Sustainability education within universities

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ABSTRACT

Sustainable development is a challenging goal established several decades ago in order to create a more harmonious relation among humans and between them and the natural environment. On the long way to this goal education is an important component that needs to undergo important changes. The nature of these changes, their expected outcome, processes and actors contributing to this and the progress made so far are examined in an exploratory approach envisaging to clarify further information needs for improving human resources for sustainable development. In terms of competences, institutions, and educational programs we report significant progresses, while in case of practitioners information availability hindered at some extent the relevance of findings which at this point confirmed the normative framework.

Keywords**:** *human resources, competences for sustainable development, higher education, economics and management, sustainability managers*.

INTRODUCTION

Sustainable development was launched for more than two decades and although it envisaged a practical outcome in terms of policy making it turn out to be a vision that is at the end of a very long transformation process to be undergone by society as a whole (Rojanschi et al., 2006). This process comprises many changes to be accomplished and it is now recognized the need of gradual approach, with a number of stepping stones that allow both changes to be implemented and resources to be gathered.

The need to endorse sustainability with appropriate human resources was recognized in an early stage and continuous to remain an important cornerstone of the progress toward sustainable development. In 1990 was signed the Talloires Declaration which consists in a ten point action plan for the integration of sustainability in education. Currently is deploying the United Nations Decade for education for sustainable development (2005-2014).

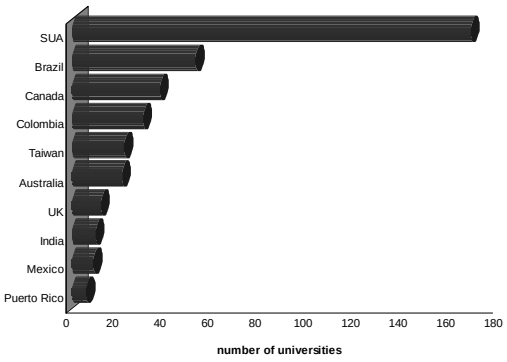
Universities are key actors in this playground since they prepare the professionals able to deliver or to manage processes, products, services etc. in accordance with the requirements of sustainable development. The challenges of sustainability are addressed by higher education institutions in various ways, but the most important transformation to occur is the change of the curriculum (Wals, 2008). Such change necessitates a careful preparation even by using a strategic approach underpinned by change management. This includes, among others, a clarification of competences and how these could be developed by various educational programs and/or disciplines.

Worldwide a number of educational programs are already focusing on the delivery of sustainability professionals, while others integrate in the content of disciplines or of curriculum components that target core sustainability competences. Our paper focuses on educational programs in the economic field using an exploratory approach that aims to outline a range of possibilities for curriculum changes that respond to the exigencies of sustainable development. The structure of the paper goes on with a first part that gives details on the institutional progress toward sustainability in higher education. The second part is a comprehensive review of the literature that reveals the state of art for the definition of competences for sustainable development. Further, there is performed a qualitative analysis of the educational programs of the top 25 universities in the world and the educational background of a selection of current or former environmental/sustainable development top managers in order to identify regularities or patterns that are relevant for both competence definition/confirmation and educational programs' development. The final section concludes and discusses the findings and their theoretical and practical relevance.

INSTITUTIONAL PROGRESS TOWARD SUSTAINABILITY IN HIGHER EDUCATION INSTITUTIONS

Higher education institutions represent a deeply conservative place (Velazquez et al., 2005) where numerous barriers could be encountered against any change, including the ones needed for improving the integration of sustainability. Some of these barriers could be overcome easier by establishing an institutional framework that provides guidance and facilitates information exchange among universities on a particular theme.

In the case of sustainability there are a number of initiatives that could be regarded as progress toward an institutional framework that supports the universities to identify the necessary changes and to implement them. All these initiatives are built on a foundation represented by the environmental education, goal that is approached by a number of dedicated events such as the Tbilisi Intergovernmental Conference held in 1977 or the International Meeting of Experts in Environmental Education held in Paris in 1982. It worth to mention the wider framework of education for sustainable development (ESD) which is promoted by the United Nations by declaring the 2005-2014 decade as the decade of education for sustainable development (DESD) with the mission, among others, to catalyze partnership, encourage monitoring and evaluation, develop a research agenda, share good practice, and create flexible working groups.



Source: ULSF, Talloires declaration institutional signatory list, http://www.ulsf.org/programs_talloires_ signatories.html, accessed in 14 July 2012.

Fig.1 **Top 10 countries by the number of signatory universities for the Talloires Declaration**

In 1990 was signed within the framework of the Conference of Rectors of Europe the Talloires Declaration (TD), a ten point action plan for the integration of sustainability in

universities. This declaration was signed until 2012 by 440 universities from 53 countries. The order of countries according to the number of signatory universities puts USA, Brazil, and Canada in top positions (fig.1).

The secretariat of the TD is represented by the University Leaders for Sustainable Development (ULSF). In 1993 emerged the Declaration of Universities for Sustainable Development which prepared the ground for the Copernicus Campus - Universities Network for Sustainability. At its 2001 conference held at the University of Lunenburg the organization expanded and became international by integrating the International Association of Universities and the United Nations Educational, Scientific and Cultural Organization (UNESCO) in the Global Higher Education Partnership for Sustainability (GHEPS). This partnership's sustainability specific goals are i. to promote better understanding and more effective implementation of strategies for the incorporation of sustainable development in universities; ii. undertake a global review and assessment of progress in making sustainability central to curriculum, research, outreach and operations; iii. identify, share and disseminate widely effective strategies, models, and good practices; iv. make recommendations based on research and review.

Beside this global framework there are also regional agreements and networks that promote sustainability in higher education institutions.

At what extent the contribution of this institutionalization is really helpful for university managers it is difficult to be judged. Nevertheless, it could be stated that if there is will for change toward sustainability in a certain university, these networks and declarations make available valuable information including research published in specialized journals such as the *International Journal of Sustainability in Higher Education* and the web sites of sustainability departments/offices of numerous universities from different countries.

EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD) IN UNIVERSITIES

Sustainable development is a goal, a vision about a society that has no social disparities and that is in harmony with its natural environment. The list of actions to be performed in order to achieve this goal is far from being completed. However, these ideals were translated in strategies and action plans, including sector specific ones.

As long as human resources are regarded, their contribution to sustainable development is a question that animated research, educational management and the novel institutions of sustainability in education in the last decades. The main issues approached by ESD research and assessment in universities are the definition of its content, capture of patterns, the process and nature of change, drivers and barriers more or less connected with the state of integration.

ESD stems in environmental education (EE), which despite its name refers to a wider context. Thus, IUCN (1970) defined EE as the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among men, his culture, and his biophysical surrounding.

The current clarification on ESD provided by UNESCO (2012) reveals that both social and environmental issues need to be integrated. Hence, ESD refers to education regarding issues such as environment, peace, human rights, health, HIV/AIDS, biodiversity, gender, inclusive, multi-cultural, holistic, global, citizenship, disaster risk reduction, climate change, and food security.

Another important feature of ESD is its role as catalyst for innovation in education since along with the changes needed to develop specific competences a co-evolution of pedagogy is occurring (UNESCO, 2012). This pattern was signaled by earlier studies too. de Ciurana and Filho (2006) note that teaching toward sustainability is the beginning of a long process that

involves a change in the epistemological, philosophical, political and social conceptions of all university members. Wals (2008) also states that ESD means a different view on pedagogy, but also on curriculum, organizational change, policy, and ethics.

As types of learning, there are opinions according to which ESD should be a transformative learning (Sipos et al., 2008; Ferrer-Balas et al., 2008; Wals, 2008). Transformative or transformational learning is a concept developed relative recently by Mezirow (1983) which emphasizes the transformation occurring in the learner by using various perspectives in the analysis of a certain issue and the transformation of passion and values in action (Sipos et al., 2008).

ESD implies changes and Thomas (2004) emphasizes that this needs a strategic approach, based on change management and supported by staff development. de Ciurana and Filho (2006) went further and outlined the characteristics of a model of the curriculum transformation toward sustainability (greening) that are presented in box 1.

Box 1 **Characteristics of a curriculum greening model**

1. Integrating the paradigm of complexity in the curriculum.
2. Introducing flexibility and permeability of the disciplines.
3. Contextualizing the curricular project – relationship with institutions and companies.
4. Taking into account the subject in the construction of knowledge.
5. Considering the cognitive, affective and action aspects of people.
6. Attempting to establish coherence and interaction between theory and practice.
7. Working within a perspective orientation of alternative scenarios.
8. Adapting new teaching and learning methodologies.
9. Creating space for reflection and democratic participation.
10. Reinforcing the commitment to transforming relations between society and nature.

Source: de Ciurana and Filho (2006), Education for sustainability in university studies. Experiences from a project involving European and Latin American universities, *International Journal of Sustainability in Higher Education*, vol.7 (1), pp.81-93.

Other practical strategies that can be used for ESD integration in universities include benchmarking, using good practices, creating networks, specialized departments and national centers.

ESD involves changes, but the changes are not necessarily completely new aspects to be integrated. Sherren (2008) stresses that there is no need to invent something disconcertingly new, but to reinforce certain concepts such as liberal education, interdisciplinarity, cosmopolitanism and civics in the philosophy, disciplinary content and pedagogy.

Despite the increasing strength of the sustainability discourse worldwide, its integration in higher education curriculum is a slow process (Winter and Cotton, 2012; Bran et al., 2009). The drivers and barriers of this process there identified and ordered at some extent. The most important drivers are academic and student interest (Chhokar, 2010), which develop then good "connectors" with society exist, along with the existence of coordination bodies and the availability of funding (Ferrer-Balas et al., 2008; Wals, 2008). The most important barrier is the resistance to change, accompanied by lack of awareness, interest, funding, training of teaching staff, and profit mentality (Winter and Cotton, 2012; Wright, 2010; Chhokar, 2010; Wals, 2008; Velazquez et al., 2005).

The interplay of these drivers and barriers could be very different from one country to another, or even among universities. For instance, in The Netherlands there a specific organization was created for this purpose the process of integration is very advanced, while in Belgium ESD is not a structural part of the educational curriculum (Wals, 2008).

The analysis of ESD integration level by knowledge field is patchy, but the existing studies reveal that technical and science educational programs are more advanced than business and economic programs. Johannsdottir (2009) states that business education failed to answer the demand for environmental literacy, while Palma et al. (2011) report that only 33% of business administration programs in Brazil included new courses to address sustainability. On the other hand, Giacomelli et al. (2003) found that the main drawback for the graduates of sustainability educational programs was the lack of socio-economic disciplines in their curriculum.

COMPETENCES FOR SUSTAINABLE DEVELOPMENT (CSD)

ESD's outcome should be a number of competences that enable graduates to address sustainability issues in a professional manner. Although the debate continues, by comparing the list of competences provided by independent inquiries it is possible to identify a pattern consisting in *six broad competence* categories: i. holistic/integrative thinking; ii. critical thinking; iii. interdisciplinary approach; iv. creative thinking; v. acknowledging complexity; and vi. transformation of feeling in action. These categories, their original description and sources are presented in table 1.

Table 1 **Broad categories of CSD**

Crt. nr.	Competence category	Original description	Source
1	Holistic/integrative thinking	analyzing and harmonizing all the relevant factors involved in approaching environmental problems	Giacomelli et al. (2003) Italy
		relevant knowledge and ability to think, act and take responsibility out of a holistic understanding of the preconditions of life on earth in a global perspective	Swedish experience (Wals, 2008)
		adopting an integral view: looking at reality from many different perspectives	Dutch experience (Wals, 2008)
		integrative lens: taking a holistic perspective	UNESCO (2012)
2	Critical thinking	think and analyze critically	Swedish experience (Wals, 2008)
		to reflect in a distanced manner on individual and cultural concepts	German experience (Wals, 2008)
		critical thinking and discussion	Stubbs and Cocklin (2008)
		critical thinking	Hurlimann (2009) Australia
		critical: questioning "taking for granted" patterns	UNESCO (2012)
3	Interdisciplinary approach	ability to cooperate over disciplinary and professional borders	Swedish experience (Wals, 2008)
		to work in an interdisciplinary manner	German experience (Wals, 2008)
		complex interdisciplinary approach	Dale and Newman (2005)
4	Creative thinking	think in new creative ways	Swedish experience (Wals, 2008)

Crt. nr.	Competence category	Original description	Source
		to achieve open-minded perception, trans-cultural understanding and cooperation	German experience (Wals, 2008)
		unlocking creativity: ability to think from new mental models and paradigms, out of the box	Dutch experience (Wals, 2008)
5	Acknowledging complexity	complex thinking and using specialists for different areas	Swedish experience (Wals, 2008)
		to think in a forward-looking manner to deal with uncertainties, and with predictions, expectations and plans	German experience (Wals, 2008)
		appreciating chaos and complexity	Dutch experience (Wals, 2008)
6	Transformation of feeling in action	ability to create enthusiasm	Swedish experience (Wals, 2008)
		to feel empathy, sympathy, and solidarity to motivate oneself and others	German experience (Wals, 2008)
		personal leadership and entrepreneurship	Dutch experience (Wals, 2008)
		independent inquiry	Hurlimann (2009) Australia
		transformative lens: moving from awareness to incorporating real change and transformation through empowerment and capacity building to lead to more sustainable lifestyle	UNESCO (2012)

Source: authors own compilation using the sources mentioned in the last column.

The list of competences is not exhausted by the ones presented in table 1. On the contrary, there are many other competences that are considered necessary for a sustainable development professional. These include: system thinking (Bran et al., 2009), problem solving, planning, continuous learning, capacity for change and others

The overall picture of CSD allows us to capture the following features: non-specificity; solid knowledge and information accrual; acceptance of knowledge limits; and feeling-knowledge interaction. CSD are not sector specific in terms of knowledge or even profession and could be regarded as transversal competences. On the other hand, holistic/integrative thinking, creative thinking and interdisciplinary approach are three categories of CSD that are very demanding in terms of knowledge and information accrual (Bran and Ioan, 2006), although even a solid foundation in this respect would not exclude unexpected outcomes due to the complex patterns of natural and social systems. It could be inferred that CSD are not easy to acquire and that the upload of knowledge and information would occur at the end of a long process and it might be of limited availability.

Eventually knowledge and information gaps could be overcome at some extent by involving feeling built up in a novel architecture of values and passion. In order to reach such an outcome it would be necessary to reconsider not only the content of disciplines, but also the teaching methods and the "value" environment of universities and campuses where students should recognize the shift toward sustainability.

EDUCATIONAL PROGRAMS THAT DELIVER CSD

Universities' reaction to sustainability has various shapes and dimensions and could be assessed against sets of criteria established at international or national level having as outcome a range of clusters. Within this area of research our paper aims to reveal the changes in the content of social sciences and management educational programs that are enforced in order to deliver CSD. The analysis is performed using the above mentioned educational programs of the world most performing universities (top 25 in the QS Top Universities classification by subject for Social Sciences and Management, Economics and Econometrics).

The rational for establishing the empirical basis is twofold: on the one hand it is related to the type of change that is assessed, and on the other hand it refers to the universities that were selected. In the first case, the analysis of changes in curricula means to reveal the patterns for the outmost in terms of sustainability integration in higher education. Curriculum changes are the first criterion of sustainability assessment in the set used by ULSF, while the Dutch organization for sustainability integration in universities considers such changes as an indicator of strong integration (Wals, 2008). In the second case, the most performing universities were selected because in their case the drivers of sustainability are strong enough to produce effects. Hence, these universities are very well connected to the research and education priorities of the society, such as sustainability, and have the necessary financial and human resources to endorse the changes needed. Further, there is little reporting on the hierarchy of universities against sustainability criteria. Therefore, the top 25 universities were assimilated as the best practice models for sustainability integration.

The occurrence of curriculum changes, their magnitude and variation among universities, the relation between social and environmental sciences, the representation of global environmental priorities and other patterns were revealed by taking in account program and course information provided by sample universities for undergraduate and graduate programs, excepting PhD degrees.

Two thirds of the universities made changes in their curriculum toward sustainability. These changes are different in magnitude, being comprised between the design of dedicated programs and the availability of at least one specific course in the elective category. Between these limits the number of courses for CSD makes the difference among universities.

Several universities have specific educational programs that deliver CSD and these are organized mainly as graduate programs. The exceptions are the *Land economy* undergraduate course of Cambridge University and the minor in *Environmental economics* at the University of Toronto. Dedicated graduate programs are *Environmental policy, Planning, growth and regeneration,* and *Leadership in sustainability* (University of Cambridge); *Environmental policy with Economics* (London School of Economics and Political Science); *Organizations and environmental management* (University of Pennsylvania); and *Green Management, energy and corporate social responsibility* (Universita Commercial Luigi Bocconi).

The minor change is the availability of only one to three elective courses. In such cases the proposed courses are broad in scope and could be introductory courses as it is the case of the University of Toronto (*Introduction to environmental studies, Multidisciplinary perspective on environment*), or courses that reflect an emerging issue that could be of interest for a graduate in economics (the course of *Philosophy and economics of the environment*, taught at the Oxford University's undergraduate program in Economics).

A broad range of CSD developing courses is featuring only several universities such as Cambridge, Harvard, Yale, London School of Economics and Political Science, Pennsylvania, and Luigi Bocconi.

The analysis of courses' content and scope was performed by creating a pool of CSD delivering courses from all universities. The first thing to notice was the size of this pool. By summing up we found 132 CSD delivering courses, because virtually each course has a

different nomination. This means that every university gave a different name and possible scope to its CSD delivering disciplines. This situation could be indicative for an *epistemological bias* which could be explained, at some extent, by the interdisciplinary pattern of sustainability and the continuous quest for better solutions against environmental problems that persist despite more and more intense effort to cope with them. At this point is worth to notice that sustainability is represented mainly as an environmental issue, its social dimension receiving much less attention.

By giving a closer look to the CSD delivering courses we noticed that although they are different in nomination there are similarities among them that suggest a certain overlap of their content and scope which allowed the grouping presented in table 2.

Table 2 **Grouping of CSD delivering disciplines**

Crt. nr.	**Group**	**Disciplines**
		Environment and society
1.	Human-environment interaction	Asian environments and frontiers; Environment and cultural behavior; Environment: science and society; Environmental change: past, present, and future; Environmental history of Africa; Environmental history of the Middle East; History, environment and ethics; Humans and the environment; Innovation, science and technology. Policy and the public good; Interdisciplinary environmental studies; Introduction to environmental history; Multidisciplinary perspective on environment; Responding to environmental challenges; Social entrepreneurship; Technology, society and the environment
2.	Business and the environment	Business and corporate strategy for the 21st century; Business and governance for sustainability; Business and the environment; CSR and corporate sustainability; Environmental law and business; Environmental management and strategic advantage; Financing green technologies; Green business operations; Management and the environment: issues and topics; Private investment and the environment; Project finance and financing strategies for green businesses; Strategic corporate responsibility and consulting projects; Sustainable business and green management; Sustainable innovation and supply chain management; The new corporate social responsibility: public problems, private solutions, and strategic responses
3.	Environmental economics	Applied environmental economics; Economics of natural resources; Economics of the environment; Environmental and natural resource economics; Environmental economics; Environmental economics and law; Environmental economics and society; Fundamentals of environmental economics and policy; Introduction to environmental economics; Philosophy and economics of the environment
4.	Environmental policy	Democracy and sustainability; Environmental governance; Global governance; International environmental policy and governance; International organizations and conferences; Managing a living planet: governance solutions for global environmental problems; The media, energy, and environment: global policy and politics; Public policy and regeneration
5.	Sustainable development	Environment and development; Land economy, development, and sustainability; Linkages of sustainability; Science and technology for sustainability; Sustainability science: interactions between human and environmental systems; Sustainability, trade, and environment; Sustainable design; Sustainable development; Technology and sustainability
6.	Environmental law	Environmental law; Environmental law, sustainable development and governance; International environmental law; Law and the environment; Local environmental law and land use practices; Planning and environmental law
		Environment and environmental issues
7.	Environmental	Applied risk assessment; Biological processes in environmental engineering;

Crt. nr.	Group	Disciplines
	science	Cancer toxicology; Case studies in ecology; Case studies in environment; Disease ecology, economics, and policy; Ecology and population biology; Environmental chemistry; Environmental design; Environmental impact assessment; Environmental planning and environmental assessment; Environmental protection clinic; Environmental risk assessment; Environmental systems modeling; Environmental transport processes; Introduction to environmental analysis; Introduction to environmental systems; Introduction to statistics in the environmental sciences; Natural science; Risk analysis and environmental management; Systems modeling of the environment
8.	Energy	Alternative energy; Culture, power, oil; Energy innovation policy; Energy markets; Energy policy analysis; Energy policy: technologies, systems, and markets; Energy systems analysis; Energy, engines, and environment; Energy, technology, and society; Energy, climate, law, and policy; Environmental and energy economics; Forecasting energy futures: pitfalls and prospects; Green energy policy; Quantitative perspective on energy and the environment; The economics of renewable and energy saving technologies; The energy business and geopolitics; The geopolitics of energy; Topics in sustainable management and energy
9.	Urban environment	Air pollution control; Biological treatment and utilization of waste; Buildings and regeneration; Cities and sustainability in the developing world; Land and urban economy; Management of utilities; Managing solid waste; Sustainable cities: urbanization, infrastructure, and finance; The urban environment; Urban and environmental planning; Urban brownfields; Urban development: politics, policy, and planning
10.	Biodiversity	Coastal ecosystems: natural processes and anthropogenic impacts; Genetics, biodiversity, and society; Issues in conservation; Landscape ecology; Maintenance of wetland ecosystems; Modeling geographic objects; Species and ecosystem conservation: an interdisciplinary approach
11.	Water	Water and development; Water and wastewater treatment; Water quality control; Water resources in the Middle East
12.	Food	Food policy and agribusiness; Global food politics and policy; Land, food, and ecosystem services
13.	Climate change	Carbon markets and carbon management; Climate change: impacts, adaptation, and mitigation

Source: authors own compilation using information available on universities' official web sites.

The above grouping allows us to remark that the social science and environmental science are balanced as representation having 64, respectively 68 disciplines. On the other hand, several disciplines that address environmental issues are in fact belonging to the first group (e.g. *Energy markets, Energy policy, Land and urban economy, Food policy and agribusiness*) because they provide students with social science and management competences that could be used in case of specific environmental issues. Further, there are disciplines with mixed content such as *Carbon markets and carbon management*; *Sustainable cities: urbanization, infrastructure, and finance; Sustainability science: interactions between human and environmental systems*. Considering these overlaps it could be stated that social science approach is prevalent over environmental science approach.

The priority of environmental issues on the public agenda is quite well represented by the size of discipline groups. Apart from the broad content *Environmental science* disciplines that are the most numerous, *Energy* is the largest group of disciplines. This mirrors the world challenge of coping with the increasing energy demand within the restrains of fossil fuel exhaustion and mounting greenhouse gas emissions from their burning. *Urban environment* is

also represented by a large number of disciplines, this being in accordance with the challenge of environmental improvement of cities and continuous growth of urban population.

The *Business and the environment* group comprise two types of disciplines: i. disciplines that provide competences for the organization's environmental management and ii. disciplines that focus on environmental or green businesses. The size of this group suggests that business executives will be more environmentally aware, but it should be kept in mind that Master in Business Administration (MBA) programs had little contribution to the creation of the pool of CSD delivering courses.

EDUCATIONAL BACKGROUND OF SUSTAINABILITY TOP MANAGERS

The opportunity to explore the educational background of sustainability managers is endorsed by at least two reasons: firstly, the normative framework of CSD is quite well established to be verified against practice, and secondly, the demand for sustainability practitioners entered a clear upward trend.

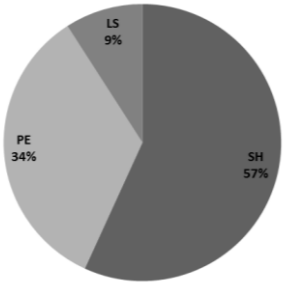
Sustainability top managers could be considered individuals that have acquired CSD. In practice, they are designated as sustainability officers, directors, consultants etc. (Bran et al., 2011). By examining their educational background we will attempt to clarify some aspects of educational programs-CSD relationship. Among the limitations of such approach there could be invoked the facts that CSD could be acquired by professional experience or that the publicly available *Resumes* are not detailed enough to present short training stages or the content of educational programs.

The individuals considered in our analysis are mainly employees of public organizations (United Nations Environmental Program, Intergovernmental Panel for Climate Change, International Union for Nature Conservation, European Commission, specific ministries at national level etc.), but also several corporate sustainability officers. The pool of 136 sustainability managers was difficult to be gathered due to the scarcity of information about their educational background especially in case of corporate sustainability officers. In the meantime, it cannot be considered a sample, since it was built using the criteria of information availability instead of selecting with a certain technique from a population. This limitation does not allow inferences endorsed by statistical significance, but still allows us to capture certain patterns in order to design further research that will explore their relation with the normative framework.

The analysis comprised the following aspects: structure of bachelor degrees by domain of science, occurrence of master and PhD degrees, domain of science for master/PhD degrees and its relation with bachelor domain.

The structure of bachelor degrees by domain of science. For this analysis we used the scientific domain classification of European research programs. This classification has three levels: domain, subdomain, and research area. The domains are: i. Social Sciences and Humanities (SH) with six subdomains; ii. Mathematics, Physical Sciences, Information and communication, Engineering, Universe and Earth sciences (PE) with 10 subdomains; and iii. Life Sciences (LS) with nine subdomains.

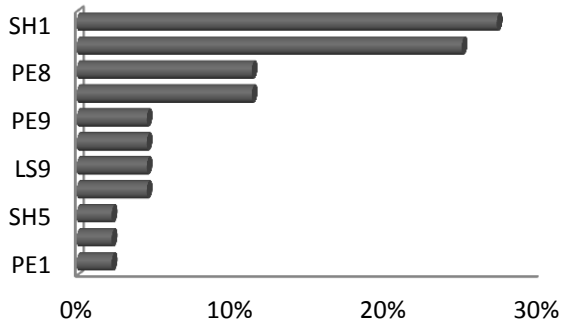
At the domain of science level the structure of bachelor degrees is dominated by SH (fig.3), which represents more than half (57%).



Source: authors own computation of educational background data of sustainability managers

Fig.2 **Structure of bachelor degrees by domain of science**

At the next level we found eleven subdomains out of a total of twenty five. In other words, more than three quarters (76%) of subdomains are represented in the structure of bachelor degrees. The largest proportion (27%) belongs to SH1 – Individuals, institutions, and market: economics, finance, and management, followed closely (25%) by SH2 – Institutions, values, beliefs, and behavior: sociology, social anthropology, political science, law, communication, social studies of science and technology. Other well represented subdomains both with 11% are PE4 – Physical and analytical chemical sciences: analytical chemistry, chemical theory, physical chemistry/chemical physics and PE8 – Products and process engineering: product design, process design and control, construction methods, civil engineering, energy systems, material engineering (fig.3).



Source: authors own computation of educational background data of sustainability managers

Fig.3 **Structure of bachelor degrees by subdomain of science**

Occurrence of master and PhD degrees. Most of sustainability managers continued their education by taking graduate courses or even PhD degrees. Thus 62% followed graduate courses (master or other type) and less than 10% held more than one master degrees. As long as PhD is regarded, 38% of the analyzed sustainability managers obtained this degree.

Domain of science for master/PhD degrees and its relation with bachelor domain. The higher level of education is better represented by programs dedicated or specialized for CSD formation and development. This is reflected by the occurrence of specific subdomains such as SH3 – Environment and society: environmental studies, demography, social geography, urban and regional studies subdomains and LS8 – Evolutionary, population and environmental biology: evolution, ecology, animal behavior, population biology, biodiversity, biogeography, marine biology, eco-toxicology, prokaryotic biology for both master and PhD degrees. Meanwhile, the number of subdomains is shrinking to nine in case of master degrees

and to eight for PhD degrees. In most cases, there is a correspondence between bachelor and graduate programs domains.

CONCLUSIONS

Education is one of the main contributors to change toward sustainable development since its outcome creates the innovative potential needed for this (Bran et al., 2010). On the other hand, education is a complex process itself and its change is featured by a great resistance. Our paper explored several aspects of this issue. We approached both the needs (competences) and the outcomes (practitioners), meanwhile performing an analysis of the means represented by educational programs and of their institutional framework.

The competences for sustainable development (CSD) benefited from a quite long and in depth process of analysis which resulted in a comprehensive description of them alongside with the development of important information hubs that allow access to relevant inputs for educational managers. CSD means holistic/integrative thinking, critical thinking, interdisciplinary approach, creative thinking, acknowledgement of complexity, and transformation of feeling into action. The UN's Decade of education for sustainable development and the Global higher education partnership for sustainability along with other associations and networks provide information exchange opportunities that could support managers in the implementation of changes in education toward sustainability.

Using a benchmarking approach we analyzed the educational programs of the top 25 universities in the world in case of Social Sciences and Management, Economics and Econometrics. CSD delivering courses of these programs are very diverse, with a good representation of environmental sciences and of current environmental priorities. Many courses are inter- and multidisciplinary and reflect a holistic approach, although the amount of knowledge to be delivered imposed the sector specific courses too. The content of the disciplines that could be inferred from their nomination give little indication regarding their contribution to the development of critical or creative thinking skills which are competences that depend more on teaching method than on content. The same is true for transformative learning, although there are courses that focus on ethics, responsibility, and society enabling the emergence of a sustainability supporting value system.

Sustainability managers had a comprehensive educational background as both domain of science and type of educational program. In fact, this background comprises all domains of science and is completed by graduate programs (master and PhD). In case of graduate educational programs, although all domains are still represented, it could be observed a certain specialization since specific subdomains occur and the number of subdomains is shrinking. Social science and humanities belonging educational programs are prevalent, their proportion being highest (73%) for master programs.

The three components (competence, educational programs, and practitioners) that were analyzed pinpoint the importance of managerial competences. This is consistent with the opinion of Morelli (2011), who also found that the proportion between technical and organizational skills should be in the favor of the second one. The important restrains encountered in case of the third component (practitioners) limits the relevance of our findings. In addition, previous studies analyzing practitioners are also very few. Hence it emerges the opportunity of a research that allows a better assessment of the outcome and the analysis of linkages between education and competences used for the design and implementation of sustainability fostering projects.

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