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THE STATE OF ART AND CHALLENGES OF AN EC LIFELONG LEARNING/LEONARDO DA VINCI PROJECT

Nikolay Vassilev and Maria Vassileva

University of Granada, Spain

Anna Kujumdjieva

Intellect Foundation, Bulgaria

Trayana Nedeva and Roumen Pankov

Sofia University, Bulgaria

Stanislav Avsec

University of Ljubljana, Slovenia

The EU education policy was reinforced by connecting education and training with labour market needs and by the consequences of the recent financial crisis. The recent trends of European industrial development are reflected in the European Policy Agenda, and are connected to the need for a knowledge-based economy. Among the important factors influencing this policy are: i) aging of the population; ii) increasing demand for lifelong learning opportunities iii) shift of the system from ‘knowledge’ to ‘competence’ and from ‘teaching’ to ‘learning’. These changes have stimulated the demand for workers’ knowledge and skills upgrade. However, the success of the lifelong learning programs has been hampered by the lack of cooperation between educational providers and national authorities. Students and employees could not use their qualifications in other countries due to the lack of transparency. Another obstacle is that the education in non-formal and informal settings is often considered of poorer quality than the formal training. The project “Structuring of work related competences in Chemical Engineering - STRENGTH” refers to LLP Leonardo da Vinci, Transfer of Innovation, and complies with the urgent need for establishing of common innovative models and initiatives for VET to enhance qualification transparency and comparability. The project launches innovative and coherent model for qualification description of knowledge intensive Chemical Engineering sector with high Green employment potential. The main aim of the project is focused on cooperation between VET and the world of work through elaboration of smart multilingual e-system for qualification description based on the European Qualifications Frameworks (EQF) principles. The EQF tackles the increased complexity of modern training systems at the European workspace. National and European systems for vocational qualifications do not offer successful strategies for obtaining the necessary skills, but the learning process is getting loaded with increasing complexity, contradictory requirements and obscure criteria. The partners in the “Structuring of work related competences in chemical engineering" (STRENGTH) project have decided to strengthen the European workspace by improving transparency of certificates and qualifications, obtained in the European states. The acquired competences are transferable and recognizable on the basis of the EQF principles. The main points of the Projects: STRENGTH need analysis for competence based description of qualifications for Green jobs development at country level; STRENGTH e-platform; STRENGTH intelligent tool for competence description; and STRENGTH mobility scheme, are presented in this work.

Keywords: Leonardo da Vinci Project, Chemical Engineering, Competences, Green abilities, Smart e-portal.

Introduction

The STRENGTH project aims at introducing a synergic transfer of an existing model training system (Vocational Qualification Transfer System in Public Health) for workplace basic skills development within the Chemical Engineering field keeping green abilities awareness in four EU countries - Spain, Bulgaria, Slovenia, and England, regarding the shift of the European labour market towards knowledge-based economy and sustainability of jobs. The STRENGTH project provides strategic advice on the formulation of a green economy strategy, engaging global best practices and making connections to global network of green economy lessons learned. It analyses the global trends in green economy with a focus on clean technology investments and fiscal instruments to generate efficient use of energy, water, mining, building, transport, and wastes.

The project objectives are focused on the introduction of the 'green abilities' concept to create new opportunities of vocational education and training (VET) teachers and systems to build up green employability skills and further ecological awareness development of job seekers. In this way participants in VET will obtain knowledge for new generic employability and green skills for performance of personal development, employability and introduction in the European labour market.

Chemical Engineering as an Academic Discipline

Chemical engineering, as an academic discipline, involves the design and management of biological, chemical and physical processes that enable raw materials to be converted into valuable products. It is a discipline that is based on scientific knowledge from chemistry, physics, biology and mathematics combined with engineering principles. Chemical engineers design both products and the processes and manage their operation and optimization in order to make them economically viable and environmentally acceptable. On the other hand, the processes that are managed, as a part of the designed plant, include biological and/or chemical reactions in a sequence that provides minimal loss of materials and consumption of energy. The same unit operations are equally applicable across industries such as petroleum/petrochemical industry, food processing, mining and related industries, production of plastics and chemicals, pharmaceuticals production, environmental management, and biotechnology where, in some cases, additional skills of the chemical engineer are needed. It is important to note that Chemical Engineers must be capable of reacting to any change in production conditions and partly because the Chemical Engineering is closely related to discoveries in the enabling sciences of the profession such as biology, chemistry, biochemistry, microbiology and physics. Hence, the chemical engineer must be familiar with the language and principles of these sciences (at least to obtain additional specific skills) and/or to be able to work closely with specialists from these fields and other fields of engineering, management and industrial relations.

Green Chemistry and Jobs: Definition, Current State and Future Trends

In general, Green Chemistry (including Chemical Engineering) can be defined as the "design of chemical products and processes to reduce or eliminate the use and generation of hazardous substances" and illustrates the 12 principles of Green Chemistry, a set of "design rules" which illustrate that field, announced in 1998 by Paul Anastas and J.C. Warner (1). Bearing in mind the "engineering part" of Chemical Engineering, it would be of great importance to additionally include the 12 Principles of Green Engineering elaborated by Anastas and Zimmerman (2). It is obvious that Green Engineering is the development and commercialization of industrial processes that are economically feasible and reduce the risk to human health and the environment. All the above principles should be taken into consideration when determining the details of the STRENGTH Project Matrix of Green Competences. To analyse historically the development of the concept of Green Chemistry it would be interesting to use a database of scientific publications generated along the last 20-30 years. The evolution of Green Chemistry scientific publications increased from less than 100 in 1990 to more than 600 in 2012. On the other hand, if we examine the distribution of these articles by a field it appears that the majority belong to Chemistry Multidisciplinary while only 3.75% of the total number belong to Chemical Engineering (3).

One of the first and widely accepted definitions for "green jobs" particularly by researchers and policy-makers is the one from the report by the United Nations Environmental Program (UNEP), International Labour Organization (ILO), International Trade Union Confederation (ITUC) and the International Organization of Employers (IOE). The report defines Green jobs as jobs created, under decent work conditions, in activities that reduce environmental impact of sectors, companies and economies. The definition further considers green jobs as "green" positions in agriculture, manufacturing, construction, installation, and maintenance, as well as scientific and technical, administrative, and service-related activities that contribute substantially to preserve or restore environmental quality (4).

It should be noted that "green jobs" are widely recognized as an evolving concept and therefore it is sometimes difficult to give a strict definition valid in a long-term. The definition of "green jobs" in wider context might comprise any new job in a defined sector of economic activity, which has a lower than average environmental sign and at least partly contributes to improving overall performance. Due to this broad interpretation of the subject, the counting and monitoring of the numbers of green jobs is a tricky task. A new job maybe greener than a previous, yet not green enough. Here, pure statistics of direct green jobs count less than the support of the idea that sustainable development transforms employment patterns and the labour market. Namely, this process at EU level is continuous and positive.

Another issue is the quality of green jobs. At present, many green jobs are still informal (mainly those connected with recycling, construction, biofuels production). This highlights the complicated route of achieving sustainability. In other words, it is not feasible to address the environmental dimension without also focusing on the national and international social and economic policies regarding decent work conditions. International labour standards provide practical guidance for green jobs, particularly instruments on safety and health, chemicals and working conditions. Thus, one of the key challenges is to make sure that the green jobs are decent jobs and contribute to socially sustainable development.

The EU has devoted more public research resources to environmental-related sciences than any other research system in the world. According to the data available, there are about 7,360,000 jobs in the EU in green sectors, but there is always a gap between the potential for eco-innovation and the current state of "green-based" activity. It should be pointed out, however, that there was, until recently, a lack of based on a reliable, comprehensive and comparable system of green jobs evaluation in the European Union. The lack of a standard data definition of green jobs resulted in highly differing figures for green jobs and their future potential in the EU (5).

Undoubtedly, Green Jobs are an important part of employment linked to a more environmentally sustainable economy. On the other hand, they are critical for making the shift to a Green Economy in general, and Green Chemistry in particular, and technically feasible and economically viable. One of the most critical points in this process is that without skilled and motivated workers in new green growth sectors and in key occupations across the economy, the investment made and the technology deployed will not generate the expected benefits for sustainable development. The manufacturing sector has a huge potential for greening. Managing materials in a green way implies not only recycling, but looking at the composition of materials themselves. Materials science and in particular green chemistry is a growing area where additional skills are emerging as technology advances. Production processes become green when green technology and improved materials are applied, outputs of waste and inputs of energy and resources are reduced, and attention is given to products and materials throughout their entire life. Occupations affected by these changes vary from one industry to another, but across the sector include those of executive manager, researcher/developer, engineer, industrial technician and machine operator. Other related occupations where skills are likely to change include those of chemical engineers, chemical equipment operators and tenders, chemical plant and system operators, chemical technicians and chemists.

The Need of Green Skills Introduction into Chemical Engineering Education

"When will ecologists learn engineering and ecologists learn ecology?"
William Mitsch, Editor-in-Chief, Journal of "Ecological Engineering"

Experts in the field of education in general, and in Chemistry and Chemical Engineering are split over which is more desirable: specific green chemical skills training or a more conventional background including more specific subjects different from the traditional ones. Production industrial sectors are split by the same manner. Some years ago, the journal Nature published a special report on Green Chemistry (7) citing hiring managers of some important companies. For example, for the hiring managers at the multinational General Electric, green qualifications are less important than raw talent while others say green chemists have some advantages, including greater awareness of environmental issues. It is now widely accepted that students following the Green Principles in their education in green chemistry are uniquely positioned to address industry concerns because of their specific training in both industry regulations and particular process constraints.

Another important point concerning the need of green skills implementation is job creation in the field of Chemical Industry bearing in mind the steady decline of students in chemistry titles in Europe. It is not a secret that chemistry has not been a popular career choice in recent years worldwide. Particularly in Europe, with 1.7 million people employed in the chemical industry in the 27 countries of the European Union, the industry is fighting to remain a competitive employer. To avoid the radical decline in chemical industry employment, the European Technology Platform for Sustainable Chemistry (SusChem; http://www.suschem.org) clearly promotes novel skills such as expertise in biocatalysis, process design and nanotechnologies. To increase work in these areas, SusChem hoped to boost the European Union's funding of training and research in chemistry by 75%, to 5.5 billion euros until last 2013. SusChem fully supports the Innovation Union and the goals of the "EUROPE 2020 Strategy" addressing direct technical innovation areas and two supporting areas such as Resource and energy efficiency; Water; Raw materials; Smart Cities; Enabling Technologies; and Education.

In order to meet the Horizon 2020 goals, innovate successfully, and remain competitive, the European chemical sector needs human resources equipped with the right mix of skills. Motivated by recommendations in the report of the European Commission's High Level Group on the Competitiveness of the European Chemical Industry published in July 2009, the Chemical Industry Council (CEFIC) published a study which aimed to investigate the critical – business, personal, scientific and technical – skills that scientists and engineers will need to boost innovation in the European chemical industry of the future (8): it is clear that the main need concerns Multidisciplinary/Interdisciplinary Broad Skills introduction into the Chemistry Curricula.

One of the most important conclusions when analyzing the available literature on Green Chemistry, Green Jobs, and Green Skills is that there is an urgent need to design appropriate educational schemes and resources that can be used at undergraduate and Master's level to develop the skills needed the chemical industrial sectors. In support of the above, let's take Ecological Engineering, which should obligatory include Green/Sustainable Concepts. Ecological engineering is defined as the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both (9, 10). The goals of ecological engineering are well defined as: (1) the restoration of ecosystems that have been substantially disturbed by human activities such as environmental pollution or land disturbance, and (2) the development of new sustainable ecosystems that have both human and ecological value (11). Particularly the development of new sustainable ecosystems makes ecological engineering broader. According to Prof. Mitsch, who is an expert in Ecological Engineering and the Editor-in-Chief of the journal of Ecological Engineering, "ecosystem restoration, as currently practiced throughout the world, is done by practitioners who have little experience in design (scientists study systems, they do not design systems) and by engineers who do not appreciate the capabilities of ecosystems to self-design (engineering is a field devoted to removing uncertainty and controlling natural processes)" (12). The approaches of many restorations projects that are less successful than anticipated are overdesigned by engineers with unsustainable technology. The main conclusion of progress evaluation of six long-term restoration projects in the USA, is that for this kind of ecological activities to become more accepted and predictable, they need to be better integrated and more trans-disciplinary-organized in Universities. It appears that ecological engineering academic programs controlled by engineers alone are unsuccessful because of the lack of both ecological and biological training in traditional engineering programs. Similarly, the field of restoration ecology should provide more allowance for emerging ecosystems, and "not always focus on putting things back to the way they were". Design and problem solving of mega-ecological problems are needed in the fields of ecological engineering and ecosystem ecology. Engineers and scientists should recognize the importance of naturally occurring self-design and accept time as a component in ecosystem development when designing projects aimed at creation of functional ecosystems. These expert recommendations based on long-term observations of in fact green-oriented activities illustrate the urgent need of reconstruction of both Engineering and Ecological Curricula in order to create more sustainable and science-based Green Education in Universities. Similar conclusion can be made following the most recent evolution of the trajectory of "green articles" which shows that in the field of research Green Chemistry in general broadens its focus (in particular to the field of biocatalysis) and is trying to work at the intersection of different knowledge fields or principles.

Active skills policies will therefore be important, with the main lessons pointing to the need of anticipating future skills requirements and make adjustments in education and training systems. In the field of Chemistry, Chemical Engineering, and Biotechnology the value of encouraging the acquisition of generic skills in science, technology, engineering and mathematics (skills defined as STEM skills) is an important task as well as the urgent need to boost green skills development as an adaptive response to the rapid climate challenges. An excellent example in this direction is the initiative of the OECD that has created a Forum on Green Skills, bringing together stakeholders in skills development for a low-carbon economy (13).

The Strength Project

Need Analysis and Conclusions of Project National Reports

As a part of the STRENGTH Leonardo da Vinci Project, a short analysis of the above information and of a set of National Reports elaborated to determine the need of green jobs, and particularly in the field of Chemical Engineering Education and Industry has been carried out.

The European Union green goods and services sector more than doubled in size in the last decade, according to the latest figures released by European Commission Eurostat. As a result, the European Union's new strategy for sustainable growth and jobs, Europe 2020, puts again innovation and green growth at the heart of its blueprint for competitiveness. The green economy comprises a myriad of jobs and it could be concluded that the growth of green jobs employment is in parallel with its intensification.

The information in the National Reports suggests that employment in green economy as well as in traditional industries, which are becoming green, increases with sustainable rate and particularly throughout the recent years of crisis. Shifting workers out of the crisis-hit construction and tourism sectors and into “green and ecological” jobs is a priority; and this transition needs to be accomplished by implementing well-designed policies. In the Project Members’ National Strategies on Employment, initiatives for increasing employment in green industries and the promotion of green jobs are foreseen. The subsidizing employment in green jobs was launched in all Partners countries simultaneously including them in the national classification of professions.

The mechanisms behind Green Chemistry, including Chemical Engineering, are based on a set of principles dedicated to creating more efficient industrial chemicals, drugs and products, and govern by a mixture of political, economic and cultural factors. The economic drive is to reduce waste. The political drive comes from regulations, existing in all Project Partner Countries, which are forcing companies to develop cleaner processes. The green economy development requires technological innovations in production as well as economic and social infrastructure based on national legislation – adopted in all countries in the last years. Finally, consumers and scientists who are becoming more aware of the need for cleaner processes provide the cultural drive. Demands for engineers, scientists and technicians are set to boom. For example, UK will need 100,000 new engineers by 2020. If industry is to adopt green chemistry technologies, today's students must learn how to design products and processes that do not use hazardous substances. Through Chemical Engineering green education, a new generation of chemical engineers will be better prepared to meet tomorrow's scientific challenges.

Although the benefits of implementing green abilities in the companies and use green technologies are still not convincing for business managers and investors, there is increasing pressure in industry for companies to become more sustainable by developing environmentally friendly products, minimizing waste, using renewable resources, and to maintain cleaner processes throughout. However, there are no explicit national strategies targeting the green abilities need. There are differences among the Member States in skills programs for green jobs due to their differing social, economic and environmental conditions-some Member States are moving faster than others. General abilities for several groups of professions, related to Chemistry/Engineering, are common. “Green” abilities are grouped for a set of professions, thus fitting the requirements of STRENGTH project for defining professions that share common special abilities. The institutions, involved in education of professionals working in the above-mentioned sectors, are Universities and other higher educational units and the adopted qualification by the specialists is in compliance with level six of EQF.

The National Reports agree that greening the economy and the corresponding education is a multi-dimensional challenge and therefore must be addressed through specific measures at the sectorial level that includes targeted economic, employment and skills-development education policies.

STRENGTH Mobility Scheme

A very important point of the STRENGTH development strategy is the description of the Mobility Scheme. The latter reflects the vision of the STRENGTH Consortium on the transnational VET mobility as a sustainable Project part aimed at international recognition and validation of competences and qualifications. It is based on the documents issued by the EC in respect to Erasmus+ Vocational Education and Training Mobility Charter 2015-2020 (14). The STRENGTH mobility scheme outlines the basic steps of a mobility procedure that serves as a basis for recognition and validation of competences acquired through performance of a training period abroad. Here, the planning and organizational steps necessary when using the model for international VET placement are described. The obligations of the training providers in the home- and host institutions as well as those of the mobile learner who wants to gain training experiences abroad are described.

The mobility scheme includes also a set of documents that provide a basis for understanding, implementation, and application of international VET placement. It includes: Memorandum of

Understanding template; Learning Agreement frame; Sending body specific documents; Training provider specific documents; Mobile learner Personal Qualification Record; and Competence-based mobility Certificate. Briefly, the mobility phases include *Preliminary phase* (establishment a partnership between competent training bodies/institutions and transmission of statement of purpose); *Preparatory phase* (establishment of a Learning Agreement and preparation of a Competence-based certificate, developed by the home organization; *Implementation Phase* (beginning of the training period abroad which ends with issue of a Competence-based Certificate for the newly acquired Learning Outcomes, LO); *Final Phase* (The newly acquired LO are integrated as a part of the Mobile Learner current qualification).

STRENGTH Qualification Record - Principles for Creation

Here, we will explain the key terms to be taken into account when assessing the STRENGTH Qualification Record based on competences related to green abilities that a chemical engineer could additionally acquire that are the central point of the Project.

Competences, Competence Areas and the Process of Developing Competences

In a broad sense "competence" means cognitive competences (knowledge), functional competences (skills) as well as social competences (behavior). A competence area comprises various forms of competences necessary for completing core work tasks in a certain occupational field. Based on core work tasks, a varying number of competence areas can be defined, depending on the complexity, range of activities or job opportunities within a specified occupation. In STRENGTH project five competence areas are defined per occupational field: Environmental Health and Safety; Biotechnology; Food Science & Technology; Agricultural Engineering; Pharmaceutical Technology.

For each competence area, XXX steps of the competence development process are described. The nature of the competence area determines whether it is reasonable to differentiate more or fewer steps of competence development. Therefore, no concrete number of steps can be predetermined. As a consequence, this means that the steps only make sense within one single competence area, and that the numbers of steps of competence development for one different competence area do not necessarily correspond to the steps for any other area. This "flexibility" of the steps also makes it possible to integrate already-existing descriptions of steps for competence development.

Description of Competences Development

The competences depend on a variety of characteristics and may be located in different dimensions (e.g. in the degree of independence or the assessment of the complexity of a task). Those dimensions need to be expressed in relation to core work tasks. The following principles have to be taken into account:

- The description of a step of competence development includes not only the degree or specification of one or more dimensions, but must be related to the work context and in STRENGTH model to the green-job related context.
- The description should not be restricted to competences that can be formulated analytically (e.g. part-competences, isolated tasks), as they cannot be identified in the work context.
- Exemplary dimensions:
  Ability to perform independent work tasks;
  Ability to deal with a certain complexity;
  Ability to deal with quality standard demands;
  Ability to deal with dynamic situations;
  Ability to deal with transparency in education.

Description of Competences in Relation to the Green Jobs Context

The description of the competences on the various steps of competence development is held in a context-related manner. STRENGTH model core work tasks are comprehensive tasks within the green jobs context a person with the respective occupational profile has to deal with. Thus, the descriptions of the competences are designed to form a clear picture of how they can be applied in the green jobs context. The descriptions include green jobs-related categories to clarify the work activities in the Chemical Engineering field. STRENGTH green jobs-related categories are those measured through:

- The so-called 'output approach'. These green jobs concern production units within the field of Chemical Engineering that manufactures green goods and/or provide green services, *i.e.* goods or services that benefit the environment or conserve natural resources. These are research and development, installation, and maintenance services;
- The so-called 'process approach'. These green jobs concern production units within the field of Chemical Engineering that uses environmentally friendly manufacturing processes and practices. Here, workers' duties involve making the manufacturing processes more environmentally friendly or use fewer natural resources. It means to research, develop, or use technologies and practices to lessen the environmental impact of the establishment, or train the establishment's workers in these technologies and practices. For example, a chemical engineer who develops a chemical manufacturing process resulting in lower pollution emissions or a chemical technician, who tests pollution emissions level.

The common competences describe what a trainee, completed a comprehensive training program in Chemical Engineering area should be able to do. The green competences specify the knowledge and skills trainees in a defined Chemical Engineering area should have in green jobs related context. Both types of competences are covered through the accomplishment of specific study courses. Each competence is related to the specific learning objectives of the relevant study courses. As the Chemical Engineering specific competencies are interdisciplinary by nature, for many of them one and the same specific course is required to be covered.

A competence consists of three basic elements:

- **KNOWLEDGE**: acquisition, understanding and memorizing of specific content (theoretical considerations, facts, phenomena, postulates, concepts, etc.). The knowledge ensures '***knows what*** …' and '***knows how to***...' i.e. ability to understand objects, events, situations, processes, structures, and to know how to operate with them;
- **SKILLS**: basic and specific in a defined professional context and directly related to a defined professional role. The skills ensure '***shows how to*** …'. The basic ones represent a basis for professional upgrading and define individual potential. The green job-related skills are applied as an indicator for individual differentiation, necessary in certain specific operations, typical for a given profession in green jobs context;
- **WIDER COMPETENCE**: general skills and attitudes, individually related to the process of learning, thinking and self-training; presentation in social life.

In the record each Chemical Engineering competence area contains its own matrix. This matrix comprises:

- Bank of cognitive information that help the trainee to attain the '**Knowledge**' part of a competence, relevant to specific core work tasks;
- Bank of practical knowledge that help the trainee to attain the '**Skills**' part of a competence, relevant to specific core skills;
- **'Wider Commences'** required for the defined area.

The competence elements can be described either as a whole (holistically) or separately (atomistically). When described holistically, they comprise unified narrative presentation of cognitive, technical and other abilities. This is the approach used by STRENGTH model for description of common competences. The other approach is used for description of the green competences and here, for each competence area, the three basic elements are defined separately.

All these principles and the development of the Project elements can be followed at the e-portal http://www.greenstrength.eu/index.php/en/ some parts of which are still in construction. It also includes a Competence Profiler unit. Being formed from defined parts of a Competence Matrix, the competence profiles generally cover definite part of all competences described in the Competence Matrix. The organizational profile is formed by identifying competences relevant to the corresponding qualification. It is foreseen to be in compliance with the requirements of the authorities responsible for the respective qualification. The individual profiles reflect the competences that can be acquired by an individual in training. Within an Institutional profile a variety of individual profiles can be generated depending on the trainee's background and current mission of training. The Individual profiles indicate the relevant competences of a specific training or qualification on the Competence Matrix.

Both Institutional and Individual profiles are measured by Credit Points that represent the time/efforts it takes for a trainee to reach a certain stage of competence development. Implementation of measurable scale of credits allows the process of training of a trainee to be certified by a Competence Profile Certificate that represents both the organizational and the individual profile.

We do hope to provoke interest in the National and European authorities, students, professional organizations, and enterprises in order to make more attractive and greener the Chemical Engineering education and work.

References

1. Anastas PT and Warner JC, 1998. Green Chemistry: Theory and Practice, Oxford University Press, New York.
2. Anastas PT and Zimmerman JB, 2003. Design through the Twelve Principles of Green Engineering. Env. Sci. Tech. 37, 94A-101A.
3. Epicoco M, Oltra V, Saint Jean M, 2014. Knowledge dynamics and sources of eco-innovation: Mapping the Green Chemistry community. Technol Forecast Soc Change 81, 388-402.
4. Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World, September 2008, UNEP.
5. ILO, International Labour Office, 2013. Sustainable development, decent work and Green Jobs. Report V. International Labour Conference, 102nd Session.
6. Euroobserv'er, 2012. The state of Renewable energies in Europe. Retrieved January 7, 2014.
7. Gewin V, 2006. Chemistry Evolution. Nature 440, 378-379. DOI 10.1038/nj7082-378a.
8. See http://www.cefic.org/Industry-support/Implementing-reach/Guidances-and-Tools1/
9. Mitsch WJ, 1993. Ecological engineering - a cooperative role with the planetary life-support systems. Environ. Sci. Technol. 27, 438–445.
10. Mitsch WJ, 2012. What is ecological engineering? Ecol. Eng. 45, 5–12.
11. Mitsch WJ and Jørgensen SE, 2004. Ecological Engineering and Ecosystem Restoration. John Wiley & Sons, Inc., New York, pp. 411.
12. Mitsch WJ, 2014. When will ecologists learn engineering and engineers learn ecology? Ecol. Eng. 65, 9-14
13. See http://www.oecd.org/employment/greeningjobsandskills.htm
14. See http://www.mobilnost.hr/prilozi/05_1399277506_ENG_VET_Charter_Call_part_I.pdf