The range of the offered education programs is not foreseeable, and its development (especially in the field of IT) is inexpediently dubbed in a range of educational establishments

Formation and development of a Web based information system will allow to use methods of formal information analysis for a quick but effective evaluation of the contents of education programs and for prognosis of possible improvements. It is planned to attract financing from the European structural funds, because the educational establishments are not ready to finance the development of such a system. The basic principles and advantages of modular instruction have been accepted by the Ministry of Education and Science, which is proved by the expected result of carrying out the project under the frame of the national program “Development of Unified Methodology to Foster the Quality of Professional Education and to Involve and Educate Social Partners”.

REFERENCES

National programm (2004), Nacionālā programma „Mūžizglītības stratēģijas izstrāde un ieviešana” http://www.izm.lv/dokumenti/es%20struktūrfondi/nac_prog/3.2.4.1.doc

Latvian National Observatory (2002), Vocational Education and Training and the Labour Market in Latvia


Teacher Tap, Professional Development Resources for Educators http://eduscapes.com/tap/topic68.htm

BIOGRAPHY

Agris Vārna is a lecturer of the IT Department of the Vidzeme University College, and the head and a lecturer of the Electronic and Electrotechnics Department of the Vidzeme Vocational Training Centre. He graduated the Riga Technical University Department of Radio engineering and telecommunications in 1984. In 1999, he attained a master's degree in the Riga Teacher Training and Educational Management Academy.
KEYWORDS

Convergence, hybrid media, news management, professional skills, journalism training

ABSTRACT

The principal goal of this article to introduce a concept of journalistic “news management”, which indicates to multiplicity of tasks applied in complex conditions of news production in the newsrooms. It seeks to show the spectrum of skills that contemporary journalists need to acquire to successfully enter professional careers.

INTRODUCTION: CHANGES AND CHALLENGES

Many things have changed since the concept of transformation was used as a keyword to describe changes in the media system (cf. Vihalemm 2002). The end of the 20th century is reasonably called the beginning of essential changes in public communications.

The electronic revolution, which began and accelerated during the late 1980s, opened new communication channels and offered the unprecedented opportunities. Newly emerged cable and satellite television side by side with the public television significantly changed the field of society information.

Due to this fact the number of the viewed TV channels increased ten times, journalists acquired more freedom to experiment with the television program formats.

Eventually the publishing quality of the printed material changed and the spectrum of the specialized publications glittered with all colours of the rainbow.

When the modern technologies began to be widely applied in the household, leisure time increased which consequently had a strong affect on mass communication: in attempts to attract the audience media organizations started making more entertaining television programs, serials and games, publishing various magazines for leisure reading.

Today the situation has normalised and a new keyword has been invented. Scholarly debates nowadays stress the process of media convergence taking place on several fronts simultaneously, such as technological, organisational and social.

The perspective of technological convergence tends to emphasise the digitalisation of all media’s content. It imagines convergence as a process of melding several mediums into one, accessible through a computer screen.

Organisational dimension of convergence results in the development of gigantic poly media enterprises. However, convergence has social implications, too. It is certainly affecting how people – both media professionals and their audiences – select and use the information.

For journalists, media convergence gives rise to new forms of creativity and multi-tasking, to trans-media storytelling and the development of journalistic stories across different platforms and media channels.

As a result, the professional communication world is facing new uncertainties and dilemmas. Previously clear boundaries of various media do not exist in nowadays media.

Technological developments and cross-media ownership patterns encourage various types of hybrids. Nowadays reporters need to adapt to rapidly changing market situations and move between various types of media.

Writers and reporters have to think visually and broadcast journalists need to work as producers and information managers as well.
This adds a tremendous pressure and increases uncertainty among those who plan to enter communications careers.

NEWS MANAGEMENT

All aspects of media convergence affect how media companies organise their everyday work. Media organisations produce information in such a way that matches their technical facilities, news production routines and corresponds to audience expectations.

News production is a complex process, which takes place in a particular cultural setting.

It is affected by many factors such as technological and economic constrains, political factors or pressures from information sources (see Figure 1).

It also takes place within organisational framework, which is determined by certain editorial policies and professional journalistic routines.

Because of the growing variety and complexity of news, more than half of the time journalists spent by selecting and managing of information.

Journalists are facing new types of pressures. On one hand, they have to work hard to acquire professional competence and knowledge, and specialise within particular medium.

On the other hand, they have to adapt adequately to changing demands of the media company they are working at.

In addition, contemporary journalists are exposed to an oversupply of information, which reaches journalists via traditional and virtual sources from different actors such as government, political parties, and PR consultants.

As a result, editorial procedures and routines change, therefore, the need arises to assess the procedural aspects of news manufacturing.

Popularly speaking, news management aims at influencing, changing, piloting, and controlling the journalistic everyday business and is considered to be a PR function.

Figure 1. Main factors affecting and determining the flow of news. Adapted from McNair, B. (1998), Balčytienė et al. (2005a), Rosenwerth et al. (2005).
Therefore, this is an outside strategy. Applying this top-down type of news management, the political and other actors seek to determine the media agenda.

But, at the same time, news management is a process, which covers different phases of news production such as choice of information sources, value judgement, assessment of news relevancy, and news presentation (Shoemaker 1999). The result of this multilevel process is the news agenda set by the media company.

Journalists select, construct, and package the news, in order to present to their audiences information that is most relevant.

Sometimes news is rejected because it does not fit relevancy criteria established by media organisation or of other more practical reasons such as lack of time or space in the publication.

For media operating under farce competition, the news value is determined by the audience requirements and commercial imperatives (cf. Shoemaker et al. 2001).

The widely discussed commercialism of the media is, in fact, strongly related to social changes.

One important argument for media commercialisation is the idea that the centrality of organized social groups and importance of loyalty and solidarity to group interests is giving way to greater individualism (Hallin & Mancini 2004).

As scholars claim, a mass audience changes into a new audience with personalized interests and the media re-orient itself towards producing news and information as a “saleable product” (cf. Balčytienė 2005b).

The arrival of interactive technologies, too, contributes to the process of personification: it provides means to personalised experience for information consumers.

In other words, new technologies challenge traditional journalistic processes in that sense that they allow reader independence from gate-keeping by the media.

The audience may become information suppliers, sources as well as contributors.

As a result, online journalism can become an open-source journalism that at some point may turn into open-content journalism where readers can actively supply media with additional information and comments (cf. Moon 1999).

Indeed, the production of news is a very complex process. News is determined by some specific professional routines. As a tradition, some events generate more attention than the others.

There exists a clear tendency that nowadays the news organisations receive the kind of information that they require.

For instance, even news agencies pre-determine types of information which is being sent to their subscribers. Local newspaper most obviously will subscribe country-focused information rather than news in foreign languages.

News production also depends on the spectrum of sources available. Most popular sources of information are news agencies, special correspondents, foreign correspondents, and press releases.

For media organisations, which own several media outlets, an important source of information is news from other newsrooms of the same company.

For large media organisations more actors cooperate in news production, therefore, it is needed to form new partnerships such as reporters working with designers and photographers working with writers.

To conclude, on one hand, news is determined by the work of journalists and editors.

But, on the other hand, news organisations are dependent on information that has been “packaged” by their sources. Very often, instead of critical analysis, the media simply reproduce information received from its various sources.

To sum up, the news production is an active process which is both top-down and bottom-up strategy of information management that is manifested through such journalistic processes as gate-keeping, decision-making, agenda-setting and news-production (see, for e.g., Rosenwerth et al 2005).

The concept of “news management” seems to be a relevant definition of the procedures applied within contexts of news manufacturing.

From journalistic point of view, news management has an emphasis on activities performed by media professionals in determining the news agenda in the media.

In this context, it is necessary to speak about new combinations of skills required for professional journalism.

SYNTHESIS: NEW REQUIREMENTS

The public communications sector in Lithuania has undergone rapid restructuring, development, and change.

Within free market conditions the media rapidly changed their orientation to capitalism and democracy. By 2000,
after a decade of experiments, the overall media system has reached stability.

Yet, at the same time, the media market remains vulnerable as competitors with different editorial lines, virtual projects, and business concepts fight for audience and advertising money.

Thus, educational and journalism training institutions have encountered new challenges.

How has journalism training changed (if anyhow) since the phase of consolidation in the national media was reached?

There is a need for educational institutions to take into consideration changes in the media industry and to re-shape journalism education programs accordingly.

Answers to above mentioned concerns and dilemmas could be found through debates and discussions among the interested actors, such as media scholars and practitioners, as well as graduate students in journalism.

It seems that the specific skills that journalism graduates need to successfully enter careers in the media industry are as follows: fundamental skills of gathering and reporting the information, critical assessment of sources, innovative thinking to make new combinations of information, ability to judge which medium fits the information presentation best, capability to solve complex problems of modern communications, and skills to reflect upon their work.

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The impact of media convergence on journalism training is assessed within NordPlus Neighbour project “Developing Nordic-Baltic-Russian Cooperation in New Media Journalism Training” (2004-2005).

REFERENCES


Balčytienė, A. 2005b. Media Modernisation and Journalism Cultures in Baltic States and Norway. In


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She has written extensively about the culture of journalism, the impact of Internet on mass media and journalistic innovations. She is involved in a number of internationally funded projects focusing on the Europeanization of the media and development of the European Public Sphere (6th Framework Programme), new media journalism training (NordPlus Neighbour) and the impact of the Internet on mass media in Europe (COST A20).
SMALL REGIONS LEADING: THE E-GOV PROJECTS FOR THE PEOPLE OF ALBORAYA (SPAIN)

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KEYWORDS
Information and Communication Technologies (ICTs) for administration, e-government, e-administration, administration workflow, user-end administration.

ABSTRACT
European Action Plans and OECD reports have set e-government and e-democracy as the priorities of the following decade. European countries face the challenge of capitalising the potential of ICTs to transform citizens' services delivery and local development by achieving a new way of operational efficiency across the public sector. Aside from special cases, the e-administration is not likely to be a revolution but rather a gradual transformation. Many governments start their journey to e-government with a simple website redesign, and then they move on to more complex ICT solutions. This paper describes the way e-government services can be both categorized and applied by analyzing a real case from a typical and small municipality rather than from a big city, which is supposed to be the leading area in e-government. We will analyze the situation and project of the Alboraya municipality, a small region at the north of Valencia City (Spain).

E-GOVERNMENT IN THE 21st CENTURY AGENDA

In June 2001, the Organisation for Economic Cooperation and Development set e-government as one of the main priorities in OECD countries. One year after that endorsement, the European Council held at Seville (Spain) launched the eEurope Action Plan¹. In January 2003 this action plan was backed up by the Council of Ministers with the eEurope Resolution of January 2003. Their first aim, though, was not the e-government implementation as such, but the implementation of broadband. Therefore, connectivity was the main concern. It is true that there was (and there is still) a need for both broadband access at affordable prices and for secure connectivity. However, there was a complementary investment along with the integration of better networks: what I consider «the meta-investment», which is the investment in ICTs for regional businesses and community development. We are on the move, but the budget and means differ from one European country to another.

The Commission reports a series of stages and challenges which are considered fundamental for Europe's Information Society issues, such as e-democracy and e-polls, electronic cards, public contents and services, ICT as a key investment sector, interoperability, time management and efficiency. According to the Information Society and Media Commissioner, Viviane Reding, e-Government services can make administrative formalities easier and more pleasant for everyone. Encouraging business and citizens to use them as widely and intensively as possible will boost efficiency and hence productivity and competitiveness throughout the economy.

E-government is definitely more than providing connectivity and official governmental websites. It refers to a whole set of ICTs infrastructures aimed at challenging/transforming the way administration, on the one hand, and citizens issues, on the other, are dealt with. The keywords are interwoven: time management and efficiency. By using networked technology, the government is capable of delivering more efficient and effective services to the people and, therefore, public sectors become more user-oriented. E-government has potential (and proven) benefits at both national and local levels of government, and a representative of the latter shared their experience for this paper. As we will see later, the Alboraya Government has focused their policies in finding innovative models to capitalise on new opportunities for content and applications. Taking into account the reports coming from Brussels, we could claim that they seem to be learning from global action plans whilst building on local assets.

¹http://europa.eu.int/information_society/eeurope/i2010/index_en.htm
E-ADMINISTRATION SPHERES AND APPLICATIONS

E-administration services can be divided up into 3 spheres according to the audience it is addressed: citizen-centered administration, business-centered administration and meta-administration (government itself). These three areas refer to community, economy and government. On top of that, they embody three types of dialogic ICT applications: government to community, government to economy and government to government (see Figure 1 and Figure 2).

As the figures show, it is all related to services. We could interpret it as a service-oriented approach to the end-user. Government to Community (eG2C) ICT services clear the way for a new sort of interaction between the citizen and the administration, since the centralization of services improves citizen’s time management. This sort of interaction is often interpreted as a big office or shop, in which we would find a back office and a counter or storefront. Therefore, the services offered to citizens by the e-administrations are often called front-office services, and the services within the administration, back-office services. It might have been said that eG2C applications will increase the digital divide between citizens with Internet connection and citizens who have not such connectivity. However, this digital divide can be solved as we will see later with the Alboraya case. Most of the eG2C services that are currently used somewhat belong to the eG2E sphere. Since e-government implementation is not at its final stage at all, most of the institutions start offering common services based on shared needs by both citizens and businesses. This ‘common services’ cluster involves permits, licences, tax income issues, certificates, and other typical bureaucratic issues. Those municipalities in which this sort of cluster has already been implemented have moved on towards a clearer distinction between eG2C and eG2E services by developing applications that allow the building of citizens’ communities of practice (associations, etc) or include job engines, electronic voting, online education, and any other social services.

Figure 1. E-gov ICTs: the users and the spheres.
Figure 2. ICTs applications for e-government.
As the figures show, it is all related to services. We could interpret it as a service-oriented approach to the end-user. Government to Community (eG2C) ICT services clear the way for a new sort of interaction between the citizen and the administration, since the centralization of services improves citizen’s time management. This sort of interaction is often interpreted as a big office or shop, in which we would find a back office and a counter or storefront. Therefore, the services offered to citizens by the e-administrations are often called front-office services, and the services within the administration, back-office services. It might have been said that eG2C applications will increase the digital divide between citizens with Internet connection and citizens who have not such connectivity. However, this digital divide can be solved as we will see later with the Alboraya case. Most of the eG2C services that are currently used somewhat belong to the eG2E sphere. Since e-government implementation is not at its final stage at all, most of the institutions start offering common services based on shared needs by both citizens and businesses. This ‘common services’ cluster involves permits, licences, tax income issues, certificates, and other typical bureaucratic issues. Those municipalities in which this sort of cluster has already been implemented have moved on towards a clearer distinction between eG2C and eG2E services by developing applications that allow the building of citizens’ communities of practice (associations, etc) or include job engines, electronic voting, online education, and any other social services.

The ICT applications for Government to Economy (G2E) are quite developed due to their implementation easiness and the legacy of traditional administration (already based on file clusters and database) before the electronic data exchange spread. The municipal authorities, however, face the challenge of motivating small businesses whilst the big companies with network infrastructures probably account for most of the exchanges with the e-government.

The back-office services or eG2G (e-government to Government) services enable data sharing by government employees. They are based on a 2-way process: standardisation and connection of pre-existing files. These pre-existing files from different departments (or even from different national administrations as we will see later) are standardised through a chosen database system and exported to software applications developed and implemented for the connection and centralization of employees’ resources. As J. Alemany (Alboraya Town Council) will point out later in this paper, it is much easier to achieve this 2-way process in-house than between administrations. eG2G system organization encounters many problems when trying to interact with strong traditional administration systems. In this case, municipalities like Alboraya, in order to standardise data to offer centralized services for the citizen, have to deal with other municipalities, different tiers of local authorities, the central State and its different areas, etc. And of course, the final e-service does not show any of these procedures so the citizen is not aware of the different management rules that operate under each command, certificate, form s/he is requesting.

PROFILE: ALBORAYA TOWN COUNCIL CASE

In order to truly comprehend the achievement of Alboraya municipality, I will describe briefly what kind of place this is. Alboraya is not a big city but a small area at the north of Valencia (the province capital). With a land area of 8.30 sq. km. and a population around 19,500, it is the most prosperous suburb around Valencia. However, the municipality is obliged to deal with a geographical divide, since Alboraya is split up in two smaller areas due to the rail tracks and the Mediterranean turnpike. Therefore, we have citizens living in the old quarters and citizens living at the other side of the motorway, the coastal Alboraya. Even though 50% of the population works for the services sector and 30% for the industrial sector, there is still an important 17% of the population working in the agricultural sector, a wealthy resource for the Town Council and which faces several challenges concerning connectivity.

The fact is that this small and probably typical municipality I have just described won the Best Management Award from the Valencian Central Government and every year, Alboraya hosts the PANDORA meeting, in which Spanish municipalities meet in order to exchange ICTs experiences with administration. The Alboraya Council started the PANDORA2 Program in 2004. For the development of this paper, I interviewed Josep Alemany, who coordinates the ICT development department for the town council. The PANDORA program includes eG2C, eG2E and eG2G services. It involves both e-government solutions and internal administration solutions since it includes workflow technologies.

PANDORA AND eG2C: THE INFOKIOSK, THE ‘FRIENDLY’ CARD AND OTHERS

As it has been pointed out before, at the early stages of e-gov implementation it is very common to find a shared cluster of services for both citizens and businesses. Pandora services for the community can be also interpreted as such by the local business community since they mainly refer to income-generating services, 2 PANDORA stands for Proyectos Alternativos y Nuevos Desarrollos en la Organización de Ayuntamientos: Alternative Projects and New Developments in the Town Councils Organization.
registration services, returns services, permits and licences. Therefore, these are services than can be either used by any citizen or by any local business. However, PANDORA also offers community-oriented services such as a cultural agenda, associations’ management, educational info, sms alerts, etc. The principle underlying PANDORA is that the improvement of the internal workflow with ICTs applications causes a general improvement of the services for the citizens.

OECD and EU eAction reports have already underlined the importance of spreading connectivity in order to avoid a digital divide among the citizens of the same municipality, province or country. It is a fact that in Alboraya, like in any other place, there are areas with poor connectivity or no connectivity at all (mainly the agricultural sector). The fact of implementing e-government services without addressing this problem would have actually led to a digital divide. However, the PANDORA program considered the implementation of INFOKIOSKS (see Figure 3). An infokiosk offers the same sort of services the official governmental website provides but the citizen does not need to have internet connection, just an electronic AMIC\(^3\) card (see Figure 4), which is issued freely.

The INFOKIOSK looks like an ATM. Apart from the advantage of providing eG2C services to anyone (no need for internet connection at home), it turns out to be a very important tool, because our region is divided up by the rail tracks, so the people living in the coastal area, when they need to carry out an administrative procedure, do not need to drive to the old town, they have the Infokiosk 24/7 in their own neighbourhood, J. Alemany added.

The INFOKIOSK consists of two main parts: public and private information. The public information offers data such as population, street maps (GIS technology), cultural events, public library issues, “old goods” collection etc. On the other hand, with the AMIC digital card, the INFOKIOSK software system authenticates the citizen so s/he can have access to his/her personal information (taxes, application forms, licences, permits, etc.).

Alemany explained that if a citizen, for instance, has applied for a permit for renovation works in their house, they can check at which stage the process is since the software we have developed tracks the administration internal workflow.

Figure 3. The INFOKIOSK.

Through the INFOKIOSK (as well as through the web), citizens can pay taxes or make any other payment related to administration procedures.

Figure 4. The AMIC e-card.

\(^3\) AMIC means Friend in Valencian language.
The AMIC digital card was implemented in 2003. Citizens over 18 years old get them via mail. When the citizen receives the card, s/he is asked to sign a free contract. There are several types of free contracts depending on whether they will use the card to make payments or not and how:

- By direct debit contract, so the payment is made directly into their account;
- No payments at all.

![INFOKIOSK screenshot.](image)

The PANDORA program is currently implementing a SMS alert system, which was already tried out at the Pandora 2004 Meeting. Users have to fill in a ‘profile form’ about their interests and needs and this information is collected and standardised in a database system. This system is called «Ciclos Vitales» (Life Cycles), what we do is to foresee the needs of our citizens taking into account the life cycle they are living in: teenagers, adults or senior people...For instance, let’s take a couple of parents who have a 3-year-old kid, before their kid needs to attend school, they will get a SMS alert in which we’ll inform them about available Kindergarten vacancies, etc. The same will happen when this kid needs to attend Secondary Education or information about grants when s/he begins the University period. In that way, the citizen is going to feel both supported and accompanied by the town council along their life, concludes J. Alemany.

PANDORA is also planning with the Central Inland Revenue a centralization of non-regional tax information; the citizen will be able to check their tax record, the deadlines, etc. Furthermore, they are going to implement more applications for municipal payment services and for social services such as scholarships information, a job search engine for local development, etc.

Finally, the European policies known as «e-Inclusion» aim at ensuring equal access to and the availability of ICT services for all, at an affordable cost (see Figure 5). PANDORA is studying the possibility of implementing a WiFi network for the agricultural areas in which broadband network is impossible to implement.

**eG2G: AGENDA AND WORKFLOW SOLUTIONS**

As well as improving services for the end-user, e-Government allows the Government itself to achieve efficiency savings through the standardisation and interoperability of back-office functions such as financial issues, resources and human resources management and procurement. If any government wishes to turn their offices into modern service centres, internal workflow needs to be simplified and standardised.
PANDORA has developed an application for internal management called AGENDA. This software helps the departments’ employees to procure and manage events, resources and files. Regarding the events management, this application allows the employees from different areas to schedule events, which are shown by the system. In this way, the event of one department will never overlap in time the events scheduled by other departments. On top of that, the AGENDA application allows the employees to book resources (such as a meeting room or equipment) while the application prevents overlapping. Thus, everybody knows what is going on and where the things are. This eG2G service is going to be implemented as eG2C as well. According to J. Alemany, we are now negotiating to export this agenda to external management services: for associations of our municipality (such as Scouts, Neighbors Assoc., Theater Assoc. and so on) so they can upload their news, book the assembly hall, upload their events calendar, etc. and the AGENDA system helps them again to avoid overlapped events and resources, etc. This events information will be available to any citizen, but only authenticated users from the associations will be able to upload and manage the events in the Agenda. This is going to save us all a lot of unnecessary questions, time and effort. This better management will help us focus on some other important tasks and issues. Employees now free of data input operations can have more ‘rewarding’ jobs.

PANDORA is entirely developed by the ICT experts of the town council, their software is developed on an IBM platform and they have integrated the data from the entire available database. However, as it was pointed out at the beginning of this paper, eG2G database applications are difficult to accomplish: each institution the Council has to deal with has their own type of database and formats. J. Alemany explains that the census must have the format the National Census Office (INE) tells us to have, the data related to territorial issues must follow the format of the Land Registry Office, taxes collection must follow Inland Revenue requirements...Therefore, the back-office e-government must integrate a myriad of diverse requirements whilst providing uniformity at the storefront.

CONCLUSIONS: THE ADVANTAGES

On the one hand, combined information and communication technologies provide Alboraya municipality with faster internal procedures; on the other they bring citizens closer to public affairs. The former receives little media coverage but they turn out to be a necessary stage prior to the successful implementation of e-government to community services: the digitisation of

in-house procedures implies the cutting down on users’ physical trips. It is said that in order to invest in ICTs applications (for government, education, etc.), it must be ensured that the end result surpasses the result of traditional (non-digital) former procedures. J. Alemany claims that PANDORA applications have clearly optimized administration by transforming it into a user-focused management so they can enable local residents to do the activities they have always done better, faster, more cheaply and more efficiently. The Alboraya case can be exported to many other places, no matter their location and population. It is about believing in the tangibleness of the project, i.e. improving services that matter to people: 24/7, secure, easy and convenient.

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REFERENCES

ALBORAYA.ORG
http://www.alboraya.org

EUROPA- Gateway to the European Union:
http://europa.eu.int

EUROPA- Press Releases

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)
http://www.oecd.org

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Elena Benito Ruiz graduated with excellence from The University of Valencia Dep. of English Studies in 1999. She is a PhD candidate since 2002. Her research field includes ICTs for learning or e-learning, Network-Based Language Learning and synchronous platforms for foreign language practice. She is the author of the Educatics.com project, a non-profit WiFi initiative for the Spanish-speaking e-learning tutors. She obtained a Fulbright grant to lecture at Wheaton College, MA (USA). She is a member of the William J. Fulbright Spanish Association. She has published several papers and taken part in conferences related to ICTs and innovative education.
RESEARCH OF INNOVATIVE LOGISTICS AND TELEMATICS EDUCATION IN THE BALTIC REGION

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KEYWORDS
Transport, logistics, telematics, innovative education.

ABSTRACT
The creation of a united European transport market without restrictions or barriers to access, based on harmonised conditions of competition, is becoming one of the principal objectives of common transport policy in Europe. Transport is quickly being acknowledged as an important human activity that will require extensive academic training and disciplinary research. Transport and Telecommunication Institute (TTI) in 2000-2004 years successfully participated in a set of regional projects directed to investigate target groups involved in the sphere of transport education about positive experience, problems and new technologies of education in Baltic countries. The paper gives an overview of the TTI experience in innovative logistics and telematics education.

IVETTA PROJECT – THE NETWORK FOR VOCATIONAL TRANSPORT EDUCATION AND TRAINING

Concerning transport, especially goods transport — still many people see it as a simple task that can be managed by people with no or low formal education. This might be so, but it will not hold long ahead. Transport is quickly being acknowledged as an important human activity that will require extensive academic training and disciplinary research. Accessibility manifested as mobility is an intrinsic quality of life. It must remain a postulate that relevant academic training and research can make the need for mobility compatible with the need for sustainability.
Training and education is objectively at the meeting-point between research, technological and organisational systems. Requirements on training of transport companies’ shift today from transport modes oriented education to more soft directions such as logistics, telematics, intermodality and others (see Figure 1).
In such conditions the objective of the education on logistic is to offer the customers the best possible service in the field of the transfer of knowledge in harmony with the trend in logistics programme development.
Within the frame of this vision the next step of the project and the model for future co-operation in transport training and education may be a network for transport training and education (NTTE).
The project IVETTA (Innovative Vocational Education and Training in Transport Area) is one of the steps toward this direction. The project completely meets the priorities of Leonardo da Vinci program and refers to the topical areas connected to innovative pedagogies, including e-learning in transport education. Relevance of the project for the objectives of Leonardo da Vinci programme is defined by the information of target groups involved in the sphere of transport education about positive experience, problems and new technologies of education as in the old and new EU countries.
The main activities of such future network co-operation may be:

• Identify centres of excellence in Europe and their type of competence,
• Define a common “knowledge data base” and how to distribute and maintain it,
• Define knowledge needs and gaps for training and education of transport in Europe,
• Good practices for training and education in transport,
• Demonstrate the effectiveness of the good practice guidelines by example,
• Create a competence centre for new partners in joining the network,
• Understand the existing experiences in the world, establishing exchanges as appropriate.

NTTE will expose the users to innovative training process and will allow for the implementation of a new type of relationship between training organizations, trainers and trainees. The main tasks of NTTE will be (Kabashkin I., 2005):

• To develop a new specialised training system based on knowledge and good-practices in the management of high-tech transport business and to disseminate it across the Europe through a multinational training network, seminars and learning materials.
• To develop, test and apply on-line training methodology for standard and personalised (self-training and tailor-made) courses based on a case studies database, identified needs, knowledge and experience of the partners, and constantly maintained feedback from the beneficiaries.

• To create an easy-to-learn virtual environment for continued professional development of entrepreneurs and managers of innovative and high-tech transport companies. It will be realised through setting up an e-Learning site and providing a set of on-line services - group standard or tailored-made open classrooms, on-line self-training sessions, group discussions, multimedia supported sessions, conference and chat sessions, frequently asked questions (FAQ), publications and bibliography database.

The results, expected to be worked out by the NTTE can be grouped as follows:

• Methodologies, models, guidelines, curricula.
• Products, software, and tools.
• Materials, workshops, seminars etc.

The process of design such network for vocational transport training must involves a tight relationship between education establishments as consultants and transport companies as customers in combining theory and practice, starting with analysis and evaluation of results and ending with achievement of expected results. The way we see how to achieve the education quality is an implementation of TQM principles (Kabashkin I., etc. 1998).

The overall work is expected to result in several major outcomes. With the help of the methodologies we will be able to successfully study the needs in each individual country. With the studied needs for training we will be able to participate in the training of the entrepreneurs from the target group (Kabashkin I., etc. 2004).

InLoC project creates better conditions for logistics operations in the Baltic Sea region by enhancing networking between logistics centres and their interest groups. The project is divided into 4 work packages, the objectives of which are to:

1. Improve the networking and operation of ports, logistics centres (LC) and other logistics operators,

2. Create conditions for the spatial integration of logistics operations, to analyse spatial and environmental consequences of logistics centre development and to remove bottlenecks in port-hinterland-logistics centre connections,

3. Enhance co-operation of logistics companies by improving the compatibility of different ICT-based networks, and

4. Educate and disseminate knowledge and potential of LC and logistics in general.

In the situation where a large increase in trade and freight transport volumes in the Baltic Sea region (BSR) is expected and in which the BSR is facing a major economic restructuring (EU enlargement), efforts to achieve more integrated and sustainable transport and communication links within the BSR are needed. One of these efforts is the development of logistics centres (LC) and their networking, which will continue to have an impact on improving communication links, spatial planning practices and approaches, logistics chain development and the promotion of sustainable transport modes. These factors will reflect on logistics processes both in major gateway cities and in remote BSR areas. InLoC will also promote the development of favourable preconditions for the improvement of logistics sector and help logistics centres and the actors related to logistics centres cope with the newest challenges in the field of LC development as well as promote sustainable transportation.

InLoC results include, for example, the creation of measures for transport networking and port modernisation, multimodal transport network strategies, integrated networks between ports, logistics centres and other operators, the better involvement of LC in spatial planning and knowledge of the land use needs of the LC, territorial impact assessments on selected transport corridors where logistics centres are located, the establishment of a common vision of the future spatial and environmental development along the transport corridors and LC-areas, the elimination of bottlenecks in port-hinterland-LC connections, the integration of telematics supported logistics networks based on identification and analysis of networks including a demonstrator showing telematics integration opportunities, the distribution of information of topical themes related to LC-development and sharing of ideas and practices especially between the EU-15 countries and the new EU-members, recommendations for the development of the supply of education based on the needs of LC and arrangements for establishing a Competence Centre for Logistics Centres in the BSR. The competence centre would be an information channel for all searching for LC information.

InLoC activities are divided into four work packages (WP):
WP 1. Integrating Networks between Ports, Logistics Centres and Other Operators.
WP 2. Spatial Planning Supporting the Development of Logistics Centres.
WP 3. Integration of ICT-based Logistics and Transport Networks.
WP 4: Educating Logistics Centres and the Public.

THE BALTIC TANGENT PROJECT
The Baltic Tangent project is funded within the frame of INTERREG III programmes. The vision of the Baltic Tangent is:
- to strengthen the Trans-European Transport Network (TEN-T) by creating an east-west economic corridor as a complement to north – south corridors under creation in Scandinavia, Baltic Countries and Russia and to the development of the Motorways of the Sea concept in the Baltic Sea.
- to enhance the preconditions for economic development in the “Baltic Tangent Regions” by focusing on which infrastructural initiatives best suited to enhance economic growth in the regions concerned, taking notice of the interconnecting TEN transport corridors.

The project work is directed towards analyses and suggestions about ways of improving local and regional access to national and trans-national transport networks and hubs and hereby strengthening the Trans-European Transport Network. Moreover the project views on developing the strengths of the Baltic Tangent cities and regions and on the fact that these together cover a territory with a population and growth potential of considerable size – to the benefit of the whole Baltic Sea Region development.

The project is address a wide range of issues concerning land and maritime transport infrastructure as means for economic growth and the proper functioning and expansion of labour markets. The project activities and proposals pay considerable attention to demands for benchmarking and establishment of best practise and procedures in integration transport in spatial planning and regional development.

The project should be viewed on the background of the recent TEN-T revision. Taking the already decided main TEN-T priorities as granted the project will be directed towards the improvement of this structure by adding improved trade access opportunities for industry in the regions concerned and – a shortest way transition link connecting the Atlantic Ocean with the Russian and the Far East markets.

The project is divided in four Work Packages with the following expected outcome:
- Spatial planning in the Baltic Tangent.
- New transport strategies in the Baltic Tangent
- Communication and Institution-building in the Baltic Tangent
- Dissemination and Training in the Baltic Tangent

FLEET - INNOVATIVE VOCATIONAL EDUCATION AND TRAINING IN TRANSPORT AREA
The project provides flexible learning for long distance lorry drivers across Europe. Starting Point of the project is that many long distance lorry drivers are employed by SMES that cannot easily release them for training. Lorry drivers are ambassadors
for their firms when abroad and so training is essential. Flexible learning is ideal for this group.

Project Activities are the following:

- Training needs analysis
- Training of trainers in producing flexible learning material
- Preparation of flexible learning materials
- Piloting of materials produced
- Translation of materials produced
- Production of multi-media language CD ROM
- Piloting of CD ROM
- Translation of CD ROM into languages of the partnership
- Training of trainers in evaluating the effectiveness of the training materials produced
- Evaluation of project activities.

Current status of the FLEET project may be defined by the following results.

Three training modules are developed in English, Dutch, Danish, Spanish and Latvian:

- Safety and Cargo (Dutch, English, Latvian)
- Customer Care (English, Spanish, Latvian)
- Intercultural Understanding (Danish, Latvian).

Multi-media language CD ROM in English, Danish, Dutch, Spanish and Latvian covering customer’s problems and training of trainers in production of flexible learning materials and evaluation.

The project has also resulted in the formation of a transnational network for training in the road haulage industry.

The FLEET project is funded by the Leonardo da Vinci programme.

CONCLUSIONS

We believe that the process of globalisation of study on transport logistics and telematics could lead the Baltic educational community to creation of regional virtual research and academic environment. For example, there is the opportunity for research development and education harmonisation on the transport and logistics in the Baltic Sea region within the frame of the “Northern Dimension” initiative. The successful economic development of the whole region requires progressive development of transport infrastructure and establishment of new connections with the pan-European transport network (Kabashkin I., etc., 2005). The future development of the region also requires telecommunication and information systems to be technologically compatible with modern business activity. And of course, this cooperation network must have the modern IT infrastructure (Misnevs B., etc., 2003)

REFERENCES


BIOGRAPHY

Igor Kabashkin is president, vice-rector, professor of Transport and Telecommunication Institute, member of the Technical Transport Committee of European Commission, Latvia. He is Professor (since 1991), president of Latvian Operations Research Society. He has published more than 350 books and papers and 67 patents. He is a member of the Technical Transport Committee of European Commission for Co-operation in the Fields of Scientific and Technical Research, member of Joint OECD/ECMT Transport Research Committee, member of the IEEE.

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ANALYSIS OF FIXED TO MOBILE TELECOMMUNICATIONS SUBSTITUTION PROCESS IN LATVIA

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KEYWORDS
Fixed to Mobile Telecommunications Substitution (FMS), Originating stage, Terminating stage, non-parametric regression, nested logit model, Generalised Method of Moments (GMM).

ABSTRACT
More than hundred years long reign of fixed telecommunications come to an end – mobiles had overthrown the leader. Mobiles after significant price reduction both in price and tariffs - overran the fixed telecommunications in Latvia.

The mobiles not only substitute the fixed traffic but as well are beginning to replace the subscribers of fixed services. In this article is shown the analysis of fixed and mobile services growth outcomes.

Evaluation of services substitution by means of an analytical model on fixed-mobile substitution in Latvia, based on the shares of various call types at origination and termination levels, and estimates the model empirically using yearly data during 1999-2003.

INTRODUCTION
Mobile phone take-up across the world was the phenomena of the last decade. Mobile telephony was a service that created substantial benefits for its users; however, it provided primarily a complementary service for fixed telephone for many years since the introduction of services in 1991 in Latvia.

Finally, in late 1990s, the mobile service gained strengths in price and quality, and since then, it has grown dramatically owing to prepaid solutions. In 2001, the number of mobile subscribers exceeded the number of fixed subscribers (Binde 2005).

The mobile services not only substitute the fixed traffic but also have begun to substitute subscription of fixed services (Davies 2005), (Wieland 2005). Detailed analysis of the effects of the growth of mobile services on fixed line services offers many policy implications for telecommunication competition (Omatseye 2005) and the outcome can be used as a primary data in predicting the development of the telecommunications market.

With this background, the paper analyses the fixed-mobile traffic substitution in the Latvia’s voice telephony market using yearly data from 1999 to 2003.

Research on fixed-to-mobile substitution (FMS) in voice telephony market started from analysis on demand for mobile services.

Gruber and Verboven find that in EU, mobile penetration rate is positively related with the level of competition in the mobile market and negatively related with fixed penetration ratio (Gruber et.al. 2005).

On the other hand, Gruber finds that in Eastern European countries, mobile penetration rate have positively related with the level of competition in the mobile market and positively related with fixed penetration ratio (Gruber 2005). However, only recently the research focusing on competitive aspects between fixed and mobile services has appeared to be rigorous.

Using EU telecommunications industry yearly data in period 1998-2002, Grzybowski shows that the decline of fixed subscribers was due to substitution into mobile and that mobile service is a substitute of the fixed line (Grzybowski 2005). In analysing the FMS phenomenon, it is quite crucial to clarify how to treat fixed-to-mobile calls and mobile-to-fixed calls which utilize the fixed and mobile networks at the same time.

Finally, both call types tend to substitute fixed-to-fixed calls, they both might be treated as substitutes to fixed-to-fixed calls.

At the same time, those call types can be considered as complements to fixed-to-fixed calls as they compete with...
mobile-to-mobile calls.

It is, therefore, several alternatives to determine the degree of FMS just by observing the traffic volumes of four call types.

This paper offers an alternative way of determination by distinguishing the FMS at the originating stage and the terminating stages.

The empirical model focuses on the change of the share of call minutes of each call type at the originating and terminating stages. At each stage, the share of call minutes has a meaning as a measure of FMS.

Accordingly, before we formalize the concrete analytical model, we have estimated the average share of call minutes of each type of calls in nonparametric method and made it possible to observe the overall trend of the change of the shares over time.

However, by analyzing the effects of determinants of the call demand only with these nonparametric estimators, a call demand model has been set up.

The model specified in this paper assumes that the call minute share of a call type at originating and terminating stages depends on the relative price and number of subscribers of fixed and mobile networks.

The functional form is assumed to be a logical function. The fact that we distinguish the decision at the call origination and call termination means that the model can be understood in the same context of a nested logit model, which is used in different models in econometrics.

In estimating the model, this paper specifies that fixed and mobile call demands, the subscription demand and the prices consist of a simultaneous equation system as Squire and Taylor have already pointed out.

In order to obtain efficient estimator from the simultaneous equation system consisting of endogenous variables, this paper adopts multiple equations GMM (Generalized Method of Moments).

DATA

For the econometric estimation and analysis, this paper uses monthly data of call minutes, prices, and fixed and mobile subscribers in Latvia during the period of 1999 to 2003.

We have categorized numerous types of call into one of fixed-to-fixed, fixed-to-mobile, mobile-to-fixed or mobile-to-mobile calls.

The call minute data include all call types of national calls, except dialup Internet access calls, international calls, and mobile Internet calls because those call types are not related with FMS for voice services.

At each time \( t \), four types of call traffic \( (Q_{FF}(t), Q_{FM}(t), Q_{MF}(t), Q_{MM}(t)) \) are measured in call minutes, where \( Q_{FM}(t) \) means fixed-to-mobile call minutes, etc. As has been already mentioned, \( Q_{FF}(t) \) includes both local and long-distance calls.

Figure 1 reflects trend of the total traffic volumes of local and long-distance (FF), fixed-to-mobile (FM), mobile-to-fixed (MF), and mobile-to-mobile (MM) calls.

From the figure, it is evident that total voice traffic increased annually by 31% on average for the past five years.

This can be interpreted as voice traffic being a normal good with positive income elasticity. However, it is deficient to confirm the network effect.

Even if mobile subscribers increased rapidly after second operator had began to provide mobile services in 1997, total traffic volume would not seem to have grown similarly.

This phenomenon can be interpreted in two ways. First, total voice traffic demand is rather fixed so that the growth of mobile subscribers leads to substitution of fixed call for the mobile one and thus, there is absence of...
network effect.

The other interpretation might be that even if network effect has taken place, nonetheless significant volume has been replaced by e-mail due to the fact that the number of Internet users increased dramatically during the same period of mobile expansion.

However, there are no strict criteria to sort out empirically those mixed effects due to lack of reliable data.

The number of subscribers of the fixed network \( N_F(t) \) and that of mobile network \( N_M(t) \) are important variables which determine the size of call demand.

Figure 2 shows that the number of fixed subscribers exhibit slow and steady decrease as the fixed service has reached its maturity, while the growth of mobile subscribers shows \( S \) growth curve as mobile service is relatively new (Yelland 2005).

Figure 2. Trend of the Number of Fixed and Mobile Subscribers in Latvia Years 1999-2003. Source: CSB reports (Transport and communications in 2003), mobile operators (LMT) data (Binde 2005).

Prices as well as number of subscribers are also very important variables that affect call demand directly. There are various pricing plans for each type of call depending on voice service provider.

Therefore, it takes complex processes to derive a single price index that captures the prices of all users, not an individual.

In this paper, we have divided each call type into pricing plans, contract types, and applied weighted average by call minutes.

However, in this paper connection fees are excluded. The price index of fixed-to-fixed calls is a weighted average of local and long-distance calls in which call minutes of each type are used as weights.

The nominal price indices are converted into real ones using CPI (consumer price index) deflator published by CSB (Transport and communications in 2003).

Derived price indices \( (P_{FF}(t), P_{FM}(t), P_{MM}(t), P_{MF}(t)) \) are shown in Figure 3.

All four indices exhibit declining trends, even though mobile and fixed-to-mobile prices have declined much more than fixed-to-fixed price.

Figure 3. Trends of Real Price Indices by Call Types in Latvia Years 1999-2003. Source: CSB reports (Transport and communications in 2003), mobile operators (LMT) data.

THE MODEL AND ESTIMATION

In voice telephony markets where all fixed and mobile networks are interconnected bilaterally, the four types of calls are either complements or substitutes.

Therefore, we need to clarify the concept of FMS by introducing the ‘call stages’. Here we divide the call stages into origination and termination, and then analyze FMS in each stage (see Figure 4).

<table>
<thead>
<tr>
<th>Origination Stage</th>
<th>Mobile</th>
<th>Fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Termination Stage</td>
<td>Mobile</td>
<td>Fixed</td>
</tr>
<tr>
<td></td>
<td>Fixed</td>
<td>Mobile</td>
</tr>
</tbody>
</table>

Figure 4. Call Types division by origination and
termination.

The first stage is considered as competition of fixed telephony (fixed-to-fixed and fixed-to-mobile) and mobile telephony (mobile-to-fixed and mobile-to-mobile) in call origination market. Fixed-to-mobile substitution at this stage can be explained by the tendency where fixed-originating calls are substituted into mobile-originating calls.

The share of fixed originating calls is given by:

\[ S_F(t) = \frac{Q_{FF}(t) + Q_{FM}(t)}{Q_T(t)} \]

It can be used as a measure of the degree of fixed-mobile substitution in the call origination stage.

Here, \( Q_T(t) \) is a total call minutes of all types of traffic. In other words,

\[ Q_F(t) = Q_{FF}(t) + Q_{FM}(t) + Q_{MF}(t) + Q_{MM}(t) \]

The second stage can be considered as competition of fixed telephony and mobile telephony in call termination market, given the originating means of handset.

For fixed originating calls, there is competition between fixed-to-fixed calls and fixed-to-mobile calls, and for mobile originating calls, there is competition between mobile-to-fixed calls and mobile-to-mobile calls.

Like in the first stage, the share of fixed-terminating calls in the fixed-originating calls can be used as a measure of the degree of fixed-mobile substitution in the call termination stage. In other words,

\[ S_{FF}(t) = \frac{Q_{FF}(t)}{Q_{FF}(t) + Q_{FM}(t)} \]

and

\[ S_{FM}(t) = \frac{Q_{MF}(t)}{Q_{MF}(t) + Q_{MM}(t)} \]

are the relative proportions of fixed termination calls, given the originating means are fixed and mobile, respectively.

This method of dividing the call decision procedure into two stages is specifically meaningful in the sense that it highlights characteristics of fixed-to-mobile calls and mobile-to-fixed calls. That is, it makes clear that fixed-to-mobile calls (mobile-to-fixed calls) complement (substitute) fixed calls in the call origination stage, but substitute (complement) fixed calls in the call termination stage.

Before we analyse the effect of prices and number of subscribers on competition among various call types in order to observe the average trends of three measures \( S(t) \equiv (S_F(t), S_{FF}(t), S_{FM}(t)) \) over time, we estimate \( E[s(t)|t]\) using of a simple nonparametric regression. The trend is summarized in Figure 5.

The reason for examining these nonparametric estimators is that it is relatively easier to see trends of three measures since variations of \( s(t) \) due to temporary disturbances are being removed.

Thus, \( E[s(t)|t]\) is a better measure than \( s(t) \) to evaluate the degree of FMS. Moreover, because of the fact that the nonparametric approach does not assume a specific form of probability distribution function, we can avoid model specification error. However, it carries a problem that this approach is not useful in predicting the future values and in analyzing policy effects. The parametric approach presented in the next section complements the shortcoming of the nonparametric approach.

From Figure 5, it is evident that all three measures namely \( (S_F(t), S_{FF}(t), S_{FM}(t)) \) have declined all the way from 1999 to 2003. It implies that FMS has occurred in both origination and termination stages during that period. Especially, it is notable that the FMS phenomena had been very rapid from 2000, and have been stabilized after late 2002.

It is interesting to observe that this trend is inversely related with the trend of growth of number of mobile subscribers (see Figure 2).

![Figure 5. Trends of FMS by stages in Latvia Year 1999-2003. Authors calculations based on CSB (Transport and communications in 2003), mobile operators (LMT) data.](image)
Underlying the division of call origination and termination in the analysis of FMS, it is implicitly assumed that the caller sequentially decides the calling handset and the called handset.

By other words, the assumption is that the caller first selects the handset with which caller wants to make a phone call between fixed phone and mobile phone, and that he decides whether calls to fixed or mobile phone of the called party, based on the selected call origination handset.

This assumption has been made in the same context of the nested logit model that is frequently used for multiple-choice models (Bierlaire 2005).

Based on these sets of assumptions explained, this paper sets up the model of shares of call minutes of each type of call and the effects of prices and the number of subscribers as described below.

\[
y_F(t) = \log \left( \frac{S_F(t)}{1 - S_F(t)} \right) = \alpha_F + \beta_F \pi_F(t) + \gamma^F \cdot N(t) + \epsilon_F(t) \quad (1)
\]

\[
y_{F|M}(t) = \log \left( \frac{S_{F|M}(t)}{1 - S_{F|M}(t)} \right) = \alpha_{F|M} + \gamma^F \cdot N(t) + \epsilon_{F|M}(t) \quad (3)
\]

Equation (1) estimates how fixed-originating calls (fixed-to-fixed and fixed-to-mobile calls) change over time as the relative price of fixed-originating calls and mobile-originating calls and the number of fixed and mobile subscribers change.

Equation (1) can be understood as a monotone transformation by Fisher-Pry method of the logit model on call minute shares \( S(t) \).

This specification is widely used in diffusion models (Yelland 2005). In other words, \( y_F(t) \) is merely the inverse function of the share,

\[
S_F(t) = \frac{\exp(y_F(t))}{1 + \exp(y_F(t))}
\]

The relative price \( \pi_F(t) \) is defined as

\[
\pi_F(t) = \frac{a_F \cdot P_{FF}(t) + (1 - a_F) \cdot P_{FM}(t)}{P_{MM}(t)}
\]

The weight \( a_F = Q_{FF}(t)/(Q_{FF}(t) + Q_{FM}(t)) \) is the share of fixed-to-fixed calls among fixed-originating calls and \((P_{FF}(t), P_{FM}(t), P_{MM}(t))\) are the previously defined price indices.

Figure 3 shows that the falling trend has been the most visible for \( P_{FM} \) and followed by \( P_{MM} \) and then by \( P_{FF} \). This means that the relative price \( P_{FF} \) compared to \( P_{MM} \) has been increasing, but the relative price of \( P_{FM} \) has been decreasing compared to \( P_{MM} \).

However, since the weight assigned to \( P_{FF} \), \( a_F \) is higher, \( \pi_F(t) \) shows increasing trend since it is affected more by the relative price of \( P_{FF} \) compared with \( P_{MM} \).

In circumstances in which fixed-originating calls and mobile-originating calls compete each other, we expect that \( \beta_F \), which is the parameter of \( \pi_F(t) \), will have a negative value. In addition, the number of fixed (mobile) subscribers is expected to have a positive (negative) effect on the share of fixed-originating call minutes.

Equations (2) and (3) estimate the shares of fixed-terminating calls under fixed origination and under mobile origination respectively, and the interpretation is analogous to Equation (1).

In Equation (2), \( \pi_{F|F} \) is the relative price of fixed-to-
fixed call price and fixed-to-mobile call price,

\[ \pi_{F/F}(t) \equiv \frac{P_{FF}(t)}{P_{FM}(t)} \]

Figure 3 shows that \( \pi_{F/F}(t) \) is constant. One pertinent point to be considered carefully to estimate Equations (1–3) is that the traffic, prices, and the number of subscribers consist of a simultaneous equation system.

It implies that the relative prices \( \pi(t) \equiv (\pi_F(t), \pi_{F/F}(t)) \) and the number of subscribers \( N(t) \) are endogenous variables of the model so that the error terms \( \varepsilon(t) \equiv (\varepsilon_F(t), \varepsilon_{F/F}(t), \varepsilon_{F/M}(t)) \) are not independent to each other.

Therefore, if we estimate each equation by simple ordinary least squares methods it will result in biased and inefficient estimators. In order to overcome this technical problem we introduce GDP \( I(t) \) and predetermined variables \( (\pi(t - 1), N(t - 1), I(t - 1)) \) as instrumental variables and estimate simultaneously Equations (1)–(3) using GMM (generalized method of moments).

In our analysis GMM is used as efficient estimator for a simultaneous equation system of endogenous variables.

Calculated results of Equation models (1)–(3) are summarized in Table 1.

Table 1. Calculated results of models (1).  

<table>
<thead>
<tr>
<th></th>
<th>Equation (1): Fixed origination</th>
<th>Equation (2): Termination on mobile given mobile origination</th>
<th>Equation (3): Termination on fixed given mobile origination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.642 (0.347)</td>
<td>0.152 (0.012)</td>
<td>-1.086 (0.031)</td>
</tr>
<tr>
<td>( \pi_F(t) )</td>
<td>-0.060 (0.555)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>( \pi_{F/F}(t) )</td>
<td>-</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>( \pi_{F/M}(t) )</td>
<td>-0.416 (0.325)</td>
<td>-0.005 (0.007)</td>
<td>-0.344 (0.018)</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.868</td>
<td>0.514</td>
<td>0.992</td>
</tr>
</tbody>
</table>

Note: The numbers in parentheses denote standard errors.

\[ y_F(t) = 0.642 - 0.06 \pi_F(t) - 0.416N(t) + \varepsilon_F(t) \]
\[ y_{F/F}(t) = 0.152 - 0.005N(t) + \varepsilon_{F/F}(t) \]
\[ y_{F/M}(t) = -0.086 - 0.344N(t) + \varepsilon_{F/M}(t) \]

Estimation results show that the relative prices \( \pi(t) \) and the number of fixed and mobile subscribers are all statistically significant, and signs are all consistent with the directions we have expected.

More the relative specifically, estimation results of equation (1) show that when price of fixed-origination call \( \pi_F(t) \equiv \frac{a_F \cdot P_{FF}(t)}{P_{MM}(t)} \)

increases (i.e. when the relative price of mobile origination call declines), the share of fixed origination call minutes decreases, implying that fixed origination call and mobile origination call are substitutes.

In Equation (2), the zero value of the estimated parameter on \( \pi_{F/F}(t) \equiv \frac{P_{FF}(t)}{P_{FM}(t)} \) implies that fixed-to-mobile call and fixed-to-fixed call are substitutes in the call termination market originating from fixed.

The result that we have larger magnitude of coefficients than in all three equations can be interpreted as indicative of the fact that multiple household members use the fixed line as the call origination means while one person generally uses the mobile phone.

The specification of Equations (1)–(3) assumes that the shares of call types can be explained sufficiently only with relative prices and the number of subscribers. Since it is possible that there may be other variables, we have added time trend variable \( t \) and estimated three equations in the same way as presented in Table 1. The calculated results are shown in Table 2.

Table 2. Calculated results of models (2).  

<table>
<thead>
<tr>
<th></th>
<th>Equation (1): Fixed origination</th>
<th>Equation (2): Termination on fixed given fixed origination</th>
<th>Equation (3): Termination on fixed given mobile origination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.348 (0.293)</td>
<td>0.186 (0.043)</td>
<td>-0.120 (0.127)</td>
</tr>
<tr>
<td>( \pi_F(t) )</td>
<td>-0.023 (0.351)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>( \pi_{F/F}(t) )</td>
<td>-</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>( \pi_{F/M}(t) )</td>
<td>-0.508 (0.365)</td>
<td>-0.067 (0.073)</td>
<td>-0.282 (0.219)</td>
</tr>
<tr>
<td>( t )</td>
<td>-0.549 (0.276)</td>
<td>0.023 (0.027)</td>
<td>-0.023 (0.080)</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.972</td>
<td>0.674</td>
<td>0.992</td>
</tr>
</tbody>
</table>

Note: The numbers in parentheses denotes standard errors.

Annual Proceedings of Vidzeme University College “ICTE in Regional Development”, 2005
Estimation results show that estimators of parameters of all explanatory variables are statistically significant.

In addition, the signs are all consistent with the directions as in Table 1, and the sizes of the parameters are of similar magnitude as in the previous results.

The fact that the estimator of parameter of time trend variable $t$ has a negative value is consistent with the fact that the shares of all three call types have been decreasing over time.

In summary, estimation results in Table 1 and Table 2 confirm that the future of FMS will depend on trends of $\pi(t)$ and $N(t)$ both.

Therefore, it is quite important to forecast prices and the number of fixed as well as that of mobile subscribers.

Based upon current situation in Latvia, there will be increasing pressure in the price of fixed-to-fixed calls due to the decrease of traffic from fixed-to-mobile call substitution.

On the contrary, the price of fixed-to-mobile call will decrease up to a certain level due to increase of competitive pressure in the retail market if effective competition is introduced via carrier pre-selection or other competitive measures.

The price of mobile originating calls will also continue to fall before the introduction of 3G services thanks to steady increase of mobile subscribers and minutes of use per subscribers.

However, the big price gap between mobile and fixed services does not seem to disappear in the foreseeable future.

First, the number of 2G mobile subscribers may decrease due to the introduction of 3G mobile service so that per unit cost of 2G mobile service may go up in the future. This will make the mobile voice services more expensive.

The price gap will give a telephone user incentive to maintain the fixed line to save expenditure for overall phone bill.

This trend makes us to predict that fixed-mobile substitution at the subscription level will not happen on a significant scale.

As the number of mobile subscribers has reached the maturity level, we may predict that fixed-mobile call substitution will not be as significant as it was in the past few years.

FMS possibilities have a few implications on the regulatory issues in telecommunications market.

Dominant market player may have a stronger urge to expand its business area into broadband data and mobile services.

It may challenge regulators because the fixed telephony market itself is not competitive at all, and market power in fixed market may transfer into data and mobile sectors while the fixed market is ever shrinking due to FMS.

CONCLUSION

This paper introduces an analytical model on FMS phenomenon in Latvia, based on the shares of various call types at origination and termination levels, and estimates the model empirically using yearly data during 1999-2003.

Our estimation result shows that the share of call minutes originating from fixed line (fixed-to-fixed and fixed-to-mobile calls) is negatively related with the relative price of calls originating from fixed phone calls originating from mobile phone, the number of mobile subscribers, but positively related with the number of fixed subscribers.

The competition model of fixed-originating calls (fixed-to-fixed and fixed-to-mobile calls) for terminating device shows similar result, i.e., the share of fixed-to-fixed call minutes is negatively related with the relative price of fixed-to-fixed calls and fixed-to-mobile calls, and the number of mobile subscribers, but positively related with the number of fixed subscribers.

The share of minutes of mobile-to-fixed calls is negatively related with the number of mobile subscribers, but positively related with the number of fixed subscribers.

From the two negative correlations found, we may
suggest that mobile service is a substitute for the fixed-line service in both caller and receiver networks in Latvia.

These empirical results of effects of relative prices and the number of subscribers on call substitution at origination and termination levels seem to be consistent with implications of the call demand theory.

This paper differs from previous studies on FMS in the sense that the model distinguishes between the call origination and call termination stages.

This paper also makes it evident that subscription, call demand and prices comprise a simultaneous equation system.

This endogenous problem is taken in the estimation process for estimating the unbiased and efficient estimators.

However, this paper does not analyze how prices and the number of subscribers affect the traffic volumes other than the share in the traffic.

REFERENCES


BIOGRAPHY

Juris Binde Chairman of the Management Board and CEO of the Latvia’s mobile telephone company Latvijas Mobilais Telefons since 1992. He had previously worked as the Director of the Technological Department of the VEF Scientific Research Institute in Riga. Graduated with degree Dipl. Ing. in radio electronics from the Riga Polytechnical Institute 1978 and has done post-graduate works in Germany, Sweden and the United States (Columbia University). He is the author of 31 scholarly publications and holds three patents. In 1993 he was awarded the Jānis Linters Award for his contributions in the development of Latvia’s telecommunications sector, and in 2001 he was awarded the Order of Three Stars, which is Latvia’s highest civilian honor. Vice president of the Latvian Information and Communication Technologies Association (LIKTA) and Chairman (Senior member) of the Latvian Telecommunications Club.
EVOLUTION OF NETWORK STRUCTURE FOR MOBILE OPERATORS

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KEYWORDS

Mobile solutions, mobile operators, GSM, GPRS transmission layer.

ABSTRACT

TODAY, many mobile operators are faced with the challenge of upgrading their infrastructure to support growth in new mobile services, whilst also trying to minimize costs in line with business objectives.

To address this challenge, operators are spending time to understand inefficiencies in their network designs, identifying areas that are not contributing value to their current or future business.

For many mobile operators, one area of inefficiency is the reliance on legacy layer 2 switching and transport infrastructure to support ATM and FR connectivity, required as part of the GSM / 3G - 3GPP standards.

This article focuses on this issue, and discusses the short and longer term advantages of a migration to an MPLS\(^1\) based design, both from GSM - GPRS operator perspective as well as new 3G WCDMA\(^2\) requirements.

IDENTIFICATION OF PROBLEMS IN LOGISTICS TRAINING

For many mobile GPRS operators, one area of inefficiency is in the transport of GPRS data traffic from many Base Station Controller (BSC) sites back to centralized Serving Gateway Support Nodes (SGSNs).

Controlling costs in this part of the network is increasingly challenging as more services are activated, and also as operators prepare their networks for EDGE. EDGE will also increase the bandwidth requirements, with data rates of up to 384 kbps.

Additionally, new GPRS based services such as MMS and introduction of Push-To-Talk will increase bandwidth requirements in the access network.

In the 3GPP standard design for GPRS, the Gb interface between the Packet Control Units (PCU) and SGSNs uses Frame Relay.

This is typically implemented using multiple E1 interfaces on both BSC/PCU and SGSN.

In many networks, there are multiple BSC / PCU sites, which aggregate into a small number of central sites where the GPRS Support Nodes are located.

In these networks, inter-exchange connectivity uses PDH and SDH transmission capacity, requiring numerous E1 channels to be nailed up.

Whilst this approach is well understood and proven in practice, it is also inefficient.

The key problems are the lack of statistical multiplexing on the data traffic, and high internal cost of using many E1 circuits delivered through traditional transmission equipment.

In addition, each incremental upgrade or new site may require ordering of additional circuits, leading to increased operational overheads and requiring longer planning cycles.

INVEST IN FRAME RELAY / ATM SWITCHES?

One option that mobile operators may consider is to concentrate Gb traffic using a traditional Frame Relay / ATM network.

Whilst providing statistical multiplexing, this approach increasingly has a number of drawbacks:

\(^1\) Multiprotocol Label Switching – IETF initiative that integrates Layer 2 information about network links into Layer 3 within a particular autonomous system – or ISP – in order to simplify and improve IP – packet exchange.

\(^2\) Short for wide-band CDMA (Code-Division Multiple Access), a 3G technology that increase data transmission rates in GSM system by using the CDMA air interface instead of TDMA.
• Limited flexibility in inter exchange and inter site connectivity; restricted to traditional PDH / SDH WAN interfaces only (for example, no Ethernet);

• Fixed ATM cell overhead can be inefficient in the case where FR circuits are inter-worked to ATM;

• No native IP / MPLS capabilities √ reduces investment protection and also means other IP traffic used by the mobile operator between those sites must use a separate network infrastructure (eg- OSS or billing traffic based on IP);

• Traditional FR / ATM switches now have a limited useful lifespan, as the amount of R&D development into these platforms continues to taper off.

AN OPTIMIZED EVOLUTION USING MPLS

A more effective alternative is to migrate to a modern MPLS solution to transport layer 2 FR circuits.

MPLS has successfully proven itself to not only handle IP services such as routing and L3 VPNs but also layer 2 transport, for a variety of services including Frame Relay, ATM and Ethernet.

Layer 2 transport over MPLS works by the efficient encapsulation of layer 2 frames within MPLS at the Provider Edge (PE) nodes.

The core technology itself has been standardised for some time, with Multivendor interoperability a reality today.

The MPLS solution takes advantage of modern routing platforms, capable of handling variety of both layer 3 and layer 2 services natively, with no performance degradation or additional hardware investment required.

Additionally these platforms have rich QoS mechanisms to ensure layer 2 service characteristics are maintained.

Advantages of an MPLS solution can be summarized as follows:

• Cost Savings - by consolidating layer 2 and layer 3 services, savings are made by significantly reducing duplicate investment in both TDM/FR/ATM switches and IP routers;

• The uplink from BSC sites can use any interface type supporting MPLS; including traditional WAN interfaces such as DS-3, STM-1 and STM-4 (both ATM cell and PoS packet variants) as well as Ethernet interfaces. For example, long haul GE over dark-fiber could be used to natively link sites up to 80km apart providing increased bandwidth at a substantially lower cost;

• Operational savings by running one multiservice infrastructure, operations can be streamlined, and also day-to-day dependencies on other groups for additional transmission capacity can be reduced;

• MPLS is likely to be already deployed as a key core data network technology, and already well understood and proven in other parts of the carrier;

• An MPLS solution built on a modern routing platform is in alignment with technology evolution to 3G, with IP centric designs standardised by the 3GPP. This provides investment protection and future proofing over many years.

INVESTMENT PROTECTION LAYER 2 REQUIREMENTS IN THE 3G NETWORK

In the initial 3G WCDMA phases with 3GPP Release 99 and Release 4, the Iu ps interface for data services between the 3G Radio Network Controller (RNC) and the SGSN uses ATM AAL5:

The IP/MPLS network platforms supporting GPRS FR transport between BSC/PCU and SGSN can be used to transport 3G Iu ps user and signaling traffic, using identical layer 2 MPLS network technology, saving costs.

In addition to the data interfaces, voice services are also implemented over ATM, using AAL2 traffic class.

The same ATM over MPLS technology can be used to transport these voice services as well.

Far from being just a theoretical design, a number of new 3G deployments are indeed using this technique with an MPLS infrastructure, rather than having to build out new or expand existing ATM networks to support new 3G voice, video and data services.
THE END GAME 3G EVOLUTION TO PURE IP

Whilst all the initial 3G deployments based on 3GPP Release 99 and Release 4 standards will use ATM connectivity either delivered on ATM or MPLS infrastructure, from Release 5 onwards, mobile operators have the option of moving to native IP protocols in their mobile networks.

One of the key enhancements in Release 5 is the introduction of the IP transport option in the UTRAN.

Whilst in Release 99 and 4, ATM connections are used at the transport layer, Release 5 offers the possibility to use native IP as the interface in the Iub, Iur, IU-Ps and Iu-Cs interfaces.

Ie is used for all traffic, including data, voice and signalling.

This enables use of a simplified network design built around IP and using common routing platforms, which can simultaneously handle layer 2 services with MPLS.

The IP UTRAN solution also enables flexible use of different link technologies, ranging from traditional TDM interfaces such as E1 and nx64k through to packet oriented interfaces such as FE / GE if Metro Ethernet access is available between sites.

This is also relevant given the other major enhancement in Release 5, being the introduction of the IP Multimedia Subsystem, allowing native VoIP / IP multimedia support directly from the client terminal.

CONCLUSIONS

In summary, mobile operators can lower ongoing costs and better accommodate future requirements by consolidating layer 2 traffic over an MPLS based solution.

This also prepares mobile operators effectively for a future evolution to native IP in the mobile network.

This approach also mirrors the trend in the core of many large wireline operators, who are looking to cap investment in core ATM switches and consolidate on a converged multiservice MPLS backbone.

Far from being a demonstration technology, layer 2 MPLS services have been successfully deployed in large production networks.

For example, leading carriers such as Korea Telecom, Verizon and MCI are benefiting from the advantages of deploying layer 2 services on Juniper routing platforms proving the maturity of this technology.

REFERENCES


BIOGRAPHY

Alexey Jurenoks is a master of science in computer science (MSCS). Now he is a PhD student at RTU Division of Applied Systems Software. He is a researcher in wireless technologies, mobile learning, and web technologies. He is an author of four educational books and many instructional materials for teaching different courses in the computer science field. Now is participating in IST 6FP project eLOGMAR-M (Web-based and Mobile Solutions for Collaborative Work Environment with Logistics and Maritime Applications).
REMOTE CONTROL
USING THE GSM STANDARD COMMUNICATION NETWORK

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KEYWORDS
Remote control, GSM.

ABSTRACT
To control some device remotely, it is necessary to establish a communication channel, which is used to transmit the control statements and receive the acknowledgment messages. Such communication channel may have to fulfill additional requirements – if the transmitter or/and the receiver of this information is moving (or in some other cases), there appears a need for wireless communications. To make this control system widely usable and independent from specific radio communication systems, there is a possibility to use the GSM standard communication network, which is traditionally used for the voice transmission.

REMOTE CONTROL
The main rule of remote control could be shortly described as “Every request should have a response” and is shown in the Figure 1.

![Figure 1. Remote control schematic diagram.](image)

The same rule could be explained as following:

\[ Y = f(X, Z, S) \]

where \( X \) – input command, \( Y \) – performed action, \( Z \) – answer to the actions initiator and \( S \) – additional external information (for example, from several sensors).

IDENTIFICATION OF PROBLEMS
IN REMOTE CONTROL
The communication channel for the remote control of some device could be formed as physical connection to this device, using electrical or optical cable and appropriate data transmission protocol. This method is useful, when the distance to according device is comparatively small. There exists a possibility to make the data transmission network for the control of a number of such devices, taking in account the maximal number of the devices in one segment of the network, limited by the data transmission protocol. Accordingly, this method is useful for control of the device (-s), placed in comparatively small geographical area. Costs of data transmission network development increase based on the distance to device.

If the communication channel is formed as special purpose radio channel with fixed or periodic changed frequency, control of the device will be possible in any place of the broadcasting coverage area. Accordingly, costs of the data transmission networks development is less dependent from the number of the devices and their placement. This method is useful for the control of moving device (-s). Weak points of this method are special purpose broadcasting equipment, which is not widespread and is comparatively expensive, and charge for frequency usage license. In addition, the broadcasting coverage area is directly proportional to power of used equipment, which is limited.
The use of the general-purpose communication channel gives an opportunity to effective remote control, because the accessibility of communication channel is nearly unlimited – in both the place of control centre and the place of controlled device, and the costs for use of the communication channel are fixed and comparatively small. In fact, there is not a fixed control centre, because the control centre device is a typical mobile phone, which can be placed in any point of the broadcasting coverage area. The costs of the equipment are comparatively small, because general-purpose products are used. Hence this method is perspective for remote control solutions.

**STATISTICAL ASPECTS OF GSM**

According to available data (CellularOnline 2000) (GSM Association 2004) there were 553 GSM networks in 187 countries in April 2004. Statistics about the period 1992…2003 are presented in Table 1.

<table>
<thead>
<tr>
<th>Year</th>
<th>Countries</th>
<th>Networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>1993</td>
<td>19</td>
<td>34</td>
</tr>
<tr>
<td>1994</td>
<td>41</td>
<td>65</td>
</tr>
<tr>
<td>1995</td>
<td>67</td>
<td>113</td>
</tr>
<tr>
<td>1996</td>
<td>97</td>
<td>189</td>
</tr>
<tr>
<td>1997</td>
<td>105</td>
<td>233</td>
</tr>
<tr>
<td>1998</td>
<td>119</td>
<td>285</td>
</tr>
<tr>
<td>1999</td>
<td>132</td>
<td>325</td>
</tr>
<tr>
<td>2000</td>
<td>147</td>
<td>384</td>
</tr>
<tr>
<td>2001</td>
<td>162</td>
<td>442</td>
</tr>
<tr>
<td>2002</td>
<td>174</td>
<td>495</td>
</tr>
<tr>
<td>2003</td>
<td>185</td>
<td>541</td>
</tr>
</tbody>
</table>

The number of GSM network subscribers in December 2004 was 1.27 billion or about ¾ of all cellular subscribers worldwide (Table 2). More as 99% of world’s population lives in GSM network broadcasting coverage area.

<table>
<thead>
<tr>
<th>Standard</th>
<th>GSM</th>
<th>UMTS/WCDMA</th>
<th>TDMA</th>
<th>PDC</th>
<th>CDMA</th>
<th>iDEN</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>1.27 B</td>
<td>16.63 M</td>
<td>94.24 M</td>
<td>57.86 M</td>
<td>237.91 M</td>
<td>20.05 M</td>
<td>10.08 M</td>
</tr>
<tr>
<td>Percents</td>
<td>74.47</td>
<td>0.97</td>
<td>5.51</td>
<td>3.38</td>
<td>13.91</td>
<td>1.17</td>
<td>0.59</td>
</tr>
</tbody>
</table>

The growth in number of GSM subscribers in period from December 2003 to December 2004 was about 250 million with 86 million of them in the 4th quarter 2004 (3G Americas 2005).

**REMOTE CONTROL OVER SMS SERVICE OF GSM NETWORK**

According to statistical data in the previous chapter, the GSM standard network is very convenient as general-purpose communication channel. In this way, SMS (Short Message Service) of GSM standard network is functionally convenient to transmit the control commands.

SMS ensures transmitting of up to 160 symbols long text messages, which could be considered as enough for industrial control solutions. As a device for control command transmission, a mobile phone with SMS support or PC with connected GSM modem and appropriate software can be used. In both cases, access to GSM network and authorization in the controlled device is provided by SIM card.

The module of the controlled device, which is responsible for the receiving of control commands and their processing, consists of the GSM modem with SIM card and the controller. The later executes control commands and sends a response to the control centre about either success or failure. Depending on the controller’s software and attached hardware, other information might be included in the response as well. The GSM modem and the controller are connected using RS232 or other standard interface, which is important for the use of the equipment from several manufacturers.

Figure 2 shows general-purpose remote control and commutation system, developed according to the technology explained above. The goal of this project was the development of a mobile general-purpose remote control system, which would be competitive with existing commercial systems and eliminate their disadvantages. The system provides remote control, using mobile phone and GSM standard communication channel as well as local control, using operator interface (LCD + keyboard).
The remote control system contains following objects:
- control unit;
- temperature sensor;
- photo sensors (internal and external);
- voltage sensors (#1, #2 and #3);
- 110/220VAC power source;
- switched circuits (#1, #2 and #3);
- remote user;
- local user.

**Link #1**
It connects the 110/220VAC power source and the control unit. The 110/220VAC power source provides the control unit and the switched circuits with necessary electricity.

**Link #2**
It connects the remote user and the control unit. The system provides a possibility to define up to 6 different remote users, each of them can be identified by the SIM card number (mobile phone number). The remote user transmits control commands to the control unit by SMS messages. In a similar way, the control unit transmits to the remote user information about the command execution, light and temperature.

**Link #3**
It connects the local user and the control unit. The system provides a possibility to define up to 6 different remote users, each of them can be identified by the PIN code, which is entered from the local keyboard. The local user transmits control commands to the control unit by local keyboard. The control unit transmits to the local user information about the command execution, light and temperature, using local display.

**Link #4**
It connects the control unit and the switched circuit #1, as well the voltage sensor #1 and the control unit. The circuit is switched, following the commands, transmitted by the remote users and the local users, as well as by the algorithm, implemented in the software, which is taking in account appropriate sensor readouts. The voltage sensor provides control of power in the switched circuit. The information is transmitted as logical states 0 and 1.

**Link #5**
It connects the control unit and the switched circuit #2, as well the voltage sensor #2 and the control unit. Functionality of the link is identical to link #4.
Link #6
It connects the control unit and the switched circuit #3, as well the voltage sensor #3 and the control unit. Functionality of the link is identical to link #4.

Link #7
It connects the photo sensors and the control unit. The photo sensors provide control of the light. The information is transmitted as logical states 0 and 1.

Link #8
It connects the temperature sensor and the control unit. The temperature sensor provides control of the temperature. The information is transmitted as change of voltage in the range 0-1VDC.

Main modes of the system:
- Switching on of one or more circuits
- Switching off of one or more circuits
- Checking of systems controlled parameters (voltage, light, temperature)

Structure of remote user SMS:
Fiat lux! Switch: _ Delay: _____ minutes
Aufer te hinc! Switch: _ Delay: _____ minutes

Figure 3. Example of remote user SMS.

Structure of control unit SMS:
Switch #_is ON! Power:___
Switch #_is OFF! Power:___
Switch #_ ON impossible, because________________
Switch #_ OFF impossible, because________________

Figure 4. Example of control unit SMS.

TECHNICAL SOLUTION

The general-purpose remote control and commutation system (Figure 5) is developed using widespread electronic components.

The microcontroller Unitronics M90-19-B1A (Unitronics 2004)
- inputs – 10 digital / 1 analog
- outputs – 6 digital
- length of software – 1024 words

The GSM modem Siemens M20 Terminal (Siemens AG 2001)
- network standard - GSM900
- power – 2W
- transmission of data - 2,4 / 4,8 / 9,6 / 14,4 kbps

The contactors General Electric MC1C310ATD (GE Power Controls 2005)
- switched voltage – 600VAC/250VDC
- switched power – AC3 4kW
- control – 24VDC

The circuit breakers General Electric Gxx(x)Cxx (GE Power Controls 2001)
- switched current – AC/DC
- switched voltage – 12...415V
- breaking current – 6/10/16/20A

The microcontroller’s software was developed using the development tool U90 Ladder Version 3.9.2 (Unitronics 2003), which contains several editors:
- Ladder (Figure 6);
- Display;
- Variable.

The software development process includes creation of the Ladder diagrams and translation of these diagrams to STL (statement list) code.

COMPARISON WITH ADJACENT SYSTEMS

During the study of the literature an investigation regarding technological solutions used in the commercial remote control and communication systems and their pricing was performed.

The following technological comparisons are based on products, manufactured by SIKOM.
Selection of products was based on conformity to the following parameters:

- usage in 110/220VAC power networks;
- general-purpose product.

Selected products were GSM Micro (Sikom AS 2003), GSM Maxi (Sikom AS 2002) and GSM Fixi (Sikom AS 2004).

The developed remote control and commutation system has several advantages, compared with existing commercial systems:

- Light control;
- High resolution timer;
- Possibility of custom software development;
- Mobile device;
- Proportionally smaller price of control unit.

One of the most common switched circuit (device) types is the illumination devices, wherewith the information about light level after control command execution is very important. The developed remote control and commutation system takes a direct measurement of the light level using the photo sensor. This method is more suitable than a measurement of the voltage in the appropriate circuit, because a failure of the illumination device can be detected even in case, when this device is damaged, but the circuit breaker of the appropriate circuit did not break.
The above-described commercial remote control and commutation systems have timers with the step of 1 hour. This scale is not suitable for the high precision circuit control. The developed remote control and commutation system gives a possibility to have timers with the step of 1 minute. As a result, the maximal time of the timer decreases from 99 hours to 45.5 hours, which is considered an acceptable tradeoff for the achieved scale improvement.

The developed remote control and commutation system uses an algorithm implemented in the software of the microcontroller. The later is a widespread general-purpose product with software development tools available. Accordingly, there is a possibility not only to configure the system - the microcontroller software can be changed and improved, according to the needs of end user of the system and without the assistance of the manufacturer.

One of the goals of this development was mobile system. The case of control unit is fitted with handle for comfortable transportation. Standard input and output sockets are suitable for connection to existing electrical network and devices without using of special connectors or adapters.

The developed control unit is more beneficial, compared with above-described model Sikom GSM Fixi in standard modification (2 outputs).

Table 3. Comparison with adjacent systems

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sikom GSM Micro</th>
<th>Sikom GSM Maxi</th>
<th>Sikom GSM Fixi</th>
<th>Developed system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated GSM modem</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Local control</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Temperature control (°C)</td>
<td>-29...49</td>
<td>-29...41</td>
<td>-29...41</td>
<td>0...100</td>
</tr>
<tr>
<td>Light control</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Timer</td>
<td>1...99 h</td>
<td>1...99 h</td>
<td>1...99 h</td>
<td>0...2730 min</td>
</tr>
<tr>
<td>Count of circuits</td>
<td>1</td>
<td>1</td>
<td>2(5)</td>
<td>3</td>
</tr>
<tr>
<td>Switched current (A)</td>
<td>16</td>
<td>10</td>
<td>16</td>
<td>6/10/16</td>
</tr>
<tr>
<td>Mobile device</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Dimensions (mm)</td>
<td>50x115x50</td>
<td>145x85x38</td>
<td>72x90x58</td>
<td>305x410x150</td>
</tr>
</tbody>
</table>

CONCLUSIONS

The use of GSM communication channel for remote control is convenient, compared to the use of the special purpose radio channel or industrial data transmission network. Even if the evolution of mobile communications technology continues, and there comes new communication standards (GPRS, MMS), author expects, that use of low costs general-purpose communication channel will still be actual. It is expected, that the offered product will receive wide prevalence because it is functionally enough and provides high efficiency.

ACKNOWLEDGEMENT

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REFERENCES


BIOGRAPHY

Artis Mednis graduated from IT Department of Vidzeme University College in 2005. His research fields include industrial remote control and automation.
Logistics, in its widest sense, is an extremely rapidly developing field of knowledge and practical applications. This development proceeds in different directions: on one hand the development of new concepts, strategies, organizational solutions; and on the other hand the development of new technical applications (most of them based on latest information and communication technologies). Furthermore, logisticians operate in a dynamically changing environment of global economies linked by international and intercontinental supply chains and new opportunities brought by e-commerce.

These developments are accompanied by a major paradigm shift in logistics. To cope with logistics networks of increasing complexity the traditionally dominating system-oriented view on logistics problems is being more and more replaced by a strong focussing on logistics processes and operations (see Arnold 2002). This leads to a new way of logistics problem solving being based upon the design of needed transformations of logistics objects at first and adding technical equipment – the logistics system – in a second step. Consequently, logisticians do not need to think in terms of systems only anymore, but instead they must be able to understand, design and run processes for controlling and managing logistics in an integrative, holistic way.

With regard to improving logistics process control and management in this complex scenario, information and communication technologies (ICT) can be seen as the key drivers again. There is a variety of multi-level architectures available for designing and structuring respective control and management systems covering all levels from the operational one (process level) to the very strategic administrative one. The well-structured design, functional specification and implementation of those control and management components and systems are crucial for efficient and effective logistics processes. Latest technological improvements like transponder technology and RFID ensure a consistent flow of data across all levels and enable direct interaction with the logistics objects as well as purposeful influencing of logistics systems and their components. To understand these complex cause-effect chains, to structure problems and decision processes, to specify control algorithms and control systems as well as to analyse processes and identify chances for their improvements well trained persons are required.

These ongoing developments and challenges demand constant updating of professional knowledge and skills by all who want to or need to understand the logistics context from the technological, economic, environmental, administrative or social points of view.

Education and training in logistics need to involve the learning of both declarative knowledge, about logistics, and also procedural knowledge of how to formulate, analyze and solve logistics problems (see Table 1). This declarative and procedural knowledge may be learned through theoretical study, supplemented by practical work involving dynamic models supported by real applications. The student should be provided with the means of learning the requisite knowledge in an active
manner, since an adequate understanding of the important concepts and methods can be grasped only through the aid of processes involving experimentation.

**Table 1: Objectives of Logistics Education**

<table>
<thead>
<tr>
<th>OBJECTIVES OF LOGISTICS LEARNING</th>
<th>To learn ABOUT logistics</th>
<th>To learn HOW TO DO logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- how to interpret its real worlds</td>
<td>- by determining assessment criteria</td>
</tr>
<tr>
<td></td>
<td>- how to understand its multiple layers</td>
<td>- by identifying problems</td>
</tr>
<tr>
<td></td>
<td>- what to see behind its complexity</td>
<td>- by solving planning problems</td>
</tr>
<tr>
<td></td>
<td>- how it operates dynamically</td>
<td>- by solving management problems</td>
</tr>
</tbody>
</table>

THE PHYSICAL LAB – PRACTICAL EXPERIENCE IN LOGISTICS PROCESS CONTROL

Taking into consideration the demand for experiencing consequences of logistics process design in practice, the University of Magdeburg developed, implemented and runs a lab enabling physical experiments to control logistics processes. Amongst others the lab contains the physical model of exemplary materials flow technology forming the complex node of a logistics system (see Figure 1). For automatic controlling it is equipped with a variety of sensors such as light barriers or metallic detectors and linked to a PC-based control system. Despite of the simple design of the node, it can be used to represent a wide variety of materials flow scenarios requiring decisions about

- the entry of objects to the central area with respect to its current occupation or sequence of goods,
- the movement of objects to pass the node by, for example, separating a flow into single objects,
- the final destination of an object as defined by the overall process.

The challenge to the students consists in designing control algorithms to solve a given logistics problem, implementing them using decision table techniques and validating their solution by demonstration.

![Figure 1. Materials flow technology of the physical lab.](image)

With this the lab session aims at providing students with a basic understanding of materials flow automation and control concepts. The main focus is put on the operational control level which is closest to the process to be influenced. On the basis of sensor signals process information need to be derived and used for deciding about on-the-spot activities necessary to influence system functionality in a way enabling object flows as desired. Decision tables are used as modelling method for control algorithms as developed my the students after they had run a detailed analysis of system functionality required as well as identified, structured and specified decision situations appearing. To implement the control algorithm special application software interpreting decision tables was created (see Figure 2).

![Figure 2. Application software to control the physical model by creating and interpreting decision tables.](image)

This way, any need for low level programming with the students was avoided to better address the particular needs of the target groups and learning goals. The target group is mainly built by logistics students whose expertise is expected to be designing logistics processes and applying ICT for logistics process control instead of implementing software for automatic process control. Engineering students mainly focus on the technical aspects of how the logistics task is physically implemented. In the end they should understand how materials flow technology has to be combined with identification and control technology to enable automated materials flows inside logistics processes. The third target group is formed by computing students who work together with the further end-users of their programming efforts and are expected to learn from this what are special requirements of materials flow automation and how process control needs to fit into a hierarchical process management and control system.

The organisational structure and scheduling of the lab session is closely linked to the respective class on managing and controlling logistics processes. This class is mainly lecture-based with the lab session forming the
practical part to apply theoretical knowledge as explained in the lectures. To introduce the lab, the physical model, the application of decision tables and the assignment to the students a special 90 minutes presentation is given. Here, also general hints on how to deal with the given problem and find a proper solution are delivered. Special attention is paid on how to work with memory to store sensor information for repeated or later use and on how to avoid process deadlocks resulting from an insufficient control algorithm. To illustrate and demonstrate this in an attractive and understandable way a series of overhead transparencies was produced showing the software’s way of working with the decision tables and an object’s behaviour resulting from this (see Figure 3).

The introductory lecture is followed by individual problem solving in groups of 2-3 students each. Before getting access to the physical model all groups had to pass an entry test on theoretical aspects, but also on their conceptual solution and control algorithm. Groups, which did not pass the test, had to prepare themselves again and return for another trial. After successfully passing the entry test, the groups worked with the control software and model implementing and testing their solution “in reality”. Usually many problems and even misconceptions did not appear until these first practical experiences. In this case the groups had to re-think their approach and control algorithm and – due to the limited time of one lab session of 90 minutes – to return to the lab for another session. Resulting from this the total amount of time spent with each of the groups sums up to 270-360 minutes plus the additional 90 minutes for the introduction. Seeing the average number of participants in the class which was growing from 10-15 to about 30 over the past years, the lab sessions have to be considered to be much too time-consuming to the one tutor running them.

Despite of the very good responses by the students on what they finally had learned in the lab, further problems had to be recognized such as

- limited lab capacity compared to the large number of students who have to pass the lab sessions,
- often quite poorly prepared students who do require lots of on-the-spot explanation by the tutor and who therefore need to spend extended time in the lab, or
- missing understanding with the students of how low level process control works.

To overcome this and increase the effectiveness and efficiency of the lab sessions on one hand, but also to improve learning processes with the students, the idea of supporting the physical lab by technology-based material for preparation arose. Latest progress in ICT for learning and especially growing experience in introducing this into traditional classroom-based courses were strong promoters of this idea.

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**Figure 3.** Sequence of pictures to illustrate relationship between control algorithm and physical flow.
ICT – CHANCE FOR CHANGES IN LOGISTICS LEARNING

In the same way as logistics systems, processes and services operate in an increasingly more European framework, logistics education and training need to change their contents taking international aspects and globalization into consideration and move from almost ‘conventional’ to networked environments. Even initial logistics education processes at vocational and higher education levels must be a part of these dynamic changes to enable their graduates to meet employers’ needs and perform at the market. So, logistics learning is required to be flexible with respect to

- learners (in the widest sense) and their individual targets, motivations to learn, specific requirements and constraints,
- varying educational needs resulting from the learner’s targets, motivations, requirements and constraints, like e.g. scope and level of knowledge, particular skills etc., and
- appropriate educational resources developed and used in form of modules and courses fulfilling the educational needs and helping the learner to reach the required, established goal.

Problems in acquiring logistics knowledge mainly consist in reducing real processes to the essentials, recognizing fundamental structures and processes, understanding parallel processes, including those in which conflicts occur, and understanding cause-effect relationships (see Ziets and Neumann 1997). For these reasons, logistics learning needs to be supported by:

(i) graphical and pictorial representations (e.g. graphics, animations, photographs, videos),
(ii) “real live experience” (e.g. from industrial visits, case studies),
(iii) individual and collaborative project work (e.g. on model building, decision making, planning – incl. presentation of results), and
(iv) laboratory training (e.g. for simulation, controlling, management).

The main objective of education and training in logistics must not consist in simply receiving knowledge, but gaining competence to apply knowledge and experience to new situations and problems. Here, multimedia applications as well as ICT like the Internet and mobile networks open up new possibilities for supporting logistics education and training in Europe. Pre-conditions are virtual learning environments that really focus on the support of learning instead of presenting information and questioning knowledge only. To design environments of such kind that help to achieve the required and intended improvement of well-chosen knowledge, abilities and skills and with this to reach the individual targets of the learning process in shorter time and better quality that is the challenge e-learning has to face if it shall successfully be introduced into education and training in wider scale.

The pedagogical frame needs to be seen in the constructivist approach of problem-based learning. Here, the student faces a specific problem to be solved that is the starting point to initiate an individualized, self-organized, highly motivated learning process. It is such kind of learning that was expected to nearly automatically become possible within virtual learning environments, especially because many sophisticated computer games already entertain their users in this way. But, integration of problem-based learning approaches into e-learning at the level computer games already have reached has not been realized yet. Instead, there is a set of difficulties, which needs to be taken into consideration:

(i) It is not an easy task to plan individualized learning for many and diverse types of learners.
(ii) To provide the right level of challenge at all stages of the learning processes and to keep students’ motivation high, this requires a sophisticated scenario and if anyhow possible a non-academic problem or case.
(iii) Students’ progress in learning is difficult to be assessed and evaluated by a non-human teacher.

Learning processes initiated on such basis usually show a high level of (ongoing) motivation with the learner. To transfer these excellent pre-conditions into learning success, long-lasting effects and best benefit with respect to all three elements of competence – knowledge, abilities and skills – that is the challenge a successful and attractive learning environment has to face, no matter if it is a real or a virtual one. LogEduGate, the problem-based e-learning environment for logistics, forms the basis for defining, implementing and testing innovative learning scenarios such as problem-based learning, communities of practice, situated learning etc. within a particular field of knowledge and competence.

LOGEDUGATE – E- LEARNING ENVIRONMENT FOR LOGISTICS

LogEduGate (www.logedugate.de) is a new kind of a logistics e-learning environment that is tailor-made to the specific needs of this complicated, complex, interdisciplinary field of knowledge. The Logistics Education Gate is a web-based learning, information and communication platform enabling to support wide-scale and multimedia education and training in logistics in both modes, face-to-face and distance learning. For this it interlinks a large number of knowledge units covering different aspects of logistics from engineering and business points of view at the same time and especially provides functionality to strengthen competencies in problem solving, decision making, organizing, designing etc.
THE HYBRID LAB – E-LEARNING TO IMPROVE THE LAB EXPERIENCE

To overcome the problems as they were experienced with the physical lab sessions and to increase effectiveness, efficiency and success of the lab sessions a series of e-learning modules were created and embedded into a particular course in LogEduGate (see Figure 5). The course covers all aspects relevant for administration of the lab session, such as registration for the lab, handing out assignments, forwarding organisational information, guidelines and rules, and delivers three e-learning modules to support student preparation for the lab sessions.

The first e-learning module contains detailed information on the lab describing the lab infrastructure and functionality (see Figure 6), explaining the tasks to be solved as well as illustrating how to create and use decision tables for describing and controlling logistics processes. It is designed as a combined information and project module not providing any particular learning path, but enabling the student to catch all information needed to run the lab session. More specific background information and knowledge that in principal is expected to be available with the student already is provided in separate learning modules. For further information and refreshing, extending or deepening knowledge on decision tables, their principle structure, understanding and design a particular learning module is offered which includes not just the knowledge and explanations, but also little exercises and quizzes to apply knowledge and test learning progress. This module can be accessed either directly from the course overview (see Figure 5) or via respective hyperlinks from the lab module. The third module is another e-learning module providing even more background knowledge on bi-logic algebra the understanding of which is necessary for being able to work with decision tables. Due to the fact that this field of knowledge is nothing special to logistics it is normally reachable from the decision table module via respective hyperlinks. This way the three modules form a kind of a hierarchical access to knowledge with the lab module as standard access point and a two level cascade of modules for further access to relevant background knowledge.
Figure 5. E-learning course for preparing for the lab session on logistics process control.

Figure 6. Interactive graphics for explaining components of the physical model.
Through introducing e-learning into the class to support student preparation for the lab session, a tremendous change in the organisational structure and scheduling of the lab sessions became possible. It is just a 15 minutes meeting where general information on the lab session and procedure are given. After that the students are encouraged to work in LogEduGate to properly prepare themselves for the entry test and lab. Because of the extended use of animations in the modules it is not necessary to explain particular situations in decision table interpretation face-to-face by use of the set of overhead transparencies as before. In case of any questions the lab’s discussion board offered by LogEduGate might be used for asynchronous communication with the tutor or even with other students from the same or another group.

So, the hybrid approach to the lab session showed the potential for improvements that can result from the introduction of e-learning into traditional classroom-based learning. Pre-condition for this is attractive learning material really adding value to face-to-face delivery of knowledge and an appropriate hybrid learning scenario. Nevertheless, there are still problems in students’ perceptions and therefore ongoing needs for improving the support provided in the preparation phase. One of the biggest challenges with the students consists in understanding what parallel events do mean and how the control algorithm and software works with them. For getting a better idea on this, a mechanical model has been built and introduced for on-the-spot discussions between students and tutor. In contrast to the already available animations showing predefined scenes only, the students can and have to take care of interpretation of signals, coming to decisions, storing information and influencing the process themselves without any technical support. This way they get a clearer picture on what happens inside the computer and how the control algorithm works (or even does not work). The tremendous effects resulting from this “manual automatism” clearly underlined the strong need for keeping physical experiences despite of all e-learning progress. Nevertheless, there is the idea of transferring some of these latest experiences into the e-learning world as well by developing virtual lab which should offer another opportunity for even better preparing for the real lab sessions.

**THE VIRTUAL LAB – VISION OF A NEW KIND OF LOGISTICS LEARNING**

The idea of introducing a virtual lab aims at providing a more interactive opportunity for self-testing own solutions to a given problem outside the real lab. It is not the goal to replace the real lab session by a virtual one, but to offer improved possibilities for a student-computer dialogue including the providing of more personalised feedback and hints. The way how such a virtual lab might become possible is already demonstrated by computer games. Despite of all efforts undertaken, Jonassen (2001) is still right when describing today’s e-learning environments as mainly being information delivery systems. Instead technology needs to be used for creating learning-by-doing and perceptual environments for problem-based learning, where you are immersed in making rapid-fire decisions, rushing to gain new information, utilizing the expertise of colleagues, and relying on your ability to create and store useful knowledge that will allow you to innovate and get your products or services to market way before your competitor. To enable this, he points on gaming-like environments where objects are interoperable and where tools from any domain can interact.
A first step towards a virtual lab was described by Weber et al. (2004). Here, a pharmaceutical lab was created enabling students to build an experiment step-by-step by selecting the right equipment, using the right ingredients, carrying out the right activities in the right sequence. At each step specific decisions are to be taken which form the basis for the next step in the process. At the end there is not just verbal feedback provided, but the outcomes of the student’s specific experiment is directly shown using a photograph.

The vision of the virtual lab for logistics process control goes ahead with this idea. The decision tree principle as explained above will be used for student’s problem solving. The effects resulting from the control algorithms as proposed by the students are planned to be visualised by respective video sequences. This way the student directly sees whether or not his or her control algorithm worked and produced the objects flow as intended. Pre-condition for this is a pool of video clips more or less covering any possible process which could result from the student’s particular control algorithm. The videos need to be stored in a database and characterised by a set of relevant information reflecting the student’s step-by-step decision process. How the database needs to be structured and in which way a most flexible association of student’s input and resulting process appearance can be created this is subject of ongoing research. But the vision of providing virtual lab sessions to better prepare for the real ones as described above seems to be worth these additional efforts.

CONCLUSIONS

Logistics process control is a challenging field of competence for logistics. It is necessary to understand technology of different kinds and the way it works together to achieve the intended target process. To create and practice such competence, practical experiments are not replaceable. But as discussed in the paper, it not necessarily has to be a real lab session only that provides the practical experience. Instead, a combination of attractive, interactive e-learning modules and even a virtual lab session with the real lab experience has been shown as being more effective, efficient and successful than the physical lab session only. This way, ICT is not just a driver of technological progress in logistics, but also provides significant support in logistics education and training to the benefit of both, the students and the tutor or trainer.

REFERENCES


BIOGRAPHY

Gabby Neumann received a Diploma in Materials Handling Technology from the Otto-von-Guericke University of Technology in Magdeburg and a Ph.D. in Logistics from the University of Magdeburg. Since 2003 she has been Junior Professor in Logistics Knowledge Management there. She co-ordinates the European logistics educators network for providing new technologies for logistics education inside the European Logistics Association (ELA-LogNet).

Arnhild Gerecke graduated from Dresden University of Technology. She was working in industry before she joined the University of Magdeburg, where she is responsible for a variety of labs in the field of logistics today. She plans, prepares and runs lab sessions with students and trainees, takes care of web design for presentation and administration purposes and is involved in respective research projects.
DEVELOPMENT OF ACTIVE TRAINING AND EDUCATIONAL METHODS IN LOGISTICS

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KEYWORDS
Logistics, information systems, training, case study, simulation games, simulation-supported training

ABSTRACT
The paper deals with description of integrated exploitation of simulation, case-studies and business games-based technologies for teaching logistics management, referring to the best practices at leading world-wide logistics companies, using the latest developments in logistics management and taking into account specifics of Latvian economic situation.

INTRODUCTION
Despite the comparatively high education levels among Latvian employess, there is still a lack of knowledge and practical skills crucial for competitiveness in market based economy. In order to ensure relevance of the qualifications and adaptability in the fast changing environment, training and re-training have a special importance. In today environment, companies need people who are flexible, team workers, good communicators and learners. Effective training is a key in delivering this type of workforce. In this context, regions are more suffered from a low level of training both in higher and continuous education. Recent developments in information technology and telecommunications call for a serious reconsideration of the actual training methods and provide a wide opportunities for developing a new educational methodology.

RESEARCH AND EDUCATION ACTIVITIES
Department of Modelling and Simulation (DMS) of Riga Technical University was founded in October, 1993 at the RTU Faculty of Computer Science and Information Technology on the basis of wide experiences in both education and research in the area of modelling and simulation of complex systems, already accumulated at the faculty by that time. The department is a basic unit for the Latvian Simulation Society. Among the international events, about six international conferences were held on the basis of the department during the period 1996-2005. The Latvian Center of the SCSI McLeod Institute of Simulation Sciences (MISS) operates on the basis of the department.

The main directions of DMS research activities are related to application of discrete-event simulation in different industries, mainly manufacturing and logistics, as well as simulation-based training.

In the context of education activities, the department teaches various courses in modelling and simulation, including domain-oriented courses, concerning application of modelling and simulation in different areas (e.g., transport, logistics, economics). Master- and Engineer-level Curriculum "Industrial Logistics Management" is launched at the department in 1998. It is arranged within the TEMPUS project "Industrial Logistics Management" of the European Training Foundation, with the University of Ghent (Belgium) and the University of Karlsruhe (Germany) as Western European project partners.

Figure 1. Courses and tools.
ACTIVE TRAINING AND EDUCATIONAL METHODS

Active training and educational methods like case studies, educational games, computer-based simulation games are widely used at the DMS for teaching logistics simulation and management. All courses are supported by modern software (see Figure 1) that has several advantages in both practical and pedagogical aspects.

The main accent in development of both training and educational methods is put on using simulation techniques in developing new teaching material such as simulation-based case studies, simulation games, etc (Pecherska and Merkuryeva, 2004). The application of simulation tools for teaching through seminars allows students to understand potential impact of various decisions on the supply chain network performance as various market conditions change.

![Diagram of simulation models](image)

Figure 2. Active educational methods.

**Simulation-based case studies**

The use of case studies holds great promise as a pedagogical technique for teaching science, because it humanizes science and well illustrates scientific methodology and values. It develops students' skills in group learning, speaking, and critical thinking.

A case book “Cases in Industrial Logistics Management” was published in 1999 with the aim to support teaching for the above mentioned curricula. This book collects more than 15 case studies proved to be educationally very useful because of integration main pedagogical issues at the same time (Muller et.al., 1999).

Going forward in improving of quality of teaching, several new cases were developed at this moment. Illustratively, a simulation-based case study “Supply Chain Network Analysis: Comparison of Alternative Scenarios” is aimed to introduce students to the logistics analysis of a company case with making the right type of recommendations to improve the performance of a company’s supply chain (Burska et.al., 2004). The case study is divided into several stages, so an instructor has the ability to decide about the amount of teaching material he wants to use depending on time available. The following materials were developed: Instructor Material, Student Material, Power Point Presentation, SimFlex Model, and Solution. The instructor material is aimed to help the instructor in specifying objectives of the case and the way to teach it. The following issues are considered in this document: target groups, objectives, plot of the case, model structure, guidelines for teaching the case. The student material is developed as handouts to be distributed to students. It guides them through the case, as well as provides templates to be used while performing tasks. The Power Point Presentation provides slides as the main visual aid for teaching the case. Finally, the simulation model represents the situation students are working in.

**Educational Games**

Educational games have a great potential as they usually are designed to teach people about a certain subject (Pecherska and Merkuryeva, 2004). The application sphere of educational games practically is unlimited.

The wide range of application has so called business simulation games that belong to educational games type. They may be defined as a simplified mathematical abstraction of a situation related to a business world.

Traditionally at DMS this teaching approach is widely used. As an example, Log_Dis Supply Chain game (Pecherska and Merkuryeva, 2004) could be mentioned. It was developed to introduce the concepts of system dynamics in supply chain. Log_Dis is a typical educational board game without a computer or any additional equipment.

**Computer-Based Simulation Games**

Simulation games provide an experiential learning process where knowledge is created by the transformation of experience. A computer simulation game may be interpreted as a sequential decision-making experience with a reality, which is simulated and animated on a computer. Trainees can see the impact of their decisions have upon the problem situation and future events and can react to these effects and make new decisions (Merkuryeva, 2000).

Business simulation games as a part of simulation games provides an opportunity for participants to practice, develop and to perfect their management skills. The most practised by simulation games are: analysis and diagnosis, decision-making, problem solving, handling ambiguity, handling uncertainty, critical thinking, managing dynamics, team working, business presentation.
The International Logistics Management Game (shortly, ILMG) has to be mentioned as a perfect example. This game is a computer simulation and Internet-based business simulation game covering different business areas such as marketing and distribution, production and purchasing, locations and inventories - that is, about logistics and what it means for the company’s success (Merkuryeva et al. 2004).

One of the most important features of this game that differs it from others is its orientation to the Internet. It provides possibility of distance learning. Internet is a communication channel between educator and trainees. Game is accessible anywhere, whether participants are located, – next door or on the other side of the globe (see Figure 3).

![Figure 3. Structure of the ILMG.](image)

The other important feature of this game is possibility of making scenarios that can simulate different markets under different economical circumstances. It means that game could be about Baltic region or Latvia as well. It provides a great opportunity for trainers to try to operate in environment familiar for them.

**Simulation-Based Case-Games**

Simulation-based case-games have features of both a case and educational simulation-based game (Pecherska and Merkuryeva 2004):

- A detailed and rather complicated situation description;
- A number of rules to be kept;
- An underlying simulation model that substitutes a real system;
- A spirit of competition, etc.

In particular, each game period could be designed on the case method.

As an example of simulation-based case-game played at the DMS the Fish Bank game can be mentioned. During the game, players receive information about the situation on previous year catch, fish sales, bank balance and fleet. Based on this information, players make their decisions for the next year: fleet enlargement or reduction, ship allocation among fishing areas. The goal of each team is to obtain the maximum possible assets at the end of the game.

After a ten-year period, the results are calculated and charted and the final discussion takes place. During the discussion, the winner’s strategy, optimal individual and group strategy, population and assets dynamics are analyzed. The discussion emphasizes the group strategy and helps participants to get a deeper insight into a sustainable management of renewable resources.

**SIMULATION-SUPPORTED TRAINING METHODOLOGY**

To improve the efficiency of education and training, the Department of Modelling and Simulation of Riga Technical University is now working on development of a simulation-supported training methodology. It is aimed to support both academic and post-graduated, post experienced training.

The main objective of this methodology is development and practical implementation of simulation-supported training in the area of logistics management, based on use of cases-studies and business games, in order to promote professional knowledge and skills in the logistics sector in Latvia. Following are the main expected results:

- Training methodology that will integrate simulation, case-studies and business games-based approaches to teaching logistics management;
- Implementation of the above-mentioned methodology by development of education tools to train in solving typical logistics management problems;
- Internet-based access to developed education tools.

Besides development of the above-mentioned methodology, analysis of advantages of web-based learning is performed. If learning efficiency is expressed like

\[
Learning = \frac{Revenue - Costs}{Time}
\]

it could be increased by decreasing either time or costs (or both of them), that now is available owing to explosion of ICT. New training and educational methods like e-learning, m-training and any web-based learning become more and more popular, also in Latvia. Web-based learning and teaching (in association with simulation-based methodology) have a great potential for the distance education. Since new web technologies are very applicable to e-learning, we would like to use them...
to make the e-learning environment more effective and useful.

**M-training**

During 2000-2002, a training course in Logistics Information Systems aimed to improve ICTE skills among students and employees of logistics companies was worked out within the framework of the Leonardo da Vinci project LOGIS LV-PP-138.003 “Long-distance tutorial network in “Logistics Information Systems” based on WEB technologies” (Merkuryev and Ginters, 2001).

Currently the department is involved into a new project LOGIS MOBILE “Competence Framework for Mobile On-site Accelerated Vocational Training in Logistics Information Systems”, that is aimed at further development of results achieved within the LOGIS project. It is aimed at designing, testing and disseminating a new m-training methodology combining a concise training dictionary in Logistics Information Systems and the latest mobile telecommunication technologies based on GPRS/GSM/UMTS mobile Internet WAP/WML applications. The novelty of the project, especially essential for the regions, is in using of mobile telecommunications in learning and training in the area of logistics information systems, combining them with m-training and e-learning methodologies. Geographically unlimited access to lifelong m-training and consulting, using only a mobile phone, provide wide opportunities for all trainees like students, logistics professionals, trainers, managers, etc.

The basic result of the project will be a concise m-training dictionary in Logistics Information Systems (first in English, French, German, and Spanish, hereafter also in Latvian), which will involve a concise version of the newest material in logistics informatics. Concision and preciseness will be achieved by a special method when project partners weight submitted keywords in order to find essentials with the highest value. Trainees will be able to check their knowledge by answering specific questions attached to each of terms.

A structure of the dictionary is currently under discussion. It is proposed to divide all terms into categories by an application area; thereto a term can be referable to more than one category from which the main one will be defined. Definition of a term could differ in some categories, but not always. The main category of the term is indicated firstly, and then all the rest. For the moment, 17 main categories, which capture all essential tracks in Logistics Information Systems, are proposed (illustratively, transport in general, maritime, railway, air, road and pipeline transport modes, inland navigation, customs, information exchange & security, software, hardware, insurance, modelling & simulation, e-application, business processes, inventory & warehouse, legislation).

**Blackboard**

To facilitate educational process and make it more efficient and interactive, as well as for distance learning purposes, such systems as Blackboard and WebCT could be efficiently used. These systems provide different means for educator and students that allow performing day-to-day operations in a much more efficient way, for instance

- publishing announcements for students;
- providing lectures materials and handouts;
- giving assignments for practical work and making tests.

In this case students can access all necessary materials and information from anywhere at any time where Internet is available. Also it is possible for students to stay in a permanent contact with their educator that is important when personal communication is impossible (for instance in the case of distance learning).

![Figure 4. Sample Blackboard screen.](image)

The Blackboard Learning System™ is an industry–leading software application used to power virtual learning environments, supplement classroom education and as a platform for distance learning study programmes. Featuring a robust core set of capabilities that enable instructors to efficiently manage courses, author content, create assignments, and foster collaboration, among other key functions, the Blackboard Learning System helps institutions to accomplish mission-critical objectives related to instruction, communication and assessment (www.blackboard.com).

The RTU Department of Modelling and Simulation successfully uses the Blackboard system (see Figure 4), supported by the university Distance Education Study
Centre, in the educational process. Currently the following courses are supported in this way:

- Systems Simulation Tools
- Introduction to Modelling and Simulation
- Introduction to Logistics
- Management Dynamic Synthesis Games
- Systems Simulation

CONCLUSIONS

Recent developments in the information technologies and telecommunications facilitate development of new training and educational methods and tools, like described above, making them available for wider scope of concerned persons. This provides possibilities for organizing educational processes not only in the traditional way, but also by means of distance learning, exploring e-learning and m-training approaches. This is of special importance for vocational training, when trainees have to combine their studies with conventional work. Also, this opens new horizons for regional development, providing people with wide education possibilities within their residence and working areas.

The paper discusses experiences of combing modern didactical approaches and technological achievements for teaching Logistics Management in general, and Logistics Information Systems in particular, at the Department of Modelling and Simulation of Riga Technical University. Future developments of the discussed approaches are planned in the following main directions:

- Further development of simulation-supported training methodology, combining simulation with case-studies and business games, and widening accessibility of developed education tools through the Internet;
- Further development of the m-training methodology, providing access to education sources through conventional business tools, like a mobile phone and pocket PC.

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REFERENCES


www.blackboard.com - Official Blackboard System Web Site

BIOGRAPHY

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COLLABORATIVE E-LEARNING AND MODEL-BASED TRAINING METHODOLOGY IN LOGISTICS INFORMATION SYSTEMS

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KEYWORDS
Training methodology, Education tools, Collaborative e-Learning, artificial intelligence, logistics information systems.

ABSTRACT
Different aspects of comparative analysis of solutions for collaborative e-learning are considered. Graph models and methods of artificial intelligence for creating a training methodology in logistics information systems are presented in the paper.

The work is a part of activities carried out under LOGIS MOBILE project within the frameworks of the EC Leonardo da Vinci Programme.

INTRODUCTION
Education in logistics is realised in many different ways, for example, within series of lectures, in workshops with case studies and problems discussions, and in exercises as well as individual study papers and examinations. In addition to these classical teaching methods, students can also use computer-based teaching methods and training systems for their self-studies in some fields of logistics knowledge, like operational research, mathematics, or simulation (Ziens and Neumann, 1997).

The basic version of a training methodology for development of the LOGIS courseware incorporates the following main steps (Novitsky et. al., 2001):
- Development of a structure of a curriculum and its presentation in the form of an oriented graph model;
- Selecting a type of a computer-based teaching programme;
- Collecting teaching information;
- Controlling a sequence of teaching information;
- Knowledge estimation of a trainee (“student”, “user”).

SOLUTIONS FOR COLLABORATIVE e-LEARNING
Learning experiences advocate “blended” (Singh, 2001) combinations of both traditional and technology-based learning methods. At the simplest level, a blended leaning combines offline and online forms of learning where the online learning usually means “over the Internet or Intranet”. It is called as e-learning. Other dimension of blending comes from the relationships between learners. On one hand is self-paced or on-demand learning that is managed or controlled by the learner. On the other hand is collaborative learning that implies a dynamic communication among many learners and brings sharing of knowledge. Online collaborative learning could be implemented only on the base of appropriate hardware and software platform. This section is about software tools and Application Service Providers (ASP) for collaborative e-learning.

Groupware is software-based solution that helps people work together collectively while located remotely from each other. One of numerous Groupware services is electronic meetings, where each participant is able to see and display information to others. Communicating or “conferencing” over the Internet is called e-conferencing. Solutions for e-conferencing differ on target usage (audio conferencing, video conferencing, collaborative conferencing, web conferencing, web casting etc.) and therefore on particular set of provided facilities.

Voice (audio) conferencing is spontaneous or scheduled interactive, real-time communication that does not require visual or data sharing. Video conferencing is scheduled communication with interactive, real-time visual and/or data exchange among compatible systems.

Web-casting (streaming) media is one-to-many, non-interactive audio and/or video communication conducted in real time or near real time via the Internet. Collaborative conferencing refers to simultaneous viewing and modification of a shared document or computer application. Also it is called as document...
conferencing. Web conferencing combines all mentioned above together. It is spontaneous or scheduled communication and collaboration incorporating visual support and shared documents. Web conferencing offers such visual tools as shared whiteboards and annotation, ability to manage collaboration using chat and polling, ability to display and share PC application files and co-browsing of web sites. There are three basic formats offered by web conferencing - presentation (often called as E-conference also), collaboration (often called as E-symposium) and E-meeting.

Another consideration regarding e-learning tools is the type of required communication. Asynchronous technology does not support simultaneous communication. It is used in web-casting for archived presentation and in a self paced course. Synchronous communication occurs simultaneously between participants with instant access to information and an opportunity for feedback. Synchronous e-learning allows managing training session and adjusted it immediately if needed. Real collaborative e-learning could be realized on the base of synchronous communication tools only.

Regarding (ConferGuide, 2003) there are more than 50 worldwide accepted e-conference software and service providers (vendors). The first step of evaluation process is to screen a number of vendors on the base of collaborative e-learning requirements. These requirements include, but not limited to:

- **Presentation Sharing** when participants could see a presentation using a standard Web browser;
- **Voice (audio) conferencing** – presenter’s sound broadcasting;
- **Document Sharing** when participants could jointly view any document or graphic with multilevel zooming and annotation capabilities;
- **White boarding** - using "snapshot" tools that enable to capture portions of information, place them on the electronic whiteboard and mark up it similar to a traditional wall-mounted board;
- **Application Sharing** - ability to demonstrate to participant any software application;
- **Immediate Feedbacks** from participants allowing to adopt presentation’s speed, volume level etc.;

Online Polling/voting of participants before, during and after the event.

There are three basic alternatives from which to choose Collaboration Management Solution (CMS) - to build own, to purchase a packaged software application or to leverage a hosted CMS. Many of industry experts (ConferGuide, 2003; Kemmeter, 2002) consider hosting as the most profitable solutions, especially for new users and small or middle-size enterprises. However using of servers placed far enough (e.g. abroad) from presenter and participants will increase running cost significantly, decrease quality of communication and make therefore the advantage of solution not so obvious. Ability or disability to host event on participant’s native language have to be considered also. All mention above give the reason to evaluate alternatives taking into account particular domestic features.

The main focus of evaluation is on technical solutions and provided services. Most vendors list the same set of features and functionality. The real difference between solutions is in terms of their quality, reliability and usability. Regarding e-conferencing there are three basic roles with appropriate rights and responsibilities - *Presenter* (or Teacher), *Attendee* (or Learner), *Moderator* (or Host). Moderator is the support person facilitating the event. Moderator can be the person leading the event; however it is usually most productive if Moderator is a person other than the primary Presenter. Despite of researches (Communiqué Conferencing, 2002, De Rossi, 2003) with comparative analysis of provided solutions, additional testing of each of the features (as Attendee, Presenter and Moderator) under particular conditions would add a value to industry.

Technical evaluation first of all refers to security and reliability. Does the solution provide confidentiality (SSL encryption to protect sensitive data etc.), authorization (password etc.), and the ability to lock and unlock the session? Does the solution work with existing firewalls (tunnelling through multiple Internet ports if a primary port is blocked etc.)? Does the solution support multiple operating platforms (which versions?) including Microsoft Windows, Linux, Solaris? How convenient are Setup/Installation procedures? Does virus protection implemented? Is it possible for Attendee to check technical ability to join a meeting beforehand? Reliability refers to system requirements and performance – how the solution works with narrow bandwidth to Attendees, how stable is virtual connection (speed of loosed physical connection recovery), quality of streaming audio etc.

Evaluation of provided services refers to functionality and easiness of it usage. All services are considered in terms of three sequential stages of event – before, during, and after the event.

First set of features include tools for presentation creation and facility for managing of pre-event activities – meeting facility reservation, audience acquisition, event scheduling, registration, reminders, etc. Good solutions implement participants online registration, e-mail confirmation with a direct hyperlink to click and automatically start a meeting, integration with calendaring and messaging products, provision of users accounts with ability to view a list of scheduled meetings, modify, start (attend) on cancel (refuse) undesirable.

Next set of features refers to activities during the event. They enable Presenter to manage presentation process and attendees. Presentation Management tools include facilities for showing a presentation and points of interest in a presentation or document - some equivalent of laser beam, a highlighter with a set of different colours, annotation, zooming in or out etc. Event Recording enables digital recording of all interaction in a meeting.
Video Integration enables to use a simple desktop video camera for video conferencing. Attendees Management tools enable Presenter to see Attendees list, collect information from Attendees by polling/voting and handle received information in real time – save (anonymous or individually), tabulate, represent as graphics, incorporated into the presentation, share to Attendees. Presenter could “give a microphone” to particular Attendee, change Attendees privileges according to their current contribution allowing them all, some or no privileges. Browser Sharing allows Attendees to see the same Internet-based information as Presenter by direct internet streamline to their PCs. Desktop Sharing allows Presenters to share anything on their PC system, including any application or file. Desktop (or Application) Control Sharing permits another participant to take temporary control of a Presenter’s desktop. Annotation allows each participant to make comments and changes directly to document or presentation during a session. File Transfer allows users conveniently upload and download files. Text Chat is intended for sending messages to individuals or all participants and receiving chats. Presenter or Moderator could distribute Attendees to Different “Meeting rooms” and remove all or some of them from a meeting if necessary.

Management tools on Attendees (Client) side enable them to see and hear a presentation, see the number of current slide (and all the slides also), answer on polling/voting questions, provide immediate Feedback (laugh, applause, agree, disagree, confirm understanding, point confusing, ask to present slower or faster etc.), rise a hand for question, chat with Presenter, Moderator or other participants, enlarge/reduce presentation, step out and return to the meeting, change video settings (compression, rate). Some of solutions provide voice conferencing only by phone line while good solutions enable both voice streaming as cost-effective and teleconference for higher sound quality. When audio and web conferencing systems are not integrated it is necessary to hold duplicate, parallel conferences (one audio, one Web) with separate interfaces, scheduling methods, and service providers. There are two basic methods to join teleconference - automated passcode audio (system assigned or custom) and Operator assistance.

Next set of features refers to post-event activities. Record and Playback enables Presenter or Moderator to edit digital recording (“cut” a noise, inappropriate questions etc.) for future download and playback. Archive management enables participants to search recordings to review visited events or to see and listen a missed training class. Part of vendors use standard media file formats while other use proprietary formats and own players.

**MODEL-BASED TRAINING METHODOLOGY**

A general structure of a courseware is presented in Figure 1.

The structure reflects a model of a curriculum presented as an oriented graph \( G_k(D_k, U_k) \) and a corresponding square binary matrix \( B_k = \{ b_{ij}^k \} \):

- \( D_k \) – set of topics included into a curriculum,
- \( U_k \) – graph arcs corresponding to relations between topics,
- \( b_{ij}^k = \begin{cases} R, & \text{if topic } i \text{ is related to topic } j; \\ 0, & \text{otherwise}; \end{cases} \)
- \( R = \{1,2,3\}; \)
- \( R = 1, \) if relation between topic \( i \) and topic \( j \) is “weak”;

![Figure 1. Structure of a courseware.](image-url)
R = 2, if relation between topic i and topic j is “mid”;
R = 3, if relation between topic i and topic j is “strong”.

For example, when a student begins to study topic 4 (“Macroprocess Diagrams”), he has to have already good knowledge on topic 3 (“Process Diagrams”), general understanding of topic 2 (“Communication Diagrams”), and must be introduced to topic 1 (“Introduction to GRAPES-86”).

Each of a curriculum topic is realised by a separate CATP. The software module CATP management (Figure 1) provides the necessary sequence of topics taught by using matrix model.

An oriented graph model presents a teaching dialogue on the selected topic by means of a corresponding CATP. Graph nodes are quanta of the teaching information. Graph model arcs correspond to transfers from one node to another.

A fragment of the graph model is presented in Figure 2.

A task estimation of knowledge and skills of LOGIS courseware users is formulated as a pattern recognition task. Two methods based on a piece-linear approximation and marks calculation can be used to solve this task. The basic version of the LOGIS courseware incorporates an algorithm that uses a piece-linear approximation.

Therefore, in comparison with other approaches the proposed training methodology is based on the set of mathematical methods, that allows formalising learning process and estimation of knowledge skills.

**INTELLIGENT TUTORING SYSTEMS**

In addition to the set of mathematical models, methods of artificial intelligence (AI) can be used to reach different level of computer-based training. Intelligent Tutoring Systems (ITS) offer considerable flexibility in presentation of material and a greater ability to respond to idiosyncratic student needs. These systems achieve their “intelligence” by representing pedagogical decisions about how to teach as well as information about the learner. This allows for greater versatility by altering the system’s interactions with the student. ITS is a system that provides individualized tutoring or instruction. Each ITS must have these three components:

- knowledge of the domain (the topic or curriculum being taught);
- knowledge of the learner (the student or the user of the ITS);
- knowledge of teacher strategies (the methods of instruction and how the material shall be presented).

A student learns from an ITS by solving problems. The system selects a problem and compares its solution with
that of the student and then it performs a diagnosis based on the differences. After giving feedback, the system reassesses and updates the student skills model and the entire cycle is repeated. As the system is assessing what the student knows, it is also considering what the student needs to know, which part of the curriculum is to be taught next, and how to present the material. It then selects the problems accordingly. Figure 3 shows the architecture of a ITS with its components and the way the components interact with each other (Thomas E.). Methodologies of Artificial Intelligence (AI) and Expert Systems (ES) can be used as a theoretical platform of ITS. For example, some ITS systems capture subject matter expertise in rules. That enables the tutoring system to generate problems on the fly, combine and apply rules to solve the problems, assess each learner's understanding by comparing the software's reasoning with theirs, and demonstrate the software's solutions to the participant's. Though this approach yields a powerful tutoring system, developing an expert system that provides comprehensive coverage of the subject material is difficult and expensive.

A common alternative to embedding expert rules is to supply much of the knowledge needed to support training scenarios in the scenario definition. For example, procedural task tutoring systems enable the course developer to create templates that specify an allowable sequence of correct actions. This method avoids encoding the ability to solve all possible problems in an expert system. Instead, it requires only the ability to specify how the learner should respond in a scenario. Which technique is appropriate depends on the nature of the domain and the complexity of the underlying knowledge.

CONCLUSIONS

- Results of comparative analysis of solutions for collaborative e-learning are considered.
- The basic version of training methodology in Logistics Information Systems, which is based on the set of mathematical models, is described.
- General approach for creating of ITS is presented.
- Presented methodologies can be used as formal basis in m-training and m-consulting.

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REFERENCES


Thomas, E. Intelligent Tutoring Systems (ITS), http://coe.sdsu.edu/eet/Articles/tutoringsystem/start.htm

BIOGRAPHY

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WEB BASED MODELLING AND SIMULATION OF LOGISTICS IN AIRCRAFT INDUSTRY INTEGRATING ACTORS COUPLED ON GEOGRAPHICAL DISTANCE

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KEYWORDS

Supply chain management, federation of interacting simulators, on-line control of integrated actors, HLA.

ABSTRACT

Complex products, like civil aircraft, characterized by long throughput time, high number of workstations and great value of the work in progress, many suppliers, elevated quality targets and mandatory delivery dates can get significant advantage from a tool simulating the assembly process.

At the same time outsourcing is more and more essential, and so is a good on-line control of internal and external events that influence each other.

Today web technologies and advanced architectures for simulation can be joined to create new sophisticated tools able to manage an environment in which the main contractor’s production line and its supply chain must be considered as a whole for optimization and control purposes.

The way is to create stochastic simulation models of each critical provider and to integrate the supply chain by mean of a federation of simulators and scheduling systems exchanging data through the web.

This was the starting concept for WILD (Web Integrated Logistic Designer), a project designed by DIP University of Genoa and carried on involving seven University Departments and seven Industrial Companies (main and sub-contractors), that were coupled basing on geographical distance.

DIP University of Genoa built the federation of interacting simulators, co-ordinated the academic community, performed the simulation runs.

Piaggio Aero Industries provided the P180 aircraft as test case, selected and co-ordinated the sub-contractors, verified and validated the results of the model from the industrial point of view.

This presentation will show the industrial aspect, with both the successful results and the difficulties faced, as well as the new targets expected to be reached with the implementation of the model of the assembly line that is currently under construction.

THE BACKGROUND OF THE PROJECT

Since the beginning (in the eighties) of its P180 project, Piaggio extensively used simulation methodologies for feasibility studies and progress control.

Sophisticated planning technologies were deemed necessary to accompany the development of such a sophisticated aircraft.

P180, in fact, is a very innovative 9-seats twin turboprop aircraft (see Figure 1), characterized by three lifting surfaces, innovative aerodynamic shape and manufacturing technologies that give him jet-like performances, smoothness and comfort accompanied by extremely low operating costs.

Figure 1. Twin turboprop aircraft P180.
The whole research, development and certification phase was managed by means of a PERT network composed by more than 1,500 activities.

It was first used to make several simulation runs and critical path analysis until the project met the target cost and duration, then to control the progress of the set of activities of the frozen network.

However the capability to simulate the real processes was limited by two main reasons:

1) the base data (mainly costs and duration of the activities) had been estimated as deterministic values, rather than stochastic;

2) external events, like sub-contracted operations, were difficult to be integrated and monitored in phase with the internal ones, in order to have a quick response on the behavior of the system as a whole.

But, while P180 was brilliantly completing the prototype phase, receiving the airworthiness certification and moving into the steady production phase, new fundamental tools became available; in particular, web technologies joined with advanced simulation tools were leading the way towards new means of control of complex logistic chains with several actors deeply integrated, but geographically distant.

The favourable occasion to catch this opportunity came when Piaggio was proposed to employ the P180 aircraft as test case for a project of applied research, called WILD (Web Integrated Logistic Designer), sponsored by MURST (the Italian Ministry for Education and Research). The proponent was the Department of Production Engineering (DIP) of the University of Genova, as the leader of an academic community also composed by the Universities of Bari, Firenze, L’Aquila, Milano, Napoli and Salerno, spread all over the national territory (see Figure 2).

The aim of the applied research was to develop innovative approach and tools for the supply chain management, with the creation of a model reproducing a complex network of relations among geographically distant actors, in order to allow on-line production planning and control with quick and flexible response, the final purpose being to guarantee the resources, material and products in time on the right site respecting quantities and quality requirements.

The institutional sponsor’s design was not to finance a merely theoretical research, but just to invest on applications able to stimulate the growth of the capability and competitiveness of the national industries.

Therefore the first step was to find out an industrial test case complicated enough, characterized by complex flows both in the main-contractor’s final assembly line and in the vendor’s sub-assembling departments, also in presence of rigid time constraints and particularly specialized manpower.

We find all of this in a private aircraft industry; so the complex enough test case was identified and WILD could proceed towards the next phases: simulation models, federation integration, demonstration and validation of the results.

THE PROJECT DEVELOPMENT PHASE

First of all, it was necessary to identify suitable productive processes to be modeled and put in correlation.

Seven Piaggio suppliers were chosen and coupled with the seven Universities involved in the WILD project, basing on geographical distance.

They were located in different Italian regions, and manufactured a wide range of components to be subsequently installed on the aircraft in different positions of the final assembly line (mechanical parts, electronic equipment, composites, interiors, etc.).
After making stochastic simulation models of each real industrial process, the Universities developed the federation composed by simulators and scheduling systems, so reproducing the entire supply chain network.

WILD federation is based on High Level Architecture (HLA), which is able to guarantee inter-operativity, distributed processing, portability and reusability.

It is worth to remember that the first series of integration tests of the SHOW (Spanning Hla Over a Wan) system (see Figure 3) through non-dedicated geographical net (internet) were successfully performed between the University of Riga (Latvia) and Savona (Italy). And this was also favored by the exchange of visits and experiences between the two Universities (both teachers and students).

![Figure 3. SHOW (Spanning Hla Over a Wan).](image)

The federation allows the main contractor to make simulation runs where data are exchanged through the web by the models located at the facilities of the partners that are responsible for them.

Starting from the master production plan, the simulation process drives the purchasing orders issue from the main contractor to the various suppliers, monitors the progress inside the proper production unit until the delivery of the component to the main contractor’s production line.

In case of variations in the production plan at the hierarchically higher level (see Figure 4), each lower level simulator is able to receive the info that fall under its own competence and to reschedule the activities of the unit under its control.

Then such reschedule, together with those coming from the same level partners, is submitted to the top level simulator situated at the main contractor’s.

After several simulation runs, in which different solutions can be tested, the program is frozen and possible request of rescheduling are spread top-down.

![Figure 4. Multilevel simulation model.](image)

Simulation models were developed by the Universities making use of simulation tools HLA compatible (i.e. Arena™, Simul8™, Simple++™) or general-purpose language (i.e. Java™, C++).

THE INDUSTRIAL PARTECIPATION AND THE PRACTICAL RESULTS

From the industrial point of view, the kick-off was very encouraging, around the table where Piaggio Chief Executive welcomed the academic and industrial partners joined in their first project meeting. To tell the truth, also the research of seven industrial partners, spread on the whole national territory, but each of them geographically close to a different University to which disclose their gates, processes and industrial data was much easier than expected.

Then, while the academic community was carrying on the construction of the models representing the industrial processes, creating the federation of simulators, making tests and validations, it became clearer and clearer that most of the industries were unprepared to fully understand the advantages of the new sophisticated simulation tools. On the other side, we must not forget that the main purpose of the project financing institution was just the promotion of a cultural growth.

So practical results have been certainly different from expectations, but for sure the WILD project is having positive effects now and is stimulating new ones for the future.
Some industries, mainly those operating as subcontractors inside an international environment, quickly realized that getting familiar with a tool for data exchange through the web could result in a powerful commercial advantage. Of course a foreign Customer preferably trusts an easily controllable partner; at the same time, any variation in the main contractor production plan can be more easily faced if known and simulated in real time.

Other companies put the condition to protect instead of distribute some of their own data. For example, they feared that the knowledge and comparison of their capacity and workload could play unfavorably during the commercial tenders. For them, the Universities designed the program so that only non-crypted data could be distributed to the federated partners through the web.

The improved ability to control sub-contractors was sometimes the leverage that convinced Piaggio to order from them not only simple manufactured parts, but also more complex structures. In these cases the subcontractor became also qualified and responsible for assembling the structure as well as for purchasing and controlling the components itself. The result was a simplified logistic flow, a greater income for the selected suppliers, a reduction in the number of Piaggio suppliers (less and better).

In other instances the improved supplier control led to the acquisition of complete set of parts rather than single components, grouping them in accordance with their destination in the aircraft assembly line in Piaggio. So the kitting activities were delegated to the supplier, making handling and distribution activities more simple and cheap.

Even the less advanced suppliers took anyway the opportunity of starting collaboration programs with the geographically closer Universities: students’ stages, consultancy and research contracts must be considered as aside benefits originated by the WILD project.

CONCLUSIONS

But let’s conclude resuming maybe the greatest benefits to Piaggio:

1. INVENTORY REDUCTION greater than 40%. Besides the above mentioned reasons, the new approach with the suppliers considered as real partners led to the contemporary condivision of speculative long term plans, flexible medium term programs and frozen short term orders, resulting in shortened lead-times, less risk and less inventory.
2. THROUGHOUTPUT TIME REDUCTION of about 33% along the final aircraft assembly line. This is not an already obtained result, but it is the target that Piaggio want to achieve, having understood the potential of simulation tools. During the WILD project became clear that the assembly line design and layout, even if already deeply analyzed, could be improved if simulated considering also stochastic events and making “what if” and bottleneck analysis. And this is just the next step that is just being performed together with the Department of Production Engineering of Genova University.

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REFERENCES


BIOGRAPHY

Giorgio Garassino is the Head of the Logistic Department at Piaggio Aero Industries, an Italian aircraft manufacturer with headquarters in Genova. He received a degree in Mechanical Engineering from the University of Genova. His professional experience includes program management of prototype aircraft, liaison in international co-productions, implementation of advanced techniques in his company in the fields of configuration control, project management and supply chain control, as well as operational responsibilities. In the WILD project he coordinated the industrial community and validated the results as Subject Matter Expert. He is a member of the Liophant Simulation Club.
IT-SUPPORT AS AN ENABLER FOR SME-BASED VIRTUAL COMPANIES EXEMPLIFIED IN AEROSPACE INDUSTRY

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KEYWORDS
Virtual Company, inter-organizational network, SME, Aerospace Industry, Computer Supported Collaborative Work.

ABSTRACT
The reorganization of the supply chain in the aerospace industry has led to a new situation for small and medium-sized enterprises (SME). The suppliers are forced to deliver completed systems instead of components and assemblies. In order to react to the changed requirements, one possible solution is the project-oriented and temporary cooperation of SME by building a Virtual Organization in order to stay competitive and marketable.

This requirement can often only be met by SME through flexible trans-regional cooperation. Thus, one possible solution is to create a network of companies. Depending on the required competencies one or several Aerospace Virtual Companies can be built up to execute a work order.

The construct of a Virtual Company (VC) with the central enabler of the information and communication technology (ICT) offers SME the possibility to expand their customer structure trans-regional. Particularly enterprises that so far operated only regionally achieve a virtual widening of their enterprise and their spectrum of products and services.

The network architecture enables the SME to concentrate on its core competence. At the same time the network provides the necessary ability to realize individual customer needs by the increased flexibility and adaptability for fulfillment of customer's requests and for profit of market prospects.

In order to provide a structure for an integrated IT-support a specific process-model for the creation and operation of Virtual Companies in the aerospace industry was developed. The model focuses on the phases for the creation of the cooperation platform which is the basis for forming project networks in the case of concrete projects.

The relevant phases – on platform level as well as on project level – are the phases of initialization, forming, realization respective processing and termination. In addition to these direct processes supporting tasks were defined on platform level (rules and regulations, platform management, marketing) and on project level (controlling, quality management).

Along the processes defined in the process model the supporting IT-functions are structured. The phases of initialization and termination mainly require informational functions like partner databases and electronic yellow pages. In the phases of formation and realization the focus lies on systems for communication,
coordination and cooperation. Specific systems in this regard are e.g. groupware-, workflow-management- and controlling-systems as well as systems for collaborative project work as in the sense of Concurrent Engineering.

In the following the process model and the connected IT-functions will be presented in detail. They will be supplemented by the results of expert interviews, which were carried out to further substantiate the model regarding specific requirements towards networks in the aerospace industry.

DEFINITION AND AIM OF VIRTUAL COMPANIES

A Virtual Company can be defined as an inter-organizational cooperation of limited duration between several legally independent companies. The cooperation is formed only temporarily for a specific project and is supported by modern information and communication technology (Bultje and van Wijk 1998).

The integration of the core competencies of several companies enables the Virtual Company to offer individualized products and services. The network does not have a corporate body but is coordinated by a lean institution, e.g. a network-broker.

The basis for the project-oriented configuration of flexible networks is provided by a stable, long term network that ideally is founded on proven relationships (Schuh et al. 2003). From this cooperation platform adequate partners are chosen in the case of a customer request or the identification of a market opportunity (see Figure 1).

Figure 1. Structure of a Virtual Company.

In the following the major aims for building up a Virtual Company, classified into the categories “increase of efficiency” and “improvement of the market position”, are listed (Brütsch 1999) (Eigeldinger 2001) (Ries 2001) (Kaluza and Blecker 2000) (Kreher 2000) (Schuh et al. 2000):

Increase of efficiency:
- Decrease of costs, e.g. through economies of scale or learning effects. Fewer investments because of the variety of resources within the network.
- Improved utilization of capacities through effects of specialization in one’s own company and through utilization by cooperation partners.
- Splitting of economic risk, especially with innovative projects.
- Time advantages during the development of new products because of the variety of specialized knowledge within the network. Reduction of delivery times and increased delivery power through optimized coordination within the network.
- Configuration of optimized business processes and total optimization of the supply chain.
- Reduction of costs of integration and interaction through the optimal configuration of a cooperation platform and the creation of adequate rules and regulations for the network.

Improvement of the market position of SME:

The cooperation allows SME to acquire projects which exceed the resources and competencies of single companies. Thus, SME may overcome restricted access to markets.
- SME that operate only regionally can realize a transnational widening of their customer structure and thus become better known to potential customers as it would be possible for single SME without VC.
- Increased flexibility and adaptability for the satisfaction of customer needs and the realization of market opportunities. The network architecture with the concentration on core competencies provides the required capability to realize individual customer needs.
- Knowledge exchange across industries: Companies gain advantages by forming information pools for the exchange of market information and by joint development of knowledge.

REQUIREMENTS OF THE AEROSPACE INDUSTRY TOWARDS A VIRTUAL COMPANY
In order to adapt the process model to the particular requirements of a Virtual Company in the aerospace industry, the present situation regarding existing cooperations and also the status quo of the requirements as a result of the reorganization of the supply chain was assessed. Therefore, a series of interviews with involved companies from different levels of the supply chain (producer, 1st-tier supplier, 2nd-tier supplier and 3rd-tier supplier) was conducted.

In order to be able to cover the demands of SME towards the design of a cooperation platform, several potential network partners were questioned about their previous cooperation and the reasons for these. Furthermore, a particular focus lay on the prearrangements of the cooperation in respect to the selection and the rating of the potential partners and the contractual agreements. Finally, the order processing was analyzed regarding the role of the IT systems, the role of the employees and the contractual agreements during the cooperation.

The main reasons for cooperation given in the survey were the expansion of the product range and of the core competencies. Most of the companies announced that reciprocal specialization as well as know-how and knowledge transfer is highly important. All interviewees stated the long-term orientation of their past cooperations. Nearly all cooperations took place without a specific legal form but mainly on the basis of customer-supplier relationships.

Regarding the organization of the network respectively the cooperation platform, it appeared that the companies join forces in the case of a concrete project depending on the requirements at hand, so that the platform is often not managed explicitly. According to the questioned companies the important processes on platform level are the definition of corporate aims and merits, the fixing of rules and regulations, the strategy for the corporate marketing which must strictly market the product range of the cooperation platform and the integration of existing as well as the development of a new consistent IT structure.

In the case of an order processing, the following aspects are important for successful operating: finding the most promising combination of the partner companies, the clear structuring of the project and the definition of work packages, quality management and controlling supported by specialized IT systems and methods.

Because of the high quality standards of the considered industry, aspects of quality management must be integrated explicitly into the structures and processes of an Aerospace Virtual Company. The most important standards are the following:

- DIN EN ISO 9001: Quality Management Systems
- DIN EN 9100: Quality Management Systems in the Aerospace Industry
- ISO/TR 17400: Space systems – Space launch complexes, integration sites and other facilities – General testing guidelines
- JAR 21: Certification Procedures for Aircraft and related Products and Parts

As a result of the customer requirements and because of the conceptual formulation, most of the used IT tools are predetermined. In this regard, a secure well-structured electronic data interchange is one of the most important aspects concerning the configuration of a Virtual Company.

Because of the common customer request of being informed about each network partner involved in the order processing, the aim of the collective marketing cannot always be reached. Regarding the different roles in an Aerospace Virtual Company there is usually a prime-contractor who closes the deal with the customer (see Figure 1). In order to fix the decisions and the work packages contractually, the prime-contractor is responsible for the arrangements with the cooperating companies.

In the context of working within a trans-national Virtual Company, the analysis of the interview results lead to the conclusion that the increasing importance of the role of the employees must be taken into consideration. The interviewees stated the increasing requirements regarding professional competencies as well as language skills, the flexibility concerning different fields of work and social competencies among other things due to the increasing international cooperation in the aerospace industry.

### PROCESS MODEL FOR VIRTUAL COMPANIES IN THE AEROSPACE INDUSTRY

Based on the results of the interviews combined with a detailed literature research a process model for Virtual Companies was developed which allows the description of all the relevant design areas of a Virtual Company in the aerospace industry (Albers et al. 2003) (Gerpott et al. 2000) (Kocián 1999) (Ries 2001) (Ringle 2004) (Schuh et al. 2003). The main elements of the process model are (see Figure 2):

- the core processes for building the cooperation platform and for the realization of concrete projects,
- the supporting processes for administration and marketing of the network as well as project controlling and quality management,
• the employee level must be considered carefully when designing Virtual Networks since especially in knowledge intensive networks the effective cooperation between employees is a success factor,

• in addition to the process level the IT-support plays an essential role in order processing in a distributed context.

In the following the elements of the model will be described in detail.

The project level - the processing of concrete orders through flexible project networks - can also be described using four rather similar phases. A project starts with the identification of a market chance or an order by a customer in the initialization phase.

According to the requirements of the market chance or the order, the project is defined, structured and planned in the phase of formation. A project network is configured considering the competencies required for the order processing and the existing core competencies of the members of the cooperation platform.

The following phase of order processing mainly consists of the direct processes of the network partners and the project management for distributed projects.

Finally the project network will be terminated, in most cases because the project goals were fulfilled. In consequence of the project, there might be further project related tasks, e.g. after sales services, that are carried out by one or several project partners.

**Supporting Processes**

The processes and tasks described so far are the direct processes on platform as well as on project level. In addition to these, supporting processes are necessary to ensure an effective and efficient cooperation based on the cooperation platform.

A number of problems often inhibit efficient collaboration in inter-organizational networks. As a matter of fact, different goals and ethic values among the network partners as well as dynamic changes of processes are very complex to handle (Killich and Luiczak 2003).

The higher the flexibility of the network, the more important the aspect of trust becomes, as it can no longer be built on extensive experience with the partners. Yet another major challenge is the overcoming of cultural barriers (Eppler and Sulkowski 2001).

The cooperation platform plays a main role in reducing these barriers. It provides a stable and long term pool of potential partners. It also supports the development of trust among partners and provides a certain degree of standardization to ensure efficient cooperative processes.

To fulfill these requirements the cooperation platform must provide rules and regulations for the general cooperation between partners on platform level as well as on project level. The supporting processes also include the various tasks of platform management, e.g. finding new network partners, excluding partners from the
network, measures of trust building and conflict management and also the development and operation of an adequate IT-infrastructure.

Since one of the general characteristics of a Virtual Company is the collective market appearance of the network companies, the marketing of the cooperation platform is also an essential task on this level. The broker of the network usually carries out these supportive and administrative tasks.

Further, supporting processes that are important on platform level as well as on project level can be distinguished. The controlling of all platform activities is necessary to ensure the compliance with the goals of the platform and if necessary to implement corrective measures.

The different processes of quality management are particularly important since the aerospace industry strongly focuses on high quality standards.

**Employee-Related Aspects of Virtual Companies**

Inter-organizational cooperation is always based on the actions of human beings (Luczak and Killich 2003). In a virtual context certain requirements towards employees are intensified and therefore should be considered carefully.

In particular in knowledge-intensive cooperations the success depends on the efficient interaction of employees to a large extent. Because of this the processes, structures and related tasks as well as supportive tools and instruments must be designed considering the effects on employee performance behavior.

In order to ensure compliance of employee behavior with the Virtual Companies’ goals three aspects are of importance (see Figure 3) (Killich and Peters, 2003): commitment ("Are employees willing to act in a certain way?") , capability ("Are employees able to act in that way?") and conditions ("Do organizational and cultural conditions enable this kind of behavior?").

Regarding the area of commitment, structures, processes, areas of responsibility, decision authority should be reflected under motivational aspects.

The area of capability takes into account whether employees have adequate competencies to carry out the required tasks. This question is of particular interest since in networked context social competencies, language and communication skills are needed in addition to excellent professional competencies.

With the third area, conditions, the view is extended to the surroundings of the employees. In this context for example aspects of organizational cultural and trust between members of a virtual environment play an important role.

![Figure 3. Employee-Related Aspects of VC.](image)

**IT-SUPPORT FOR VIRTUAL COMPANIES**

Because of the collaboration in a distributed environment, an adequate IT-support of the processes of a Virtual Company is essential. The specification of the IT-support of a Virtual Company can be structured according to the life cycle as described above and the functions that are supported (see Figure 4), namely information, communication, collaboration and coordination (Mertens 1998).

The initialization phase mainly requires support regarding informational functions, e.g. for identifying potentials for cooperation. These tasks can be supported for example by web-based databases or by electronic yellow pages.

During the phase of formation, communication systems – e.g. email, chat, ICQ, telephone and video conference, blackboard, news – gain importance in addition to information systems.

In the following phase of realization the focus lies on the support of the operative project work by systems for collaboration and coordination.

Examples for these are groupware, document and Knowledge Management systems, newsgroups, Workflow Management Systems, Project Management Systems and Supply Chain Management systems. The phase of termination finally requires support by systems providing mainly informational functions.

The main challenge, however, lies within finding adequate IT-support for the cooperative work that can be efficiently integrated into the existing operative systems of the network partners.
In conclusion the survey confirms the experiences made in practice that an increase in value can only be achieved by the flexible integration of the IT tools into well-defined procedures of a Virtual Company. Both aspects combined provide a framework for the work in a Virtual Company.

The key factor for success, however, still remains the employees. On the one hand employees need the qualification for handling the IT systems on the other hand the workflow must be intuitive and transparent in order to create the acceptance required.

CONCLUSION

To provide a basis for the specification of a Virtual Company in the aerospace industry a model describing all the relevant design areas was presented. The model was detailed regarding the special requirements of the aerospace industry through a series of interviews with small and medium enterprises that have experiences with cooperative work in the respective industry. In order to also collect the requirements of potential customers of an Aerospace Virtual Company further several interviews were carried out with aircraft manufacturers and their direct suppliers. Furthermore a survey with the aim of identifying the IT-functions presently used in cooperation was conducted.

The next step in the project will be the development of concepts, IT-Tools, methodological support and framework agreements for the development and operation of a Virtual Company in aerospace industry according to the specification model. The project consortium will work accompanying the conceptual work the acquisition of a concrete evaluation project on. This project will be used to configure a Virtual Company according to the developed concepts and to apply and evaluate the supporting tools and methods.

As a result a complete and validated guideline for the development and operation of an Aerospace Virtual Company for SME will be provided.

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Figure 4. IT-Support.

For the identification of characteristic hard and software as well as IT functions used in cooperation and especially Virtual Companies, a standardized questionnaire was designed and distributed among selected SME. This questionnaire is divided into two sections. Section 1 consists of questions about the existing infrastructure as well as hard and software (infrastructure, IT functions, operating system, basic software, security functions, application software and special software for cooperation). Section 2 deals with the use and the relevance of individual functions in the context of a cooperative processing of projects. The results of the survey pointed out that classical information and communication functions such as telephone, fax and internet are usually present and used. Regarding operating systems Microsoft Windows is mostly used. The security-relevant functions were listed almost completely by all SME, which points out that these aspects have a high value in aerospace industry. As far as software is concerned, internet (www, email) and different Office products are commonly in use.

The use of dedicated systems like CAD-, FEM- or simulation-systems depends on the core competence of the company. For asynchronous information exchange mostly file servers, e.g. FTP-Servers or file sharing, and organizer tools like Outlook or Notes are applied.

Concerning the importance of different IT-functions and systems in the context of cooperation mainly those presently used by the companies were rated highly. A certain lack of information concerning newer systems and their potentials seems to prevail. In particular the implementation of a Computer Supported Cooperative Work (CSCW) system (Teufel et al. 1995) in the context of the research project has shown that it was used intensively by SME after a period of familiarization with the system.

Key success factors for this were the simple usability, a clear role concept and the accessibility via standard software like internet-browser. This especially underlines the demand that IT systems must be integrated into the existing and well-known infrastructure as well as into the existing operational workflow, in order to achieve a high acceptance.

The results of the survey evaluated the supporting tools and methods according to the developed concepts and to apply and evaluate the supporting tools and methods.

As a result a complete and validated guideline for the development and operation of an Aerospace Virtual Company for SME will be provided.
REFERENCES


BIOGRAPHY

Jochen Bernhard studied mechanical engineering at the University of Kassel, Germany. After graduation he worked at the Volkswagen AG and became an employee at the Fraunhofer Institute for Material Flow and Logistics in 2001. Since May 2004 he is leading the team Simulation Concepts and Tools. His main activities include the development and realization of concepts as well as the practical application of systems in simulation, planning, and training.

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KNOWLEDGE REPRESENTATION SUITABLE TO IMPROVE FLEXIBLE MANUFACTURING SYSTEMS

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KEYWORDS

ABSTRACT
The exact optimal solution of a production, a distribution or a transport system-planning problem is quite complex and difficult, may be impossible to obtain. Simulation models have proved to be useful for examining the performance of alternative system configurations and/or alternative operating procedures for complex systems. However, when applying simulation techniques to improve logistic systems performance, several limitations arises due to its inability to evaluate more than a fraction of the immense range of options available. Different Decision Support Systems (DSS) for particular production schemes has been developed, however, the acceptability of its results are constrained to the particular application field. In this paper we present a generic framework to formalize the behaviour of discrete event systems (manufacturing systems, logistic systems, services systems, etc) that allows the translation of a scheduling or planning problem to a search problem in such a way that different search heuristic algorithms can be tested to deal with an acceptable solution.

The proposed approach is based on the intelligent pruning of a coverability tree that is built dynamically from a system behaviour knowledge representation.

INTRODUCTION
O For more than 35 years researchers and technologists have built and investigated Decision Support Systems (DSS) (Power et.al. 2003, Shim et.al, 2002). Towards 1970 Little in an earlier article identified criteria for designing models and systems to support management decision-making. His four criteria included: robustness, ease of control, simplicity, and completeness of relevant detail. These four criteria remain effective in designing modern DSS.

By the late 1970s, a number of interactive information systems were developed to analyse semi-structured problems. Despite there was not a unified approach neither a formalism to represent system knowledge (mainly based on data and models) all were considered Decision Support Systems. From those early days, it was recognized that DSS could be designed to support decision-makers at any level in an organization. DSS could support operations, financial management and strategic decision-making. DSS could use spatial data in a system like Geodata Analysis and Display System (GADS), structured multidimensional data and unstructured documents. The type of knowledge representation would depend then on the specific characteristics of the system in study.

Artificial Intelligence (AI) researchers began to work on management and business expert systems in the early 1980s, and the financial planning systems became popular tools of support for decision-making (Power et.al. 2003).

In the specific field of production planning some DSS have been developed (Riane et.al 2001, Özbayrak et.al. 2003, Gazmuri et.al 2001, Mallya et.al. 2001), but they have been designed for particular production schemes: Flow Shop, Continuous Manufacturing, or Flexible Manufacturing Systems (FMS), based on techniques of knowledge representation whose rules or premises must be adapted and some times redefined to the particular characteristics of the application problem.

Due to the economical effort to develop, code and tune a DSS, some prototypes has been developed that try to increase both: knowledge and decision rules reusability. Thus, at the beginning of 90s, object-oriented technology for building “re-usable” decision support capabilities was widely recommended.

In spite of the ample diversity of knowledge and research areas that include the DSS, since the decision-making process usually goes through stages of problem definition, identification of alternatives, analysis, and evaluation of alternatives, followed by the prescription of the best alternative, in the author’s opinion, reusability should be achieved in those fields where the same knowledge representation framework can be used to specify the problem definition stage.

This paper presents a test-bed simulation system to evaluate different heuristic search strategies to deal with the best configuration of the decision variables, of any planning or scheduling logistic problem of a system that can be thought as a discrete event oriented system. Coloured Petri Net formalism is used to represent the
knowledge the expert got about the system behaviour, and a discrete event simulator together with a tool to build dynamically the coverability tree has been developed as a reusable technique for the automatic evaluation of alternatives. By considering a DSS as a “... computer technology solutions that can be used to support complex decision making and problem solving” (Shim et al. 2002), the developed framework can be considered by its self a reusable DSS for the discrete event oriented field.

A summary of different knowledge representation techniques in the field of logistic systems (discrete event oriented) is presented in section 2. Section 3 introduces the main characteristics of Petri Nets (PN) and Coloured Petri Nets (CPN) as knowledge representation formalism for logistic systems. In section 4 the dynamic generation of the coverability tree according to prescription of the best alternative of a DSS is presented. Section 5 illustrates by means of a new heuristic algorithm the benefits of using the test-bed developed to improve the selection of the best alternative task of a DSS.

KNOWLEDGE REPRESENTATION.

When designing or choosing a Knowledge representation (KR) formalism, both the nature of what will be modelled using the particular method (i.e., the semantic aspect) and the expressive form of the method (i.e., the syntactical aspect) are two aspect that must be taken in care to be sure that the selected formalism will give a proper answer for the application field.

In the particular case of logistic systems, and more broader speaking discrete event oriented system (DEVS), the main characteristic of its behaviour is that the system state remains constant between events, and those usually can appears as a result of a stochastic activity (Figure 1). A typical example is the finalization of a transport or a processing activity.

Decision-making complexity in DEVS systems arises because the new state achieved as a result of an event, can block, freeze, delay, enable/disable future enabled/disabled events.

There are many KR formalisms that address data/information only and many that address processes only. In the particular case of DEVS systems the KR formalism should relate these two fundamental kinds of formalisms.

An important aspect related with the KR formalism is that the language used to support the knowledge should be explicit (let alone machine-interpretable). Natural language processing (NLP) has been a driver for much of the work in artificial intelligence. Despite the objective of formally acquiring knowledge by parsing and interpreting text is of interest to a large community of researchers and to industry, knowledge about DEVS system behaviour can not be easily acquired by analysing output data (a DEVS system can show a non bounded amount of different behaviours), but by understanding all the event-relationships, in such a way that the effects of firing an event could be easily predicted, in order to be able to enable or disable the firing of other events.

Another aspect that should be kept on mind when deciding the KR framework to be used to specify the problem definition stage of a DSS is that the expert knowledge about a logistic system, as it is represented in some model, is never complete nor either completely accurate. To be useful, it need only be complete and accurate enough for its intended purpose. Despite the reasoning capabilities of a knowledge representation system is beyond the scope of this paper, it should be point out that when conceptual models are to serve an ongoing purpose, the KR formalism should support automatic model improvement and expansion over time, as well as revised to reflect changes in the domain they model.

Thus, when designing or choosing a KR formalism to support knowledge expert got about a DEV System, some aspects inherent to DEVS behaviour should be
considered:
- A DEVSe can be both: event and/or state driven
- The state space of a DEVSe can be discrete or continuous.
- Typical DEVSe patterns of behaviour comprise, concurrency, synchronisation and resource sharing

To illustrate the complexity of the KR in such a way that it could be useful to satisfy future DSS demands, let's consider the interacting processes in a manufacturing system: The dynamic nature and the complexity of tooling and synchronization with parts in automated systems require particular attention in order to guarantee streamlined manufacturing. Because all the jobs use the same finite (limited) resources such as machines, stocks, tools, time, etc., the competition for resources makes part flow a vital function for successful manufacturing. The scheduling policy should deal with the timely assignment of manufacturing operations as well as the set of orders that should be ready for processing at each particular station at each particular time, deciding on the sequence in which they will be run and calculating the resulting start and finish times for each operation.

In this sense, the stochastic, dynamic and synchronous nature of production systems demands a technique of knowledge representation that considers all these characteristics and allows representing so much the structure as the different ways in which a system can behave.

The DSS developed until now in the planning and scheduling area, have used different KR formalisms: Markov Decision Processes (Madani et.al. 2003, Majercik et.al. 2003), Production Rules (Mohamed et.al. 2002, Özbayrak et.al. 2003, Zha 2002), Genetic and Evolutionary Algorithms (Mesghouni et.al. 1998, Esquivel et.al. 2002), Object-Oriented techniques (mohamed et.al. 2002, Feng et.al. 2001, Zha 2002), Agents (Feng et.al. 2001, Zha 2002) and Petri Nets (Zha 2002, Li et.al. 2000), among others, which usually deals with complex representations of the system behaviour if a certain low abstraction level is required to deal with a proper plan. Furthermore, most of these techniques separate the knowledge on the structure from the knowledge on the behaviour of the system, which usually is stored in relational databases, constraining in this way the possibility to explore the DEVS performance in those situations not previously modelled, giving poor answers (estimations) during the “evaluation of alternatives” step of a DSS.

The complexity of designing a DSS to deal with the planning and/or scheduling problem of a logistic system is that it requires knowledge about all the event-relationships that affect the system behaviour and its performance. The evaluation of the different states that can reach the system, in order to evaluate all the possible alternatives of the planning problem, is a considered as a NP hard combinatorial problem.

Given the main characteristics of discrete event oriented systems, in the author’s opinion, the knowledge representation in an intelligent DSS context should provide both: all the events of the system and the relations among them, in order to represent the whole system behaviour, and to be able to choose the best alternative at each decision step, which will be the one that will allow to reach the industrial targets with the best combination between the use of resources and the time of production.

In the following section PN and CPN formalism are introduced as suitable tools for the knowledge representation of a logistic system.

KNOWLEDGE REPRESENTATION BY PETRI NETS AND COLOURED PETRI NETS

Every modelling or KR paradigm reflects in its fundamental conceptual constructs certain views about the things in the world (the real or imagined world), as well as the concepts we use to represent and describe those things.

Petri Nets (PN)

Petri net is one of the most popular graphical and mathematical tools available for studying systems of discrete event nature, due to its ability to model the precedence relations and structural interactions of random, concurrent, asynchronous events (Zimmerman et.al. 1995, Zimmerman et.al. 1995, Silva et.al. 1989, Zhou et.al. 1999).

Despite there are several formalism that support DEV Systems behaviour description, PN constructs formalism offers several advantages as KR framework in DSS, such as:
- PN can be considered a modelling paradigm with several levels of abstraction and interpretation, which is essential to integrate at the appropriate detail description level the logistic aspects of a system.
- It is possible to carry out both a qualitative analysis (identification of alternatives) and a quantitative analysis (evaluation of alternatives) suitable for DSS.
- There are several mechanisms to determine all the activated events at a particular system state, and all the new events that can be triggered as a consequence of the activation of a certain event.
- They allow the description of a complex system by means of a bottom-up approach.
- PN constitute a model formalism with very few constructors and syntactic rules.
PN Description

A PN is a particular case of directed, weighed and bipartite graph, with two types of nodes, places and transitions. The marking defines the state of the system that will evolve according to the firings of the transitions when their associated events occur.

Place nodes (represented by circles) are used to describe both logical conditions and stocks, transition nodes represent the system events, weighted arcs are used to describe the logical preconditions to allows the firing of an event, and also the consequences on the system state. Tokens (represented by black points) are used to model the number of elements (pieces, resources, people, etc.) that are stored in stocks (places), or boolean conditions (binary places). Finally, the state of the system can be described by the distribution of tokens in the places, which is known as marking.

One says that a transition is not enabled when the number of tokens in anyone of the places at the entrance of a transition is less than the value of the arc weight connecting the place to the transition. Otherwise says that it is enabled. When a transition is fired, tokens at the input places are eliminated and added to the output places. The number of tokens eliminated/added is specified by the weight of the corresponding arc of input/output.

Coloured Petri Nets (CPN)

Despite a PN model might be suffice to describe the logic constraints between a list of resources (processing machines, transport units, local stocks) a list of operations, and their precedence relationships, it lacks of information data representation independent of the system architecture, which is essential to deal in an efficient way with the best logistic policy for a given system state and a given goal state (Zhou et.al. 1999).

Simulation Models as evaluation of alternatives mechanism in DSS arises out of an inability to evaluate more than a fraction of the immense range of options available. Most of commercial discrete event oriented simulation packages are designed to perform simulation as an analysis tool. That is, the system to be studied is modelled, perturbed or parameterised in some interesting fashion, and simulated to predict what changes those disturbances or parameter configurations would cause in a real system.

PN models of complex logistic processes consist of large aggregate graph structures due to its inability to describe entity information changes. In general, there a lot of circumstances inherent to logistic systems where it is necessary to distinguish the entities (tokens) that flow through the system. The PN formalism does not facilitate the description of those activities whose behaviour depends on certain information that denominates state of the entities.

Model maintenance and model fitting task inherent to the evaluation mechanism of a DSS becomes a hard and difficult task when models structures are complex.

A suitable KR formalism for a DSS in the logistic field, should offer easy to use modelling constructs to support entity information description to specify aspects such as:

- Entity priorities in a waiting queue.
- Event firing according to entity attribute values.
- Time event functions according to entity attributes.
- Coloured Petri Nets allow a higher level of modelling, by using colours that allows to represent entity attributes of commercial simulation software packages:
- The flow of entities can be specified by describing what it happens to an entity as flows through a sequence of subsystems.
- Transition time can be evaluated as a random function of entity characteristics (attributes).

The CPN offer the necessary modelling tools to represent both the entity attributes (characteristics) that flow through the system, and the object properties that should allow the firing of each system event.

CPN Description

The main CPN components (Jensen 1997) that empower this methodology as KR formalism in the logistic field are:

- State Vector: The smallest information needed to predict the events that can appear. The state vector represents the number of tokens in each place, and the colours of each token.
- Arc Expressions and Guards: Are used to indicate which type of tokens can be used to fire a transition.
- Colour Sets: Determines the types, operations and functions that can be used by the elements of the CPN model.
- Places: They are very useful to specify both queues and logical conditions.

COVERABILITY TREE

Planning and scheduling of logistic systems are considered NP-Hard problems that cannot be solved by means of polynomial time algorithms. Despite important efforts from the OR and AI research communities have been made, these kind of problems are still open research areas due to the economical benefits that a good scheduling algorithm could bring in several fields such as
production planning, computer design, logistics, communications, etc.

In this paper a test-bed system for the evaluation of heuristic search algorithms to deal with the planning and scheduling of logistic system is proposed. Our approach consists to open the coverability tree of a system described in the CPN formalism. The main goal of the coverability tree is to find all the markings that can be reached starting at a particular initial state \( M_0 \).

The root of the tree consists of the initial marking \( (M_0) \). For each node in the tree, all the enabled events are recognized (identification of alternatives), and with each event a new state is calculated (evaluation of alternatives) and its marking is added to the tree together with an arc joining both nodes specifying the transition fired.

This method of analysis, whose formal definition is described widely in (Jensen 1997), is the base for the construction of a generic DSS for DEV Systems, such that the initial and the goal state, will generate the sequence of actions that will drive the system to the desired target minimizing a certain cost function (Piera et.al. 2003, Narciso et.al. 2003, Narciso et.al. 2002).

When applying the proposed methodology to real logistic systems, the amount of nodes (system states) of the coverability tree can grow to computationally prohibited size. On the other hand, the computer time required to explore a tree of these characteristics constrain its use to academic systems.

To tackle this combinatorial explosion problem, an alternative is proposed: To build dynamically the coverability tree according to some heuristics. The underlying basic idea to dynamically build the coverability tree of a logistic system specified in the CPN formalism is to translate a scheduling problem into a search problem, i.e. to obtain a path from a certain system state to a desired goal state in a graph structure that represents the problem space.

This alternative allows the evaluation of different search methods such as Tabu Search, Simulation Annealing, Neighbourhood Search, Agents, and other, (Aldowaisan et.al 2003, Lee et.al. 2002, Yu et.al. 2003, Yang et.al. 2003), to deal with the best sequence of actions that will drive the system to a certain final state.

A GENERIC TEST-BED FRAMEWORK FOR SEARCH ALGORITHMS.

Computer memory capacity is an important factor to consider at the design phase of a framework for the construction, analysis and maintenance of a coverability tree. It should be noted that the huge amount of decision variables inherent to most logistic systems leads to coverability trees whose dimensions exceed the limits of memory allowed by the computer at a certain moment during the evaluation of alternatives step of a DSS. The design of search algorithms to tackle the combinatorial explosion are needed to “cut” branches of the tree that, according to certain criteria, do not will lead to an acceptable solution. Most of these algorithms are based on the concept of “cost function” to determine which paths are worth to be evaluated.

Cost Function

The formalization of an objective function to drive the program through the search space, will allow to summarize certain expert knowledge and express it in the mathematical formalism used by the search algorithms. The knowledge expressed through the objective function can be used to select those markings (states) within the solutions space that could lead to the optimal solution.

In industry, production requirements are defined usually as a compromise between time and cost. To assess a production process, the engineer has to be aware of performance indexes such as: total time that a part spends in a queue; total time that parts spend in transport systems; equipment utilization; proportions of time a machine is down (waiting for parts of a previous work station), blocked (waiting for a finished part to be removed), or undergoing setup operations, etc.

Attempting to group the production performance indexes, a corresponding cost function is defined. This cost function is formalized by two components: a place or “work in process” (WIP) component and a time component.

“Work in process” is the current number of pieces (or quantity of material, in the processes industry case) in the production line. In terms of Coloured Petri Nets, the WIP can be obtained by computing the sum of tokens in every place representing a stock. Thus, the cost that a company pays for pieces stored in particular queues (places), can be expressed mathematically by an objective P-function (1), where \( P_i \) represents the internal values of the place \( i \) (number of pieces or tokens stored in queue \( i \)), and \( A_i \) is a weighting parameter defined by the user.

\[
J_p = \sum_{i=1}^{n} A_i \times P_i
\]  

(1)

Note that the performance of the P-function depends on the tuning of the weighting parameters. Thus, the final user can penalize those places where tokens should not remain for long (row material places).
Example

The test-bed framework has been designed under the Object Oriented Programming paradigm to improve its reusability to support both:

- The evaluation of different search algorithms,
- A DSS to generate the best planning policy for a logistic system.

Below, the use of two different heuristics is presented to illustrate the versatility of the proposed tool.

Local Search by Amplitude

Figure 2 illustrates the possibility to open the full tree up to a certain level 1, choosing the best n nodes (system states) according to a certain cost function as the root of a new coverability tree. This operation is repeated successively until a goal state is reached. The user specifies parameters l and n.

![Figure 2. Heuristic Pruning Algorithm.](image)

## CASE STUDY

The method has been implemented by means of a computational tool, and has been proven, among others, with an example of scheduling for a Job shop system of three machines and three jobs proposed in (Yu et.al. 2003). The optimum makespan for this problem is know to be 15 time units. The system found the solution in 5 minutes exploring all the possible paths (6,667 nodes of the state space), without heuristic. The solution presented in (Yu et.al. 2003) (a similar system but that uses the ordinary Petri nets to represent the knowledge of the production system), found the same optimal solution, but exploring 36,997 nodes and bounding 40.261 nodes and the execution took 2 h to explore all the accepted paths.

A system well known is benchmarking problem that consist to solve the scheduling problem of 6 jobs into 6 machines in a job shop production system. The machine sequence of each job is known (see Table 1), and each machine can serve only one job at a time. The optimization target consists to minimize the make-span to finish all the jobs. The optimum make-span for this problem is known to be 55 time units. Table A, B y C in section 2 describes colours, places, and transitions used to model the job shop production system.

Figure 3 shows the CPN of the system, and Figure 4 illustrate by means of a Gantt diagram the results obtained when the initial state M0 corresponds to the vector:

\[ [1'(1,2,1,1)+1'(2,1,8,1)+1'(3,2,5,1)+1'(4,1,5,1)+1'(5,2,9,1)+1'(6,1,3,1)] \]

Table 1. Operations Sequence of each Job.

<table>
<thead>
<tr>
<th>Job 1</th>
<th>Job 2</th>
<th>Job 3</th>
<th>Job 4</th>
<th>Job 5</th>
<th>Job 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mac</td>
<td>Time</td>
<td>Mac</td>
<td>Time</td>
<td>Mac</td>
<td>Time</td>
</tr>
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<tr>
<td>5</td>
<td>3</td>
<td>0</td>
<td>10</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

The goal state will be to leave all the jobs with the last processing task finished. This goal is specified by the vector M:

\[ [1'(1,0,0,7)+1'(2,0,0,7)+1'(3,0,0,7)+1'(4,0,0,7)+1'(5,0,0,7)+1'(6,0,0,7)] \]

Where the wild card is used to specify that any value can be accepted.

## CONCLUSIONS

A Coloured Petri Net based state space tool has been developed in order to generate planning, routing and scheduling policies in logistic systems. The proposed framework allows exploring the state space from an initial state to a desired goal state.

The high number of decision variables in present logistic systems, usually can lead to a huge state space, which make practically impossible its computational handling. A method to tackle timed old nodes has been proposed to avoid useless redundancy information.
Figure 3. CPN of the 6x6 Job Shop System.

Figure 4. Gantt diagram with the scheduling solution.

REFERENCES


Miquel Angel Piera received his MSc (Control Engineering) from the University of Manchester Institute of Technology in 1990 and his PhD degree from the Autonomous University of Barcelona (Spain) in 1994. He participates in industrial research projects in the logistics and manufacturing field and at present he is Co-director of LogiSim, a Modelling and Simulation Institution sponsored and founded by the local government of Catalunya. Professor Piera is the coordinator of the Spanish Simulation group of the International Federation of Automatic Control. Recently, he has published a modelling and simulation book that is being used for teaching in many Spanish universities

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SIMULATION OF RAILWAY TRANSPORT

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KEYWORDS
Discrete simulation, Simula 67, object-oriented programming, bulk service model.

ABSTRACT
This paper describes discrete simulation of a simple railway transport, process of which is controlled by software developed in object-oriented language Simula 67. Classes Map, Exper and Multitask were developed to control simulation of railway transport.

The class Map describes a railway network formed by towns, switches, railway lines, and trains.

The class Exper describes simulation of railway transport; the class Multitask deals with controlling of railway simulation in its every moment through the use of keyboard or mouse.

CLASS MAP
This class contains resources for work with graphs. It creates a model of railway network where graph node points are towns and switches.

Graph edge conforms to real joins of these places that are a single-track railway.

Values of graph edge indicate real destination between towns and switches.

In order that the graph is finite and connected, then applies:

1. The number of towns, switches, and railway lines is finite.
2. At least one line leads to every town and switch.
3. A railway line cannot originate if there is no town or switch at its beginning and end.

In this class, there are definitions of procedures to find the shortest way by means of the Dijkstra’s algorithm, and to find the minimum frame by means of the Kruskal’s algorithm.

In the class Map are created:
- Procedures Input and Output - they enable to gather input data and the presentation of the results; they are specified as virtual in the class Map. That is why the modification of these procedures can be specified as lately as in the particular sub-classes in dependence of the way of gathering the input data.
- Class Towns – it enables to work with the names of towns, their coordinates in 2D space, their connection to corresponding railway lines. Two places cannot have the same coordinates.
- Class Points – it enables to work with the names of switches, their coordinates in 2D space, their connection to corresponding railway lines. Two switches cannot have the same coordinates.
- Class Rails – it enables to work with the data such as initial and final coordinates of railway lines in 2D space; their length; towns and switches connecting railway lines. This class can identify the minimum frame by means of Kruskal’s algorithm - towns form node points and the assumption is that every town is connected with every other town by means of railway lines. After finding the minimum frame, recognised railway lines and switches are created. The switches are intersection points of recognised railway lines.
- Class Trains – it works with the name, route and speed of a train, this class can find out the current position of the train and the shortest route by means of the Dijkstra’s algorithm. Every train has three options of its route. The first one is set by the sequence of towns and switches (input data), the train must go through all of them. Between every two members of such a sequence must be a railway line. The second option of the train’s route is given by the calculation by the means of the Dijkstra’s
algorithm when only the initial and final towns are known. The third option is given by the knowledge of the minimum frame; again only the initial and final towns are known. All three options are further examined in the simulation.

- Operation part of the class Map - it releases input data and their verification.

The class Map is suitable not only for railway network, it can be used as well as for road or airline network, or everywhere where people or materials are transported along fixed routes.

CLASS EXPER

This class describes discrete simulation of railway transport.

Here the means of transport are trains, lines are represented by single-track lines, places of loading and unloading of persons and material are towns, all towns are connected with railway lines, switches are determined by the points of intersection of two railway lines.

The class Exper uses already created class Map (that describes a model of railway network) and standard class Simulation. (see Figure 1).

To change planes of the simulation processes we use means specified in the class Simulation – activate, reactivate, passivate, and hold.

For describing processes in railway transport (for example train movement, loading and unloading people and materials in towns, switches actions) we use simulation processes.

The activities of these processes are modelled by the synchronised launching of pieces of these processes: PrTowns, prPoints and PrTrains.

In the class Exper are created:

- Procedures InputMap and PrintThread - they enable to use input data of the class map and to display the course of the railway transport simulation. The procedures are specified as virtual in this class. That is why the modification of this procedures can be specified as lately as in the particular sub-classes in dependence of the way of gathering the input data, for example from keyboard or file. The course of simulation is displayed e.g. on monitor or printer.

- Class Print – it enables displaying of current status in every important instant of time of the railway transport simulation.

- Processes PrTowns – they describe dispatching of the trains in towns according to the order they arrived to the particular towns. The time period they spend there is determined by the necessary time for loading and unloading of people and materials, and until the track is unoccupied. There are as many processes as towns; they are distinguished by the names of towns.

- Processes PrPoints – they describe delaying of trains in front of a switch until the train can continue on an unoccupied track. There are as many processes as switches; they are distinguished by the names of switches.

- Processes PrTrains – they describe movement of trains along railway lines. Only one train can occupy one railway line at a time. Trains can pass by only in towns. There are as many processes as trains; they are distinguished by the names of trains.

CLASS MULTITASK

This class describes simulation of simulations of railway transport. It uses the class Exper and system classes Simulation and Terminal (see Figure 2).
Figure 2. Class Multitask.

The class Multitask describes concrete simulation models of railway transport, thanks to tools of the class Terminal it can control the simulation program by means of the mouse or keyboard, and the course of simulation experiments can be displayed on a monitor.

It enables more simultaneous simulations. It is possible thanks to class Simulation; it enables to simulate different "internal" simulation of railway transport and to use a mouse or keyboard.

For describing all actions are used simulation processes, these processes are modelled by the synchronised launching of pieces of these processes: Thread, Mouse, Menu, Main_program1, Main_program2.

Pieces of all these processes are activated constantly in the same order at time 0.

This "external" simulation is extraordinary by not working with time.

In the class Multitask are created:

- Process Thread – it describes launching Mouse, Menu, Main_program1 and Main_program2.

- Process Mouse – it describes control of a mouse with the use of the class Terminal.

- Process Menu - it describes control of a menu with the use of the class Terminal.

- Processes Main_program1 and Main_program2 – they describe simulation of railway transport. This simulation is an "internal" simulation.

By this so-called „multitasking“ was introduced – the processor of the computer manages several tasks at a time in the operating system MS DOS (therefore under Windows, too).

It enables to change characteristics of towns, switches and lines during the railway transport simulation itself.

CONCLUSIONS

This paper offers a new approach towards the simulation of railway transport with the use of the tools of the object-oriented programming language Simula 67.

It describes classes Map, Exper and Multitask; these classes describe railway network, discrete simulation of railway transport and a simultaneous application on a single-processor computer.

It is interesting to observe a simultaneous course of individual simulation experiments of the railway transport with the use of different models of railway networks.

REFERENCES


BIOGRAPHY

Zdeněk Kramář teaches Mathematics and Computer science at the Nicolas Kopernikus Grammar School of Bílovec, Czech Republic.

He also progress with his postgraduate studies in applied Mathematics at the Faculty of Science of Ostrava University in Ostrava, Czech Republic.

He devotes himself to modelling and simulation of discrete systems.
SIMULATION AS A COGNITIVE METHOD IN THE RESEARCH OF SOCIAL SYSTEMS

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KEYWORDS
Socio - technical system, Simulation, Agent - Based Simulation

ABSTRACT
Vidzeme University College for regional human resources developing elaborating a new professional Master’s study programme “Research and Management of Sociotechnical Systems”. One of the most essential courses in the programme is Social Systems’ Simulation Tools and Technologies. To design the contents of this course, it is important to choose well grounded necessary tools and technologies both for training and practical needs, etc., covering a wide range of social systems utilization.

The authors offer the quantitative research method to provide the choice of the most frequently used tools on the Internet from all the simulation tools being on offer at present.

INTRODUCTION
We are living in a period of accomplishment of the new information society. Any society can be considered as a large and complicated system of exchange and processing of information.

The level of development of knowledge and information technologies has reached the critical mass causing the consecutive technological revolution in the world. Rapid exchange of information and knowledge enhance utilization of information and knowledge at work and in work relationships, studies, and everyday life. The knowledge becomes important, even strategic national wealth like natural resources and sources of energy.

For centuries, people have been interested in the question whether it is possible to describe the regularities of social processes in the society. Discovering them it would be possible to create models of social systems allowing to forecast not only the trends of society development, infrastructure, but even events.

One of the cognitive methods is modelling, including simulation leading to sufficiently precise systems analysis for different goals. Currently we can find enough information on simulation methods, for the implementation of which a large number of tools are applicable.

The problem is how to choose the optimal tools or packages. To clarify what is essential in the choice of analysis of the given social system type, how large the spectrum of problems is that we can use with the chosen package.

TECHNICAL VS. SOCIAL SYSTEMS
The name “System” has a Greek origin meaning combination, arrangement (Dictionary of foreign words, 2004). The scientific literature offers many definitions of systems:

- A system is an entity ensuring its existence and interaction of its component parts (Shannon et.al. 1975);
- A system is a set of objects united for continuous interaction or interconnectedness for reaching a certain goal. (Omsk State University, 2000);
- A system is a set of elements which are in mutual connection and relationship creating a qualitatively new entity (Averil et.al. 2004);
A system in mathematics is a set of mutually connected mathematical elements, which can be used for doing specific operations. For example, an algebraic system, systems of calculation, systems of functions, vectors, and equations (Grundšpeņķis et al. 1983).

The question connected with the conception of systems, the creation of a system, systems classification, quality of systems, etc., is a topic of systems theories studying the basic general conceptions and mathematical aspects of functioning (Grundšpeņķis et al. 1983).

As a result, we can look at the system as a set of elements where each element has its typical qualities, but the links among the elements in the set provide new qualities for the system, which are not possessed by the elements taken separately.

As a whole the system has to act according to the synergic principle stating that “the whole is bigger than the sum of its parts” therefore the systems approach stresses the necessity to study the system as a whole, not only its separate parts.

Systems classification is wide and depends on granted priorities: branch, component elements of the system, the system characterising activities or any other typical features of the system.

At present, there exist versatile classifications of systems. Traditionally, depending on component elements of the systems, it is accepted to divide the systems at least in two groups:

- Technical systems;
- Social systems.

While designing the technical systems, we dissociate from human factors, but when the aim is to optimise, for instance, the traffic, the technical system modeling does not sufficient, because it is important to take into account the existing conditions, where a human appears as the basic element. As soon as a human enters the technical system, we may not talk of it as a technical system, but as a social or a socio-technical one.

According to the systems theory of Schmidt and Taylor, a system is a set of objects (people, mechanisms) functioning and interacting to reach a certain goal (Averil et al. 2004).

A simplified form of a Goal Systems model $M$ can be seen as a mathematical relation $F$ between input set $X$ and output set $Y$ (see Figure 1).

![Figure 1. Functional model of a goal system.](image)

Where $Y = F(X, Z, H)$  \hspace{1cm} (1)

$H$ – impact of external environment, often ignored or researched only as a restricted set of external factors, but $Z$ – feedback.

In the case of social systems, $H$ is the human factor, the influence of which has a crucial role defining the $Y$ set, therefore the next position of the system:

$Y_i = P(Y_{i-1})$  \hspace{1cm} (2)

is always accepted with a probability $p(t)$. This is the typical difference between the technical and the social systems.

TECHNICAL VS. SOCIAL SIMULATION.

While doing scientific research of systems, usually certain assumptions of the functioning of the system are used. These assumptions are given in the form of mathematical or logical relationships describing the model $M$ of the Goal System (see Figure 1).
If the relationships forming the model are relatively simple, mathematical methods or analytical modelling can be applied. However, with more complicated systems having many influential factors, or when the influence of the factors is difficult to be defined, the simulation methods are used for a sufficiently precise description of the model.

The aim of simulation is to understand and forecast the behavior of the system or to evaluate different strategies of activity (regarding certain restrictions or set criteria) in the processes of the system, namely, for:

- The process analysis and forecast of social processes which are taking place in the society;
- Design and analysis of manufacturing systems;
- Research of financial and business systems;
- Modelling of biological systems;
- Assessment of different military systems and evaluation of material technical basis;
- Defining telecommunications and data exchange protocols and stating requirements for the relevant equipment;
- Tourism systems analysis;
- Transport and logistics systems design and operation analysis;
- Assessment of projects for mass services of different organisations;
- Modernisation of different processes in the applied sphere and in communication;
- Teaching and training, especially in Edutainment (education + gaming).

The most essential nuance between the simulation tools of the technical and social systems is the ability to provide the structural and algorithmically changes of the model in the modelling process, taking into consideration the ability of the human factor to acquire new knowledge and skills, and generate a new output.

Certain tools are used for simulation both technical and social systems. They can be classified into groups:

**According to the mode of access:**
- Local;
- Web access;
- Distributed.

**According to the description of the goal systems model:**
- Flow model;
- Process model.

**ESTIMATION OF SIMULATION TOOLS**

There are different classification types of simulation tools one of which might be problem orientation. This allows dividing the package into two groups:

- Universal packages;
- Problem oriented packages.

Universal packages (Averil et.al. 2004) for instance are:

- Arena (Systems, 1999; Kelton et.al., 1998);
- Extend (Imagine, 1997);
- AweSim (Pritsker and O’Reilly, 1999; Symix, 1999);
- GPSS/H (Henriksen and Crain, 1994; Schriber, 1991);
- Micro Saint (Micro, 1998);
- MODSIM III (Banks et al., 1996; CACI, 1997; Marti, 1999);
- SES/workbench (SES, 1998);
- SIMPLE++ (Tecnomatix, 1998);
- SIMUL8 (Visual, 1999);
- SLX (Henriksen, 1998).

Problem oriented packages are following.

**For simulation of manufacturing systems:**
- Automod (AutoSimulations, 1999);
- AutoSched AP (AutoSimulations, 1999);
- Extend + Manufacturing (Imagine, 1997);
- Arena Packing Edition (Systems, 1999);
- ProModel (PRMODELL, 1999);
- UEST (Deneb, 1998);
- Taylor Enterprise Dynamic (F&H, 1998);
- WITNESS (Lanner, 1998).

**For simulation of communications networks:**
- COMNET III (CACI, 1999);
- IT DecisionGURU (MIL 3,1999);
- OPNET Modeler (MIL 3, 1999).

**For simulation of modernisation and service processes:**
- Arena Business Edition (Systems, 1999);
- Extend + BPR (Image, 1998);
- ProcessModel (ProcessModel, 1998);
- ServiceModel (PRMODELL, 1999);
- SIMPROCESS (CACI, 1998).

**For simulation of medical institutions:**
- MedModel (PRMODELL, 1999).

**For simulation of Call processing centres:**
- Arena Call Center Edition (Systems, 1999).
- Some tools for the social systems simulation can be named as relatively wide used (Ginters et.al. 2002):
  - SWARM;
  - RePast (REcursie Pours Agent Simulation Toolkit);
  - AnyLogic;
  - StarLogo;
  - AgentSheets;
  - SDML (Strictly Declarative Modeling Language);
  - MAGSY (OZ Language, InterRap);
  - MIMOSE (Micro and Multilevel Modeling Software).

Our task is to find an environment, which could be utilized for as wide range of social systems as possible.
To investigate the quality and functionality of the offered tool and its application options, it is essential to acquire information about the range of applications for the specific tool.

By using the quantitative research method, it is possible to count references on the Internet about the chosen set of simulation tools $T_M$:

$$T_M \subseteq \bigcup_{j=1}^{N} T^j_M$$

(3)

Where $T^j_M$ – the specific tool of simulation of social systems (for instance, SWARM).

Following the change of the number of references, using, for example, Google with the given modelling tool (see Table 1) we will acquire data characterising the prevalence of the specific tool in the given year. The method is not applicable for precise analysis, however, it allows to state the trend, thus giving a sufficient notion whether the package is still popular, whether it is used frequently enough, if it has maintained and the authors’ support, if it is compatible with other information processing environments and systemic tools.

Table 1. Number of references $W^j_M(T^j_M)$ (at search engines).

<table>
<thead>
<tr>
<th></th>
<th>Gads</th>
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</table>

This will allow to choose the most appropriate sets of simulation tools both for the aims of training and for utilisation where:

$$W^j_M(T^j_M) \rightarrow \max$$

(4)

as well as sufficiently wide possibilities for using them in analysis of different orientation of social systems.

Considering the results, we conclude that packages for technical systems simulation prevailing over the tools aimed to social systems simulation. If many simulation packages exist useful for technical systems simulation by non-programmers, then for social systems simulation mostly is necessary good programming skills. The author’s choice of the simulation tools for training is following:
• SWARM™ is selected as classic wide used multi agent-based simulation tool. The package demonstrates enviable stability and viability during last ten years. SWARM will be well suited for programming fans;

• AgentSheets™ is selected as good sample of cellular automaton used for agent-based simulation of social systems and appropriate for attracting non-programmers;

• Extend™ is well-developed and maintained general-purpose tool that would be used for discrete-event as well as continuous simulation of sociotechnical systems.

CONCLUSIONS

It is difficult to separate social systems from technical systems and vice versa. Almost any system has two sides, for example, a traffic management system. On the one hand, it is a technical system, for example, managing of traffic lights, on the other hand, the vehicle is driven by a person, which is the human factor, and the human action depends on the set of different factors. Thus, simultaneously, it is also a social system requiring a different approach. This means that both types of modelling are inseparable. It requires a complex approach, relevant tools, and specialists. Vidzeme University College will ensure training of such specialists in its Master’s programme “Research and Management of Sociotechnical Systems”.

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REFERENCES


Аверилл М. Лоу, В. Дэвид Кельтон, Имитационное моделирование, Издательская группа ВНУ, Киев, 2004.


http://www.univer.omsk.su/socsystextbook.win.html


Carson and Nelson ”Discrete-Event System Simulation”, 1996


http://www.uni-koblenz.de/~kgt/Learn/Textbook/Book.html, May, 2005


BIOGRAPHY

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USING OF CELLULAR AUTOMATA IN AGENT-BASED SIMULATION FOR REGIONAL DEVELOPMENT

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KEYWORDS
Simulation, Cellular Automata, AgentSheets

ABSTRACT
This article describes different cellular automata in agent-based simulations that can help regional development.

INTRODUCTION
The term “agent-based” refers to a particular type of simulation. Agent-based simulations have two essential components, agents, and environment:

• An agent’s behavior is the result of rules based on local interactions.

• The environment has certain autonomy, i.e. it has a certain level of independence from what the agents do, but it can also be influenced by the agents’ behavior.

The interaction of agents among each other, as well as the interaction of agents with the surrounding environment is modeled. (Pleifer R. et.al. 2003)

A cellular automaton is a collection of “colored” cells on a grid of specified shape that evolves through a number of discrete time steps according to a set of rules based on the states of neighboring cells.

The rules are then applied iteratively for as many time steps as desired (Wolfram et. al. 1999-2005).

These programs help regional development by giving information, during analysis of a goal system, what will happen in future and in different situation.

COMPARISON OF CELLULAR AUTOMATA SIMULATION ENVIRONMENT
In this article are surveyed pluses and minuses of different programs - AgentSheets 2.2.5.2, RePast 3, StarLogo 2.1, NetLogo 2.1, MadKit 3.1b5, Ascape 1.9.1, AnyLogic 5.2., Moduleco 1.47 , Breve 2.2, SeSAm 1.8, what depends on following criteria:

• Users – programmers or non-programmers;
• Applet (can or cant create);
• Specific options (sound, drawing options etc);
• Data output;
• Chart options (plot style, grid, labels axes);
• Help system;
• Tutorial (do you need to read tutorial to start use this program);
• User interface;
• Data import/export facilities;
• Examples (amount examples of model).

However, some most popular of these programs are SeSAm, RePast, Breve and NetLogo, whereof indicated in google.lv searching.

AGENTSHEETS 2.2.5.2
AgentSheets is created by AgentSheets Inc. AgentSheets Inc. is a privately held company founded in 1996 and the software is popular in the education market.

AgentSheets runs on both: Windows Macintosh platforms. To use AgentSheets on pre-OS X (at least version 8.6) you will need at least 8MB of RAM (16MB recommended) and 20MB free disk space, but on OS X 10.1 and later versions you will need 30MB free disk space.

To run AgentSheets on windows 9x (95, 98, ME), 2000, XP minimum requirements are 64mb (96 recommended) of RAM and 35MB of free disk space.

With AgentSheets can create interactive games, virtual worlds, training simulations, information gathering and personalizing agents, and other interactive content (Agentsheets, Inc et. al. 2003).

Therefore, current environment would be used for designing of Edutainment objects.
For instance, this interactive simulation presented aquarium with fishes (blue fishes are healthy, but red ones are ill) would be used as basement for environmental protection modelling.

The task simulates how long time takes until ill fishes infect healthy. But we can imagine that aquarium is, for example, Burtniekku lake (see Figure 1).

Figure 1. Simulation scene in AgentSheets.

Benefits:
- User friendly interface;
- Can use non-programmers;
- Can include sounds;
- Can create plug-in for AgentSheets (e.g. new methods);
- Easy to make Java Applet;
- Interactive (can add and remove agents in Java Applet also);
- Tactile programming;
- Drawing options;
- Wide range of example models;
- Can import agents;
- Can load worksheet background;
- Can export plot data to excel.

Disadvantages:
- Could not make data output were want, but only in message box, which is bellow the worksheets;
- Creating plug-in, need programming knowledge’s;
- There can be much better Plot (e.g. can choose type of Plot and the X – axis, Y– axis labels :)
- Cannot see Java file source.

REPAST 3

Many people have worked to build Repast. Core developers (Nick Collier and others) write most of the code in the framework, but contributors provide bug fixes and also powerful new features.

Repast is available on virtually all-modern computing platforms including Windows, Mac OS, and Linux. The platform support includes both personal computers and large-scale scientific computing clusters. (RePast et.al. 2003)

Possible Repast modeling application areas:
- Agent-Based Computational Laboratories
- Learning and the Embodied Mind
- Evolution of Economic Institutions and Social Norms
- Evolution of Economic Networks
- Industrial Organization
- Technological Change and Economic Growth
- Financial Market Issues
- Agricultural and Natural Resource Issues
- Labor Market Issues
- Restructured Electricity Markets
- Design of Auctions and Other Market Forms
- Automated Markets and Software Agents
- Organization of Firm and Markets
- Multi-Market Modeling
- Network, Path-Dependence, and Lock-In Effects
- Political Economy
- Parallel Experiments with Real and Computational Economic Agents
  (Tesfatsion L. et.al 2005)

Benefits:
- Chart system is well considered. You can write the chosen value on X and Y axes;
- You can choose different kind of models (GIS model, network model, grid model);
- Good help system;
- Can export to Java.

Disadvantages:
- Can’t use non-programmers;
- Before start work with program, need to read a manual;
- Can’t make Java Applet;
- Only few example models.
STARLOGO 2.1

StarLogo developed by Eric Klopfer, and others at the Media Laboratory, MIT, Cambridge Massachusetts, with support from National Science Foundation and the LEGO Group.

To use StarLogo, you will need to have a version of Java 1.4 or higher installed on your computer. StarLogo supports Windows, UNIX, Solaris, Linux platforms and MacOS X 10.2.6 and higher with Java 1.4.2 update installed.

However, there are problems with MacOS X Java. StarLogo will no longer runs on MacOS 9, because it does not support Java 1.4.

StarLogo is a programmable modeling environment for exploring the workings of decentralized systems -- systems that are organized without an organizer, coordinated without a coordinator.

With StarLogo, you can simulate (and gain insights into) many real-life phenomena, such as bird flocks, traffic jams, ant colonies, and market economies (starlogo et.al. 2003)

Benefits:

- User friendly interface;
- Developed successful chart system (you can point minimal and maximal value, or grid background. Also can point refresh rate);
- Five kind of charts (line, bar, histogram, scatter plot, x-y plot);
- Drawing options;
- You can save a project as WEB page;
- Can import/export picture;
- Can print simulation code and worksheet interface;
- Quite lot of example models.

Disadvantages:

- Can’t use non-programmers;
- This program in help menu bar has only FAQ with five questions and answers; if you need help, then you must go to programs homepage.

NETLOGO 2.1

NetLogo runs on MacOS, Windows, Linux platforms and should work on other platform on which a Java Virtual Machine, version 1.4.1 or later, is available and installed. Version 1.4.2 or later is preferred.

On all systems, you need approximately 25MB of free hard drive space.

To run NetLogo on Windows NT, 98, ME, 2000, XP you need at least 64MB RAM or probably more for NT, 2000 and XP, but to run on Mac OS X (at least version 10.2.6) you need 128 MB of RAM (256 MB RAM recommended).

You can choose to include a suitable Java Virtual Machine (JVM) when downloading NetLogo. If you want to use a JVM that you install separately yourself, it must be version 1.4.1 or later. 1.4.2 or later is preferred. (Wilensky et.al. 1999).

On OS X, the Java Virtual Machine is supplied by Apple as part of the operating system. OS X 10.3 includes an appropriate JVM. OS X 10.2 users must install Java 1.4.1 Update 1, which is available from Apple through Software Update.

For OS X 10.3 users, installing Java 1.4.2 Update 1 is recommended, for improved application reliability. The update is available from Apple through Software Update (Wilensky U. et.al. 1999).

Operating systems Mac OS 8 and 9 are no longer supported by the current version of NetLogo. MacOS 8 and 9 users should download NetLogo 1.3 instead (Wilensky U. et.al. 1999).

With NetLogo you can model in different kind areas. You can model in the natural and social sciences, including biology and medicine, physics and chemistry, mathematics and computer science, and economics and social psychology.

Benefits:

- Easy to make Java Applet;
- Three kind of plots (line, bar, point);
- Wide range of examples of model;
- Easy help system in HTML format;
- Can export plot and world to Excel.
- Can export graphics and interface as picture.
- Can import from Excel.
- Wide range of example models.

Disadvantages:

- Can’t use non-programmers;
- You can’t have grid chart background;
- Need to read a user manual.
MADKIT 3.1B5

MadKit developed by Olivier Gutknecht and others. MadKit is operating system independent (written in an interpreted language).

MadKit uses a Java 1.3. It uses only the JRE (run time support) for its own purpose, but if you want to develop your agents in Java, you should have a JDK 1.3 (or higher, we use JDK 1.4 for our own purposes) installed (Madkit team et.al. 2005).

MadKit is a multi-agent platform for developing and running application based on an organizational oriented paradigm. This multi-agent paradigm uses agents, groups, and roles as the basic standpoint for building complex applications. MadKit does not enforce any consideration about the internal structure of agents, thus allowing a developer to freely implements its own agent architectures.

Benefits:
- Good help system;
- Wide range example of models.

Disadvantages:
- Non friendly user interface (fading menu, what makes difficult to work with this program);
- Complicated modeling;
- Can’t export any data;
- Cannot use non-programmers;
- Cannot choose charts.

ASCAPE 1.9.1

Ascape developed by Miles Parker of the Brookings Institute in Washington, DC.

This version of Ascape works with Java version 1.1.x, meaning that it is compatible with all Mac systems and web deployment.

Ascape should work fine in JDK 1.2 and 1.3, but needs a few minor package related changes if you wish to recompile the aa.LHV "Long House Valley" Models (The Brookings Institution et.al. 2000).

Ascape was developed primarily to support models of social and economic systems, which typically comprise agents with rules of behavior interacting in networks (e.g. regular lattices, random graphs, soups), but the framework may be adaptable to other model types.

Benefits:
- Non-programmers can successfully modify existing examples;
- Chance to make own charts. There are three types – line, histogram and pie chart;
- Quite lot of example models.

Disadvantages:
- To make own models, you need additional program (It is not necessary to have an IDE (Integrated Development Environment) such as Symantec Visual Cafe, IBM’s VisualAge, Metrowerk’s CodeWarrior or Borland’s JBuilder);
- Can’t export plot data;
- There is no help system.

ANYLOGIC 5.2

AnyLogic developed by XJ Technologies. XJ Technologies is a privately owned company with office located in Saint-Petersburg, Russia and a large network of partners worldwide.

AnyLogic runs on Windows XP with service pack 1 and Windows 2000 with service pack 4.

You need at least Pentium III or compatible processor (1 GHz recommended), 256MB of RAM (512MB recommended), 170MB free disk space (250MB during the installation) and 1024x768 resolution monitor.

In addition, you need Microsoft Internet Explorer 5.0 or higher and Java 2 plug-in to run models as applets in browser.

With AnyLogic can develop agent-based, system dynamics, discrete-event, continuous and dynamic system models, in any combination.

Benefits:
- Easy to create applet;
- This program has wide range of modeling options. You can model in strategic level, operational level and physical level;
- Detailed manuals;
- Also have 3D animation;
- Excellent data output options;
- User friendly interface;
- Can export chart data to excel;
• Wide range of example models.

Disadvantages:
• Complicated program;
• Can’t use without programming knowledge;
• Need to read manuals before start to work with this program.

MODULECO 1.47
Moduleco is a modular multi-agent platform designed to simulate markets, organizations, social phenomenon, and population dynamics.

Its intended audience is economists, physicists, and computer Scientists.

It is implemented in Java, and runs on all platforms (Windows, GNU/Linux, MacOS, etc) with a Java Virtual Machine (Java version 1.4 or higher) (Phan D. et.al. 2004).

Denis Phan, ENST-Bretagne, France, and Antoine Beugnard originally created Moduleco, but now Gilles Daniel, University of Manchester, UK, and Denis Phan maintain it (Phan D. et.al. 2004).

Benefits:
• Non-programmers can modify existing models.
• Can print graphic;
• Quite lot of example models.

Disadvantages:
• Non-programmers can’t make their own models, because need programming knowledge;
• Poor graphical user interface;
• Can’t make own models via graphical interface;
• Bad help system.

BREVE 2.2
Breve was initiated by Jon Klein as a thesis project at Hampshire College and was developed further into a Master's thesis at Chalmers University (Klein J. et.al. 2005).

Breve runs on Mac OS X, Linux, and Windows operating systems.

With Breve you can model a wide variety of simulation applications: simulated virtual creatures, artificial ecosystems, simulations of molecular biology, visualization and much more.

Breve facilitates the construction of complex agent-based simulations by automatically handling agent communication, representation in 3D space, graphical rendering, physical simulation, and a number of other features that are useful to agent-based simulations.

Benefits:
• Can model 3D simulation;
• Full help system;
• Quite lot of example models;

Disadvantages:
• Can’t use non-programmers;
• Can’t make Java applet;
• Can’t import/export data;
• Poor graphical user interface.

SESAM 1.8
SeSAm was developed at the University of Würzburg. The SeSAm Team currently consists of Franziska Klügl, Christoph Oechslein and others.

SeSAm runs on Windows, Linux, Mac OS X 10.0 or later and other Java-enabled platforms.

As a graphical interface for implementing a simulation model, SeSAm provides built-in animation capabilities, tools for collecting and analyzing protocol data, etc.

The simulation tool is domain-independent. Existing models vary from the simulation of social insects to businesses process modeling (Universität Würzburg et al. 2005).

Benefits:
• User friendly interface;
• From Internet can download full manual of this program.

Disadvantages:
• Few example models;
• Complex program;
• Need to read manuals before start to work with this program;
• Need programming basic knowledge;
• Can’t create Java Applet;
• Can’t export plot data;
• In program have no help manual.
CONCLUSIONS

After analyzing pluses and minuses of different kind cellular automata in agent-based simulations some conclusions would be made:

- Non-programmers can work only with AgentSheets.
- Ascape 1.9.1. With this program also can work non-programmers, but in existing model modifying variant.
- The best graphic effect program is AnyLogic, but it has complicated interface and need quite a lot of programming knowledge.
- The best of help systems I liked was in RePast 3, because it makes work faster and easy to find needed information.
- Overall MadKit is good program, but of having fading menu, it is difficult to work with it.

After analyzing different programs, what depends on above-mentioned criteria it is concluded that most useful program in social study process would be using the AgentSheets, because non-programmers can use it.

In addition, this program runs on different kind of operating and need not powerful PC system requirements. That can be used as extra material in learning process. AgentSheets program is simple and in future, it will be used in mobile solutions, for example in mobile phone.

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REFERENCES


BIOGRAPHY

Ieva Lauberte is student of Vidzeme University Colledge. She studies in faculty of Information Technologies third course. Her research field includes agent-based simulations and agent-based toolkits.
USAGE OF FRAME SYSTEM FOR MODELLING OF INTELLIGENT TUTORING SYSTEM ARCHITECTURE

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KEYWORDS

Intelligent tutoring systems, frame systems.

ABSTRACT

This paper presents the design of multi-agent system (MAS) for simulation of tutoring/learning process. An approach is based on a frame system that uses structural modelling principles for representing agents in MAS. It is necessary to make experiments with tutoring techniques, methods, and strategies, tutoring material representation and delivering order of it to find better ways how to perform cognition promoting learning. Analysis of these experiments will allow assessing decisions made, and success of learning process depending on selected tutoring strategies. It will increase student’s role in learning. The more forms of information, data, knowledge exists, the larger chance that Student agent can find a form that will help to learn in the best possible manner is. During the last decade informatization of schools and libraries has widely increased computer availability in regions of Latvia that facilitates formation of information society. Intelligent tutoring systems can have large prospective in pupils and students tutoring as well as in life-long learning.

ARCHITECTURE OF INTELLIGENT TUTORING SYSTEMS

Computer-based learning, especially intelligent tutoring systems provides tools to create personalized tutoring according to user feedbacks in order to find best ways of tutoring. Use of multi-agent systems in tutoring makes it possible to support the development of more interactive and adaptive systems. Agent can easily perform complex operations based on their goals (Shen et al., 2005). A multi-agent intelligent tutoring system (Garro and Palopoli, 2002) extends a traditional course management system with a set of “intelligent” functions allowing student modelling and automatic curriculum generation (Capuano et al., 2000).

Set of agents can be used instead of traditional modules in intelligent tutoring systems. Each of agents provides achieving the same objectives as modules. The tutoring agent can create and expand the curriculum, communicate with students as well as store several tutoring strategies. The Student agent can perform learning using delivered materials by the Tutoring agent. It also stores knowledge about learner’s personality and habits of learning (Grundspenkis and Anohina, 2005).

PROPOSED ARHITECTURE

For modelling tutoring/learning process we propose MAS (Weiss, 1999; Wooldridge, 2002); usually MAS and separate agents are used in providing tutoring process, as pedagogical agents (Johnson, 2003; Dorca et al., 2003; Grundspenkis and Anohina, 2005) other agents that support student activities, like filtering agents, search agents, recommender agents and other personal agents (Grundspenkis, 2003).

In our proposal humans and/or their communities are replaced with agents to perform experiments with large and complex systems within they are involved, like education in our case. Our conceptual MAS consists of four agents (see Figure 1), namely, a Tutor agent that simulates the real tutor and has knowledge about tutoring process and particular courses; a Student agent that corresponds to real student and it has knowledge about learning process and possibilities to get additional information, not only delivered one by the Tutor agent; a search agent that supports search of additional information using internet, intranet and available databases, a Communication agent that provides communication and collaboration protocols.

![Figure 1. Hierarchy of agents.](image-url)
Agents in a MAS necessarily interact with other agents to achieve their goals, such as performing students tutoring. There are interactions needed for finding solutions of the problems, like choosing the proper tutoring strategy. Figure 2 shows main information and data flows between agents that provide interactions in a MAS. The Tutor agent delivers course materials, quizzes and results to the Student agent and receives from it answers to quizzes. The Student agent can make questions if course materials are hard to understand. Questions are given to the Search agent to find information on the Web, in databases and other resources. In our case the Tutor agent includes functions from test agents and content manager which are used in other architectures (Graudina and Grundspenakis, 2005).

**Frame system**

Usually a frame system represents a hierarchy of frames. Two or three level hierarchies of frames are commonly used, namely class frame, subclass frame and instance frame. In our proposed MAS architecture each agent’s knowledge base is represented by several frames (see Figure 3). Traditional frame hierarchy is kept. Different types of frames describe agent properties, behaviour etc. Usually to describe one concept one frame is used, but in our proposal we use frame set instead of one frame. That provides static and dynamical description of different agent characteristics, behaviour, knowledge etc. Each of MAS agents’ describing frames is specific data structure. Each agent is represented by one class frame, which contains general information (agent name, superclass name). One class frame can be connected with 0..N procedure frames and contact frames where N is a number of connected frames. Procedure frames store knowledge about reactions to changes in other frames and change slots of other frames according to captured rules about processes simulated. Contact frames store information about agent communication moments and information exchanged. Contact frames have special properties called behaviour frames, which store agents’ activities and reactions. One contact frame includes 3..N properties. The number 3 is gained from the predefined properties (Function, Number of Contact frames, Number of Procedure frames). Each property list can have 0..N behaviour frames. Property list is the list of all defined contact frame properties.

![Figure 2. Interactions between agents.](image)

The Tutor, Student and Search agents are subclasses of Communication agent and they inherit its knowledge. A frame system is used to describe agents as concepts with corresponding instances.

**Representation of agents’ knowledge base**

In this section we represent knowledge that is recommended to be stored in agents of proposed MAS. We show knowledge base of the Tutor agent. Other agents are described in same manner. Since the Communication agent is used for providing system’s functions, activation of actions and organisation of interaction, we can say that ITS actually consists of three agents which are subclasses of Communication agent that is an abstract class. Subclasses inherit knowledge about interaction and communication protocols from the Communication agent.

Remaining part of this section contains the description of the Tutor agent, its behaviour, actions, and functions using frame system. In Figure 4, Figure 5, Figure 6, and Figure 7 words in italic are values that are user-defined or automatically updated. Asterisk (*) points predefined slots. All empty fields can be specified later by user depending on particular course. User-defined properties follow after - - - - line.
Figure 4 shows the Tutor agent’s class frame. Tutor agent has following functions:

- Deliver course materials (lecture notes, course outlines, reading lists, assignments for each course) according to students’ learning style and preferences (at first time course material is delivered according to curriculum built in the tutor agent or entered by the human who makes experiments with the system; the material can be evaluated with other materials).
- Store student’s learning preferences (keeping track on student-performed actions (mouse cursor movement, link history) and given feedback; preferences help to find appropriate, individual way to represent course material).
- Identify Student’s current level of knowledge and skills (identifying of effectiveness of learning by using different testing and assessment methods (Race, 1994)).

If we consider that we have defined only one contact frame and one procedure frame, then values N and M is automatically set to 1.

<table>
<thead>
<tr>
<th>Contact frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name/identifier</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Flow name*</td>
</tr>
<tr>
<td>Type (input/output)*:</td>
</tr>
<tr>
<td>Connection with another class frame contact*:</td>
</tr>
</tbody>
</table>

| Behavior frame 1: |
| The combination of the course material |

| Behavior frame 2: |

| Behavior frame N: |

N – value is computed automatically
M - value is computed automatically

Figure 5. The Tutor agent’s first contact frame.

Figure 6 shows details of previously defined behaviour frame. Parameter name/identifier begins with symbol “P” and numbers (x, y, z and q) separated with symbols “-” and ends with user-defined parameter name. The number is automatically assigned, where x is a class frame index number in the frame system, y is a contact frame index number in particular class frame, z is a behaviour frame index number in particular contact frame and q is a parameter index number.

Course material can be combined of a text, some visualizations and audio. In behaviour frame these are defined as parameters P_1_1_1_1_Text, P_1_1_1_2_Visualisation and P_1_1_1_3_Audio, with values 0.65, 0.25 and 0.1 that shows text, visualisation and audio proportion. Internal links show relations between defined parameters, that is important in cases if there are parameters which are not interconnected in bounds of behaviour frame. External links show relations with parameters from another frames.

<table>
<thead>
<tr>
<th>Behaviour frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name/identifier</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Number of parameters*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name/identifier</td>
</tr>
<tr>
<td>P_1_1_1_1_Text</td>
</tr>
<tr>
<td>P_1_1_1_2_Visualisation</td>
</tr>
<tr>
<td>P_1_1_1_3_Audio</td>
</tr>
</tbody>
</table>

Figure 6. The Tutor agent’s first behaviour frame.
Figure 7 shows the Tutor agent’s first procedure frame, which defines procedures that are called by changes in other slots’ values.

### Procedure frame

<table>
<thead>
<tr>
<th>Name/identifier</th>
<th>Course material delivering changes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Properties</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Name</strong></td>
<td>Value</td>
</tr>
<tr>
<td>Number of procedures*</td>
<td>2</td>
</tr>
</tbody>
</table>

### Procedure

<table>
<thead>
<tr>
<th>Type</th>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>If Changed (GET Course contents)</td>
<td>IF Course_contents=&quot;*&quot;, THEN Send_Message: &quot;The course contents are deleted!&quot; AND Course_contents=&quot;Not Available&quot;</td>
<td>If someone change the property Course_contents, then the warning message to the user is sent and a new value for the property assigned</td>
</tr>
</tbody>
</table>
| If Deleted (GET Course contents) | IF 1_1_1_Text_CURRENT
P_1_1_1_2_Visualisation = P_1_1_1_2_Visualisation
P_1_1_1_1_Text_LAST THEN
P_1_1_1_1_Text_LAST
P_1_1_1_2_Visualisation = P_1_1_1_2_Visualisation + 1 | If someone delete the defined actions following the defined actions |
|               | IF 1_1_1_Text_CURRENT= P_1_1_1_1_Text, LAST THEN P_1_1_1_2_Visualisation = P_1_1_1_2_Visualisation + 1 | If someone change the parameter P_1_1_1_1_Text then changes the parameter |

**ROLE OF ITS IN REGIONAL DEVELOPMENT**

Latvian society also definitely moves towards information society, although it happens slowly. Information society is characterized by usage of IT, including Internet. Unfortunately, development is not equal in all regions. At present there are computers in almost all regional centres, libraries, there is Internet connection in many places, and it would be great beginning of developing the region. Different study programs built in intelligent tutoring systems contribute inflow of new knowledge to the region, thus increasing its level of knowledge. Usage of ITS for long time is profitable investment, because people won’t need to go away from home to get qualitative education. Education opportunities in regions could promote that working people stay in region rather than going to big cities or abroad, looking for job and education.

**RELATED WORKS**

Our search for related works confirms that the proposed approach for describing agent’s inner structure is a novel approach. In our first paper concerning this approach (Valkovska and Grundspenkis, 2005) we have presented this approach in general. Now we are applying this approach for particular case that describes knowledge bases of agents involved in intelligent tutoring systems.

Related works concerning different intelligent tutoring systems are rather many; they present different architectures of them (Grundspenks and Anohina, 2005; Capuano et al., 2000; Dorca et al., 2003). Simulation in education mainly is concerned with different animated pedagogical agents. Classical examples of pedagogical agents described in the literature are Adele (Johnson et al., 1998) and Steve (Rickel and Johnson, 1998). Typically animated pedagogical agents emulate the aspects of dialogue between a human teacher and a learner. In field of agent-based simulation of education we have found only SimEd for simulation and modelling of search for the optimal educational policy (Sklar et al., 2004).

**CONCLUSIONS**

This paper describes novel approach of how to represent agents included in intelligent tutoring system architecture. We show how to define agents using frame system. We propose to define agents’ knowledge base with different frames (class frame, contact frame, behaviour frame and procedure frame). Frame system uses structural modelling principles for representing agents in MAS. We show example of proposed frames’ structures used to describe main issues of the Tutor agent.

**REFERENCES**


BIOGRAPHY

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AN ADAPTABLE COMPUTATIONAL MODEL FOR SCHEDULING TRAINING SESSIONS

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KEYWORDS

Scheduling, School Timetabling, Genetic Algorithms, Neural Networks

ABSTRACT

Human resources management is a significant item of many kinds of activities, and it commonly involves various scheduling events. In terms of computational complexity, scheduling is a highly constrained combinatorial problem, which is often being solved by evolutionary techniques, such as genetic algorithms (GA). Human resource planning is often characterized by a great extent of human factor to be considered, so it could turn out hard for it to be reduced to a constraint satisfaction problem. For solving such problems the paper proposes the GA model reinforced by neural networks in order to provide GA with an adaptable rating procedure. As a case of scheduling, school timetabling has been analyzed to demonstrate the idea. The computer system using the proposed model is still being developed, and the goal of the paper is to describe the new methodology.

TIMETABLING PROBLEM

The timetabling problem is a highly constrained combinatorial problem and has an NP-complete degree of complexity (Arous et al. 1999). Various kinds of timetabling problems differ in terms of constraints to be observed and objectives involved. For instance, the timetabling in schools may differ a lot of the one in universities. This paper deals with school timetabling as a case of scheduling.

In general scheduling problem, events must be arranged around a set of time slots, to satisfy a number of constraints and optimize a set of objectives. Events to be arranged are lessons. Resources, to be referred by constraints and objectives are groups of trainees (groups), teachers and classrooms (rooms).

There are two types of constraints – hard and soft (Fernandes et al. 1999), (Tam et al. 2003).

Hard constraints:

- A group, a teacher, or a room cannot be assigned to more than one lesson in the same time slot,
- A group, a teacher or a room cannot be assigned to a time slot if a predefined unavailability exists,
- The assigned room should be large enough for the group,
- The assigned room should contain all features necessary for the lesson.

A few of soft constraints:

- Avoid gaps as much as possible,
- Arrange lessons uniformly over the days of week,
- Observe limitations on faculties of teachers and trainees,
- Observe predefined recommendations as much as possible,
- Balance the layout of lessons in terms of themes (subjects),
- Some lessons need more then one period in turn.

In timetabling of training sessions, especially in school timetabling, an important problem is the human factor involved, e.g. thematic arrangement of lessons according mental faculties of trainees. It makes constraints hard to define and even hard to recognize, so it becomes more difficult to obtain really usable timetables.

GENETIC ALGORITHMS – MEANS OF SOLVING OPTIMIZATION PROBLEMS

To solve optimization problems like timetabling problem, GA are often been applied (Arous et al. 1999), (Fernandes et al. 1999). GA (see Figure 1) exploits principles of evolutionary biology, including such biology-originated techniques as inheritance, mutation, natural selection, and recombination.

A population is a main object dealt by GA. It consists of individuals, which are being improved during evolutionary process. When solving optimization problems by GA, the single solutions are regarded as individuals. The operation of a GA is a cyclic process, which resembles alternation of generations in biological systems.
An important requirement for the problem domain using GA, is a possibility to evaluate (rate) solutions at any phase of the evolutionary process. The rating is done by the **fitness function**.

**GENETIC ALGORITHMS TO SOLVE SCHOOL TIMETABLING PROBLEM**

The school timetabling is a specific problem in the respect that constraints are divided into hard and soft ones.

**REINFORCING GENETIC ALGORITHMS BY NEURAL NETWORKS**

**General Suggestions**

One of the most complicated items to implement GA is providing with the rating procedure, i.e. creating the **fitness function**. It’s hard to evaluate various conditions, and it’s still harder to even define the rating criteria.

**Observation.** The layout of subjects scheduled is of great importance in schools. Unlike universities schools have to observe the correct distribution of subjects over the learning period considering mental faculties and psychological features of schoolchildren.

**Observation.** Ready-made school timetables represent useful knowledge for timetabling process. In general, ready-made school timetables provide significant information on layout of subjects in timetable. Considerably less information can be obtained on teachers and classrooms. That’s because of differences among schools on teachers and classrooms available, whereas the information on subjects is considered to be usable, since various schools keep similar sets of subjects. Having explored available data on timetables in many schools has made such considerations.

**Proposal.** Make use of subject information of ready-made school timetables to rate timetables within GA. Since school timetabling is characterized by having human factor involved to a comparatively great extent, the proposal is to use neural networks as the information base (see Figure 3). By the mentioned approach the ready-made school timetables are regarded as “the positive practice”, and the fitness is defined as resemblance to them.

Application of artificial neural networks to support decision-taking processes is known with similar problems. E.g., (Alifantis et al. 2001) describes a methodology of using neural networks to develop job-scheduling advisor. Unfortunately, without solid experimental work done, it’s impossible to make out the modification, thereby ensuring the algorithm to operate just valid timetables,

– Timetables are being rated according soft constraints only.

GA themselves do not use specific timetable knowledge when it exists. The way out is using heuristics at various phases, especially at the modification phase to determine the type of modification and amount of solutions (timetables) involved. Applying soft constraints at the modification phase could substantially improve upon GA. Yet another specific character of timetabling with GA is mutation as the only genetic operator available.
extent of neural networks to be able to extract essential features from existing timetables. There are just suggestions based on experience in solving another problems.

Artificial neural networks

Artificial neural networks represent a set of computational models made with a certain resemblance to the human brain. Work on artificial neural networks has been motivated by recognition that the human brain computes in an entirely different way from the conventional digital computer. The brain is highly complex, nonlinear, and parallel information-processing system. The brain has a great structure and the ability to build up its own rules through the experience. (Haykin 1999)

In its most general form, a neural network is a machine that is designed to model the way in which the brain performs a particular task or function of interest (Haykin 1999). To be even shorter, a neural network is a model of the human brain. However, to compare to the human brain a neural network is regarded to be very simplified, resembling the brain in two respects:

- Knowledge is acquired by the network from its environment through a learning process;
- Interneuron connection strengths, known as synaptic weights, are used to store the acquired knowledge.

A single neuron is a quite simple computing unit; nevertheless a certain quantity of connected neurons can perform complex tasks. Neurons are approximately six orders of magnitude slower than today's digital processors. However, the enormous potential of the brain is reached by approximately 10 billion neurons and 60 trillion interconnections between them.

Representation of a Timetable

Timetable is defined as a set of timetables of separate classes. \( U = \{A_1, A_2, ..., A_c\} \), where \( A_x \) represent the timetable of the group \( x \).

The week timetable of a fixed class is represented by a vector of elements \( A_x = [a_{11}, a_{12}, ..., a_{1h}, a_{21}, ..., a_{dh}] \), where \( a_{ij} \) represents a lesson or lessons for the class of the day \( i \) and period \( j \).

In the simplest case there are no parallel lessons for the class, so in terms of subjects – \( a_{ij} \) can be coded as one subject. However, in general there can be parallel lessons, so \( a_{ij} \) is to be coded as a set of subjects.

Observation. Subjects can be categorized according the themes comprised, and doing this will bring useful additional information on timetables.

Observation. To evaluate the timetable style in terms of subjects’ layout, there might be enough with less detailed information as subjects – subject types. This observation can be exemplified by the following soft constraint: Avoid assigning to many lessons of hard sciences in turn.

Proposal. Any timetable element \( a_{ij} \) can be coded as a set of subject types.

Constructing the Neural Block for Timetable Rating

Various schools have got different sets of classes – there are primary schools and secondary schools, and there are schools with parallel classes and without them. It makes constructing a single neural network to rate a whole timetable practically impossible.

Proposal. Construct several neural networks – one for each grade (see Figure 4). So the neural block for rating timetables will consist of 12 separate networks \( F_1, F_2, ..., F_{12} \).

Layout of subject types represents timetables stored in the neural block.

To rate a timetable \( U \), the neural block performs following steps:

1. The appropriate neural network \( F_x \) is rating each timetable of a separate class \( A_x \). Thereby we obtain separate ratings for each class \( r_1, r_2, ..., r_c \).
2. Obtained ratings are combined together in a certain manner to make out the total rating of the timetable.
Choosing the Neural Model

Neural network is a computational model that acquires ability to function through a learning process. The goal of each neural network in the neural block is to rate one piece of the whole timetable. The model should be chosen according the problem to be solved and the data available.

The following features of the problem domain will affect into choice of the neural model:

- The set of available timetable patterns consists of valid and practically utilized ones, i.e. representatives of “the positive practice”, but we have no patterns representing invalid or not so good timetables. Thus a pure model of perceptron rather wouldn’t suit. For the perceptron a uniformly distributed set of training patterns is required to ensure the necessary performance.
- The output of the rating function is a value with a lot of possible degrees, not just “valid” or “invalid”. Considering that, a pure model of Kohonen network wouldn’t suit as well.

A hybrid model of perceptron and Kohonen models seems to be able to help solving the problem

CONCLUSION

Since ready-made timetables contain a lot of information about the manner timetables are built, there’s a reason to believe that incorporating neural networks into timetabling system will improve upon pure model of genetic algorithms.

The proposed model is characterized by a high specialization, and it isn’t a universal means to solve scheduling problems. The model is being designed with the emphasis on practical usability considering the human factor.

Although the proposed model seems to be very specific and available just in particular cases (here – school timetabling), it demonstrates a new approach – the adaptability of a model. This idea could be useful solving other optimization problems even if to be applied in a different, problem specific manner.

A substantial experimental work is required to construct and configure a block of neural networks to be able to properly extract features from timetable patterns. The computer system based on the proposed model is being implemented.

REFERENCES


BIOGRAPHY

Jānis Zuters has graduated from the University of Latvia Department of Computer Science in 1999 (Mg. sc. comp.) and now is a doctoral student here. He is a lecturer of information technologies at the University of Latvia and at the Vidzeme University College. The main field of his researches is Artificial Neural Networks.
KEYWORDS

Extreme programming, software development methodologies.

ABSTRACT

Information systems are important part of modern economics. Business entities improve their systems to gain advantage over competitors, quality of those information system can decisive for business success, in though battles of free market. Many new systems are developed every year. And in this development market is place not only for big brands. Modern communication technologies remove almost all barriers related with distance and open new possibilities for regional companies to get into previously inaccessible markets. Quality and development speed have increased importance as market demands short system development cycles with reasonable costs. Unfortunately too many new projects can’t be finished within initially set time limits and costs. Main reasons are incomplete or changing requirements and specifications as well as lack of user and executive support.

Classic methodologies of software development often can’t ensure best results dealing with those issues. As a result new methodologies e.g. Extreme programming (XP), Agile processes and Rational unified process become more and more popular. They offer new approach to software development process. But will they improve quality of software development?

ISSUES WITH CLASSIC WATERFALL METHODOLOGY (WFM)

Most software projects in Latvia are developed based on classic waterfall methodology introduced by W. Royce (Royce W. 1970). This mainly is a straight forward development process (Figure 1.), where at the end of every development step determined set of documents or software applications are delivered.

Main issue with waterfall model is lack of flexibility. It is based on assumption that there will be no need to change results of previous steps and those results are used as starting point of following steps. Unfortunately during system development often occur situations when new functionality should be added to the system or already defined functionality substantially changed, because of changing business environment or gaps in initial system analysis.

Figure 1. Waterfall development model (Royce W. 1970).
Even if the system is completed, it is very difficult and costly to make any changes in the future to fit new requirements that will arise with the time.

The philosophy of WFM is not oriented on system development in a way that would make changes easier to incorporate.

**KEY PRACTICES OF EXTREME PROGRAMMING**

Extreme programming is a lightweight methodology for small-to-medium-sized teams developing software in the face of vague or rapidly changing requirements (Kent Beck, 1999).

Lightweight in this context means it is using more resources on programming and less on creation of specifications and other documents of system analysis. XP is iterative development method (Figure 1). Development process consists of release planning, coding, testing and creating routine application releases.

Every release adds some new functionality to the system, users test it and in next project meeting they can give feedback and new stories to realize in next release. And so it goes on.

Key practices of XP are:

- Costumer involvement

In project team are involved not only developers, but also costumers – interaction with them plays important role in XP. Customers become members of development team and take part in every project meeting. In discussions with the rest of the team they decide what functions should be included in next release.

- Short releases

Project releases are done often, so costumers can test this system and require new improved functionality, if it’s necessary. Usual release cycle is one or two weeks. Such short release cycle helps

- Continuous Integration.

After creating of every piece of functionality, it is immediately integrated into a project. So cannot occur situations than two or more modules of the system are created and at the end they aren’t compatible with each other.

- Stories

Stories are small pieces of functionality required and informally described by costumer. From beginning functionality is described only general and stress is put only on main aspects of it.

It’s not aim in XP to realize new functionality perfectly with the first time. It’s opposite – in 1<sup>st</sup> release only the basics of that functionality are incorporated. And when costumers have seen it, they can describe, what should be improved to better fit their needs.

- Simple design

The program is developed as simple as possible to fulfill requirements of the costumer. If there is something complex, it is divided in many simple tasks (stories) and they are realized one by one.

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![Diagram](image-url)  
**Figure 2.** Extreme programming development model.
• Test-Driven Development
Automated tests are created, before writing a program code itself. As program code in XP gets changed often, it helps assure, that those changes don’t influence the proper functioning of accordant code.

• Pair programming
Programmers work paired – two programmers sit together on one computer. It should help reduce amount of errors, facilitate faster solving of challenging problems and improving of productivity.

• Refactoring
Refactoring means changing the program code without changing the behaviour of that program. It is done to improve code quality – make it more readable and easier to change if necessary (Neil Roodyn, 2004).

“EKOSYS”
“EKOSYS” is a project with aim to create fully web based Enterprise Resource Planning system. It includes bookkeeping, warehouse, production, sales accounting and customer relationship management modules.

Resources used in project development:
• PostgreSQL DBMS
• Appache HTTP Server
• PHP programming language,

This project was started in 2003 and system should be ready at the end of 2005. As there were no strictly determined time limits, costumer requirements weren’t clearly defined and could change essentially during development period, for this project as base methodology was chosen extreme programming.

XP isn't a strictly defined methodology, and developers can adopt set of practices that they find best suited for their project.

ASSESSMENT OF EXTREME PROGRAMMING BASED ON “EKOSYS” PROJECT DEVELOPMENT EXPERINIENCE.

After two years of "EKOSYS" development using methods of extreme programming, it is possible to evaluate positive and negative aspects of different XP practices as well as overall influence of XP methods on project costs, time limits and fulfilment of costumer requirements.

• Costumer requirements
The most important aspect of every information system is that this system fulfils all requirements of the costumer. In "EKOSYS" project in this aspect XP acknowledged itself as very suitable methodology.

Costumers are actively involved in development process, they participate in regular project meetings, test every new release of application and take part in assigning tasks to create or change existing functionality for next release.

But choosing XP as development methodology, project leaders should be aware, that cooperation with costumer is of very high importance in XP.

If customers take passive attitude and communication with them is inconvenient, it could be dangerous for the success of the project. With Waterfall model costumer would be less involved in project.

• Costs
As the XP don’t use different formal program specification documents, most part of human resources can be assigned to programming tasks. That helps reduce costs. But that's not the main cost sparing are.

In XP system is developed in the way that makes it easier to change (as changes in system design are integral part of XP methodology). Developers working with XP get used to write code in such a manner, that allows later adopt different changes with minimal costs.

• Time frame
As there is no detailed system specification at the beginning of the development using XP, it’s hard to estimate exact time, when the project will be finished.

It requires excellent knowledge of development environment and team capabilities as well as detailed understanding of business system requirements. Without those knowledge’s it will be hard to estimate time necessary to realize project.

In this aspect WF is better – it first makes system analysis and then it’s easier to assess time necessary for development. Also with approved functional specification and project schedule it is easier to organize development process so, that it can be finished in time.
In reality there are only rare projects using WFM, that are completed in the time and after completion no further changes are required.

Also with “EKO.SYS” it's not going forward as fast as it was thought at the beginning. Mainly that's because of unforeseen improvements of the system and adding functionality, which initially wasn’t supposed.

- Pair programming

Project organization didn’t allow us to use pair programming widely, so it's not possible to assess usefulness of this approach.

- Short releases and continuous integration

Short releases and continuous integration came out as very suitable methods for project development. After realizing of every task it's easy to test how it fits in whole application as well as ask costumer to assess the added functionality.

“EKO.SYS” is developed using PHP. It's interpreted programming language and there is no need to compile program code, before it could be added to project. It's enough to copy program code files into project directory.

It makes adding new versions of code man maintaining continuous integration very simple. For controlling of different code versions Concurrent Versions System was used.

- Test-Driven Development

The idea of automated tests is very good, but another practices of XP - short releases and continuous integration makes it hard to fully implement.

Creating of automated test is time consuming and if with every change of code functionality, also tests should be rewritten, it uses a lot of resources.

Another problem was, that most data processing functions read and write to directly to database. So also tests can’t simply compare results of tested function with predefined right answers, tests should read source data and function results from database. This makes such tests even more complicated.

So it should be carefully considered whether automated, that facilitates testing procedures, will not make development process so difficult, that it would be better use ordinary testing methods.

CONCLUSIONS

Extreme programming is a new approach to the process of software development process. In many cases, particularly with small and mid-sized projects, XP could offer methods, which could lead to improved quality of system, faster development time, easier support and further changing of application's functionality.

At any case, new experience with XP will help to find best approach to the new projects in the future.

Small regional programming companies or teams could use XP’s flexibility as advantage on regional market competing with big software giants with their impressive brands and less flexible approach to software development.

REFERENCES


BIOGRAPHY

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STUDYING COLLABORATIVE LEARNING IN ONLINE DISCUSSION FORUMS

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KEYWORDS
ICT, e-Learning, discussion forum, online collaborative learning, qualitative research, content analysis asynchronous online communication.

ABSTRACT
We present part of a research project on the teaching-learning processes afforded by e-Learning. We detail a system of categories that allows us to analyze formative processes of online teaching-learning. The system was created through content analysis of discussion forums in web-based training in higher education. The forum appears to be a potent tool that positively affects collaborative and critical learning.

ORIGIN AND LITERATURE REVIEW
This research stems from previous works about content analysis conducted by the IDEA! research group at the University of Seville in Spain (Marcelo y Mingorance, 1995; Marcelo, Torres & Perera, 2002). In addition, we also base our research on the Community of Inquiry Model developed by Canadian researchers from the University of Alberta and Athabasca University (Anderson et al., 2001; Archer et al., 2001; Garrison et al., 2000; Garrison et al., 2001; Rourke et al., 2001; Rourke & Anderson, 2001). Space limitations preclude discussion of previous results, but these and a detailed analysis of the research process are available in Torres (2003a,b) and Perera (2003).

FRAMEWORK: SYSTEM OF CATEGORIES
Our research led us to establish three interrelated dimensions through which we analysed online formative processes occurring within the forum: cognitive, social and didactics.
Through meticulous analysis of the data, we established a validated system of categories (Torres, 2003a,b). This system helped us become familiar with the teaching-learning processes that tutors and students use when they interact in a training modality such as e-Learning. The content analysis of the forums allowed us to examine those processes, which are reflected in this system of categories:

A. COGNITIVE DIMENSION: defines the extent to which the members of a critical community of research are able to construct meanings (critical thinking) through sustained communication with each other. (More directed by the tutor).

Categories for cognitive dimension and definitions
A.1 CINIC: Initiation (triggering event): begins or presents a new problem or before the sensation of confusion (through questions). (No technical topics).
A.2 CEXPL: Exploration of ideas, search for outstanding information for the problem.
A.3 CINTE: Integration-Building.
A.4 CRES: Resolution of dilemma/problem.

Indicators
CINIC
a. Recognizing the problem: information is presented about a problem, that usually culminates in a question.

RESEARCH METHOD
For this qualitative research project, we used the content analysis method to describe and analyze asynchronous communication processes and e-Learning.
We used qualitative research design (a recurrent model). We analyzed ten forums with different purposes from five different courses that were delivered through e-Learning.

The total number of tutors participating in the courses was 29, with 217 total students. The qualitative data analysis package AQUAD5 was used for the computer treatment of the data. In total, 2124 messages and 41346 lines of text were analyzed.
b. Sense of confusion: questions: asking questions when there is sense of confusion or loss in some topic, or a new
discussion begins

CEXPL
a. Divergence within the group: unsubstantiated
contradictions of previous ideas in a topic which cause
discrepancies with the group.
b. Divergence within a single message: discrepancies
within a message about the idea or presented topic.
c. Exchange of information: personal narratives, facts or
descriptions (not used as evidence to support a
conclusion).
d. Suggestions for reconsideration: suggestions presented
about a problem or topic to be they are considered by the
group.
e. Brainstorming: offers ideas (not justified) about a
topic.

CINTE
a. Convergence within others members of group
(agreements): agreements or coincidences (argued, justified) within the group about previous ideas or
messages, which help to build a idea or to solve a
problem.
b. Convergence and agreement within a single message:
provisional/tentative agreements or coincidences with a
message, as a justified, developed hypothesis.
c. Connecting, synthesizing ideas: integrating ideas from
various sources (books, articles, experience...).
d. Proposing solutions: proposing possible solutions to a
problem.

CRES
Application of testing solutions to real world: commenting on the application of a solution given to
solve a problem or defending a possible solution.

B. SOCIAL DIMENSION: defines the capacity/ability
of members of a critical community of research to project
their personal characteristics into the community, thereby
presenting themselves to the other members as "real people".

Categories for social dimension and definitions

B.1.1 SAEM: Affective - Expression of emotions (Positive
Emotions). Possessing an affective load in the form of
expressing the messages (emoticons). Emotional
reactions are given that can include jokes or irony.

B.1.2 SANA: Affective - Narratives of aspects of daily life
(Experiences). Description of participant’s personal
aspects, with references to circumstances of their daily
life.

B.1.3 SACR: Affective - Critical, out-of-place remark
(Critical). Intense emotional reactions are given,
stimulated by contributions whose content is understood
as critical of a comment or moving away from goals of
the course.

B.2 SINT: Interactive. Specific reference of agreement,
disagreement, amplification... to a text, contribution or
manifested idea at another moment by another member
(student or tutor). It can include the use of the option
"quote" or to use specific texts from others' messages. It
is based on the idea of another participant’s, contributing
group sense (there is intention).

B.3 SOCI: Leisure. Offers pleasure, entertainment...
contributions which are external to the content (goals) of
the course.

B.4 SCOH: Cohesive. Group identity appears through
expressions such as: us, we, our, group... Also greetings,
closures, formalities of communication...

C. DIDACTICS DIMENSION: defines the design,
facilitation and direction of social and cognitive
processes for the purpose of obtaining the result of
significant and educationally beneficial learning.

Categories for didactics dimension and definitions

C.1.1 DGPR: Instructional design and management
(related to the course only) - References to the program,
curriculum (Program). Comments about the course
program, calendar, content, activities, assessment,
teachers, rhythm of the work...

C.1.2 DGMT: Instructional design and management
(related to the course only) - Designing methods
(Methods). References to the methodology or strategies
that will guide the development of the program.

C.1.3 DGME: Instructional design and management
(related to the course only) - Using media, materials
(Medians). References to the media or resources
(didactic materials and communication channels)
necessary for the development of the course (it can also
refer to the platform).

C.1.4 DGNO: Instructional design and management
(related to the course only) - Establishing rules (Rules).
Agreements about the conditions or rules that should be
completed for the appropriate development of the
program.

C.2.1 DDAD: Facilitating discourse - Identifying areas
of agreement/disagreement (chat). Tutor or students try
to center the discussion. It also includes identification of
agreements and disagreements in the expressed ideas
(seeking to reach consensus).
C.2.2 DDPA: Facilitating discourse - Prompting participation, discussion (Participation). Prompting participation, discussion about a topic, encouraging, reiterating, reinforcing contribution of the students, favoring debate...

C.1.3 DDEP: Facilitating discourse - Assessing the efficacy of the own communication process (Efficacy). Assessing the efficacy of the dialogue process through interventions that express obstacles or facilitators to reach the established goals.

C.3.1 DTAR: Tasks - Execution of the tasks. Responding to the execution of the tasks proposed in the course.

C.3.2 DTPR: Tasks - Content of the task: references to the parts of the students' assigned tasks. Goals to reach: description of the task; how, when and where to present the parts of the students' assigned tasks.

C.3.3 DTAP: Tasks – Support. Support that assists the tutor or students during the accomplishment of the task.

C.3.4 DTEV: Tasks – Assessment. Judgment about the students’ performance on assignments (students or tutors assess the quality of the task).

C.4.1 DIFP: Direct teaching - Asking questions (Request). Questions formulated about the teaching process. Also requests for materials, information, elements... by students.

C.4.2 DIES: Direct teaching - Presenting a new idea (Structuring). Interventions by tutors or students to begin a new topic, explaining their background knowledge and principles.

C.4.3 DIRP: Direct teaching - Answering explicit questions (Answers). Answer to explicit questions arising during the development of the teaching process.

C.4.4 DIRI: Direct teaching - Reacting (with or without valuation) to intervention (Reactions). Interventions generated by a previous comment that gives an opportunity to continue with the idea or to produce another new idea. It may or may not to incorporate assessment.

C.4.5 DIEC: Direct teaching – Scaling, support (Scaling) (it can be an answer or reaction). Step by step explanation about how to understand something, how to carry out some practical task, and clarification of difficulties (especially the most technical learnings). Also includes metaphors.

C.4.6 DIRD: Direct teaching - Summarizing the discussion (Summary). Attempts to synthesize the ideas developed in a discussion (like final summary to organize and to clarify ideas).

C.4.7 DICF: Direct teaching - Providing knowledge from different sources (Increase knowledge). Complementary information contributed from different sources (reading articles, other comments, urls…). It is always a reaction.

C.4.8 DIEX: Direct teaching - External comments to the course. Comments, situations, projects... external to the course.

CONCLUSIONS

Conclusions that we present in this article have built off previously research which applied the above-mentioned system of categories and the use of multiple evaluation techniques and strategies. On the one hand, the system of categories has provided information about teaching and learning with relation to the quality and nature of the cognitive processes reflected in the discussion forum; as a result, we can better understand the role of cognition in the transaction of teaching and learning in asynchronous environments and using text-based discussion. On the other hand, the value of using content analysis as an analysis strategy for e-Learning transactions is that it allows us to identify linguistic structures characterized by the indicators that conform to the three dimensions of our system of categories: cognitive presence, social and didactics.

The last objective of this study is to characterize, from the participants’ perspective, the context of the teaching-learning processes that take place in discussion board forums, according to pedagogic, social and cognitive dimensions. In the educational environment of the online discussion forum, social-emotional communication is an important variable in online teaching. In our study we confirmed that there is a sufficient level of social presence that supports the development of significant learning in discussion forums. This social aspect of communication within forums can create an environment of trust and confidence between students and tutors, which promotes collaborative learning. In this way, personal and/or social-emotional communication help to create a sense of the learning community. Consequently, the social aspect of groups in the forum is a factor that enhances the interactive processes of teaching and learning.

Next to the previous premise, the constructivist character of the activities undertaken in the courses we analyzed allowed us to deduce that the forum is a space that facilitates the social construction of knowledge. Nevertheless, the cognitive dimension of our system of categories shows us the difficulty and the enormous effort that students have to make to move past the “exploration of ideas” phase and focus on “integration-
building” activities. Students are willing to share ideas, but not to deepen their knowledge through debate. Therefore, the forum supports students’ learning, but students do not come to the point of describing on the forum how they transfer their forum-based learning to real-life practice. That is to say, we cannot determine if the learning taking place on the forum is being carried out successfully in real-life practice.

In the educational activities developed through the forum, instructors and students take on different profiles and tasks than those they might assume in traditional educational models. Instructors in online teaching have different, more reactive roles: they facilitate or moderate debates; respond to students individually and to the complete group; negotiate the flow of content through the tasks. Students acquire a more active role, intervening in the administration of the communication in educational processes and as agents of new ideas inside the learning process in group. This confirms that students’ participation is predominant in the didactic functions that were traditionally carried out by tutors.

REFERENCES


BIOGRAPHY

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DEVELOPMENT OF STANDARD OPERATING ENVIRONMENT

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KEYWORDS
Standard Operating Environment (SOE), Operating System (OS), Pure OS Image, SYSPREP Image, Unattended or Scripted, Clone Partition.

ABSTRACT
It would perhaps be no exaggeration to say that using computers in business increases the productivity and the effectiveness of management including Information & Communication Technologies and Electronics (ICTE). However, with the increasing of the quantity of workstations in the long run, grows the heterogeneity of computer systems on workstations (see Figure 1). Non-homogeneous systems make the installation of additional applications and users’ support more difficult, increase help desk calls and time for new application compatibility testing, as well as time of system restoring on desktops; create the unstable platform for business applications and decrease uptime.

It should be noted as well that increasing the time of updating operation systems and patch distribution decreases the security overall.

As a result, the costs for supporting workstations extend.

STANDARD OPERATING ENVIRONMENT (SOE)

For solving the above-mentioned problems we must standardize operation systems and applications on all desktops and notebooks. The method of standard environment is called Standard Operating Environment (SOE).

The Standard Operating Environment (SOE) is a specification for standards for computer hardware, operating system, security and applications software, arrived at through extensive consultation, development and testing undertaken by X company’s project.

Figure 1. With the increasing of the quantity of workstations in the long run, grows the heterogeneity of computer systems on workstations.
The major advantage of having an SOE within a large-scale environment is that the time taken to deploy and configure a new computer is greatly reduced.

In a scenario where departments might be buying different computer configurations, it is not possible to have a streamlined install and setup process due to variations such as disk sizes, hardware, and other factors.

The SOE concept also includes a life cycle component and the SOE will be reviewed annually. Hardware will have a life span of four years. The concept of the SOE is currently limited to standard Windows-based PCs, but could be extended to cover other platforms.

Standard Operating Environment image include (see Figure 2):

- Operation System Sources (Services Pack, Fixes)
- Common Software (Java, BDE, Oracle Client)
- Antivirus
- PDF viewer
- Office Software (Microsoft Office)
- Archiving Software (WinZip, WinRAR etc.)
- User Profile Settings
- Security Settings (Firewall, Policy)
- Etc.

**Figure 2. Standard Operating Environment (SOE) image content.**

**SOE IMAGE’S BEST PRACTICES:**

Separate Users Profiles, Program, and Files from System Files.

Best practice is if SOE image have 3 different partitions with:

- Hidden Partition for TOOLS (ZENWORKS, Symantec Ghost system partition etc.)
- Operation System Files
- Users Data Files

If workstation has software problems with operation system or common software best solution – only System partition cloning from SOE image.

This solution decreases workstation down time and saves user Data Files and User Profile settings (Favourite, Files from Desktop, etc.) (see Figure 3).

For example, we have workstation with 80 GB HDD. We separate HDD as 10 GB for System partition and 70 GB for User Data Files partition.
If we have crash of Windows system, need only clone System partition and don’t need copy 70 GB of Users Files from HDD and copy back 70 GB of Users Files to HDD after imaging:

![Diagram of file system]  
Figure 3. Separate Users Profiles, Program, and Files from System Files.

- Move a User's Documents and Settings Folder to D:\ partition
- Customize Default User Profile
- Security Templates Preparing and Using

With Group Policy, you can ensure that the machines on your network remain in a secure configuration after you deploy them.

When you create or modify a Group Policy Object (GPO), you can configure several security settings located under Group Policy Editor (GPE) Computer Configuration, Windows Settings, and Security Settings.

Group Policy makes it easy to configure security settings on the machines in your Win2K domain.

In addition, two tools, Security Templates and Security Configuration and Analysis, are extremely useful for applying network security policy and evaluating whether individual machines comply with the policy, as Image shows.

With these tools, you can build templates with particular security settings, apply the settings to the machines, and then periodically evaluate the machines to verify that they remain properly configured.

**Security Templates**
You can use the Microsoft Management Console's (MMC's) Security Templates snap-in to build different templates that you can import into Group Policies. You can either create a new policy from scratch or modify one of the built-in policies.

After you decide which template to use, you can import the template settings into your GPO using Group Policy Editor (GPE) by right-clicking Computer Configuration, Windows Settings, Security Settings, and choosing Import Policy. This process applies all the settings you configured in the template to all the computers in the container (e.g., site, domain, OU) that you link the Group Policy to.

**SECURITY CONFIGURATION AND ANALYSIS**
You can use the MMC's Security Configuration and Analysis snap-in to verify that the security settings you apply with Group Policy are in use. Before you perform an analysis, create a database to store the results.

After you create and open the database and choose the template containing the settings that you want to apply to a specific machine, right-click the snap-in and choose Analyze Computer Now to check the actual security settings against the desired settings.
You can also use Security Configuration and Analysis to apply the security template to the machine, but it's better to use Group Policy.

If you use Security Configuration and Analysis to apply the settings, a user can come behind you and change the settings.

With Group Policy, if a user changes a security setting, it changes back to its original value the next time Win2K applies the policy.

On a final note, be sure that you thoroughly test any security templates in a lab environment before rolling them into production.

The Win2K default security setting provides a significant increase in security over the NT 4.0 default settings. If you need to ensure compatibility with any non-Win2K certified applications, you might have to use the built-in Compatible Template (compatws.inf) or put your users in the built-in Power Users group.

If you want to ensure that all your machines are using the Win2K default settings, you can apply the appropriate default template (basicwk.inf, basicsv.inf, or basicdc.inf).

THREE MAIN METHODS OF DEPLOYING A BASE OPERATING SYSTEM

See Figure 4:

- **Pure OS Image**
  
  This method use when hardware is near identical Enterprise wide (Classes, Operation Centre, etc.).

  Extremely rapid development of SOE.

  Use when hardware is near identical Enterprise wide
  Extremely rapid development of SOE
  Fast installation (5-10 minutes)

- **SYSPREP Image**

  SYSPREP allows for more varied hardware
  SOE can be developed and customized quickly
  Fast installation (15-30 minutes)

- **Unattended or Scripted**

  Install anywhere – almost hardware agnostic
  Most complex to develop SOE
  Slower installation (35-90 minutes)

  Scripted installation don’t guarantee homogeneous Standard Operating Environment, therefore we don’t discuss this method of installation.

  Software for Standard Operating Environment (SOE)
  For preparation, distribution and management can use next software:

  - Novell ZENWORKS
  - Symantec Ghost
  - PowerQuest DeployCenter
  - Altiris CMS
  - LANDesk LDMS

Figure 4. Methods of deploying a base operating system.
Our choice of software for Standard Operating Environment (SOE) is next:
If company has NOVELL Network Environment best and obvious solution is Novell ZENworks.
If company has only classes or operate centres (Educational institutions, Call Centres, etc.) best solution is Symantec Ghost Solution Suite.
If company has only Microsoft Windows Network Environment need select from Novell ZENworks and Altiris Client Management Suite.

CONCLUSIONS
For solving the above-mentioned problems we must standardize operation systems and applications on all desktops and notebooks. The method of standard environment is called Standard Operating Environment (SOE). The following method - Standard Operating Environment, allows achieving the following results:

• helps to centralize and automate application management, patch management,
• centralizes and automates desktop configuration,
• improves the availability and protection of user’s data,
• keeps systems secure,
• keeps up-to-date operation systems by automating the rollout and maintenance of a standard operating environment—including the latest patches and updates—across all desktops as well as the risk of security breaches and virus attacks,
• enables simplified maintenance and reduced help desk calls through standardization,
• facilitates creation and enforcement of a secure computing base for all employees,
• minimizes management variables and costs,
• assures business continuity,
• increases productivity by keeping crucial systems available to users and quickly restores them if a disaster occurs,
• strategically helps to create holistic damage recovery solution.

REFERENCES
Microsoft course 2152, Supporting Microsoft Windows 2000 Professional & Server
Microsoft course 2153, Supporting Windows 2000 network infrastructure
Microsoft course 2154, Implementing & Administering Windows 2000 directory services
Microsoft course 2150, Designing a Secure Windows 2000 network
Microsoft course 2126, Managing a Microsoft Windows 2000 Network Environment.
Microsoft course 1561, Designing a MS Windows 2000 Directory Services Infrastructure.
Symantec Ghost Implementation Guide.
Novell ZENworks for Desktops Administration Guide
http://www.sysinternals.com/ntw2k/source/newsid.shtml
http://support.microsoft.com/default.aspx?scid=kb;en-us;321709

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E-LEARNING IN REGIONAL DEVELOPMENT PERSPECTIVE

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KEYWORDS
Quality education, E-learning, online courses

ABSTRACT
The aim of the paper is to show possibility to offer the qualitative education in non-traditional form like e-learning for regional development purposes. Paper contains recommendations for creating and managing e-learning courses, benefits and disadvantages of e-learning program, the impact in regional development of IT bachelor program in electronic environment.

IDENTIFICATION OF PROBLEMS IN REGIONAL DEVELOPMENT
As pointed in government report about development of national economics in 2001, creating of information society opens up new opportunities to develop society based on intellectual capacious branches, forward regional development, to form new working places, taking part in global information and cultural processes. Technologies are obviously a major component in today’s educational practice. Now is not necessity of narrow branched specialists but for large-scale qualified specialists with extensive knowledge and skills who are able to adapt oneself in changing labour market and quick technological development. There appear necessities of new formats for assessment on WWW, reviews aspects o formative and summative tutorials designed primarily for Web-based delivery. There are lacks of qualified specialists in Vidzeme region in IT branch what witness high labour offer for IT program students in Vidzeme University College. Functions of IT specialists in many institutions and organizations execute workers with necessity to acquire new IT and to get appropriate education. The aim of project is to give possibility to get higher professional education in-plant-training.

Computer managed learning as an aid to formative assessment in higher education, focuses on an advantages provided by computer managed learning systems that provide assessment and student tracking functions (Zellner, 2003). There is no doubt that digital or e-learning, or e-enabled learning has made a difference to our lives, and that is largely based on digital information and communication technologies. ICT will go through cycles of development, hype, overshoot, disillusionment, shake out, and consolidated growth. We are probably currently at the disillusionment and shake out point and will start to see more tentative, consolidated growth from now on.

The mission of Latvia regional politics is to approximate Latvia and regions to the level of country of Europe also contribute competitiveness of Latvia level with other countries of European Union. Differences in development between local government indicate to necessity more develop centres of economical growth centres accordingly programs of regional development and territorial division.

To promote social integration, effective education and use of possibilities of business activities rural population particularly important is access to qualitative information and communication technologies. As like as other regions use of Gross Domestic Product is limited from physical access and also expenses, besides not only in rural area but also in centres of ulterior regions.

E-LEARNING AS A TOOL FOR DEVELOPMENT OF REGIONAL EDUCATION
Quality assurance is one of the Bologna action lines. One of the aims of regional development is to give possibility to get qualitative education what means caring about the goals, needs, desires and interests of customers and making sure they are met. This approach is also applicable to distance education where teaching and learning are separated in terms of time, place and space. Quality means those features of products and services that meet or exceed customer needs and thereby provide satisfaction. Quality means freedom of deficiencies – freedom from errors that require rework, customer dissatisfaction, customer claims and etc. (Steyn, 2003).

The quality of teaching influences the quality of learning and thus the teaching remains important. Qualitative education contains distance education, learner responsibility, educator responsibility and administrative responsibility. Quality assurance is undoubtedly a
specific purpose for evaluations. And students themselves want to get good education. Hence, fundamental knowledge is coming to be more and more important in the training of graduates for a rather broad field of future professional activity. Information technology has revolutionized education in terms of how we organize, structure, and empowers our daily education practice. Since networked communication came into being, it has affected the way we teach and learn. The use of technology now has not only increased in the classroom, but also homes, libraries, coffee shops and other places throughout our nation’s communities. E-learning and distance education programs have spread, while the opportunities for using them have increased. Within the field of Human Computer Interaction formative and summative evaluations are characterised by stage in the development process at which they occur although this also defines their purpose (Dyson, Campello, 2003).

The inclusion of online learning technologies into the higher education curriculum is frequently associated with the design and development of new models of learning. Constructivist approaches started to replace instructional methods: the focus went away from the teacher and moved to the individual learner. Despite the fact that e-learning exists for a relatively long time it is still in its infancy. A multitude of definitions of e-learning already exists in literature. For many authors the adoption of electronic media in a learning scenario is already sufficient to constitute e-Learning. An alternative definition of e-learning has been that e-Learning in aggregation of all kind of learning with use the computer for medial support of learning process. Also e-learning will be broadly defined to include e-courses, e-training, e-spaces, and e-publishing. In contrast others only see e-learning where all real business process of learning, teaching and organisation has been migrated into digital environment. We will define e-learning based on German definition that e-learning contains all forms of electronic supported learning and teaching, which are procedural in character and aim to effect the construction of knowledge with reference to individual experience, practice and knowledge of learner. Information and communicators systems, whether networked or not serve as specific media to implement the learning process. This definition is based on the constructivist learning model Individual content and learner specific interaction is the media specific value software based systems could contribute to learning (Tavangarian and others, 2004). To support the constructivist learning theory the learning material must be customized to the individual learner. Methods to maintain and reuse learner specific content have been introduced with the multidimensional learning objects and modular lectures markup language data model.

There are two tasks to organize quality education program in non traditional way:

- It is necessary to look for a flexible system that affords the possibility of training not just the mass specialist but also the kind of specialist that is specifically sought by an enterprise,
- How to make the most effective use of the freedom enjoined by institutions of higher learning today

**BENEFITS AND DISADVANTAGES OF E-LEARNING**

Many of researches contain comparison studies, comparing the new mode education with traditional education. Subsequent writers have faulted these studies for poor research design and inadequate controls, a naive understanding of what affects learning and lack of recognition that online students are different from their on-campus counterparts. Studies worth mentioning are: the role of individual differences, instructional design and specific skills that are enhanced by online environments. There is evidence that students will certain learning styles or behavioural types do learn better in the Web environment. Males were more likely to control online discussions, post more questions, express more certainly in their opinions and were more concrete. Whereas females were more empathetic, polite and agreeable (Meyer, 2003, Cakula, 2001).

Much of the early research on Web-based learning focused on the technology and ignored the instructional design imbedded in the course. Meyer shows that the low numbers for integration and resolution were due the need for students to take more time to reflect on the problem, and individuals were reluctant to offer solutions that would be scorned by others in the class. The opportunity for reflection is especially suited to asynchronous learning environments, as well as for students whose learning styles require some time and reflection to make sense of information.

A successful distance class needs to solve a number of new problems that have not been seen before. One of them is how to effectively use e-learning environment to improve the quality of distance learning through networked learning interactivity and new format of instructional tools. It will serve as feedback to the producers and help them make better decisions on developing, administrating and manipulating internal network for educational purposes, and a feedback to the educators to better understand the Learning-Space-Assisted class, and improve their instructional design and methodology for the networked distance class. The online class adds a different array of pedagogical concepts and practice to instruction. Students do not know the regulations of the class, how to learn online, how to discuss, and how to keep up with the class schedule and the instructor’s expectation. Findings of
research of Sha Li are that as new learners in online class, many students expressed their excitement about trying a distance class. The reality of taking part in the first distance class could be hardest when the class first started. This made it difficult for the new users to get into Learning Space and easy for them to make mistakes. The skills necessary to use Learning Space take time to acquire at the start of the semester while students are busy taking new course (Sha, 2003).

One advantage is, that personalized documents, which lead the learner without needless detours directly from her/his current base of knowledge to the desired learning objective, can be generated automatically and every time. A further point to consider, which might seem less essential but nonetheless might prove rather disruptive when not needed, could be the use of heterogeneous data formats for the fundamental building blocks. It might be a desirable vision to bring together any kind of data formats but the resulting differences in presentation and handling might also distract the learner from learner (Tavangarian and others, 2004).

There are some positive and some negative aspects of distance learning in e-learning environment. On technology aspect the positive is that technology is an incentive for learning, it provides variety of tools to full fit academic accomplishment. Also technically intimidated with learning network, concerned with lack of technology background. The benefit is to offer e-learning course for IT students. Distance learning class provides learning any time and any place; helps mediate the time and space conflicts. Asynchronous interaction is convenient to communicate any time and anywhere, also check assignments during travel. The negative aspect is not accustomed to the asynchronous interaction. Synchronous interaction is more emotionally, cognitively, and mentally engaging. Immediate responses could generate fast and more effective feedback that asynchronous response. Learning environment could be a convenient network for online learning, can secure retrieve any course resources from it and perform any class-related learning activities in this place but learning environment could be not user-friendly. It could be really hard to find things student want for the course preview and class assignment. It is easy to mess up with the work. The solution is to find an environment user-friendly. The instructor is patient and ready to help students. His responses to the e-mails and discussion questions could meet student needs but the instructor do not teaches students. Sometimes student should wait for an answer for longer time that he wants. Disadvantage if using e-learning is that student could never show up in the discussion board. Also once the class was shifted to cyberspace, students could not see the teacher’s face and effort and could not grasp what was the right way for a teacher to teach. The better way is to start course with some introductory face-to-face part. When the student is switching to the distance-learning environment, his own old traditional often confuse him learning style and caused problems such forgetting the online class. The other problem is that the students complained that this class require more work than a regular class (Sha, 2003).

A good transition and accommodation to the new learning format could minimize the starting difficulty, maximize learning effect. Information technology revolutionizes education but human effort makes an essential difference.

There are some e-learning benefits and problems described by researchers of the United Kingdom. As the first benefit is independent/autonomous learning. Through using educational technologies students have more control over the management of their learning. Each learner is an individual, with his or her own motivation for studying, access to resources, and study habits and practices. The other benefit is peer support. Conferencing and discussion tools enable learners to interact independently from tutors. Often students share their professional experience to each other. E-learning can be more responsive to the needs of both tutors and students. As students are engaged in a number of different forms of communication, new strategies to assist with the learning process can be utilised quickly and easily. Also this form of learning, particularly with distance students, can result in a sense of isolation or disengagement of students. There can be no denying that distance students are working, in theory, at least, in isolation from other students. There is the perception, sometimes among students and management, that e-learning can take less time. However, as anyone involved with online learning will testify production of materials and adequate support of students using online materials can take a phenomenal amount of time. Students often expect much more when materials are online unless clear criteria established to address this. Therefore increased expectations for enable clear boundaries to be established in terms of responsibility and ensures that the students know where to go for support and guidance on using online resources (Quinse, Hurst, 2004).

**CREATING ON-LINE COURSE**

Much of the literature on web based learning shows that one of the main barriers to the effective use of teaching materials is the technology rather than design of the learning materials themselves. Distance education programs on natural sciences combining asynchronous e-learning with synchronous AV-learning have been used with success in recent years (Stav, Tsalapatas, 2004). Two of the main developments in web based learning have been the adaptation of communication technology to support learning and the changes in distance learning strategies necessary for delivering online courses.
(McKimm, 2003). While distance education is anything but traditional, many of the programs are mimicking the traditional models. The primary goal is to offer numerous fine-grained teaching and learning modules to combine easily with each other in order to fit on concrete educational objectives. Every module could be structured subject specific as well as according to didactical considerations. In reality, most web based learning courses are mixture of static and interactive materials, and most ensure that some individual face to face teaching for students is a key feature of the program. The subject structure of module provides base for the content implementation proper and is equivalent to structuring in chapters and sections. The purpose is to divide the subject matter into parts, which can be easily handled by the learner. To achieve this, the module is being divided into lectures and learning steps independent from its subject structure. The first step in designing a web based course is to identify the learner’s needs and whether the learners are to be considered as part of a group or as individual learners (McKimm, 2003). The later are being classed into introductory, motivation, knowledge procuring, summarizing and applicatory learning steps. Learning objective are units of learning that include learning objectives, content, competencies, activities and even assessment. Only the scaling concept integrated into the multidimensional learning objects and modular lectures markup language data model allows the definition of learner specific content and enables, in combination with the features previously described, the production of high-quality content for e-learning. A module can be scaled within three dimensions: intensity, target group and usage scenario (Tavangarian and others, 2004). The component of learning objects are combinations of what are generally called granules. These include photographs, texts, animations, graphics, matrices, statistics, spreadsheets, workshop exercises, assessment questions, articles, video and audio clips, through to case studies that might be quite substantial. Course assessment similarly may or may not be the sum of the assessment of several modules (Roy, 2004).

When designing web based programmes (also IT professional bachelor programme), the learner’s needs and experience must be taken into account. Appropriate technology any reasonable computer skills are needed to get the best out of web based or online learning. Web based learning offers huge opportunities for learning and access to a vast amount of knowledge and information. The role of teachers is to ensure that the learning environment provides takes account of learner’s needs and ensures that they are effectively prepared and supported (McKimm, 2003).

MANAGING E-LEARNING

Staff and students need professional development, training and preparation to cope with online learning. Staffs needs educational development in the following areas: CMC (computer mediated conferencing) and online discussion tools: production of materials, management of online information, tracking and assessment issues.

Everyday handling of on-line course content in the communication to the learner is a significant part of learning process (Tavangarian and others, 2004). Course could be structured around weekly “sessions” to provide continuity and structure. The needs of the students combined with the requirements of the course should be carefully balanced. Making the design of the environment consistent and clearly structured can assist with student usage (Quinse, Hurst, 2005).

The specific objectives of the system are:

• Single point of access to possibly distributed content and services including compatibility with present or forthcoming e-learning initiatives, for administrators, learners and content providers;
• Efficient educational content management, emphasizing use of standard mathematical formalism in engineering and internal information representation using open standards like XML;
• Flexible internal representation of content (XML) that can be transformed to several existing and forthcoming formats Multiple interaction methods will be explored, including web technology, light pens, electronic blackboards and digital document cameras;
• Integration of mathematical software tools for on-line execution of computations and visualization of results, and integration of legacy code developed at the participating institutions will be explored as proof of concept;
• Minimal requirements for installation of client tools. Services for the support of cheap online web-solutions for large groups of learners based on the above-mentioned infrastructure;
• Efficient collaboration and communication that facilities the learning process through asynchronous tools (forums, chat-rooms) and synchronous applications as vide-conferencing through desktop units;
• Online structured course development and editing
• Autonomy of providers through distribution of material and metadata descriptions (Stav, Tsalapatas, 2004).
CONCLUSIONS

The realization of the project to offer IT professional program in e-learning environment:

1) Conduce creating such society in Latvia what oriented to education and knowledge;
2) Conduce development of knowledge management process (creating knowledge, accumulation, identification, adaptation, development, deepening, popularization, distribution, using etc.) in the scale of country as priority of society and the base of the development of country economics and social life;
3) Conduce accessibility of all kind of information and knowledge for any member of society;
4) Encourage creating of country information infrastructure; including technological, informative and normative component, development of information services and applications;
5) Conduce quality of higher education and scientific investigation, creating of strategic of research and innovation development, coordination of nation order in higher education, researches and innovation;
6) Conduce possibilities of using of results of researches and encourage its implementation in national economics, developing innovation system in the country, improving cooperation of sector of researches and technology and producers;
7) Conduce regular further education for IT specialists, conducing formation of information society.

As a result of the project will increase qualification of IT specialists what secure elaboration of service programs for quickly and effective exchange of information, also development of IT infrastructure what is the base of educating and improvement process of the society. Implementation of recent technological processes and qualified labour force in the producing encourage producing of new, competitive in the world market with high added value, what can accordingly secure higher increasing rate of gross domestic product, promote Latvia economical development and welfare of society.

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REFERENCES


Quinsee Susannah, Hurst Judit. Bluring the Boundaries? Supporting Students and Staff within an Online Learning Environment. In The Turkish Online Journal of Distance Education Vol. 6 Issue 1, 2005, ISSN 13026488

Sha Li. The Format-Shifting Dilemma in Distance Education. In The Quarterly Review of Distance Education. Vol. 4(2), 2003, pp 109-127


BIOGRAPHY

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A NEW APPROACH OF E-LEARNING SOLUTIONS FOR EMPOWERMENT OF PEOPLE IN REGIONAL DEVELOPMENT CONTEXT

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KEYWORDS
E-learning, Knowledge Management, Social Inclusion, Regional development.

ABSTRACT

This paper reports on new approach of e-learning solutions for empowerment of people in regional development context.

Often young adults with disabilities are marginalized or socially excluded therefore it is much harder for them to get opportunity to work. Traditional social worker education currently puts emphasis on social matters and organisation of care but have no clear focus on social inclusion of disabled people. To cover this gap in training of disabled people in College RRC (now State Agency “Social Integration Centre”) a new innovative project “Achieving Social Inclusion by the Application of E-Learning solutions at College RRC” was implemented. The project piloted the new e-learning solution for promotion of social inclusion. The piloted approach is well applicable also in regional development projects.

To ensure more effective decision making in College RRC the Enterprise Knowledge Development methodology was used to promote effective Social Inclusion of disabled people.

The staff has been trained on Social Inclusion with specially prepared online e-learning courses. They also learned how to apply advanced e-learning technology with interactive multimedia study materials in courses. A group of disabled persons was trained in necessary skills to help them become employable and independent. They have been trained in business planning, e-business, IT and communication skills as well as self-development related courses.

INTRODUCTION

In many countries unemployment and social integration are very topical in particular in relation to people living in country regions and disabled. Training combined with other activities could be efficiently used to empower these people.

E-learning courses, Enterprise Knowledge Development methodology and other tools have been used in regional development projects to reach better social integration old people.

The aim of the project “Achieving Social Inclusion by the Application of E-Learning solutions at College RRC” was the piloting of modern e-learning solutions for strategic development and teaching activities for the disabled at College RRC. The objectives of the project were the following (Project Final Report, 2004):

• to promote the social, economic and political inclusion of disabled individuals into the community;
• linking College RRC education to the labour market needs, and providing training for teachers of special education;
• to develop life long leaning solutions to promote local and regional labour and business needs, as well as modern understanding of social inclusion approaches;
• to provide access to necessary information, knowledge and technology for the College RRC management, the administrative and academic staff;
• to ensure effective decision making in College RRC by means of EKD (Enterprise Knowledge Development modelling) to promote more effective Social Inclusion of disabled people.
The target groups comprised disabled people, social workers and the management of College RRC.

PROBLEMS IN LATVIA

In Latvia quite high unemployment rate is observed and in particular in border regions and among adults with disabilities these rates are much higher. Young adults with disabilities are marginalized or socially excluded therefore it is harder for them to get opportunity to work.

Social workers as professionals want to be leaders in the area of social work. To be in the front ranks in helping this changing society it is not enough what they have learned at school/university, it requires a continual growth in the professional area throughout their life.

Traditionally, in educating social workers emphasis is laid on social matters and the need for care but there no clear focus on social inclusion of disabled people. Teachers are not trained in the application of e-Learning technology.

METHODS USED

To achieve social integration of marginalized groups we used a number of tools developed during both nationally and internationally.

At college management, administration and academic level Enterprise Knowledge Development (EKD) method was used, to get an overall picture on a strategy of training development for the disabled at College RRC.

The EKD is one of the Enterprise modelling methods that was developed a few years ago and is being used by business consultancy companies with increasing frequency. This method has been subject of research in a number of multinational European projects (including 5th framework programme). It has proved its productivity both in the business and the public sector by providing a framework for articulating, modelling, and reasoning about pertinent knowledge and ill-structured even “wicked” problem situations, typically occurring in organisations and society.

EKD aims at setting organisation Vision, Mission and Goals, providing guidance in restructuring and changing different processes (Bubenko J.A., Kirikova M., 1999). On the college management, the administration and the academic levels a Social Inclusion (Module I, Module II and Module III) course was used as a mechanism for promoting accredited continuous professional development of the relevant staff. By exploiting the functionality of the Blackboard Virtual Learning Environment the course was provided support that turned out to be very collaborative in nature, since it incorporates the element of action research.

The overall project development strategy is illustrated in Figure 1.

The outcome of the project development strategy is shown in the table.

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Trainee people</th>
<th>Economic independence</th>
<th>Promoted community development</th>
<th>New networks created</th>
<th>Marginalized group empowerment</th>
<th>Encouraged socio-economic and political participation</th>
<th>Improved course delivery methods</th>
<th>New courses in college RRC</th>
</tr>
</thead>
</table>

Figure 1. Project “Achieving Social Inclusion by the Application of E-Learning solutions at College RRC” development strategy.

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MAIN ACTIVITIES OF THE PROJECT

The project constitutes a model for human development. It is intended to improve the technical capacities and the managerial skills needed to deal with the issue of social marginalization.

To achieve the project goals, the main activities performed, are described in this section (Project Final Report, 2004).

1. EKD modelling in College RRC

To get high quality models and the result that can actually be used, a number of activities have to be performed. Before the modelling session it will be necessary to conduct interviews to be able to survey the current situation in College RRC and set the scope for the modelling. During the interviews participants for the meta-modelling session were selected. The size of the modelling group size was varying between 7 and 10 participants including the area experts and representatives from the target group.

With the selected meta-modelling participants there was a training session on the method fundamentals was conducted. Experienced moderators took care of the meta-modelling session.

2. E-course on Social inclusion from a community perspective

Rationale: The theoretical basis of the course draws its inspiration from the view that people construct social reality through social interaction. Different social contexts produce different ‘versions’ of this reality, which is the reason the project team lays emphasis on situational learning rather than on universal models.

Aims: To develop management skills and to become more aware of the relationship between community cultures and social inclusion. The purpose is to help students to focus on this relationship in their professional work as potential, future leaders.

Desired learning outcomes: To enhance professional reflection in order to gain a deeper understanding of the process of social inclusion

Content, structure and methodology: Through fieldwork, students will reflect upon their existing attitudes towards the parents of children. In terms of content particular emphasis is placed upon how existing attitudes may influence notions of inclusion.

3. E-course on Social Inclusion

Rationale: Professionals working with people and their families/careers require the skills to recognize and work effectively with the diversity of the individuals they encounter. Many individuals and groups within society are marginalised and excluded from participating as active citizens. People can be marginalised within the classroom both by adults and other people. Likewise, marginalisation can occur at a group, community and societal level.

This module seeks to help participants understand the complexity of the issues in relation to social inclusion and equip them with some of the skills to work more effectively to combat discrimination on a range of levels within the workplace and wider society.

Aims: This module seeks to enable participants to have a greater understanding of the philosophical background in relation to social inclusion, to recognise different perspectives across countries in relation to social inclusion and to identify aspects of social inclusion/exclusion that affect their own environment.

4. E-course on promoting social inclusion through games

Rationale: Playing is the most important way of acting at preschool age. People show their behaviour and attitude towards other people through play situations. The educators should be able to identify and to analyse play situations, where they can promote social inclusion and prevent exclusion (David S.V., 2004).

Aim: Participants were able to observe the impact of the power structure (young adults in different roles) and the diversity (age, education, ethnicity, gender, personality) in people’s group. The participants become familiar with the observation methods for use in play situations and was able to analyse those situations.

The participant was able to use play situations in promoting social inclusion and preventing exclusion, with special attention being paid to young adults at risk. The participants were able to help young adults to learn together.

5. E-course on Business Planning for Open Markets

Purpose: The overall purpose of the course is to aid Central & Eastern European (CEE) countries to adjust themselves to trading in open markets and thus aid their planned accession to the European Union. The
course aims to improve business skills and understanding of the open market process amongst the working population. Key objectives are to educate business managers (and their staff) on how market economies function together, on how to write a business plan, and to help develop knowledge and skills on applying structure, methods and tools in the development, the presentation and the implementation of business plans. By adopting interactive multimedia and Web-based learning techniques as a fundamental element of the course structure, a by-product will be to enhance acceptance and understanding of information technologies by tutors and learners throughout CEE.

Figure 2. The course “Social Inclusion” in Blackboard environment.

Content, Structure, Methodology: an interactive multimedia CD-ROM, a printed workbook, three face-to-face sessions, a project assignment, student support over the Internet.

A Certificate of Riga Technical University Distance Education Study Centre (2 credits free choice course in non-business study programmes).

6. E-course on IT for users

Course Description: The course was intended for those without previous experience in computer applications. The aim of the course is to enable students to handle IT applications with as much confidence as TV sets.

The assigned materials give students a chance to practice what they have learned. Instructors are available on request.

7. E-course on WEB design

Course Description: Web design applications such as Front Page XP (including HTML language, JavaScript). At the end of the course the student should be able to design his own home page. The course assignments will teach students to apply new materials. An instructor will be available for consultations, at the student’s request.

8. E-course on Electronic Commerce

Course Aims: to help the participants to acquire basic knowledge and skills to do business in the new IT-based economy, to get practical skills the E-business, in selling and buying goods through the Internet and doing banking transactions, to learn about the structure of economy and the basics of business management under the conditions of the new economy, to become
familiar with the main internet services and their significance in the e-conomy, to get acquainted with the structure of the internet and its operational principles as well as the needed software for e-business.

9. E-course on Technical Communication

Course Aims: The course takes into account ethical issues that are especially relevant in the contemporary world, not only such traditional concerns such as copyright, plagiarism, but also issues concerning breaches of technological security.

At the end of the course participants have the skills and know-how to enter the job market with confidence and maturity.

E-learning course environment see in Figure 2.

CONCLUSIONS

EKD modelling represents an effective method for getting an overall picture about training development for the disabled at College RRC.

E-Learning courses with hight quality interactive multimedia learning materials constitute an effective approach for training in the basic skills for integration into the labour market. E - course Social Inclusion gives new and applicable knowledge on integration of disabled people in knowledge society.

The results of this project promote sustainable development of social aspects.

The presented results will be implemented in further projects “Strengthening the economic demand driven training delivery capacity in Liepaja Academy of Pedagogy by the application of advanced e-Learning solution”; „Availability Increase of Innovative E-learning for Promotion of Knowledge Based Economy in Latvia”; “IST Requalification of the Disabled Persons”.

REFERENCES

Project Achieving Social Inclusion by the Application of E-Learning Solutions at College RRC, project Final Report, 2004


BIOGRAPHY

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Dr. Atis Kapenieks has participated in more than 20 international e-learning development projects in Europe.

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E-COURSES ON PROFESSIONAL COMMUNICATION FOR PROMOTION OF SOCIAL INCLUSION

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KEYWORDS
Professional communication, e-learning, social integration.

ABSTRACT
The present report will supply information on the way the e-courses for studies of The Professional communication were organized and conducted, on the behaviour and attitudes of the target audience and on the results obtained. In addition, the choice of the teaching method, namely the e-course delivery, will be motivated.

The impact of the obtained results on the social environment and on each individual, their significance and usefulness will be analyzed.

Also will be motivated the efficiency of these courses in complex projects for developing human resources.

INTRODUCTION
The present report based on the author’s two year experience delivering an e-course in professional communication to 9 groups of learners at the township of Līvāni and the RRC college at Jūrmala within the framework of EU PHARE programme projects and in the consistory of the Lutheran church. The audience was widely representative.

It comprised local self-government employees and workers, artists, labourers and administrators from enterprises, rural and urban entrepreneurs, teachers, jobless people, pensioners, students and pupils and church workers. Among the college students there were people with special needs.

Concerning all these cases it was assumed that by including a Professional communication course in the general conception of developing human resources would mean a substantial achievement. Use was made of the Professional communication course in the project of developing human resources and of social integration with the purpose of acquiring basic communication skills as being essential and along with knowing how to use computers and having a command of foreign languages enhance people’s ability to compete in the labour market and to integrate themselves in their social milieu.

In all the cases the audiences had both common and also their own distinguishing traits.

- At Līvāni several projects were implemented in consecutive order that were aimed at adding to the population’s knowledge in areas that are conducive to competitiveness in the labour market and to sustainable urban development. Represented were nearly all the social and age groups, educational levels, as well as different nationalities.

- At the Jūrmala college RRC the course in Professional communication was intended to provide the students and teachers with additional skills. This additional knowledge that was not included in the other teaching subjects was expected to enhance the learners’ chances in the labour market. This is very important for students with special needs, of whom there were quite many at the RRC College at Jūrmala. There was ground to believe that teachers also would take interest in acquiring communication skills.

- The group of the consistory of the Lutheran church was not large and the church workers expected that mastering a course in Professional communication would provide them a chance to improve their ability to communicate in written form. Such skills are vital in realizing joint projects with colleagues from abroad.

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CHARACTERISTIC OF THE NEEDS OF THE TARGET GROUP

Currently, the economically active part of society can be divided into those who have spent the longest part of their lives in a business environment dictated by socialist planning, and those whose ideas about professional relations have been formed thereupon.

Many people are in need of skills in processing documents for practical purposes. These may include filling out application forms, when taking up a job, writing letters of intent, writing complaints to shop owners with a demand to cover the losses caused by using bad quality electric appliances, etc.

It can also be an instruction about how to assemble self-manufactured piece of furniture or an invitation addressed to the local self-government to support a project conceived and made by a social organization. Or it can be an extended Report on the progress of a sizeable project financed by a European structural fund. In all the mentioned cases knowledge is requisite about how to prepare an effective, ethically correct and well-finalized professional document.

During the studies, the learners make reports and accounts of the way laboratory tasks were carried out. Many of the students subsequently get engaged in NGO and process documents on their behalf, beginning with a reminder to a business partner or colleague, an informative booklet and ending with a letter of intent. Schools generally provide no knowledge and skills required for performing such tasks and they rest upon the teachers’ own knowledge ability in preparing written documents.

In the field of acquiring new skills there exists yet another target group comprising those who have found themselves outside the set of economically active and successful people. These have at one time either lost their work because of the enterprise going bankrupt or when the number of working places has been reduced. Belonging young mothers who are bringing up small children and have therefore lost their jobs. Hereto also belong people who in performing their jobs have turned out to be skilled and enough and have been ousted from economic circulation by younger and more knowledgeable people.

In further search for work skills in professional communication will be vital. Of importance will be also a certificate testifying to having covered a respective course, as well as the applicant’s self-assurance.

In all the above-mentioned groups there are people with special needs. Invalids and handicapped people are capable of engaging themselves in economic activities and social life if opportunities are created for them to do so. Professional skills required in competing in the labour market are of vital importance for them. Many people with special needs study purposefully with great seriousness and single-mindedness.

Acquisition of professional communication develops skills in properly structuring the document’s text and helps one to keep in mind the purpose of it as well as to reckon with the target audience.

A successful mastery of the offered course in professional communication helps one to apply these skills to matter-of-fact language. Developing self-confidence and self-assertion which find reflection in contacting people, enhance the chances of the target group to integrate themselves in their social environment.

THE PROCEEDING OF THE COURSE

Initially the idea was to design a distance-learning course that could be mastered with minimal participation in the classes to be attended.

The professional communication course provides for the attendance of:

- At least four seminars classes,
- Independent work of the students by mastering the material through bilateral communication via computers with an e-course recorded in CD ROM with voice over,
- Students’ independent work in both compulsory and optional,
- Virtual classroom („Blackboard”) that offers access to the materials of the course, communication and discussion and of opportunities of discussing each acquired module,
- A constant opportunity to communicate with the course advisor by means of e-mail or the telephone,
- Preparation and presentation of the graduation paper.

The course is divided into 5 modules:

- Module 1: ethics, readability, design, style, figures to be inserted in the document,
• Module 2: writing and checking of a communicative document,

• Module 3: description of devices and mechanisms, instructions, description of procedures and writing of summaries,

• Module 4: kinds of reports and the way to write them,

• Module 5: writing reminders and letters.

The course does not deal with documents, in which of greater importance is completion of a certain form. In this course emphasis laid mainly on processes and structural components, on which the effectiveness of the document depend (Rumpite et. al. 2002).

When taking up the course, the student receives:

• A virtual course on CD ROM,

• Printed course material to be acquired during the course,

• An e-mail address, in case the student has not one,

• A site and password in the virtual classroom.

The computer classes are organized in cooperation with the local IT specialist in each particular locality:

• At the Liiväni Study Centre 14 computers are available,

• In the computer class at the RRC college there are 20 computers,

• In the premises of the consistory of the Lutheran church 3 computers can be accessed.

The students could use these classes for doing independent work. The local IT specialist consulted them. In all the classes the number of the students exceeded that of the computers available. As the attendance was good, (80 % or more), one computer had to be used by 2 students. It was possible to go on working after conclusion of the seminar classes.

The courses were organized on the means afforded by the project; the students attended them free of charge or at merely symbolical cost. In case somebody failed to complete the course, he or she had to return the handed-out study materials. The acquisition of the course was based on the students’ cooperation with the computer, availing themselves of a virtual course in Professional communication recorded in CD ROM, which was rendered more attractive by means of figures and graphs, animation elements, reading and exercises.

Virtual learning can be manipulated, the shots being changed manually or else in the television mode. It is likewise possible to use identical printed material, tough less attractive in form. This is willingly used by people who work on computers may be every day or by others if a computer is not available.

The content of the printed material is identical with the virtual one. Of course, it is impossible to render as attractive a study environment. Questionnaires revealed that at Liiväni approximately 2/3 of the number of students mastered the material by using the virtual environment, but at the RRC college the percentage was 90%.

The compulsory independent tasks were planned so as to efficiently consolidate the mastered subject matter without taking too much time for that.

Generally, the students are to form some document, beginning with reminder-documents and ending with structuring some report, depending on the intended aim and the target audience.

Some students also chose tasks to be performed voluntarily, which to evaluate they asked their consultants. The voluntarily undertaken tasks are usually more sizeable, i.e. preparation of larger documents, interviews and the like.

The tests to be passed in the virtual Internet classroom are compulsory and the questions contained in them enable the teacher to check, whether the student has actually mastered the material.

In order to avoid needless stress, the testing time is not limited and the students may do the test repeatedly. With the aim of improving the result, the students more often than not revise the subject matter.

The advising consultants can evaluate the students’ performance. Altogether more than 80% of the students strive to approximate their result to what is maximally possible. Vast possibilities are offered in choosing the kind of document to do for the graduation work.

The students are to choose the target audience, the product that is to be written about and the goal that must be reached by means of the document in question. A situation, in which the student chooses to work on a document required for public activities or for a hobby.

The questionnaires revealed that most students realized that the decisive role in the way the course proceeded...
was played by cooperating with the consultants. By means of the telephone or the e-mail the consultants could be accessed nearly all the time. In all the groups, except one group in the RRC college, the consultant actually always provided an immediate answer to all the e-mailed letters. The e-mail correspondence not infrequently turned into a discussion and served as an exercise in professional communication.

The only group, with which the consultant agreed that he would send individual answers concerning the delivered papers only if there was a necessity. By the end of the course the number of students had dwindled almost by 40%.

In the group following it, in which the consultant unhesitatingly answered to any letter 94% of the learners graduated successfully. Some of he „dropouts” from the first group graduated together with them.

Most time-consuming is answering the e-mailed letters. Usually these were written individually, thus avoiding the „ctrl+c; ctrl+v” method.

These were meant to serve as samples of good communication, therefore letters written by the learners measured up to the corresponding proper level.

The course is to provide a set of particular skills and to develop the students’ ability to perceive and understand essential relationships in the formation of professionally communicative documents.

The acquired material constitutes a foundation for the ability to analyse diverse possibilities and versions. The exercises to be done also offer a vast range of possibilities to choose.

Doing the course in Professional communication the students acquire and develop skills in writing documents and conviction about their aptitude to manage it.

This does not mean that they will put these skills to good use as early as the next day upon graduating from the course.

Many may have need for availing themselves of the gained knowledge only after a lengthy period.

Then again the necessity would arise to have a look into the books and the study materials and brush up what they have learned.

Therefore, as far as possible, together with the study materials, the learners will be given books, such as: „Latviešu valoda lietišķos rakstos” („Business Latvian” by V.Skuja, Zvaigzne ABC, 1999), and „Text and Graphic Design „ Step by Step” by S Huss, Lielvārde, 2003.

RESULTS

The number of graduates from the e-courses in Professional communication over the period from 2002 to 2004 is given in Table 1

Table 1. The number of students of professional communication in 2002 through 2004.

<table>
<thead>
<tr>
<th>Place</th>
<th>Number of applicants</th>
<th>Number of certified learners</th>
<th>per cent of the successful ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livāni</td>
<td>122</td>
<td>104</td>
<td>85 %</td>
</tr>
<tr>
<td>RRC College</td>
<td>82</td>
<td>63</td>
<td>77 %</td>
</tr>
<tr>
<td>Consistory of the Lutheran church</td>
<td>4</td>
<td>3</td>
<td>75 %</td>
</tr>
<tr>
<td>Total</td>
<td>208</td>
<td>170</td>
<td>82 %</td>
</tr>
</tbody>
</table>

The Table does not reflect the circulation of students in the groups

All respondents have pointed out that they enjoyed participation in the courses. „The courses and their content were interesting, the teachers offered very good instruction„, and the „virtual classroom”.

General evaluation by the students: of the RRC College was that the courses were very well organised. However, there were two kinds of attitudes. Most students appreciated studies both in real and in virtual classrooms, but some students prefer studying only in the real classroom

There are students who highly appreciate the opportunity to publicly defend their graduation papers. At the same time some students have said that they would rather defend their paper when there are present only two persons, namely only the student and the teacher

Opinion polls conducted among the Livāni people having attended the courses revealed that approximately 2/3 of the respondents have in their studies availed themselves of the CD ROM version of the course and worked with the computer but the others used printouts.

In evaluating the courses in Professional communication it becomes obvious that along with improving and perfecting the course also it becomes more highly appreciated (Atis Kapenieks et. al. 2003), (Ilze Trapenciere et.al. 2004).
From Table 2 it is seen how the courses have been evaluated by the respondents at Livāni in 2002 and at the RRC college in 2004.

Table 2. Evaluation by the respondents of the offered courses in Professional communication. The evaluation is done in the scale from 1 to 5, in which 1 = „very poor” but 5 stands for = „excellent”.

<table>
<thead>
<tr>
<th>Evaluation at Livāni</th>
<th>Evaluation at the RRC College</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality in general</td>
<td>4,5</td>
</tr>
<tr>
<td>Consultants</td>
<td>5</td>
</tr>
<tr>
<td>Explanation</td>
<td>5</td>
</tr>
<tr>
<td>Possibility to meet consultants</td>
<td>5</td>
</tr>
<tr>
<td>Course materials/books</td>
<td>4,5</td>
</tr>
<tr>
<td>Supplies</td>
<td>5</td>
</tr>
<tr>
<td>Internet</td>
<td>4</td>
</tr>
<tr>
<td>Method of distance learning</td>
<td>5</td>
</tr>
<tr>
<td>Value of training for individual</td>
<td>4,5</td>
</tr>
</tbody>
</table>

Most participants were very much satisfied with the contents of the course. They did not find the course too complicated. There were only 3 students who had minor complaints. 1 student considered it unnecessary to tell in the introductory seminar about the computers. 1 student found Module 2 too complicated and said that mastering Module 2 had taken him much time. However, he was very much satisfied to have managed it after all. One student found the book too complicated. She said she had to ask many questions to be able to understand everything dealt with in the book.

One student has complained that the language of the printed material was too complicated for him, he did not know the terminology used in the book. He would have liked to have a short glossary at the end of the book.

All the respondents commented that they had enjoyed participating in the courses. All of them pointed out the sincere atmosphere prevailing during the certificate conferring ceremony. And said that the certificates might be of use in their search for a new job.

ANALYSIS OF THE RESULTS

Delivering the course to learners of different ages and coming from different economic and social backgrounds afforded an opportunity of investigating the usefulness and efficiency of the e-course in Professional communication and the students attitudes to it. I inquired into the interconnections in the way the groups worked, the efficiency and usefulness of the course, the differences in individual perceptiveness and results of evaluating the evolution of the learners’ skills. Several times I carried out questionnaires in different stages of the courses and compared their independent contributions. (Diana Rumpite et. al. 2004) Particular emphasis was laid on the results achieved in teaching students with special needs.

It is important to compare the traditional courses and e-learning courses with face-to-face seminars.

Let us start with accessibility and availability. In a provincial town far from Riga a person is not in the position to betake himself to a class where a lecture is being delivered. A skilled teacher well versed in a certain/specific area will not be able to cover 150 kilometres to reach the small township. More accessible the needed knowledge will become if the learner is able to study at home or at his working place or in a nearby computer class, and if he is able to exchange views and forward questions and assignments.

Opportunity to choose The learner will be able to master study material by using computer-provided multimedia or read it up in a book. He or she will be in the position to voluntarily choose tasks to be done or to express his view on a problem on the discussion forum. It will be possible for him to send the teacher a question and to receive an answer immediately or wait for a class seminar. On stumbling upon an unknown concept it will be possible to interrupt acquiring the material and look up the answer in a CD ROM glossary, the Internet or in a book.

Another opportunity offered by an e-course is attractability. By this we mean factors not characteristic of conventional methods that help to sustain interest. To these belong:

- virtual separating and distribution the shots in accordance with the learners’ perceptiveness, the dynamics of the text and the opportunities offered by multi-media and the support of the audio and video facilities
- additional skills in working on computers and skills to avail oneself of opportunities offered by the Internet.
- the innovation induced psychological factor born from awareness that one is learning by particularly up-to-date methods.

A course in Professional communication reflects and meets the needs, felt by everybody in his work makes use of written communication. Mastering the course is to result in skills to choose the right kind of the document to be written, its structure and content suitable for the targeted audience and the purpose of writing the document.
Yet the ability developed during mastering the course to size up the target audience and recognize the aim to be achieved through communicating, to structure one’s thoughts to expound them intelligibly affect substantially one’s ability to communicate orally. It affects the learner’s way of thinking as well as his personality. This ability is also transferred to those around one. This is a positive factor conducive to making one’s career.

The choice of the teaching method is determined by the learners’ needs, interests and aptitudes,

Needs are decisive in inducing the desire to acquire the skills necessary for landing a job, for which the corresponding entry in one’s CV is of importance. There are learners who have comprehended that these skills become ever more necessary for enhancing one’s ability to compete. With some these are born out of an inner urge to perfect oneself and not to fall and lag behind others. In all the cases persons, interested in mastering a course lies at the base of the efficiency of the distance learning method. In its turn, a precondition of the efficiency is the learners’ own motivation and ability to organize their learning process.

Interestedness most frequently is related to a desire to learn the opportunities of availing oneself of the computers, the awareness that one is handling up-to-date technologies, uses the Internet and thus attracts the attention of those around one. This fosters and enhances one’s self esteem and sense of self-assertion. Hence during acquiring the course every situation is made use of that is conducive to learning new skills in computer applications and maximum dexterity in making use of the Internet. During the training learners pick up and learn to use in conversation terminology that so far had seemed unintelligible. With the aim of inducing and stimulating interest besides skills required in studies additionally were demonstrated arranging video conferences and several computer applications of practical use we taught, such as making graphs, inserting figures and drawings in the text communicating in the milieu of Internet „virtual classes” and the vast opportunities of using the e-mail. Likewise the very "theoretical „ course itself was organized so as to as to enable the learners to discover for themselves new and exciting shades of professional communications.

Important for sustaining interest is prompt response by the consultant to the learners’ queries by means of the e-mail. Such „blitz like” reaction by the consultant stimulates the activity of the learners so hat they of their own accord engage themselves in discussions. During the courses the word „compulsory” found but little application. Even extremely busy students manage to spare time for mastering the subject matter, provided the relations between consultant and student are dominated by the attitude expressed in the words: „We are jointly engaged in doing the same thing, aimed mainly at gaining knowledge and skills” The most by effective method of managing to make the students do exercises and tests their own constant and regular interest on the part of the consultant in what has been accomplished by the student and evaluating it. Exerting such benevolent “pressuring” acts much more effectively than allergy arousing being obliged and compelled since it does not give rise to a chronic sense of guilt in those who have failed to manage something in due time. The result is that many students manage exercises that are not compulsory. In several cases when for some reason they could not manage the exercises, they moved to next group and successfully completed the course (Diana Rumpite et. al. 2004)

In developing skills and fostering interest it is specially important for learners to be afforded the possibility to solve problems and to do the tests on their own. The course delivery approach helps to sustain interest in the course to be acquired and to make sure that the mastered material has been understood correctly. This purpose is served by tests carried out in the virtual classroom, which the students are to pass after having mastered material at a time chosen by himself. The tutor can control and check the results of the tests through keeping track of the learning process. They likewise provide basis for, making comments and doing discussions in the Internet. By repeatedly doing the test the learner once more uses the opportunity to go through the material to be mastered. Experience shows that thus the quality of the learning process is raised, since the questions of the tests cover the entire material:

• Enables the consultant to control and guide the ability of every student to design documents for professional communication and provides training for the students. This purpose is served by doing home assignments and the assignments to be fulfilled during the seminars, whose volume generally is not large.
• It allows the students to develop their skills on their own by doing voluntary exercises. These might be writing larger documents, evaluating of documents or even selecting materials and proofs towards designing documents, e.g. interviews. Such tasks are usually voluminous and take much time Nevertheless there are some students who choose them of their own accord and ask the consultant to evaluate their performance

The assignments to be done independently constitute a basis for summarizing and evaluating what has been acquired.

The quality of the course in Professional communication is reflected in the Graduation paper since it shows the acquired skills and is compulsory. The
graduation papers are presented at the concluding lesson and the other students by means of their questions and comments evaluate each work. More than once the graduates designed documents, which subsequently were of use in developing projects in communicating with cooperation partners or with customers. Such cases were marked by great interest and high activity. In several cases the students created document, which subsequently, also some time after completing the course the students communicated with the consultant in order to tell him how the document prepared by them had „worked” and to consult him on some question related to it. The consultant’s role in running the e-course is important, yet it differs from the role a teacher plays in his class. The basic task of a consultant is to achieve its purpose, namely mastering the subject matter without entering into hierarchical relations with the learner. It is supported by tests whose results are evaluated by the class.

CONCLUSIONS

The course in Professional communication contributes considerably to social integration of different groups in society:

- By enhancing their chances of competing in the labour market owing to the knowledge and skills acquired;
- By engendering self-assurance as a positive factor for job seekers
- By developing their skills as a positive factor conducive to social integration.

The most important advantages of the methods of e-education are

- Extension of accessibility of knowledge and enlightenment,
- Additional possibility of adapting studies to individual needs and aptitudes,
- Possibility to render the learning process attractive and varied.

The training of students in e-courses in Professional communication at Livāni and at the RRC college show that:

- All the students are satisfied with the course in Professional Communication and the methods applied,
- Most students enjoy the opportunity to work in an virtual class and to master the subject matter of multimedia CD ROM, but part of the students prefer printed matter,
- The students highly appreciate the possibilities of communicating with the studies consultant and gladly make use of it,
- Most students find it important to be able to present their graduation paper publicly,
- As the course is being improved and perfected, also raised the appreciation of it on part of the students.

The results obtained testify to the long distance e-course in Professional communication being worthy of getting included also in further projects of developing human resources.

REFERENCES


BIOGRAPHY

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A VISION OF E-LEARNING COURSE IN AMBIENT INTELLIGENCE CONTEXT

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KEYWORDS
Ambient Intelligence (AmI), Ubiquitous Knowledge (U-knowledge), Knowledge Slot (KS), Knowledge Object (KO), knowledge modelling, context awareness, unobtrusiveness.

ABSTRACT
The purpose of this paper is to reflect the possible strategies, environments, models and scenarios of e-learning products in the context of Ambient Intelligence paradigm.

Development of the future oriented e-learning concepts and solution prototypes for the rapidly emerging Ambient Intelligence context aware environments are a very exciting and challenging issue.

This paper will deal with the holistic approach to the ubiquitous knowledge acquisition schemes based on the state-of-the-art research and today’s e-learning solutions.

Ambient Intelligence theoretical framework is one of the key driving forces of the future e-learning technologies.

LEARNING ENHANCED BY AMBIENT INTELLIGENCE (AmI)

Our vision of a future Ambient Intelligence enabled e-Learning course is based on the following three basic concepts: (1) ubiquity, (2) context awareness (individual/social/environmental/etc.) and (3) unobtrusiveness.

E-learning and e-knowledge, if we project it on Ambient Intelligence space, gives us a Ubiquitous Knowledge or U-knowledge concept.

Today’s research of individual’s internal perception of knowledge portions (objects) and their respective external representations may be a basis for future’s well functioning marketable U-knowledge services and U-content providers (ISTAG 2002).

Ambient Intelligence among the other benefits offers an opportunity for co-ordinating resources – which is generally accepted to be necessary to overcome the knowledge fragmentation (ISTAG 2003).

This offers us the possibility to more effectively apply the available learning resources through greater (1) coherence, (2) co-ordination and (3) concentration.

The evolution of knowledge delivering scenarios is targeting some point in the future as described by David Deutsch in his highly fascinating work The Fabric of Reality and shown in the Wachowski-brothers Matrix-film-trilogy.

The overall ideal is formulated as follows:

(1) Right knowledge at right time (Trinity learns to fly helicopter).
(2) Learning from the real expert (Morpheus teaches Neo Kung-Fu) and
(3) Learning in virtually no time - the only thing that seems not likely to be available by the realisation phase of AmI (as described by David Deutsch – increasing/decreasing the individual’s speed of brain impulses would be a possible solution).

Nevertheless Ambient Intelligence concept offers us instruments to make great parts of the mentioned vision reality. On the way to there, besides the human2human (h2h) and human2machine (h2m) knowledge exchange we are approaching the dawn of the third important variation, namely, machine2machine (m2m) co-operation (a Smart Players concept).

Ubiquitously available knowledge demands to rethink on motivation gaining mechanisms. This is mainly about how to make learning more enjoyable for the particular learner.

Games with learning process just as a side effect, unobtrusive knowledge consumption techniques, and extremely personalized knowledge services – all these strategies are subjects to profound today’s research.
MODELS OF TRUST

Social acceptance of U-knowledge will essentially depend on a variety of well defined trust models and scenarios (ISTAG 2001).

A Model of Trust has to be composed of (1) User Defined Laws of Trust and (2) Situation- or Context-dependant Common Laws of Trust. The two main questions that every Model of Trust should be able to handle are:

1. To whose or what Knowledge Objects and to whose or what Knowledge Slots a particular user in a particular situation or context may have how much access?
2. Whose Knowledge Objects are eligible to be accessed in a particular learning context by a particular user?

Models of Trust play important role in Knowledge Development Scenarios building carried out by Knowledge Slots context dependently, personalized and on the fly.

KNOWLEDGE OBJECT (KO)

All Knowledge Objects can be divided into two main groups:

1. Internal Representations (IR) Knowledge Objects (IRKO)
2. External Representations (ER) Knowledge Objects (ERKO)

The properties of Internal/External Representations Knowledge Objects include (1) Data format and type, (2) Data itself and (3) Relation(s) to the corresponding Knowledge Object(s) from the opposite representations group.

Knowledge objects can be dynamically arranged by the Knowledge Slots and delivered in the course of Knowledge Development Scenario implementation.

Knowledge Objects are created using the participating effort of co-operation between various Knowledge Providers including individuals, academia, industry, learning GRIDs and possibly other means (ISTAG 2001).

KNOWLEDGE SLOT (KS)

In the context of Ambient Intelligence space we can think of Knowledge Slots as a kind of docking-points of a ubiquitous Knowledge Server. These docking-points can be located virtually anywhere although some locations are surely more suitable than others.

Best preconditions for setting up Knowledge Slots probably are in places where people - the potential Knowledge Users - are relaxing or reside somewhere that would allow some kind of knowledge developing activities like: a park, a café, a walk, a lengthy waiting phase or similarly.

A connection to a Knowledge Slot should occur transparently, unobtrusively, and according to the Trust Model of a particular Knowledge User.

Figure 1 shows one possible connection scenario to a Knowledge Slot.

Following steps have to be performed to ensure that Knowledge User receives the best possible Knowledge Development Scenario in the particular Ambient Intelligence space and Environmental Context.

Some of these steps can be also performed asynchronously (i.e. 3, 5 and 7):

1. Knowledge Slot (KS) detects some wireless device of a Knowledge User (KU) and Knowledge User’s (KU) wireless device connects to the Knowledge Slot (KS).

2. Knowledge Slot (KS) uses the available Micro Electro Mechanical Systems (MEMS) and Sensors in order to collect information about the actual Environmental Context.
(3) MEMS and Sensors return the collected data about the Environmental Context to the Knowledge Slot (KS).

(4) Knowledge Slot (KS) connects to the User Knowledge Profile Database (UKPD) in order to retrieve the current Knowledge Profile Information of the actually connected Knowledge User (KU).

(5) User Knowledge Profile Database (UKPD) returns data about the user’s current Knowledge profile (state) according to the user-defined / context-dependant Trust Model.

(6) Knowledge Slot (KS) connects to the Knowledge Objects Representations Database (KORD) in order to retrieve Knowledge Objects that are applicable to be used with the current Knowledge Development Scenario under the current contextual circumstances.

(7) Knowledge Objects Representations Database (KORD) returns data in Knowledge Objects format to the Knowledge Slot (KS). Knowledge Slot (KS) is responsible for detecting, accessing, providing or possibly even developing the functionality to process the Knowledge Object data in the appropriate manner.

(8) Knowledge Slot (KS) delivers the dynamically composed Knowledge Objects to the Knowledge User (KU).

THE ARCHITECTURE OF THE KNOWLEDGE SLOT

Defining the architecture of Knowledge Slots (KS) and developing the implementation mechanisms for them into the context aware Ambient Intelligence environments, we consider a major research area within the technology enhanced learning field.

According to the specific model of trust Knowledge Slot should be able to:

1. Transparently connect to the knowledge profile databases of individual’s wireless devices (knowledge interface),

2. Intelligently assess the current knowledge status of an individual (knowledge assessment e.g. according to the Knowledge Assessment Standard - KASTA),

3. Intuitively pre-select the possible complementary knowledge portions (objects) and/or knowledge development scenarios (knowledge modelling, knowledge evolution),

4. Autonomously select the appropriate knowledge delivery method, form, and style according to the environment’s context parameters.

KNOWLEDGE OBJECT REPRESENTATIONS (KOR) DATABASE (KORD)

Knowledge Objects Representations Database contains all available Internal and External Knowledge objects developed by the knowledge content providers. These databases are connected by the Knowledge Slots and supply Knowledge Users with modules for the Knowledge Development Scenarios.

Figure 2 shows the life cycle of a Knowledge Development Module request:

A KOR-Database should be able to:

1. Store and access the Internal Representations (IR) of Knowledge Objects (IRKO)

2. Store and access the External Representations (ER) of Knowledge Objects (ERKO)

3. Implement logic to build Knowledge Development Modules (KDM) from the different kinds of Knowledge Objects (grouping, categorizing, building hierarchical structures, assigning data types and formats, etc.)

Figure 2. Life cycle of a Knowledge Development Module request.
USER KNOWLEDGE PROFILE (UKP) DATABASE (UKPD)

User Knowledge Profile Database (UKPD) represents the Knowledge User’s learning history and the actual knowledge state.

An UKP-Database should be able to:

1. Implement safe functionality to check requests against the corresponding Trust Model from the Trust Model Database (TMD),
2. Access the whole history of the personality development data from the Personality Database (PD) for the currently connected Knowledge User (interests, preferences, hobbies, etc.),
3. Access the whole history of the knowledge development data from the Knowledge History Database (KHD) for the currently connected Knowledge User (courses, test results, success rates, etc.),
4. Store and access the current Knowledge Development Model for the currently connected Knowledge User,
5. Store and access the actual state of knowledge within the current Knowledge Development Model for the currently connected Knowledge User.

CONCLUSIONS

We expect the practical application of our research in U-knowledge and particularly in Knowledge Slots in that we will be able to better:

1. Understand the necessary models of trust inside the U-knowledge environments,
2. Develop the context aware knowledge delivery schemes for Ambient Intelligence space,
3. Establish a valuable reusable and modular repository of internal and external representations of Knowledge Objects.

We also expect U-knowledge concept to contribute to the promoting of individuals’ more active participation in society, social and business communities and administration.

It will require but also allow the better individual planning of the time resource through the decentralized on-demand-knowledge offer.

At the same time there will be a need for highly effective control mechanisms over the U-knowledge providers to ensure a stable, consistently evolving maximum quality knowledge orchestration framework.

REFERENCES

ISTAG (2002), Strategic Orientations & Priorities for IST in FP6, European Commission.

ISTAG (2003), Ambient Intelligence: from vision to reality, draft consolidated report, European Commission.


BIOGRAPHY

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USE OF ICT IN PROJECT MANAGEMENT

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KEYWORDS
Electrical Engineering: Multimedia Learning Tools, Course Curricula

ABSTRACT
New interactive multimedia learning material of the course „Electrical Engineering and Electronics” has been presented in form of CD ROM. It opens new opportunities for specialists and learners in regions to improve the learning process by introducing new ways and means based on use of ICT and long distance training technologies.

INTRODUCTION
We cannot imagine prosperous and sustainable development of modern society without electrical and electronics engineers. Demand for such specialists is rising in Europe.

However, traditional training methods are not able to cope with this demand. New learning methodology must be involved. There the headlight is the principle of learner centred and in information technology based learning material.

PILOT PROJECT
Since the 1st of December 2002 to 31 March 2005 the pilot project “Improving Vocational Education in Electrical Engineering and Electronics (IV4E)” of the Leonardo da Vinci Community Vocational Training Action has been performed. Distance Education Study Centre at Riga Technical University coordinated the project.

The target priority of the project is to raise the number of skilled electrical and electronics engineers as high as possible in partner countries as a replay to challenge of European industry demand and as a replay to challenge of the European social problems opening to young people an assured way to be involved in productive activities.

Following partners took part in the project realisation:
- Riga Technical University, LATVIA
- Politecnico di Torino, ITALY
- XGrant, THE NETHERLANDS
- E&L Instruments Ltd, UK
- Tallinn Technical University, ESTONIA
- Kaunas Technical College, LITHUANIA
- Centre of Professional Education, LATVIA
- Latvian Transport Development and Education Association, LATVIA
- Latvian Electrical Engineering and Electronics Industry Association, LATVIA

Main project aim was to create a modularised training programme at ISCED level 4 for Electrical Engineering and Electronics using multi-media training tools in order to make learning more attractive, accessible to the individual user, and efficient, and thus promoting an increase in the number of skilled electrical engineers. It means that vocational education system could be remarkably improved by introducing new modules (curricula) for the course of “Electrical Engineering and Electronics” (EEE modules) linked with interactive student centred EEE learning tools (computer programs).

PROJECT RESULTS
The tasks of the project were realized in compliance with the project Time Schedule. The planned aims and objectives were attained. The main project outputs are the EEE modules (curricula) and EEE learning tools.

They are presented in form of CD ROM, hard copies and partly accessible on-line. Six CD ROM versions have been produced: in English, Italian, Dutch, Estonian, Lithuanian, and Latvian languages. It is recommended to
use the learning material (learning modules and learning tools) of the course at colleges, technical universities, and individual studies relevant to ISCED fourth level.

EEE learning modules (curricula)

Learning module (curricula) is a limited training programme characterised by definite entrance conditions, aims, contents, duration and evaluation. There you will find 8 learning modules for specialist in:

- Mechatronics
- Computer programming
- Car repair and maintenance
- Woodworking technology
- Power supply
- Electrical assembling
- Maintenance of electrical devices
- Road maintenance and construction

EEE learning tools

Learning tools are the packages of interactive computer programs (software), which let make it possible to performer the learning activities in dialog regime “PC-learner”.

Learning tools have been developed for following essential topics of the course:

- Analysis of electric circuits
- Electrical machines
- Basics of electronics

The total number of learning tools is 21.

List of EEE learning tools

1. Topology of electric circuits.
2. Series and parallel connections.
3. Labelling of voltages and currents in schematics
4. Parameters of sinusoidal current (voltage)
5. Addition of sinusoids.
7. Operating conditions of DC circuits
8. DC circuit transients.
9. Series connection in AC circuits
10. Power factor correction.

Figure 1. Front page of Blackboard.
12. Elements (R, L, C) and their series connections in AC circuit.
13. DC circuits calculation
14. DC circuits calculation
15. Single-phase transformer
16. Three-phase induction motor
17. DC generator
18. DC parallel-excited motor
19. Logical function synthesis
20. Circuit of operation amplifier
21. Rectifiers

Figure 2. Translation of EEE learning tool from English to Estonian in LOTUS NOTES.

USE OF ICT IN PROJECT MANAGEMENT

The project development characterises effective use of ICT.

Learning platform BLACKBOARD 5

Learning platform Blackboard 5 (see Figure 1) is a comprehensive and flexible e-Learning software platform that delivers a course management system and a customizable institution-wide portal and online communities.

We used it as suitable tool for project management for resolving the following tasks:

- Important announcements (project workshops, meetings, conferences, seminars)
- Documentation of project material (text of project proposal, financial reports, meeting agenda and minutes)
- Digital photos on project events
- Discussion of project products development (testing EEE modules and tools, feedback)
- Management of information flow
- Use of appropriate internet links

Learning platform LOTUS NOTES

Learning platform LOTUS NOTUS was adapted by staff of the Distance Education Study Centre of Riga Technical University for several project requirements. In the frame of IV4E project management it was used for resolving the following tasks (see Figure 2):
• English edition of project output drafts (in general EEE curricula and tools) and final versions;

• Translation and edition of project products in the partner languages.

The use of ICT in project development has been considered.

Making use of powerful learning platforms Blackboard and Lotus Notes has attained advantageous experience.

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REFERENCES


BIOGRAPHY


Rudolfs Gulbis graduated from the University of Latvia 1998, Mag. physics, presently PhD student at Riga Technical University, since 2002 scientific staff member with RTU, 2000-2002 staff member of IT administrator group at Latvijas Mobilais Telefons, 1995-2000 network administrator and project manager at Eurofaculty, 1995-2000 lecturer at University of Latvia. Guidance of 9 projects on ICT education and network security, 5 scientific papers.
EVALUATION OF ADVANCED MULTIMEDIA TECHNOLOGY SOLUTION IN E-LEARNING, CASE: "SQL FUNDAMENTALS"

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KEYWORDS
E-learning, instructional multimedia, internal/external representations, multimedia principles, cognitive theory.

ABSTRACT
The article provides a description and analysis of state-of-the-art multimedia instructional material designed in collaboration between Riga Technical University and Abu-Dhabi Men’s college. As a theoretical background for analysis internal and external representation approach is used. The aim of this article is to acquire a new level of knowledge about multimedia supported learning and to set the priorities for further improvement of e-learning materials for better use in regional development as well as outline new research questions.

INTRODUCTION
With advances in new technologies ability to deliver instruction in multiple ways has improved dramatically. Multimedia technology can provide instructions to students in a new, more advanced ways the tutors often are not able to. One of the most widespread ways of teaching – a lecture – has a number of disadvantages (Foreman, 2003); e.g. it is a one-way auditory communication rarely illustrated by static visual enhancements which are far from the multimedia potential used in films, PC, video games and advertising. Another disadvantage of lecturing is that a lecturer has to make certain assumptions about hundreds of students’ perceptual and intellectual uniformity as he has to proceed at a certain tempo. The rate of student - tutor interaction, e.g., asking questions, discussions, problem solving remains quite low. Traditional approach represents tutor-centred teaching model that makes a student passive consumer of the teaching material. By using multimedia for the instruction it is supposed that students can benefit from multiple and dynamic ways of material presentation. Furthermore multimedia enhanced instructional materials allows to change the learning model and to put the student in the centre of the learning process and allows him or her to benefit from the different course delivery methods, develops course management, and time management skills. Still this approach is more demanding than a traditional one and requires from the student’s active participation in the learning process. Furthermore the quality of multimedia enhanced learning is not defined as much whether we use multimedia but rather by how we use it. In fact the issue is multidisciplinary; on the one hand it is determined by development of the technology and on the other supported by psychological/pedagogical research. Despite the fact of multidisciplinarity the design of multimedia educational content is often given in hands of multimedia designers who follow the “information presentation” and/or “sophisticated technology possibilities” philosophy. The human cognitive system is not taken into account they often follow “a common sense” and “a best examples examination” path and are not aware of scientifically proven effects of human cognitive system. The education value of such products is often far below the level it claims to be. This paper aims to use internal/external representations approach in analysis towards more optimal, effective and efficient application of instructional multimedia.

INTERNAL/EXTERNAL REPRESENTATIONS
Multiple External Representations
Important in analysing of how multimedia can help to deliver instructional messages is the concept of multiple representations (Jong et al., 2004). By definition a representation is something that stands for something else. The theory makes a distinction between external and internal representations. External representations are external in relation to the learner’s sensory and cognitive system and can be constructed using some representational code. Internal representations, in turn, are cognitive constructs internal to learner’s cognitive
system. Internal (mental) representations are constructed when a learner observes some external representation - a text, picture, animation, etc.

One of the courses produced recently in collaboration between RTU and Abu-Dhabi men’s college – SQL Fundamentals – contains a rich multimedia to illustrate important points of the course. The purpose of the SQL Fundamentals course is to introduce students to multi-table databases and SQL as an international standard for creating, accessing and maintenance of the relational databases. It is a basic level SQL course for business informatics students.

Depending on the part of the course there are a certain number of media elements combined to construct a multiple representation. From a theoretical point of view there are three main functions for multiple representation usage (Ainsworth, 1999):

- to complement (use representations that contain different information and different mental computational properties),
- to constrain (constrain possible misinterpretations of a representation or a domain),
- to construct (encourage deeper understanding of a situation).

According to sign systems representations are classified into descriptive and depictive (Schnotz, 2002). A descriptive representation system of signs has an arbitrary structure and is associated with the content they represent by means of a convention. A depictive representation is a representation consisting of iconic signs. Signs are associated with the content they represent through common structural features on either a concrete or more abstract level.

**Description of the representations, representational code and the modality**

Most of the material included in the course represents MS SQL and Oracle server environments with databases, tables, indexes, SQL language syntax and procedures this is a represented world. Video interviews add a wider perspective of practical SQL application in real world. This is achieved by interviewing different SQL practitioners.

Representing world is multimedia based learning environment with animations and simulations that visually closely resembles the representing world lacking some functionality of represented world or adding extra when necessary for achieving study goals. Rest of the material presents the represented world in terms of text pictures, diagrams, tables, manipulable drills. The correspondence in the latest case is symbolic and not that obvious.

Representational codes used in SQL Fundamentals multimedia materials include: Text; Speech; Narration; Images; Graphics; Animation; Video; Simulation. Visual and Aural modalities are prevailing throughout the material. Some parts are of the course material are built to involve tactile modality, as in simulation performing the right sequence of actions. See detailed description of simulations available in the course.

The SQL fundamentals multimedia materials contain following types of representations:

- Concrete (pictorial imagery)
- Pattern imagery (depicting relationships)
- Icons or symbolic elements (numbers, expressions and formulae);
- Kinesthetic (manipulable) imagery (involving some kind of manipulation or activity)
- Dynamic imagery (including animations and also static representations structured so to express motion or transformation)

**The dimensions of representations & forms of dynamic representations**

The SQL Fundamentals course contains multiple media elements providing multiple perspectives of representing world. Simulations included in the material provide operational user experience performing sequence of actions. Animations included in the course are of two types; presenting SQL environment from operational user perspective and functional perspective. Static diagrams are typically used to reveal a functionality of the SQL environment.

The representations vary in precision in SQL fundamentals course; those revealing functionality and describing concepts of the environment are mainly qualitative, and those revealing user experience tend to be precise, like step-by-step execution of programme code or step-by-step joining of two tables.

The SQL Fundamentals material organisation units 1 to 13 follow a classical sequence of complexity from simple to complex. Material organisation within unit follows the same principle. Separate simulations are either too short to follow that rule or use different organisation of the material i.e. step-by-step development in time.

Animations included in SQL Fundamentals course materials are either time-singular as in sequence of actions on the screen or time-implicit as in step-by-step code execution.

**Course unit layout**

SQL Fundamentals course consists of the following components:

- General course information
- 13 Units of teaching material
- Glossary
- Course Goals and Objectives
- Online instructions about the specific topic.

Course delivery is based on a standard layout (Figure 1): The central and biggest part of the screen is allocated to a learning material represented in a textual and static
picture form. The contents of the main unit is split in slides each containing material just as much to fit well on
the screen without scrolling. Along with the diagrams and pictures complementing the text there are action
buttons to allow direct access to multimedia elements where appropriate. In the right lower corner of the slide
there is a counter showing the sequential number of the current slide as well as the total number of slides in the
current unit. The headline on the top of the window indicates the number and the title of the unit. In the lower
left corner there are action buttons allowing access to the slide depicting the objectives of the unit. Below there is a
button allowing access to the examples section of the unit. Button activity allows access to the simulation or
simulations that are relevant to the content of the current unit. Video button allows watching video interviews
available in this unit, and shortcut “Main menu” leads to the start menu of the course. In the bottom there are
navigation buttons allowing moving forward and backward slide by slide, and also to move to the very
beginning or the very end of the unit. When reaching the end of unit, the text “End of unit” is being displayed.
On the right hand side there is a vertical bar that indicates the progress through the unit.

![Unit 2 - Introduction into SQL](image1)

**Figure 1.** Layout of SQL fundamentals course unit.

The next example helps students to create internal links between (1) commonly known objects, like the English
language, (2) specifically known objects, like Visual Basic programming language and (3) the new learning
object, SQL - database query language.

![IF YOU SELECT A CHICKEN THEN TRY TO ESCAPE THE NEXT FOX AND GO HOME](image2)

**Figure 2.** Selection and integration of knowledge.

A consolidating element – one sentence – is used to show
that all the three objects, represented in three different
colours, belong to one logical category, namely the
language. The student is challenged to (1) understand the
sentence as a whole and (2) to think about the sentence as
a collection of different classifiable parts in the context
of the current learning course. Colours are used to
support the information selection/differentiation process.
By contemplating the screens material student may
discover the following: (1) the learning object is a part of
something that he or she already knows or prior
knowledge; (2) some parts of the already known belong
or can be connected to the current learning object -
recursive knowledge chains; (3) not all the parts of what
he or she already knows belong solely to what she knows
- reassessment of the existing knowledge.

The next screen presents a complete list of common
operators used with SQL conditional statements. The
meaning of each operator is given in a short form right
nearby. The screen is accompanied by two examples
showing the most frequent usages of the current learning
object (the SQL operators) and also a very common
pitfall belonging to the matter (i.e. unquoted string).

<table>
<thead>
<tr>
<th>Operator</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>=</td>
<td>Equal to</td>
</tr>
<tr>
<td>≠</td>
<td>Not equal to</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
</tr>
<tr>
<td>≥</td>
<td>Greater than or equal to</td>
</tr>
<tr>
<td>&lt;</td>
<td>Less than</td>
</tr>
<tr>
<td>≤</td>
<td>Less than or equal to</td>
</tr>
<tr>
<td>in</td>
<td>In list</td>
</tr>
<tr>
<td>between</td>
<td>Between two values</td>
</tr>
<tr>
<td>not between</td>
<td>Not between two values</td>
</tr>
<tr>
<td>starts with</td>
<td>Starts with specified value</td>
</tr>
<tr>
<td>contains</td>
<td>Contains specified value</td>
</tr>
<tr>
<td>not contains</td>
<td>Does not contain specified value</td>
</tr>
<tr>
<td>is null</td>
<td>Is blank</td>
</tr>
<tr>
<td>like</td>
<td>Like a specified pattern</td>
</tr>
<tr>
<td>not like</td>
<td>Not a specified pattern</td>
</tr>
<tr>
<td>a string</td>
<td>Any single character</td>
</tr>
<tr>
<td>%</td>
<td>Any string of characters</td>
</tr>
</tbody>
</table>

In the WHERE clause, when referring to variables in character
fields, you must enclose the values in single quotes.

Example: `WHERE Weather = 'sun'`.

Variables that refer to numeric fields should not be enclosed in quotes.
Example: `WHERE Speed > 120`.

![Information presented in table.](image3)

**Figure 3.** Information presented in table.

The next screen attracts the eye by the means of three
geometrical constructions representing (1) Union, (2)
Intersection and (3) Exception logical operations used
also in SQL language. These concepts may already have
been familiar to the student e.g. from the high school
geometry course. The course material allows exploring
these concepts in an interactive manner.

![Graphical representation of logical operations.](image4)

**Figure 4.** Graphical representation of logical operations.
The next screen introduces a concept of stored procedure. It demonstrates how the Stored Procedure helps to save the execution time and takes the overloaded traffic off the network lines. The elements used are as follows:

- A stylized clock shows to the student the time necessary to get the result.
- “Good” and “bad” colour concepts are utilized. It is emphasized that sending less information over the network is good (blue colour). And it is represented simply by the shorter announcement: “Single statement” compared to the longer one i.e. worse (red colour) announcement: “Request possibly containing hundreds of commands”.

The intention here is to connect the learning object to the well-known paradigm: saving time is advisable. Simple “good” and “bad” colours concept is intended to make an association allowing faster decisions in the future.

![Figure 5. Representation of stored procedure concept.](image)

Examples section

In these thirteen sections of the course two instructor-side generated external representations are used: animation and narration, affecting visual and auditory channels of the students.

Most of the screen area is allocated to animation – a screen recording, representing actions performed by the tutor on his or her computer. Above the animation area there is a slider bar representing the actual progress of the animation. The slider allows controlling animation progress by dragging the progress indicator forward or backward. There are several action buttons placed to the right of the progress bar allowing start, pause or stop the animation. On the right side of the animation there is an adjustable vertical slider bar representing the sound volume level of the narration. In the upper right corner there is an action button for closing the animation. Goal of this particular narrated animation is to teach students how to create a table in MS SQL Server database using Enterprise manager.

In this case a narrated animation is used because it helps a lot to illustrate events on the screen and to learn more profoundly. Usage of a narrated animation fits well with dual coding theory. Mayer (Mayer & Moreno, 2002) found out that the combination of animation and narration enhances the comprehension when they are presented simultaneously and synchronized in time, since the two code systems address different channels. In this case learner can use the cognitive resources of both visual and auditory system for information processing (Brünken et al., 2004).

![Figure 6. The Examples section.](image)

Single representation in this case, either text or narration, would not be sufficient for representing actions happening on the screen (a process). Text or speech description would become too complicated and too difficult to interpret. The situation could be improved only a little by adding static images and diagrams as we find them in textbooks. Learners generally do not like reading long texts on the screen and static information representation is not good enough for representing a dynamic process e.g. creation of table in MS SQL Server database.

Although animation can present dynamic information that is either tacit or unavailable in static graphics, single representation would not allow adding extra details to the study material or overload learners cognitive resources. In this case both representations have partial redundancy, i.e. have certain parts of the content in common, but also add some new aspects to optimise the learning process. Despite its advantages, animation may or may not promote learning depending on the conditions of its usage. Researchers at Universities of California and Santa Barbara have carried out a series of experiments to find out conditions under which animations can improve learning process (Mayer & Moreno, 2002). The findings were summarized in a number of design principles based on cognitive theory of multimedia learning. The examples (narrated animations) designed for SQL Fundamentals course fit well with following principles listed below:
multimedia principle: deeper learning is achieved from animation and narration than from narration alone;

temporal contiguity principle: when corresponding narration and animation should be presented simultaneously rather than successively;

coherece principle: deeper learning is achieved when extraneous narration, sounds, pictures, and video are excluded;

modality principle: deeper learning is achieved from animation and narration rather than from animation and on-screen text;

redundancy principle: deeper learning from animation and narration is achieved rather than from animation, narration, and on-screen text;

Spatial contiguity principle: deeper learning when the corresponding text and animation are presented near rather far from each other, does not apply here;

Personalization principle: deeper learning when narration or on-screen text is conversational rather than formal is realized only partially, because the style of narrations is closer to formal than conversational.

From a practical point of view narrated animations have turned out to be very successful in demonstrating how to work with the server: they allowed a repeated viewing of the material as well as arbitrary stops along the demonstration.

Activities section

In thirteen activities sections of the course there are several types of activities available and they require students’ interaction with the course material. Most widely used activities throughout the course are MS SQL and Oracle server simulations; they are representing real servers on the learner’s workstations. There are two instructor-side generated external representations available: a simulation and a textual hint both affecting visual channel of the learner.

Most of the screen just as in the case of animation is allocated to the simulation – an interactive area for the student. Above the animation there is a slider representing the actual progress of the simulation. The slider does not allow any interactivity and it is placed for indicative purposes only. In the right lower corner there is a hint for the next action to be performed by the student.

The simulation restricts student from doing any other action than the one asked for and displaying a warning message “Wrong action please follow the instructions below” when he fails to follow the instructions. The goal of this simulation is to facilitate students in developing practical skills of creating backups for the SQL Server database using Enterprise manager. The simulation of the server is chosen for several reasons:

- It allows novices to act safely in the simulated environment without threatening the server stability by accidentally launched command.
- It allows simulating the environment of the server where the server is not available, for instance, at home or on the notebook computer.
- It allows students to simulate a diversity of platforms (this case MS SQL server and Oracle) and notice the differences.
- They receive extra guidance compared to the real system (in the form of restrictions and hints).
- Length of the backup process; depending on the size of the database, hardware and other conditions it might take quite a long time to create a backup of a database. Within simulation it is not necessary to make a student wait till the database backup is completed. It is equivalent for student to have it for few minutes and additional note displayed “Note on a real system this may take a long time for the backup to complete.”

An important aspect is the choice of representation code of the hint; narration would be more appropriate according to dual coding theory. But when there are multiple representations, student has to be able to translate between representations. The problem might arise with people who do not know English so well, which is often the case in non-English speaking countries. When they receive a hint via the verbal channel, they might not be able to relate it with the corresponding menu title of the software as the spelling in English differs from pronunciation. Extra advantage of having the hint in writing is that it is available on the screen until the students perform the actions correctly and he could be easily referenced when necessary.

However, there is a danger of oversimplification in this simulation, as many actions might be performed on the server in different ways and each way may be more appropriate under certain conditions. The simulation does not allow the student to simulate every possible way of doing the action, just only one pre-defined way. Such approach is acceptable for the beginners only, but they should always be aware that this particular representation is not the real system. Information discovered and knowledge gained in the simulation should be translated back to a real system. Another point must be taken into account - the course itself has practical purpose and the multimedia instruction must be considered as the introduction into the subject, and the practical sessions based on usage of real servers and databases should not be ignored.
In addition to the types of activities described above there are a number of other activities included in SQL Fundamentals course. For example, in the picture below (Figure 8) there is an interactive test/drill where the student has to select a proper function corresponding to the definition provided, drag it, and drop it on a proper cell in the table. When the job is completed student can click “Check result”. The result of the practical exercise will be displayed: the right answers are coloured in blue and the wrong are coloured red. The Activity can be repeated until the student is happy with the result.

The next type of the activity is step-by-step execution of the certain actions and seeing the results in different representations. In this case there is an example of flight database being updated using data manipulation language commands. Learner has to “execute” a command by clicking the command line that normally would be sent to SQL Server and see the representation of the resulting data in two formats - SQL table and in user interface form that might be displayed to an airport operator.

The next activity illustrates a process of selection of data from a multiple tables using Join operation. Initially the screen shows two tables filled with data that has to be joined in a third one. Below the Table B there is a code displayed that normally is executed on a SQL Server. The third table illustrates the result of the action and step-by-step procedure how data are combined together.

The next activity illustrates the concept of views in the database. The Learner is free to choose any three select statements available and then see the results of the execution of a chosen statement.

The next activity illustrates cursor orientation options in the database. The Learner is free to choose from 5 available commands and see the results of the cursor movement. The triangle on the left side of the activity screen shows the current Cursor position (row) within the
table. The five illustrative Cursor movement actions show to the student what the Cursor does (it points) and what it is (something that points to a certain database table row).

Student learns that Cursor is not that Cursor he/she already knows (short blinking line inside the text editor’s window), but Cursor may be also a synonym for ‘currently selected row of the database table’. Student also learns that Cursor can be fetched, it can be relative (to the current row) or absolute (to the table as a whole) and it can move forward and backward by defined number of rows.

**Video Interviews**

This section describes a very important and valuable component of the course delivery material – the video interviews with IT professionals who are sharing their experience with students. Obviously, it is impossible to invite such number of professionals in the classroom during semester and this feature of the course therefore is essential enhancement for multimedia course material.

Two instructor side generated external representation codes are used: text, speech and video, affecting visual and auditory channels of the learners. On the left side of the screen the question and the answer of the interview appear in textual form. This representation is added for the purpose of easier interview content comprehension by non-native English speakers. On the right there is a video interview clip with standard set of action buttons for start, stop and pause of the interview. There is also interactive progress bar beneath the video indicating the progress of the interview and allowing fast forward and backward feature. On the right side of the video there is an adjustable vertical slider bar representing the sound volume level of the interview. Beneath the video window there is basic information about the person being interviewed as related to the topic of SQL.

Goal of video interviews contained in this course is to give to a novice a practitioner’s perspective on how the SQL is used and applied in real life situations. Video-interview adds an extra perspective to the learning material illustrating how knowledge they gain could be applied in practice.
slide when done with the current one. The example above shows that the learner should reduce redundancy as expertise grows or at least it should be controllable.

**Student feedback**

Course SQL Fundamentals has been offered to CNET (computer networking) students during Jan.-Jun, 2004 Semester. Online multimedia material, online quizzes, in-class practical sessions and tests were used to deliver course. Students’ feedback on multimedia material has been collected in form of interviews and as ongoing questioning during the entire duration of the course. Although the course has been well received there were parts that received more welcome than others. So for example the course user interface was characterized as being simple, easy manageable, and clear. Clear instructional text, basic terms being highlighted; examples being clear and describing basic functions and options available in SQL. For most students it made examples being clear and describing basic functions and easy to understand. They found verbal description and animation being combined successfully well illustrating essence of the topic, making the learning process more effective, and faster. Ability to navigate directly to various types of material e.g. examples, activities, video without necessity to go through entire text was also rate highly.

Less favourable feedbacks were received about some units having too many static slides and some video interviews being too long even unclear, causing students to loose their attention. Also there was a criticism towards inability to see the title of the unit on the screen all the time. This caused some confusion. It was also noted that it would be better for error messages (or hints) in simulations to disappear automatically instead of closing them manually. What was really unexpected in the course material like this; that is having a high numbers of multimedia segments, they would welcome even more with emphasis on more complicated cases, like analysis of different constraints, selection criteria, selection from multiple tables, nested queries, etc.

**CONCLUSIONS**

One of the most important tasks of multimedia-enhanced learning is to find an answer how to use multimedia to support learning in a most optimal, effective, and efficient way. By using approach of internal and external representations, we were able to explore the landscape of multimedia solutions more precisely. Our study demonstrates the usability of internal and external representation approach for conceptual and technical improvement of quality of multimedia learning materials. On the other hand, this approach does not offer clear and empirically founded guidelines for each and every multimedia design situation. This is partly because of research deficiencies in the cognitive theory of multimedia learning area and partly because of inability to adjust learning materials to endless combinations of learner’s abilities, their prior knowledge and their emotional states. Nevertheless the research in cognitive sciences gives a good general guidelines and overview of what factors are important when designing effective instructional multimedia.

A number of conclusions could be also derived from student feedback:

- to make text material as short as possible.
- to provide as many examples as possible with the help multimedia.
- to make video interviews short and clearly pointing the relevance to the study material.

**REFERENCES**


**BIOGRAPHY**

Bruno Zuga has MSc degree in Electronics and Telecommunications from Riga Technical University (RTU). He is a PhD student and author of more than ten publications in e-learning and multimedia.