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The field of information and communications technology is characterised by dynamic and fast changes reflected in a permanent development of communication technologies, on the one hand, and market globalisation and growing competition, on the other. In recent years one has been a witness to *revolutionary changes* in the field of communications. Mobile devices have taken priority over fixed devices, and the internet technologies such as VoIP enable traditional and internet services to mutually converge. New wireless access technologies are complemented with cellular networks. The expansion of wireless sensor networks is noticeable all around us, since the aforementioned networks offer a multitude of new possibilities in industry, economy and everday life. Every private sector nowadays depends on the quality of communication, since it is considered crucial to the decision-making process to obtain information at the right time. The ICT industry is under constant pressure to respond to the users´ increasing demands for higher bandwidth and greater availability of various services (speech, data, video contents) of a suitable quality. It is also faced with tensions regarding ever shorter deadlines, increasing globalisation and competition, etc. Consequently, it is very important that those who are involved in this sector are capable of responding to increasing requirements, of understanding new business principles and of exhibiting innovations at work [1].
The European Higher Education in the light of the Bologna Process is undergoing major changes. The impact of globalisation in higher education has assigned a new role to the so-called "knowledge-based society". The modern-day information and communications technologies immensely contribute to the improvement of the system of education by introducing innovative methodologies, such as long-distance learning or e-learning, to the teaching process. The aforementioned services have offered a good basis for a further extension of ICT application in higher education by applying various network and wireless systems with the purpose of supporting scientific research and improving the quality of the teaching process [2].
On the other hand, "the Bologna Process" places students in the centre of educational development strategy, and insists upon the significance of learning outcomes. This implies that the quality of educational process is focused on the levels and types of knowledge, i.e. skills, abilities and attitudes which students acquire during their studies. The latter implies further support by introducing additional elements and activities into the process of education, such as internship programmes of students´ practice and companies and institutions which aim to prepare students for their profession. Besides, enormous attention within the Bologna Process is dedicated to continuous education, which is directly connected with a dynamic development of the ICT sector. As ICT industry rapidly releases new technologies and applications, the key element of the future progress is the knowledge and competence to use and further develop these technologies [2].
It is important to emphasise that in ICT industry one typically encounters three career models (directions):

- Standard engineering model (development from engineer trainees to technical experts on a specific field)
- Line management model
- Project management model

If one considers the overall WP1 results, which are related to the waste management field (both to the field of economy and the field of education), it becomes evident that any improvement in this field through the development of the suitable professional staff demands a strong ICT support.
Namely, by analysing the NQF level qualification descriptors for the levels 6.1, 6.2 and 7.1, on the one hand, as well as by defining the sets of knowledge, skills, abilities and attitudes which future waste management engineers should have, on the other (Table 1), the previously presented conclusion is quite reasonable [3].

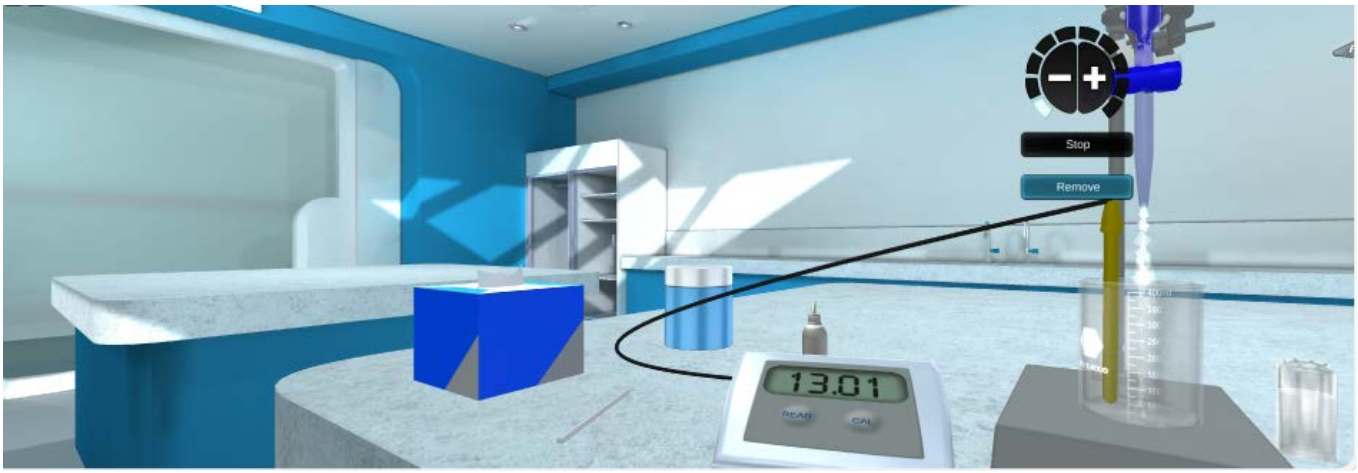

Figure 1. Virtuel Lab, source http://learnexx.com

Table 1. Qualification descriptors for vocational and academic undergraduate studies, as well as for vocational and academic studies

	UNDERGRADUATE STUDIES	SPECIALIST STUDIES	VOCATIONAL MASTER STUDIES
KNOWLEDGE	Applies the principles of waste management; Knows the properties of different waste materials; Implements national and Europian legislation; Applies the knowledge regarding the waste management procedures such as: collection, selection, transport, treatment and disposal; Collects and interprets the data obtained in the waste management related processes; Suggests measures for improvement of waste management procedures; Uses the knowledge in the field of waste management in a professional manner..	Plans, organises, applies and controls waste management procedures in accordance with waste management principles; Explains, implements and follows national and European legislation; Ensures the compliance of the working process with the current legislation dealing with waste collection, transportation, management and disposal; Organises waste collection and monitors its transportation; Participates in the development, promotion and implementation of new waste care procedures.	Applies the waste hierarchy model for the purposes of reducing waste generation, its re-use, recycling and waste material disposal; Evaluates and realises waste management plans; Co-ordinates the necessary documentation for labelling, transportation, and monitoring of waste, including report writing; Evaluates the life span of consumable products and recommends options for materials and processes which are more efficient and more environment friendly; Estimates optimal waste management procedures from technical and economical aspects; Participates in the development of strategies at organisational and local levels.

SKILLSs	Explores and uses reference literature; informs the superiors regarding working results; communicates verbally and in writing with the surroundings in the native and English language; Takes waste samples; By means of an experiment determines waste composition and its energetic value; Conducts monitoring of gasses and waste waters generated through various waste management procedures; Participates in multidisciplinary projects, in the part realting to waste management.	Follows and adopts innovations in the field of waste management; Suggests solutions to improve waste management processes; Communicates with professional and social community; Participates in the development of promotional material and notifications regarding waste management; Co-operates with other persons in charge of enforcing waste management legislation; Consults with the population, institutions and organisations regarding waste management issues, identifies their requirements and secures suitable solutions; Possesses good organisational and administrative skills; Performs qualitative and quantitative analysis of waste.	Conducts research and analytical studies regarding various waste management problems and issues; Secures training on waste management for clients and employees; Performs research into waste and consults other professionals; Communicates with colleagues and clients, presents conclusions and offers recommendations.
ABILITIES ATTITUDES	Has the ability to continue with the studies; analyses obtained experimental data and estimates their influence on the environment; Informs the authorities on a possible harmful impact on the environment; Works independently and as a part of a team; Possesses patience and adaptability.	Makes various types of operational plans with regards to waste management; Develops professional projects and contributes to the activities of national groups engaged on solving different waste management issues; Analyses statistical data and formulates reports.	Participates in budget preparation and control, including the definition of financial methods and cost assessing procedures dealing with waste management and environmental protection; Plans and co-ordinates various waste management projects; Participates in the review of all waste management activities; Controls waste management facilities and reviews waste management practice.

By carefully analysing the abovementioned requirements for various types of knowledge, necessary skills and sets of required abilities and attitudes, one can conclude that it is necessary to create an integrated teaching model which would, first and foremost, secure the acquisition of knowledge, skills and habits, develop required abilities and attitudes and, finally, contribute to the development of a whole personality. The aforementioned integrated model should contain all elements of modern learning, such as experiential learning, learning everywhere, enhanced learning, and extended learning [4].

Likewise, an integrated model would be supported by the classical or traditional teaching process, which would take place in classrooms, laboratories, in a face-to-face contact, in a hybrid or combined teaching process which would be a combination of a classroom teaching and the use of different technologies, as well as in online courses [4].

This model should enable an efficient delivery of educational material and hence secure the basic precondition for a successful promotion of learning. It should also secure a faster communication and co-operation, create conditions for an efficient evaluation, secure the approach to support and data bases and keep precise records of the results.

An integration of information and communications technologies into the teaching process requires adequate qualifications and competences of teachers and professors. ICT knowledge and skills of the teaching staff included in the curricula development are key factors which have impact on the quality of education. To train and educate teachers, to prepare them for the life learning process, to teach them how to keep up-to-date with the changes in information and communication technologies is a step which cannot be eschewed. [4].

On the other hand, one of the most efficient and most frequently applied approaches nowadays is the virtual lab concept. The advantages of a virtual lab are manifold. First and foremost, this is a modern, efficient and independent manner of learning. Furthermore, one is introduced to measuring equipment in detail by means of adequate software. There also exists a possibility of learning through independent experiment management by means of virtual, simulated systems. This automatically secures students´ improvement by mastering certain skills and acquiring certain competences. At this point we should emphasise the possibility of integration by means of an e-learning system. Finally, the financial aspect should not be neglected. A virtual experiment is an inevitable approach and unavoidable support for learning and understanding how dynamic systems function, especially complex dynamic systems. Virtual experiments represent experiments with a mathematical model of a system. This eliminates the need for an actual laboratory. However, it is necessary to construct a precise mathematical model and a suitable experimental platform [5, 6].

The application of virtual laboratories offers special advantages if one focuses on a wider circle of users. The advantages are numerous and they include the possibility of a remote access to resources, an unlimited number of repetitions of experiments and simulation processes, the possibility of fast analyses and data processing of performed experiments, as well as the possibility of transferring practical knowledge long distance [7].

Engineering education, which includes environmental engineering, i.e. waste management engineering, is a specific field in which knowledge is acquired on the basis of theoretical facts and practical experience. Consequently, laboratory exercises are a significant segment of education in the waste management field. The knowledge acquired through the simulation of various processes and objects important for waste management should be confirmed in a laboratory through experimental verification on a real model. By developing and applying ICT in education one creates conditions for a new, more sophisticated manner of organising laboratory work in engineering disciplines. The aforementioned virtual laboratories, based on the simulation of real systems and experimental animations by means of Web simulation techniques with possibilities of a remote approach [8], resolve numerous disadvantages of traditional laboratories to a great extent. Those disadvantages are mainly reflected in numerous limitations with respect to spatial capacities, human resources and time. Here one should add the issue of verifying the obtained results, i.e. the fact that in order to check the obtained results one should repeat one and the same exercise (the experiment) several times, which demands additional financial means. Taking all this into consideration, it is quite logical that a serious, modern method of teaching, supported by ICT in the field of environmental engineering, the subfield of waste management, should include an integrated virtual laboratory [9, 10].

The trends in management systems development move towards a greater hardware decentralisation, along with functional connectivity in industrial networks. As a result of a fast technology progress

numerous complex management tasks have been solved by connecting programmable logic controllers (PLC) and the central computer, as well as PID controllers [11].

Standard digital systems of automatic control generally contain analogue parts too, primarily bearing in mind the object of control. Considering the fact that digital systems are described by differential equations, the main task of digital systems theory is to project a discrete equivalent to analogue parts for the purposes of creating a possibility for processing exclusively discrete signals.

The aim is to find a discrete transfer function of a system which should enable the system to have the same output as in the case of a continuous transfer function, but only in the moments of selection. A control law is a mathematical dependence on the basis of which a control device processes relevant signals and generates suitable control actions. In the case of basic control laws, their effect can linearly depend on the error, its integral or first error derivative per unit time.

One of the most popular controllers used in automatic control systems is the PID controller, which is a combination of proportional, integral and differential control. The reason of its prevalence is in the simplicity of its use. In practice, PID controllers are made so that each of the three controller functions has adjustable parameters. After a simple parameter adjustment procedure one can most often achieve a satisfactory system response, even in those cases when one is not familiar with a mathematical model of control. In that case, these controllers are the best solution [12-14].

Considering the complexity of industrial processes in the waste management field (selection of different types of waste in different physical states, sorting, suitable chemical and thermal processes, a large number of parameters in analysis), it is sensible that students be introduced to all technical and technological aspects of the process and enabled to follow the parameters and control them.

Therefore, a modern teaching method supported by ICT and intended for engineering field should contain a production process model managed by a PID controller, for the purposes of making the real system more close to students, so as to prepare them to work within it.

In the following part of this report the authors shall present a possible integrated solution to the support in curricula implementation in the waste management field, through a functional description.

BIBLIOGRAPHY:

[1] Ključni podaci o učenju i inovacijama kroz ICT u školama u Evropi 2011, © Education, Audiovisual and Culture Executive Agency, 2011, ISBN 978-92-9201-501-5

[2] Vera Marković, Divna Vučković, Zlatica Marinković, TRENDOVI U ICT INDUSTRIJI KAO PODSTICAJ REFORMI U VISOKOM OBRAZOVANJU, XXVIII Simpozijum o novim tehnologijama u poštanskom i telekomunikacionom saobraćaju – PosTel 2010, Beograd, 14. i 15. decembar 2010.

[3] Report on defined WM-related knowledge, skills and competencies WamPPP 2016.

[4] Nemanja Đelošević, LMS u E-učenju, Univerzitet u Kragujevcu 145010-TEMPUS-2008-RS-JPHES-ETF-JP-00059-2008, 2010

[5] Sveučilište u Zagrebu. (2014, Jun) Sveučilišni računski centra. [Online] http://www.srce.unizg.hr/proizvodi-iusluge/obrazovanje/centar-za-e-ucenje/e-ucenje

[6] Vasiljević V. , Pavić B. , kostić I. , Komunikacioni sistemi – Priručnik za labaratorijske vežbe, VISER, Beograd, 2010

[7] Mile Živković, Stefan Tešanović, Željko Gavrić, Boris Slijepčević, UPOTREBA VIRTUELNE LABOROTORIJE U OBRAZOVANJU: KORIŠĆENJE PROGRAMSKIH ALATA LTSPICE I FILTER DESIGN U STICANJU PRAKTIČNOG ZNANJA IZ PREDMETA OSNOVI TELEKOMUNIKACIJA, INFOTEH-JAHORINA Vol. 10, Ref. F-17, p. 976-979, March 2011.

[8] Snežana Dragićević, Slavica Gospavić, PRIMENA VIRTUELNE LABORATORIJE VLTERMO U ANALIZI TERMODINAMIČKIH KRUŽNIH PROCESA, TEHNIKA I INFORMATIKA U OBRAZOVANJU 4. Internacionalna Konferencija, Tehnički fakultet Čačak, 1–3. jun 2012.

[9] Milica Naumović, Inženjersko obrazovanje u upravljanju - izazov savremenih informacionih tehnologija, Zbornik radova Infoteh Jahorina 2001, pp. 31-35, mart 2001.

[10] Nataša Popović, Milica Naumović, PRIMJENA VIRTUELNIH OKRUŽENJA ZA UČENJE U AUTOMATSKOM UPRAVLJANJU, INFOTEH-JAHORINA Vol. 7, Ref. E-III-12, p. 518-523, March 2008.

[11] Vera V. Petrović, UPRAVLJANJE U REALNOM VREMENU, Priručnik za laboratorijske vętbe - četvrto izmenjeno izdanje, Visoka Škola Elektrotehnike i Računarstva Strukovnih Studija, BEOGRAD 2013.

[12] Č. Milosavljević, B. Peruničić-Draženović, B. Veselić, D. Mitić, "A new design of servomechanisms with digital sliding mode", *Electrical Engineering*, **89** (2007), 233-244.

[13] G. Golo, Č. Milosavljević: "Robust discrete-time chattering-free sliding mode control", *Systems and Control Letters*, 2000, **41**, pp.19-28.

[14] Č. Milosavljević: "General conditions for the existence of a quasi-sliding mode on the switching hyperplane in discrete variable structure systems," *Automatic Remote Control*, vol. 46, pp. 307-314, 1985.