# Information Technologies Step into New Scientific Areas

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**Abstract.** The Faculty of Information Technologies of the Latvia University of Agriculture was founded in 2001 by uniting the Department of Physics, the Department of Mathematics, and the newly established Department of Computer Systems and Department of Control Systems. The main directions of scientific activities at the Faculty are: 1) application of information technologies in forestry (leading researcher – I. Arhipova); 2) heat and mass transfer (leading researcher – U. Iljins); 3) computer control systems (leading researcher – E. Stalidzāns); 4) bioinformatics (leading researcher – L. Paura); 5) systems and synthetic biology (leading researcher – E. Stalidzāns); 6) pedagogics (leading researcher – A. Zeidmane); 7) modern elementary mathematics and didactics of mathematics (leading researcher – L. Ramane); and 8) educational management (leading researcher – A. Vintere). In 2008, the Laboratory of Computer Control of Bioprocesses was established and equipped with computational servers, laboratory bioreactor, and sets of Programmable Logical Controler (PLC) based micro automatics. The Faculty of Information Technologies organizes biannual international conferences. The first and the second conference took place in the years 2004 and 2006 under the title "Information and communication technologies for rural development". The title of the conference has been "Applied information and communication technologies" since 2008. Participation in European scientific projects is the main future objective to use advantages of the European research area and to implement recent scientific achievements of the European Community.
**Key words:** information technologies, computer control, forestry, systems biology, pedagogics.

## Introduction

The beginning of scientific activities at the Faculty of Information Technologies (ITF) can be found in the activities of its departments which formed the basis for ITF. The scientific activities at the Institute of Informatics of the Latvia University of Agriculture (LLU) from 1992 to 2001, and at the newly established ITF starting from 2002, can be divided into the following trends:

- application of simulation modelling methods and tools for the modelling of the technological processes of production (1990-1995);
- establishment of expert systems for the diagnostics of grain sorting machinery and choosing of separators (1990-1995);
- the Analytic Hierarchy Process and its usage for decision making (1994-2009);
- the influence of information and telecommunication technologies on the development of the regions of Latvia (1994-2005);
- information systems of risk analysis (2003-2009);
- dynamic modelling of the labour market demand and development of a long-term forecasting system (2005-2007).

**Application of simulation modelling methods and tools for the modelling of the technological processes of production** began with the development of the simulation model for the reception of grain at the complex of grain primary processing (Bērziņš, Rivža, 1995); later the model of the all grain primary processing complex was developed (Rivza, 1995). These models were developed as complex simulation models of mass attendance system in several stages. The simulation modelling system SITA C, developed at the Institute of Mathematics and Informatics of the University of Latvia, was used as the modelling environment (Jonin et al., 1992). The modelling of grain primary processing, especially the modelling of grain drying, was studied by S. Arhipovs (Arhipovs, 2005).

I. Arhipova, the doctoral student of the Institute of Informatics of LLU, developed the first expert system in the agriculture of Latvia – a prototype of expert system for the choice of separators in the grain winnowing machines (Arhipova, Rivza, 1994). Also a

prototype of the expert system for technical diagnostics of the grain winnowing machines was developed.

The AHP method (The Analytic Hierarchy Process) – a decision-making method popular in the world – developed by T. Saaty (Saaty, 2007), was first applied in Latvia at the Institute of Informatics of LLU in 1995 when making a decision about the territorial distribution of the grain primary processing companies (Rivza et al., 2001). Since 1995 this method has been popularized and taught to the undergraduate, master and doctoral students of the LLU. Thanks to this, the AHP method is applied in many graduation papers and dissertations. It is also applied in searching for a better developmental scenario of both higher and secondary education, in the evaluation of administrative-territorial division as well as in the evaluation of the regional development scenarios (Rivza, Rivza, 2007).

Within the framework of the co-operation projects of the Latvian Council of Science ("The risk factors, their evaluation and risk management in the agriculture of Latvia" and "The management systems of risk and crisis in the agriculture of Latvia"), the prototypes for the risk evaluation information system of a public catering company (Avsjukovs et al., 2004) and for the risk evaluation information system of a fruit and vegetable processing company were developed.

Research on the development of information and telecommunication technologies in the regions of Latvia as well as its influence on the economic development of a region was started in 1996 (Rivza, 1994), and later was continued in E. Kopeika's dissertation "Information and telecommunication technologies for the regional development of Latvia", which was successfully defended in 2007.

Participation of the Faculty's scientists P. Rivža, E. Kopeika, I. Ruža, and I. Arhipova in the project "Studies of the long-term forecasting system of labour market demand and the analysis of improvement opportunities" of the ESF National programme "Labour Market Studies" resulted in the development of the dynamic model of the labour market and, on the basis of it, the labour market forecasting system in the environment of "Powersim Studio" (Darba tirgus …, 2007). The labour market forecasting system was introduced at the Institute of Statistics of the Ministry of Economics of the Republic of Latvia, and now is being applied for analysis and forecasting of the labour market.

**Information Technologies in Forestry**

Within the framework of the collaboration between the Forest Faculty and the Faculty of Information Technologies, an interdisciplinary team of researchers from the scientific disciplines of information technologies and forestry was established. In 2005, the methodological basis of the forest inventory and management planning algorithms was studied; project leader – I. Arhipova, executors – D. Dubrovskis, S. Arhipovs, J. O s, S. Daģis, I. Sīle, J. Donis, and J. Zariņš (Daģis, Arhipovs, 2006; Sīle, Arhipovs, 2006). In order to define the requirements for the information system of forest management planning, within the framework of the project carried out in 2006, a model of the information system objects of the forest management planning process was developed, which is a precondition for further development of the information system; project leader – I. Arhipova, executors – D. Dubrovskis, S. Arhipovs, J. Ošs, S. Daģis, I. Sīle, J. Donis, and V. Osadčuks (Arhipovs, Arhipova, 2006). Within the framework of the Forest development fund project of 2007, an information system model of the forest territorial planning was approbated. The model consisted of the following blocks: the obtaining of forest inventory data, the strategical, tactical and operational forest management planning, and the control of management activities; project leader – I. Arhipova, executors – D. Dubrovskis, S. Arhipovs, J. Ošs, S. Daģis, I. Sīle, I. Šmits, and V. Osadčuks (Dagis, 2007a; 2007b; Smits, Dagis, 2007).

The model of the information system objects of the forest management planning consists of three subsystems:

- the subsystem of forest capital value;
- the subsystem of geographical information;
- the subsystem of wood resources flow.

As a result of the research performed within the framework of the previous projects, a detailed first unit of the information system – the subsystem of forest capital value – was developed. The unit of geographical information has been implemented partially, but the unit of wood-pulp resources flow has not been implemented. In order to develop a full-value support system for decision making concerning forest management planning,

a research (development of models) was needed into the management processes of the wood-pulp resources flow and the regularities of different-level plan hierarchy in correspondence with the conditions of Latvia.

Therefore the aim of the Forest development fund project of 2008 "The support system for the strategic, tactical and operative planning of forest management" was not only to study theoretically the structure and functioning principles of the support system for decision making regarding the forest management planning, but also to show in practice its application possibilities to the public at large: leading researcher – I. Arhipova, project executors – D. Dubrovskis, R. Ozoliņš, S. Arhipovs, S. Daģis, I. Šmits, A. Mežals, and V. Komašilovs (Smits, Dagis, 2008).

The application of Web (http://mapis.itf.llu.lv) was developed, which practically shows the opportunities to apply the object models developed within the framework of the previous projects and serves as a basis for the planning of forest management, for improvement of the professional skills of people employed in the forestry industry, and for training and consulting of the forest owners.

As a result of collaboration between the faculties:

- the Web application of the forest management planning information system (FMPIS) was developed, which is envisaged for public presentation of the functioning of the system with the following subsystems: determination of the forest capital value, and determination of the economically optimal amount of felling;
- the information on the planning objectives for the forest management and a wood-pulp supply company was defined;
- an information system model, which supports decision making concerning supply of wood-pulp resources at different planning levels, was developed including:
  - optimal choice of renewable wood species;
  - choice of an economically efficient forest stand cultivation model;
  - economically efficient determination of the parameters of the main felling;
  - determination of the investment capital return of the forest infrastructure;
  - the model of the flow management of wood-pulp resources;
  - forecasting of the amount and value of round timber.

The following objectives were set within the project for the years 2009-2010:

- classification of the decisions and aims of forest management and a wood-pulp supply company depending on the planning level;
- analysis of IT standard solutions for the planning systems of forest (wood-pulp) resources;
- development of the algorithms of forest (wood-pulp) resources planning system;
- analysis and evaluation of the planning system algorithms at different hierarchy levels taking into consideration the conditions of Latvia;
- development and description of the application scenarios for the models of forest transportation planning.

The results of the project have been presented at several international scientific conferences and published in the proceedings of the conferences.

**Mathematical Modelling of the Forest Stands**

Dr.silv. R. Ozoliņš, Professor (Emeritus) of the Department of Mathematics of ITF, has been carrying out research into the forestry science already since 1970. On 8 September 2004, the Latvian Academy of Sciences awarded him the title of the State Emeritus Scientist for his research on the trunk forms of the tree species more often found in the forests of Latvia. For R. Ozoliņš' lifetime contribution to the development of the forest science in Latvia, the Ministry of Agriculture of the Republic of Latvia awarded him the highest award of the forest industry, "Gold Cone", on 26 January 2007. The research into mathematical modelling of the forest stands is being continued. Latvian and Finnish companies use the algorithms developed by R. Ozoliņš for the designing of a virtual dustsheet and contour line.

**Heat and Mass Transfer**

A co-operation has been established with the Faculty of Rural Engineering into researching the qualities of a foam plaster and other molded building materials (Skujans et al., 2007). The leading researcher from ITF is professor U. Iljins. The materials under research interest are characterized by a high level of humidity in the initial samples, which determines that during the first stage of the drying process the prevailing

are the qualities of the surrounding air which absorbs the moisture, but the qualities of the materials start to determine the drying process only after a certain period of time. Therefore before starting the research on the drying of such materials it was necessary to work out a corresponding research methodology of humidity. Electrical humidity determination methods with electrodes built in the samples were recognized as the most appropriate. Several publications dealing with the calculations of the corresponding forms of electrodes and their distribution were presented both at conferences organized at LLU and abroad (Iljins et al., 2008). The results of the research on the material drying were presented in Latvia and at an international scientific conference in Italy (Iljins et al., 2009).

A co-operation is being carried out with the Faculty of Engineering concerning the research on solar collectors (Iljins, Ziemelis, 2004) – I. Pelēce, lecturer of the Department of Physics, in her dissertation compares the conventional flat plate solar collectors with our patented semispherical solar collectors.

**Modelling of Water Pollution**

The development of phosphorus (P) index was the first attempt to design a model suitable for the assessment of phosphorus runoff risk in the conditions of Latvia, taking into consideration the experience obtained by the scientists of several European countries and the USA in design of the index. P index is recognized as an easy applicable instrument at the farm level for carrying out a qualitative assessment of risk caused by agricultural activities, when the phosphorus compounds may pollute the surface waters. Taking into consideration the physical and chemical qualities of phosphorus, the development of its runoff models is especially complex and labour-intensive. Within the framework of the project, P index was modelled by combining the conclusions of environmental engineering and the possibilities provided by information technologies for efficient model designing suitable for risk analysis under certain circumstances on the basis of the present knowledge and approach to the forecasting of phosphorus runoff risk (Bērziņa, Zujevs, 2008). E. Stalidzāns, A. Zujevs, L. Bērziņa, and R. Sudārs were involved in the implementation of the project.

**Computer Control**

The computer control as one of the trends of the master studies became a part of the scientific activities of the Faculty around the year 2006, when a bee wintering building with an automated temperature regulation and an air recirculation system was put into operation for the project of the Institute of Agrobiotechnology of LLU (Stalidzans et al., 2004). It was envisaged to place bee colonies in the bee wintering building with an appropriate-for-bees temperature for the period of time from November till March with the purpose to economize honey and physiological resources of bees. Different thermoregulation experiments are possible in the bee wintering building concerning bees or other objects. The size of the bee wintering building is 6×4 meters, the height – 2.40 meters. The control system is designed on the basis of the programmed logical controller Siemens S7-224. The control system co-ordinates functioning of eight temperature sensors, three ventilators, and one electric heater.

The computer control applies also to another project connected with bees: grant of the Latvian Council of Science "Determination of the bee preswarming situation according to the parameters of microclimate dynamics" (leading researcher – E. Stalidzāns, executors – J. Meitalovs, and A. Histjajevs). Within the framework of the project, a system for monitoring the temperature and relative humidity of two bee colonies was designed using the digital sensor systems "Dallas Semiconductor" with parallel connected sensors (Meitalovs et al., 2009). In order to find out whether the changes in microclimate are characteristic to bee swarming, television surveillance (2 video cameras) is switched on at the moments of significant changes in the indications of microclimate, which allows detecting the cause of the changes – swarming of bees or external conditions (thunderstorm, extreme temperature, or something else). Both the indications of sensors and the videotape recordings are stored in the computer.

A training set "TraSe" has been developed for university students specializing in information and communication technologies for industrial applications to simulate physically two types of industrial computer control tasks: 1) early deviation recognition, and 2) real-time control. The training set addresses some methodological issues that can be solved by training sets based on real physical processes (Mednis et al., 2008).

"TraSe" uses the feature of a rolling ball to keep predictable direction on a horizontal surface (Fig. 1). "TraSe" is developed as a game where two players develop programs and algorithms allowing computers to compete for better performance. The defending player using a starter mechanism has to hit with his ball the ball started by the attacking player. The computer of the defending player can see the actions of the attacking ball by a webcam.

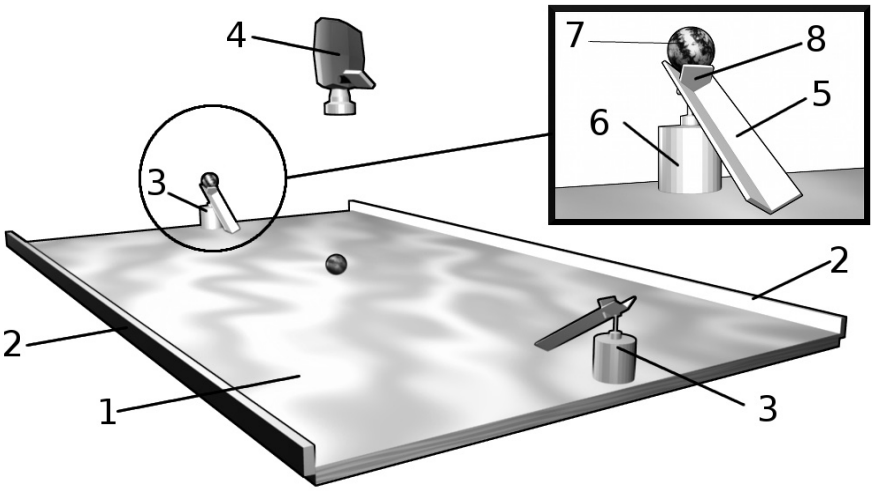


Fig. 1. Training set "TraSe": 1) a table; 2) two side guards on the long sides of the table; 3) two starter mechanisms; 4) a webcam; 5) a trough; 6) a stepper motor; 7) a ball; 8) a stopper mechanism.

In case of a single player, the following exercises can be performed: determination of a trough angle, forecast of the ball trajectory by speed and direction, determination of the table angle by the trajectory of the ball, avoiding visible obstacles on the way of the ball, scanning of invisible obstacles on the table by registering perturbations of the ball trajectory.

The tasks can be solved using methods of artificial intelligence, statistics and other methods. Time and information constraints request creative development of algorithms. Thus the skills of industrial control task performance optimizing can be developed.

The concept of "TraSe" is developed by E. Stalidzāns, M. Mednis, and S. Viļums. The mechanical and electronic parts as well as the control system are made by M. Mednis and A. Stalidzāns.

E. Stalidzāns deals also with the issues of the computer control of complex production lines and systems (Stalidzāns, 2007).

Further development of the trend of computer control is connected with the use of artificial intelligence and other methods in the management and analysis of industrially applied processes.

**Bioinformatics**

Bioinformatics is an interdisciplinary field which comprises application of computer science for the analysis and processing of biological, agricultural and molecular genetics data. The development of modern biology, genetic technology, as well as agricultural technologies and scientific research performed in these trends are connected with the obtaining, storage and processing of a significant amount of data and information, therefore it is necessary to have specialists to be able to deal with the issues of these fields.

The first steps in this direction were made in 2005, when ITF in co-operation with the Norwegian University of Life Sciences, University of Copenhagen (The Royal Veterinary and Agricultural University), University of Tartu, Lithuanian University of

Agriculture, and St.Petersburg State Agrarian University, established the Bioinformatics Network, within the framework of which the project "Nordic–Baltic–Russian academic network in bioinformatics" was developed for the financing of the Nordplus Neighbour programme (project leader – I. Arhipova, executors – L. Paura, and E. Stalidzāns) (Arhipova, Bāliņa, 2004; Arhipova, 2006a, 2006b; Paura, Arhipova, 2007). Within the framework of the project, international courses were organized for the master students of the Baltic States. Foreign guest lecturers were invited from the University of Copenhagen, Norwegian University of Life Sciences, University of Tartu and other higher education establishments. The themes of the courses covered a wide range of topics and were arranged into three larger themes:

- biology (the courses took place at the Lithuanian University of Agriculture in 2006);
- analysis of biological data (the courses took place at the University of Tartu in 2007);
- bioinformatics (the courses took place at LLU in 2007).

Together with the implementation of the international project, within the framework of the EU Structural Fund project "The modernization of the information technology study programmes at the Latvia University of Agriculture" (project leader – I. Arhipova, 2005-2007) ITF improved its master study programme. One of its main objectives was improvement of the curriculum for the study programme trend "Bioinformatics".

**Systems Biology and Synthetic Biology**

In 2005, after the involvement into the international bioinformatics project "Nordic–Baltic–Russian academic network in bioinformatics" (lead by prof. I. Arhipova and implemented within the framework of the programme Nordplus Neighbour), E. Stalidzāns became interested into the systems biology; the theme of his dissertation is close to the new scientific discipline. The mission of the systems biology is: by means of mathematical modelling integrate the huge amount of the accumulated molecular biology information into a single, dynamic holistic perspective in order to show how the systems' qualities of an animate emerge out of the molecular interaction and, at the same time, to provide an opportunity to anticipate precisely and quantitatively the reaction of the cells towards the performed genetic modifications or changes in the external environment.

There are excellent preconditions for the development of systems biology at the ITF, because the field is interdisciplinary and the computer technology is one of the most powerful instruments in the systems biology (Žukova, Stalidzāns, 2006). Besides, this trend agrees with the activities of the master study specialization "IT in Biosystems". This has facilitated intensive participation at international conferences (6 conferences in 2006) in order to understand the present developmental stage and future trends of the systems biology and to choose "the main emphasis" of future scientific activities when getting involved in international projects. The application of control theory methods for the management of biological systems by means of technical and biological aids was chosen as the main research trend (Mozga et al., 2006). The main instrument in this trend is the computer, which is used for the solution of modelling and optimization problems. At present the research on the trend of systems biology is performed by four doctoral students (according to their enrolment): I. Mozga (Artificial intelligence for the dynamics modelling of glicolysis processes (Lagzdina et al., 2008)), U. Grunde-Zeiferts (Computer control algorithms for the molecular processes of cells), V. Brusbārdis (The control network model of the thermostress reaction of a human cancer cell), and T. Rubina (Computer modelling of the structure of biochemical control networks).

One of the themes addressed is the analysis and contrasting of technical and biological systems and their control principles on the scale of many generations (Mozga et al., 2007).

Since 2007, ITF has been co-ordinating the international innovation transfer project "Modular education for interdisciplinary systems biology" (MOSBIO) (Stalidzans, Mozga, 2008). The project is implemented within the framework of the "Leonardo da Vinci" programme, and the partners involved in the implementation of the project are from Germany, Finland, Spain, and Estonia.

The projects related to the systems biology and financed by the Latvian Council of Science are being implemented: "Rationalization of biofuel production by means of the dynamic models of biochemical reaction networks" (project leader – E. Stalidzāns,

executors – L. Lagzdiņa and I. Mozga) – from 2008, and "The application of cell control networks for the control of bioprocesses" (project leader – E. Stalidzāns, executors – T. Rubina, I. Mozga and V. Brusbārdis) – from 2009.

The Biosystems Group has been increasingly more involved in the activities of the synthetic biology since 2008. The representatives of this new discipline, which is close to systems biology, try to apply the principles of technical system designing when designing systems from biological elements. A very important part of the synthetic biology is the forecasting modelling of the systems functioning.

In 2009, within the framework of the European Social Fund (ESF) activity "Involvement of human resources into the scientific activities" (1.1.1.2.), a 3-year project "The formation of the Latvian interuniversity scientific team in the field of systems biology" (headed by E. Stalidzāns, the senior researcher of ITF) was approved. The partners in this project are the scientists and students from the University of Latvia and the Riga Technical University, thus ensuring a high quality of interdisciplinarity necessary in the systems biology.

In the future it is planned to expand co-operation with the Institute of Microbiology and Biotechnology (under the leadership of prof. U. Kalnenieks) of the University of Latvia where the applied methods of metabolic engineering fit well with the modelling technologies applied by the Biosystems Group.

**Pedagogics**

Research in pedagogics (leading researcher – A. Zeidmane) covers mainly the didactics of the study courses on the sciences. In 2007, within the framework of the LLU research project No. XP 61 "Studies of the developmental tendencies of engineering education" (project leader – A. Zeidmane, executors – A. Vintere, and I. Ozola), the main emphasis was laid on the research performed on issues related to the development of cognitive abilities:

- the role of the studies of natural sciences in the development of cognitive abilities was established (Vintere, Zeidmane, 2007);
- the factors determining information technologies as an instrument for the development of cognitive abilities were identified (Vintere, Zeidmane, 2007);
- the role of languages in the development of engineers' competencies within the study process was evaluated (Malinovska et al., 2007);
- the methods applied in teaching the natural sciences were evaluated (Zeidmane, 2007).

In 2008, within the framework of the LLU research project No. XP 112 "Engineering education for the development of knowledge society", the following was succeeded:

- "Knowledge Structure" in engineering in relation to the engineers' special and professional qualifications was evaluated (Zeidmane, Vintere, 2008);
- components describing the information and communication abilities, their integration and evaluation in the engineering education were found out (Zeidmane, Vintere, 2008).

**Educational Management**

Educational management is a relatively new scientific trend in Latvia; however, several research issues are topical also at LLU:

1) organization of the engineering study process (leading researcher – A. Zeidmane);
2) integration of information communication technologies (ICT) into education (leading researcher – A. Vintere);
3) organization of the mathematics study process (leading researcher – A. Vintere).

In order to improve correspondence between the supply of higher education and the tendencies of public development, the ITF in co-operation with the scientists from the Faculty of Engineering and the Faculty of Rural Engineering carry out continuous, co-ordinated and systematical studies of the tendencies in the field of engineering education, which includes research, experience exchange, co-operation between all parties involved in the educational process, etc. In 2008, within the framework of the project of the Latvian Council of Science "Research of competencies needed for engineers in the labour market of Latvia and the development of these competencies during the study process" (leading researcher – A. Zeidmane; executors – L. Maļinovska, S. Strausa,

K. Vārtukapteinis, and A. Vintere), the challenges facing the engineering education were identified (Zeidmane, Vintere, 2008):

1) changes in the practical training of engineers (sustainability, complexity, risk management, ability to see the opportunities, etc.);
2) changes in the engineering labour force (lack of abilities in the industry, changes in the generations, global mobility, etc.);
3) changes in the curriculum of engineering education (structural changes, broadening of variety, etc.);
4) transfer from engineering education to the development of engineering abilities.

In 2009, a team of researchers is continuing to carry out the project No. 09.1444 of the Latvian Council of Science "Research on the possibility of developing the competences needed for engineers during the study process" (project leader – A. Zeidmane; executors – L. Maļinovska, S. Strausa, A. Vintere, S. Čerņajeva, and S. Atslēga). Within the framework of the project, the role of languages and ICT in the development of engineering competences during the study process has been evaluated, the role of co-operation in the development of competences has been found out, and the possible models under the Latvian circumstances have been identified.

Within the framework of the research trend "Integration of information communication technologies (ICT) into education" (leading researcher – A. Vintere, doctoral student of the doctoral programme "Educational Management" of the University of Latvia), ICT in society management in Latvia have been evaluated, and theoretical aspects of ICT integration into education as well as the role and place of ICT in the study process and its development have been identified (Vintere**,** 2006a).

From the aspect of ICT integration into education it has been found out that qualitative changes in technologies nowadays require also significant changes in the society, therefore changes in the education based on ICT become especially important. The consequence of the ICT development is globalization, which causes several new types of risks that influence the welfare and safety of every individual. The research has showed that the new technologies provide possibility of both improving and destroying the individual's safety and welfare (Vintere, Bogdanovs, 2006; Vintere, 2008). Information literacy is one of the main preconditions for an individual's legal capacity (the capacity to use social activity opportunities offered by the community). It is obvious that information literacy is closely related to ICT. An individual's skill to use the computer and the Internet is a significant assistance in the exploration of the world and in the use of social activity opportunities offered by the community (Vintere, 2008).

The integration of ICT into education requires also new competences for the teaching staff, which should be planned and implemented together with the integration of ICT into education. In the result of research, ESF project "The improvement of the LLU academic staff's competences regarding the data processing technologies" has been implemented (Aboltins, Vintere, 2006).

The research has showed that for successful integration of ICT into education, the management of an educational establishment and its vision of the meaning of ICT not only in facilitation of the teaching/learning process but also in the strategic planning have a special role (Vintere, 2006b, 2009; Zeidmane, Vintere, 2008). Education faces a specific set of objectives: to alter the study programmes, standards, technical aids and, as the most important, methods in order the teaching/learning process implemented at school would correspond to the changes in ICT taking place in the society and to the future perspective of the economy based on knowledge. In this way there were identified problems which emerged when significant cultural and organizational differences, having started the integration of technologies, had influenced the environment of modern educational management. An encouraging study environment facilitates the educational quality. Within the framework of the research, the issue on the enrichment of the study environment with ICT has been addressed (Vintere, 2009).

Within the framework of the research trend "Organization of the mathematics study process" (leading researcher – A. Vintere), the factors determining the development of the mathematics education, as well as the problems and their possible solutions have been identified. The factors determining the educational quality, as well as the possibilities of facilitating the quality of the mathematics study process at LLU have been evaluated. The possibility of applying ICT in the mathematics study process has been evaluated (Vintere, 2009). The research resulted in modernization of the mathematics

study process within the framework of the ESF project "Modernization of the mathematics and physics study process at the LLU" (Vintere, Aboltins, 2007), and in establishment of an international co-operation network with the University of Siauliai.

**The Beginnings of Doctoral Studies**

A significant moment in the scientific activities of ITF was September 2006, when the first graduates of the ITF master study programme started their studies in the newly developed doctoral study programme "Information Technologies". A little later the Biosystems Group was commenced – its scientific activities officially started at the meeting of the Department of Computer Systems in January 2008. At the beginning, doctoral students I. Mozga and U. Grunde-Zeiferts were involved in the activities of the Biosystems Group under the guidance of E. Stalidzāns; the themes of their dissertations related to the issues of the systems biology.

Besides the scientific activities, the Biosystems Group organizes scientific seminars, 90-minute meetings open to the public, where different discoveries and tendencies related to biology are discussed. Also representatives of the Faculty of Agriculture participate at these seminars; in particular should be mentioned Dr.agr. Z. Grīslis' helpful assistance. The events organized by the Biosystems Group are attended by the scientists from Germany, Spain, Finland, the Netherlands, Estonia, and Lithuania.

The renovated room No. 307, appropriately equipped and envisaged not only for seminars and scientific activities but also as a venue for creative work of the present and future doctoral students, was opened in December 2007. The room is used by the Biosystems Group for its weekly seminars as well.

In summer 2009, already 12 doctoral students were studying at the ITF doctoral study programme. In the future it is planned to broaden the doctoral study programme by involving its first graduates as scientific advisors of the doctoral students in the teaching/learning process.

**Establishment of the Laboratory of Biosystems Computer Control**

The specializations "Computer Control" and "Information Technologies in Biosystems" of the ITF master study programme may also mutually supplement the trend of biosystems computer control. In 2008, in order that the Laboratory of Biosystems Computer Control could start functioning, within the framework of ERDF financing the project "The equipment of the Laboratory of Bioprocesses Computer Control at the Faculty of Information Technologies of the Latvia University of Agriculture" was implemented under the leadership of E. Stalidzāns and A. Paura. The obtained equipment consisted of 3 parts:

1) a laboratory bioreactor with a control system which sends the results of temperature, oxygen concentration, pH value and other data measurements to the computer enabling to study the dynamics of the control process (produced in Latvia by the company "Biotehniskais Centrs");
2) computer servers for computing the bioinformatics and systems biology problems, which is a necessary precondition for comparison of sequences, optimization of biochemical networks, and solution of other problems addressing a significant number of figures. By means of these servers it is also possible to study the speed and efficiency of different computing algorithms;
3) microautomatic sets, produced by the company "Siemens", are envisaged for realization of computer-designed management systems with programmed logical controller sets S7-200 and S7-300 which are widely applied in industry. The microautomatic sets include different sensors (pressure, temperature, distance, etc.), executive mechanisms (electromotor, output blocks, etc.), and blocks for different kinds of communication (including use of the Internet) between the controllers.

The future prospects of the Laboratory of Bioprocesses Computer Control are closely linked with the development of the bioprocesses modelling methods in order to be able to realize the computer control algorithms based on developmental forecast of the bioprocesses. It is planned also to improve the management system functionality of the laboratory bioreactor with the possibility of diagnosing deviations of the processes.

**ERA-Net Project "ICT-AGRI"**

Thanks to participation of the ITF staff, Latvia is represented in the 7th framework programme ERA-net project "ICT-AGRI" which will address the issues of the application

of information technologies in agriculture covering the following topics: agricultural communication systems, agricultural robots and automatized machinery, precision cultivation of grain, management of agricultural environment, precision cattle breeding, evaluation and documentation of agricultural produce quality, agricultural decision support systems, systems of farm management, and agricultural information management. As a result of the project we hope to integrate into the European-level network of the specialists of information technologies, which deals with agricultural problems. Thus we will also have an opportunity to introduce in Latvia the innovations created within the framework of joint projects. The period of the project implementation is from 2009 to 2013.

**Conclusions**

In the field of science, the Faculty of Information Technologies is successfully co-operating with other faculties of the LLU, higher educational institutions of Latvia, as well as with partners of other European countries. Scientific trends are being developed which agree with the specializations of the master study programme (systems analysis, computer control, and information technologies in biosystems which comprises bioinformatics, systems biology, and synthetic biology) as well as with the study courses provided by the Department of Physics and the Department of Mathematics. The team of researchers performing studies in pedagogy functions as a separate trend. The projects of the Latvian Council of Science, European Social Fund, European Fund for Reconstruction and Development and other projects for researching and providing the Faculty with the necessary equipment are being successfully implemented. Besides, the ITF successfully uses the unique opportunity provided by LLU to co-operate with other faculties in developing information technologies as a powerful instrument in any scientific discipline and business sector. Thus, the trends of scientific activities are developed jointly with other LLU faculties: Faculty of Engineering, Forest Faculty, Faculty of Rural Engineering, Faculty of Agriculture, and others. The doctoral study programme, developed in 2006, plays a very important role for further scientific development of the Faculty. The project "ICT-AGRI", which will be implemented within the 7th framework programme from 2009 to 2013, provides an opportunity to integrate into the relatively specific sphere of the agricultural application of IT at an international level.

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