Changing professional demands in sustainable regional development:

Changing professional demands in sustainable regional development: a curriculum design process to meet transboundary competence

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Abstract: Within a region, public sector organisations, private sector organisations and knowledge institutions all have a stake in finding novel ways to face tomorrow's demands. In this paper we focus on the enhanced role of universities within the social network of our increasingly knowledge based society. The regional level of this study is the cross-border Rhine-Scheldt Delta and its knowledge network on sustainable innovations in water management. The challenge of sustainable development implies a frequent crossing of boundaries between disciplines and stakeholder perspectives and leads to what is called transboundary competence. This paper considers the implications of changing professional demands in the domain of sustainability from the point of view of the university. It addresses the research questions: How can a university incorporate transboundary competence in its view on learning and curriculum development? And how can the academic quality of learning outcomes be guaranteed in such curricula designed to meet the needs of stakeholders? Proposed is a design process based on open curriculum development in interaction with the workfield. The design process has been tested in the design of a blended learning Master in Delta Water Management.

Key words: Sustainable regional development, transboundary competence, open curriculum design, networked learning, professional competence, water management, Rhine-Scheldt Delta

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1 Introduction

Our society can be seen as a global networked society in which the regional level is increasing in importance. Regions have an optimal size for communication and learning for sustainable development in a multi-level system (Adomßent, 2011; Castells, 1996): it is the regional level (or meso-level of organisations), which is in interaction with both the local level of initiatives (at micro level of the individual citizen) and the global level of challenges (at the macro level of key stakeholders, politics and society). Within a region, public sector organisations, private sector organisations and knowledge institutions have a stake in finding novel ways to face tomorrow's demands. The implications and scope of regional development may vary according to the geographic region and to how its boundaries are perceived internally and externally. The regional model of innovation dynamics between the public, private and knowledge sectors is often referred to as the 'knowledge triangle', although the term is not always quite clear as to the three actors involved and the aim of the interaction processes. The so-called and widely-used knowledge triangle of the EU innovation agenda (van Vught, 2009) refers to education, research and innovation as the key drivers of the knowledge based society. Another concept based on mutual, networked learning in strengthening innovation dynamics is the Triple Helix Model (Etzkowitz and Leydesdorff,

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2000). The triple helix represents the more overlapping, intensive interrelationship between academia, government, and industry as shareholders in regional development. Whereas the triple helix is rather focused on academic business and the commercialization of the results of research processes, in Burton Clark's 'entrepreneurial university', more attention is paid to teaching and learning (Clark, 1998, 2004). To sustain knowledge change, the latter concept blends care for academic values in well-endowed curricula, meanwhile interacting with the dynamics of the professional practice (Clark, 2004). Starting from this theory, the 'third mission' of universities on regional economic and social development is not only to meet the widespread need to generate knowledge-based innovation (Etzkowitz, 2003), but also to incorporate within the curricula a triple helix process of mutual, networked learning. Zilahy and Huisingh (2009) highlight the complex nature and barriers of university cooperation in such multi-disciplinary, multi-stakeholder regional sustainable development initiatives.

In this paper, we focus on the role of academic curricula in sustainable regional development in our increasingly knowledge based society. The level of study is the Rhine-Scheldt Delta region: a cross-border estuary area in the western part of Belgium and the Netherlands. The process of mutual, networked learning among public, private and knowledge sectors in this region can be defined as transitional learning to overcome discontinuities caused by boundaries and sub-dynamics of innovation (Lansu et al., 2010). Such an engagement in regional learning has of course consequences for the way university curricula are designed. The latter is especially true for curricula on sustainable development, where fostering transdisciplinarity and stakeholder collaboration (Lozano et al., 2011) and learning to cope with uncertainty and complexity at various levels of spatio-temporal scale are of vital importance.

At the regional level, stakeholders involved in the triple helix will have to discover in mutual interaction what works and what actions are needed. That is why professionals

working on technological, environmental, economic, or societal solutions for sustainability problems (Lozano, 2008), have to cope with a continuously changing labour market and continuously changing professional demands. This of course must have implications for the design of curricula on sustainable development in higher education. This article reviews the design process of a university curriculum within the triple helix of government-industry-academia, to suit these changing demands into regional curricula for lifelong learning at master level. We will now illustrate such changing professional demands, with examples from water management as a domain in sustainability science.

Current examples in water management show that the professional demands in this domain are rapidly changing. Research on the role of professionals (Hutchins et al., 2008) during the Hurricane Katrina disaster in 2005 showed the necessity of role change in water management. The Katrina storm surge caused most (2/3) breaches in human designed levees, flooding 'safely', water-managed residential areas (ASCE, 2007). Learned from the effects of the Katrina disaster, the prospect of more severe hurricanes, as an effect of climate change with higher chances on levee failures, demands new solutions in this domain. In the search for those solutions not only water managers but also policy-makers, citizens and stakeholders are involved. In sustainable water management, building higher levees is no longer the 'one and only' (technological) option. The post-Katrina American practice of water management now focuses on predicting disasters and mediating by 'building with nature' the effects once they have happened (van Koningsveld et al., 2008): a role change of the water management professionals. Bijker (2007) noticed that the Dutch water managers seem still merely aimed at keeping the water out. Picture this as the water manager in the role of the iconic Hansje Brinker who plugs a dike with a finger. In her study, Wesselink (2007) analysed the response of this post-Katrina American practice of water management on Delta Water Management in the Netherlands. She concludes that the challenge is to find solutions that are consistent with

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local and regional culture, and to avoid locking-in whether technologically or politically. Addressing this challenge, the professional demands on Dutch water managers will change.

The example demonstrates that the professional demands for water managers change over time and over space and so does the role, sustainability professionals have to play in interaction with citizens and policy-makers. If entrepreneurial universities want to incorporate such continuously changing professional demands into their academic curricula, they have to translate these demands into intended learning outcomes.

2 Changing Professional Demands in University Curricula

2.1 Professional Demands and Learning Outcomes

The focus on learning outcomes in university curricula is relatively new. Since the early nineties, higher education in The Netherlands and Flanders has been changing from a mainly input-based approach (completion of pre-described study-load) towards a more competence-based approach (NVAO, 2003). This implies an emphasis shift from the learning process to learning outcomes (Felder et al., 2011). Therefore, the learning outcomes become the measurable goals of the expected level of competence. In competence-based learning, the delineation of learning outcomes is often done by unravelling the job domain in separate key competences, skills, and attitudes. If these are generic qualities related to the potential contribution of the graduate to society and the labour market, the Australian educational system speaks of ‘graduate attributes’ (Barrie, 2006; Byrne et al., 2010; Desha et al., 2009), a term followed in other educational systems (Avard and Zenios, 2012) . Current critiques point at the disadvantages of this kind of competency-based learning and generic graduate attributes. According to Koper and Tattersall (2004), this decomposition of job tasks is a behaviouristic approach, which leads to endless lists of very small, pre-described learning objectives. Following Gonczi (1999) and Schlusmans et al. (1999), they state that learning design should be based on an integrated competence-based approach that takes a more

holistic, less detailed view, because competence has to be used in various combinations to undertake occupational tasks professionally. Barrie (2006), signalling that the present lists appear to mean very different things to the individual academics, suggests to overcome inconsistency in curricula, a dialogue between academia, learners, employers and society before identifying 'central achievements of a university education'. According to Eraut (2004) lists of competences based on the analysis of job tasks are situation-specific, although they can contribute to general understanding within an occupational domain. Also van Merriënboer and Kirschner (2007) point at the necessity for a holistic approach in instructional design, especially for complex learning and whole-task sequencing. This means that learning is not divided in different compartments, but that students are offered whole tasks, in which they are confronted with the total complexity of a problem. While the learner is progressing in the study the level of complexity rises, not its scope. According to van Merriënboer and Kirschner (2007), in ill-structured and complex domains with quick changes of acquired knowledge, professionals should be prepared to deal with continuous changes in their working environment and should be able to direct their own lifelong learning. Eraut (2004) describes competence as a moving target: "what counts as competence will change over time as practices change and the speed and quality of work improves". He therefore prefers a definition of 'competence as meeting people's expectations', instead of an individual-centred definition in terms of personal qualifications. His definition implies a holistic rather than a fragmented approach to knowledge, and leads to a learning environment in which the 'apprentices' are expanding their competence through a combination of peripheral participation and coaching (Eraut, 2004). In their analysis of the instructional design domain, Leigh and Tracey (2010) found that such a holistic need assessment of professional demands is often missing. This prompts new questions: if a university focuses on complexity and continuous change in the professional practice of sustainable regional development, how then

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can learning outcomes be defined? And how can the academic quality of education be guaranteed in curricula designed for professional performance in the region? Current challenges for higher education policy is to connect the traditional focus on education and research with the grand challenges for a more sustainable world (UN Decade, Europe 2020) as a 'third mission'. To keep up with these changes, curricula have to consider innovative sustainable ideas and regional needs, as well as responses from various, public and private stakeholders. Traditionally, the influence of the regional demands and its labour market on most curricula in universities was rather low; professionalism was defined as 'academic quality in the disciplinary research work'. Faculty, the academic staff involved in both research and education, guaranteed the inset of professionalism (Steinert et al., 2005). The prevalence of purely academic criteria for the development of curricula, changed recently by the introduction of external, authoritative bodies who assess the quality of learning outcomes and curricula of universities. They do so according to frameworks for joint quality standards for curricula in higher education. Examples are the American system of ABET criteria for engineering curricula (Felder and Brent, 2003; Felder et al., 2011; Shuman et al., 2005), the Australian generic 'graduate attibutes' (Byrne et al., 2010; Desha et al., 2009) and the similar European qualification framework of the Bologna process (Bergen Conference, 2005; ENQA, 2009). The latter describes, based on the Dublin Descriptor criteria (JQI, 2004) (Table 1) the academic, generic standard of learning outcomes of the differentiating cycles of higher education. However, in a number of countries academic curricula require complicated conditions and decisions made at the central-governmental or central-institutional level. Hence, coping with changing curricula should account for the hidden, institutional side especially in the global field of sustainable education (Rikers et al., 2011). By indicating the main obstacles, this study explains how one could cope with these conditions in the implementation process of the new curricula design. It departs from the national

implementations of the joint European qualification framework for the Netherlands (NVAO, 2003, 2011).

Table 1. Quality standards for higher education: the European Dublin Descriptors and their criteria at Master (2nd cycle) and Bachelor level (1st cycle) (Bergen Conference, 2005).

Dublin Descriptor	*Level (=cycle)*	*Quality standard (differentiating Dublin Descriptor criteria between cycles)*
Knowledge and understanding	Master (2nd)	Have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle and that provides a basis or opportunity for originality in developing and/or applying ideas often in a research context.
	Bachelor (1nd)	Have demonstrated knowledge and understanding in a field of study that builds upon secondary education and is typically at a level that, whilst supported by advanced text books, includes some aspects informed by knowledge at the forefront of their field of study.
Applying knowledge and understanding	Master (2nd)	Can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
	Bachelor (1nd)	Can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study.
Making judgements	Master (2nd)	Have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments.
	Bachelor (1nd)	Have the ability to gather and interpret relevant data (usually within their fields of study) to inform judgments that include reflection on relevant social, scientific or ethical issues.
Communication	Master (2nd)	Can communicate their conclusions and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
	Bachelor (1nd)	Can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
Learning skills	Master (2nd)	have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
	Bachelor (1nd)	Have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy ..

2.2 Transboundary Competence

As sustainable development can be seen as a process of change this entails the need for learning which occurs across the boundaries of institutions, literacies and practices: 'environmental meta-learning' (Scott and Gough, 2003). This process takes diversity as its point of departure because the broad spectrum of perspectives on sustainable development will constitute a successful strategy for coping with uncertainties and change (Ferrer-Balas et al., 2010; van Dam-Mieras et al., 2007). Such a process implies a frequent crossing of boundaries between disciplines and perspectives and leads to what is called 'transboundary competence'. Transboundary competence is the ability to communicate and collaborate across

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traditional boundaries, while working in interaction with actors/stakeholders (de Kraker et al., 2007). Transboundary competence is a multi-competence including the communication competence, collaboration competence and competencies that enable people to deal with different situations (expectable as well as un-expectable) in their professional lives. It mirrors the nature of sustainability science (Kates et al., 2001), which is transdisciplinary and uses various methodologies on the boundaries of the triple helix. These boundaries to cross were analysed in the context of the current transnational debate on water management in the Dutch-Belgian Scheldt Estuary (Lansu et al., 2010). Boundaries identified are between systems, disciplines, science and society, nations, cultures and scales of space and time, so between the multiple perspectives on sustainable development issues. These approaches to cross these boundaries should be system-oriented, interdisciplinary, transdisciplinary and participatory, inter/transnational, cross-scale, future-oriented, creative/ design-oriented (de Kraker et al., 2007) and entrepreneurial (Felder et al., 2011). The professional field in sustainable development needs academic professionals equipped with these transboundary competences (Kastenhofer et al., 2010). Experts with their professional expertise are essential in these domains “where there are no right answers”. Expert decision makers have been found to use strategies such as reliance on group feedback, willingness to make adjustments to overcome effects of cognitive limitations (Shanteau, 1988). In their synthesis of the development of expertise in engineering education, Litzinger et al. (2011) indicate that the curricula are often not designed to allow learners to prepare for these professional competencies, both knowledge and skills, needed to address the complex problems and preparing students to become experts.

The transboundary competence described above may be needed for regional sustainable development, but how can a university incorporate it in its view on learning and curriculum development? The usual methods appear to fail to do so. Academic curricula are designed with certain demands on professionalism in mind, but in a domain such as sustainable

development, the reality is that professionals and academics often find it difficult to articulate what they might need graduates to be capable of in the near future (Lozano et al., 2011). Sustainable development is directed to processes of change in the context of complex and uncertain futures, with unknown problems on a variety of scales. To educate for a rapidly changing professional field, the university and the professionals should jointly and consciously design curricula (Arlett et al., 2010). One cannot define transboundary competence by a definite list of skills, as it depends on the unpredictable complexity of future problems. Transboundary competence should also be seen as a transferable competence that can be applied in professional situations different from the specific situation in which it is learned.

This paper outlines a methodology for giving the changing professional demands from the domain of sustainable development a place in university curricula. The methodology of the design process aims to be a method for fine-tuning between the different institutional systems and traditions and the professional demands in the region. In the design process, proposed in this paper, the triple helix of complex dynamics of innovation (Etzkowitz and Leydesdorff, 2000) is related to the integration of the different roles professionals have to play in the changing context of their work.

In the next section (section 3), we elaborate on the design process to suit professional demands for sustainable regional development in university curricula. In section 4, we describe the methodology of such a design process, with participation of the professional field, the academic professionalism, and external quality assurance. In section 5, we consider the case of the recent application of the design process to academic curricula for adult distance education. It was applied in the concrete case of curriculum design for the sustainability domain of Water Management. We conclude section 5 with some points of discussion and main obstacles on incorporating professional demands in university curricula.

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3 Requirements of the design process

According to Litzinger et al. (2011), curriculum-level instructional design processes should be used to implement the development of professional expertise, thus meeting the professional demands in those domains, where expertise is essential. In this study, a design process was developed which allows to optimally fit into university curricula, the changing professional demands of the sustainable development domain. The process takes the following guidelines as points of departure. First, the curriculum design should be directed towards the acquisition of transboundary competence. Second, competence development should be a holistic rather than a fragmented approach; what counts is that professionals have to adapt to roles and that competences will change over time in sync with the changes in society and professional practice. At third, Eraut (2004)'s conception of competence as meeting people's expectations, the professional experience of academic workers in the domain should be adopted as definition of competence development. Fourth, to be able to connect curricula of the 'entrepreneurial university' (Clark, 2004) to the demands for professional expertise in the domain, one should be aware that 'even in an era of 'globalization' territorial dependencies and strategies remain a dominant factor' (Oinas and Lagendijk, 2005) in regional development. Participation of the professional field in the design process should reflect the complexity and diversity involved in proximity of the regional economic activity. Fifth, to be able to extract learning outcomes from professional demands, the professional, academic experience of the faculty (domain educators) should be incorporated. And finally, universities offer programmes for formal learning, in the form of curricula. A curriculum design embodies the objectives of the formal learning programme as well as the learning outcomes of the programme. The curriculum must fit within the higher-level framework of the (governmental and/or institutional) accreditation authority, to ensure recognized qualifications.

4 Methodology of the design process

In this section, a design process is presented that meets the described requirements, applied to the concrete case of curriculum design for sustainability science. The resulting curriculum must enable learners to develop 'transboundary competence' as extracted from the regional professional demands on the one hand, and deal with established criteria for academic quality and complex learning on the other.

4.1 Identifying Professional Demands by Consultation of Professionals

The design process is structured as an expert meeting: a university-moderated consultation of professional experts in the sustainable development domain of work organised along with the professional networks. As we cited Mieg (2009), the establishment of professional performance criteria is a task of the experts in the very heterogeneous domain of environmental experts. Mieg (2009) concluded that in these domains, other than in 'established' occupational sectors, the experts are the professionals: those who are setting the standards and those who hold jobs. Therefore, the invited experts should be heads, coordinators, process managers, and human resource managers of firms, institutions, and organisations in the field. As stated before, the professional expertise should reflect the variety in networked relationships in regional economic activity: in complexity, in diversity and across scales. The heterogeneity of the groups of experts is essential to match the heterogeneity of the domain, taking the ranges and trends in transboundary competence into account.

Usually, in a consultation of the professional field, the experts are asked to translate professionalism in terms of learning outcomes (Avard and Zenios, 2012; Barrie, 2006). Asking the professional field for their demands will result in a long list of design criteria tuned to a specifically defined profession. But here, in this step of the design process, the moderators ask the professional experts to define, from the perspective of their daily core

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activities, the future challenges related to sustainable development in their domain. This is done in accordance with the consensus workshop method (Miller, 2007; Stanfield, 2002). In a consensus workshop approach, the broad diversity of perspectives among these experts converges in the defining of the main challenges in their domain. The work form of a consensus workshop of five tasks, listed in Table 2, guarantees an integrated description (Stanfield, 2002) of these challenges.

Table 2. The design process starts with the five tasks of a consensus workshop of expert professionals to get consensus on major challenges in the domain.

task	to get consensus	results in
1	Set a context	Keynote on the future of the domain by a leading expert
2	Brainstorm in layers	Brainstorm on defining the future challenges of the domain
3	Cluster ideas	Cluster these challenges
4	Name the clusters	Defining the selected clusters as new domains
5	Resolve the names	Resolve the names of these new domains

With the consensus on the major challenges to academic workers in the domain, the academic faculty acquires insight in the need for future domains and future perspectives of the world of work. These needs are the basis of what has to be learned and what this learning should involve in proficiency to handle these major challenges in sustainable development.

In a next consensus workshop, these challenges are to be diverged into manageable professional demands, fitting within the accreditation system of academic qualification. In this second workshop, the moderators ask the expert professionals to pick each of the major challenges (as defined in the first consensus workshop) to draw up job adverts for future academic personnel (Table 3). Job adverts are ideally suited to help professionals to organize their non-codified knowledge, as they outline the ideal candidate's qualifications and experiences (Chapman, 2001-2009). This goes in particular for the emerging field of sustainable development as it lacks structured and standardised information on qualifications in the professional domain. Part of the design process is the use of a pre-structured job advert template to outline the candidate profile, indicating desired qualifications and experiences.

The job advert template (Table 3) is structured to the academic quality criteria, the 'Dublin' Descriptors (Bergen Conference, 2005; JQI, 2004).

4.2 Application of the Design Process

What is new in this method of consultation of the professional field is that the regional experts are triggered to concentrate on their own expertise in the professional domain challenges and define academic job qualifications and professional expertise instead of learning outcomes and graduate attributes. Moderators – university-faculty – are able to incorporate 'invisibly' the complex quality standards for academic programmes and their instructional expertise.

Fig. 1. The design process: consultation of professionals to get consensus on domains/ challenges and on professional demands (method: two successive consensus workshops of each five tasks resulting in job adverts, structured to the qualification framework).

This design process consists of a double round of consensus workshops (Fig. 1), which can be done in a half-day meeting, preferably connected to a scheduled expertise exchange meeting of the professional network involved.

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Table 3. A tool in the design process: the Job Advert template, to help professionals organize their non-codified knowledge along the academic qualification framework (here: the European Dublin Descriptors; Table 1).

Job Advert template (searched qualifications):	***Connected to Dublin Descriptor (academic qualifications standard):***
The Delta Water Knowledge Network is looking for a Delta Water Scientist in the area of Delta Water Management, who is willing and able to take on the challenges of the next 10 to 20 years.	
Has knowledge of and understanding of ...	Knowledge of and understanding
Can apply knowledge and understanding in; Can carry out problem-solving tasks on ...	Applying knowledge and understanding
Can handle and make judgements on ...	Making judgements
Can communicate to enable ...	Communication
His/her learning skills enable to ...	Learning skills

5 Implementation and evaluation of the design process

The design process described in section 4 was applied to the case of curriculum design for sustainable development in the domain of Water Management in the Rhine-Scheldt Delta region. During the design's implementation, opportunities for improvements were identified, both on the systematic use for curriculum design and on the specific use to identify how transboundary competence can be gained in an academic curriculum.

5.1 Identifying Professional Demands by Consultation of Professionals

Case: A New Curriculum on Delta Water Management. The consultation of professionals to identify the future challenges and related professional qualities in a changing domain, was tested in the development process of a new curriculum on Delta Water Management. As described in the introduction, in the domain of water management a strong demand for professionals exists who can operate in changing roles in interaction with academia, policy and industry. This leads to a currently renewed definition of the professional competences of the academic water manager. Government administrators, business people,

and environmental educators work together in a partnership: the Knowledge Network Delta Water (KNDW). On instigation of this regional innovation network, the Zeeland University of Applied Sciences (ZU) started the development of an international graduate research degree (MSc) programme for workers in Delta water management. The Dutch-Flemish Open Universiteit (OU) developed the design process to draw-up the MSc curriculum framework, in cooperation with the institutes who intended to offer the programme: the Dutch ZU and the Belgian University of Applied Sciences West Flanders (UWF). In that phase the design process was applied and reported (Lansu et al., 2008). The aim of the design process was to design an academic curriculum for international adult education in blended learning, with enrolment of professionals in water management with a bachelor's degree (in engineering).

Participants in this survey. Participants in this professional consultation are expert professionals and the future employers of the students. Participants (N=32) were selected from the network of delta water managers (N=24) and academic faculty (N=11) in water management research. The gender distribution was 16% female and 84% male; distribution of nationality was 12.5 % Flemish (Belgian) (100% male) and 87.5% Dutch (18% female; 82% male). The estimated average age was over 40 years. The participants were asked to describe their professional function and the firm or institute they represented. We assigned these functions to categories of professional status and managerial responsibility (leadership). The majority of the participants in this survey indicated, that they had medium and upper level leadership responsibilities. About 56 % of the participants could be seen as professionals working on the highest or upper level of leadership (CEO, Dean, professor, director). The other participants (44%) had positions with medium level responsibilities (tutor, project manager, specialist). Regional distribution of participants (Fig. 2) over the three levels of professional status shows that almost all participants at all status levels came from the Rhine-Scheldt region.

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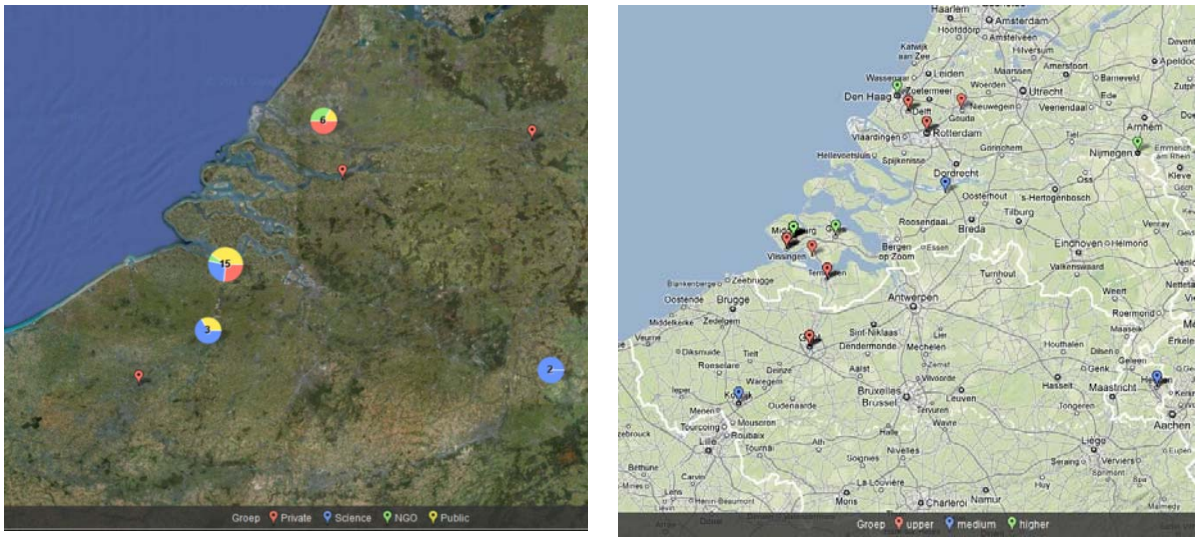

(a) (b)

Fig. 2. Maps of the Rhine-Scheldt Delta with regional distribution of participants: (a) over the four professional sectors (clustered locations are Rotterdam (6 participants), Zealand (15), Ghent(3) and Heerlen (2); (b) over three levels of professional status (upper, medium, higher) [online web mapping: (BatchGeo.com, 2011; TerraMetrics, 2011)].

Current professional activities of these water managers (WM) were mostly (34%) on the scientific domain (universities at Zeeland, Gent and Heerlen) and in the private sector (31%). A quarter (25%) of the participants worked in public administration and about 9 % had professional activities in NGOs. To assess if the distribution of the professional sectors of our participants could be compared to others domains in SD, the data were compared with data from a survey on professional activities of environmental sciences (ES) graduates (N = 535) in Switzerland (Hansmann et al., 2010). Notable is the larger share of the Public Sector in water management (25% on WM, 15% on ES), whereas about 50% of the participants in the environmental sciences survey work in the Private Sector (48% on ES; 2nd sector in WM with 31%) (Fig.3). The distribution on the sectors Science (34% on WM, 29% on ES) and NGOs (9% on WM, 7% on ES) is comparable (Fig. 3). The larger share of public above private in water management is probably related to primary responsibility in flood control and defence by public services. Almost all sectors were distributed equally over the region (Fig. 2) except for some experts: the moderating academics and a few employers from the private sector. With this fair regional distribution over the sectors, medium to upper level of professional

status, and their many years (> 15 yr) of experience, the participants can be viewed as a representative group of leading professional experts.

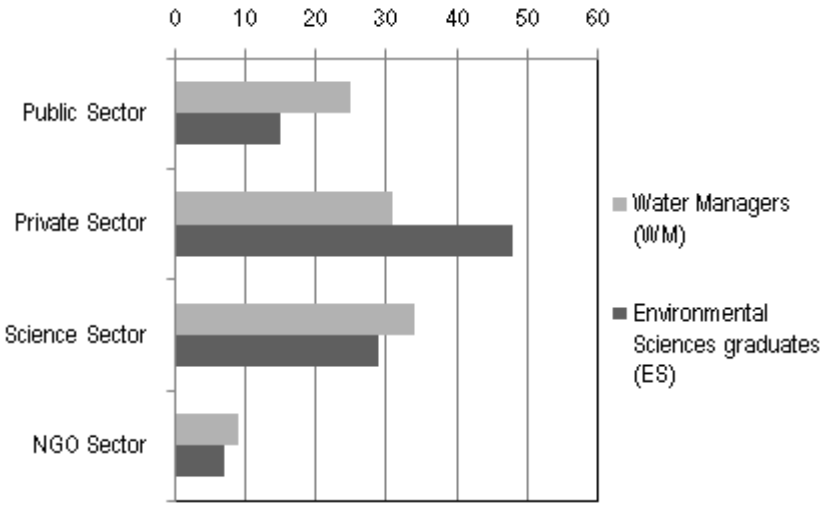

Fig. 3. The distribution of current activities of the participants over four professional sectors; of Dutch-Flemish water management (WM) professionals (N = 32) (this survey) and of Swiss environmental sciences (ES) graduates (N=535) (Hansmann et al., 2010).

5.2 Application and Evaluation of the Design Process

Application. The professional consultation of the water managers, was scheduled in a regular expertise exchange meeting of the delta water engineers' network (Vlissingen/Flushing, NL, January 24, 2008), applied as a double round of consensus workshops. Moderating the workshops was done by the coordinator of the network – a water manager – and two university scientists. In the consensus workshops the participants worked in five groups (5-7 persons) with mixed professional sector, each group constituted of participants from at least the three domains Private, Science, and Public. The three professionals from NGOs participated each in a different group. In the first round consensus workshop, the professionals got the task to define "Which are the challenges in delta water management in the next 10-20 years?" In a lively brainstorm, the professionals came up with 50 challenges, which were clustered to 13, from which after short presentations 7 major future

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challenges were selected. This consensus process results in a list of future challenges with accompanying job titles (Table 4).

Table 4. Results from the 1st round consultation on Water Management: the joint list of future challenges and the accompanying job.

Future challenge in Delta Water Management	*Job Title Delta Water Scientist*
Integral approach (life cycles; multiple levels) to water systems	Estuarine Ecosystem Scientist
Building with Nature (economy & ecology)	Wetland Engineer; Water Nature Engineer
Political administrative break-through towards non-complex water management	Political-Administrative Water Manager
Drinking Water provision (quantity & quality) by drifting fresh/salt water boundary (Ghyben-Herzberg lens)	Drinking Water Technologist
Safety, risk management & crisis management planning for future disasters	Disaster & Crisis Management Planner
Sustainable water use (greywater)	Water Technologist

In the second round workshop, the same steps were made to solve another real-task (Fig. 1): “Draw up a job advert for a new delta water scientist to achieve this challenge in the next 10-20 years”. Each workgroup, working on one or two of the challenges, outlined the ideal candidate’s qualifications and experiences for this challenge. We provided a job advert template, pre-structured according academic quality standards (Table 3). After clustering, presenting and renaming six unique job adverts were selected, describing the professional qualifications for future delta water scientist, according to the quality standards. Fig. 4 shows two, out of 6 results, all professional qualifications collected by these job adverts are described in Lansu et al. (2008).

In the design process of the new curriculum, the results of the professional consultation were considered as an input. The output of the first workshop, the denomination of future challenges, was used to define the domains and subjects to be learned and assessed in the study programme. The output of the second round, the job adverts, were used to define the professional competences of a delta water scientist (Table 5): the competence to be able to explore and to investigate in a participative manner innovative solutions for the future challenges in water management and, to be able to ‘make it happen’: to head for a set goal in cooperation with public and private stakeholders (Lansu et al., 2008).

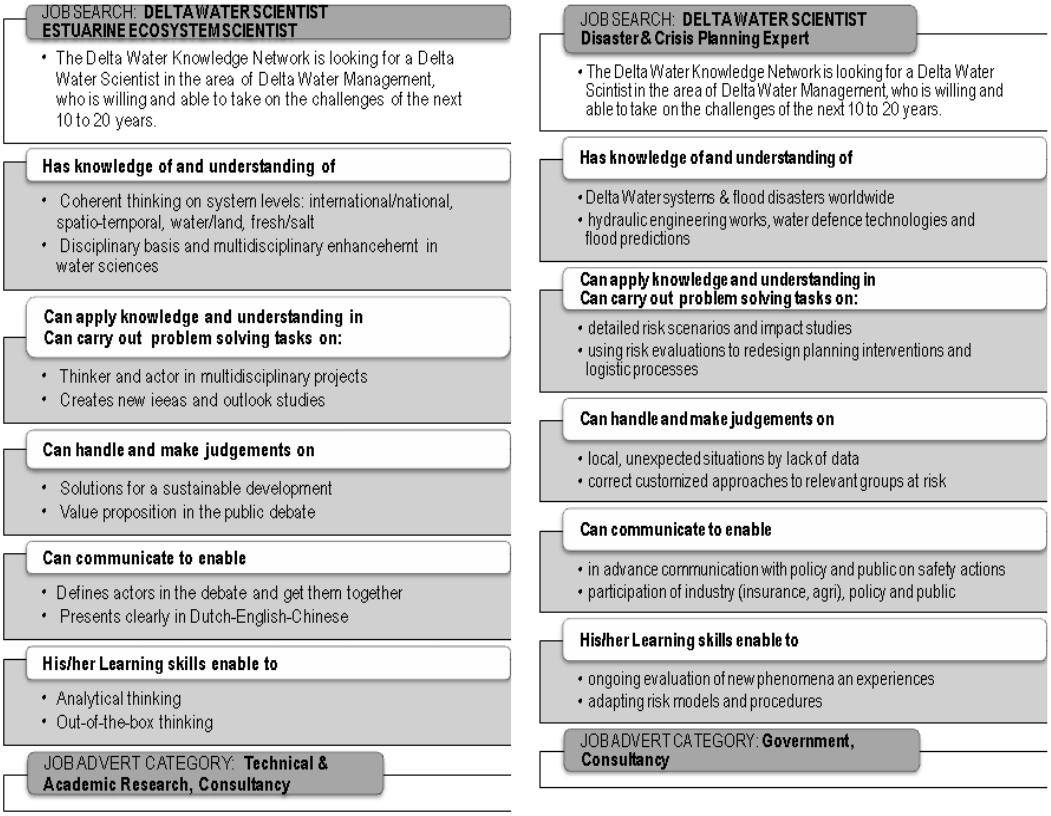

Fig. 4. Results from the 2nd round consultation on Water Management: two job adverts structured to the academic qualification framework.

Table 5. A result of the design process: the transboundary competence goal of future delta water scientists (Lansu et al., 2008).

The competent delta water scientist (professional with 5 years experience)
• explores new and complex ideas and developments beyond discipline and culture, based on critical system analysis, on their merits for the water management challenges.
• has sufficient knowledge of current technology, management processes, and multidisciplinary and participative methods to research problems in water management practice.
• able to head for a set goal, by ensuring the creation of values and innovation through participatory collaboration, and can boost that the solutions are supported by the public and private parties.

The results of the design process were applied in the development phase of the new curriculum for Delta Water Management, under coordination of the engineering department of the ZU, who administers and confers the master research degree.

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Evaluation. The design process - the consultation of professionals – worked well and easy, it took 5 hours only. It resulted in the definition of the professional competences and the new domains in water management, according to the structure of academic quality standards.

The professionals can define – with help of university moderators and scaffold by the design methodology – the professional competences for future performance in changed roles in interaction between academia, policy, and industry. This leads to a renewed definition of the professional competences of the academic water manager, defined within the regional triple helix. The future challenges defined, match with the challenges mentioned in the Water report and assessment programme of (UNESCO, 2009). The German Foundation for International Business Administration Accreditation (FIBAA), a HE quality assurance organisation, evaluated the design process to define the new Master curriculum on professional qualifications as good.

The impact of this design process, interacting with the practice of regional sustainability innovations, on the curriculum seems to be significant. The joint partners within the knowledge network, are involved in joint thesis research programmes and in the development of course contents. As a result of the process, the joint partners developed four online serious games as open educational resources (emergo.ou.nl). These games are on authentic sustainability innovations in the Rhine-Scheldt Delta region, (on managed retreat of coastal levees by salt marsh ecosystems, sustainable aquaculture, local water governance on salt water intrusion, and decision-making on building with nature in sea defence): similar challenges and domains that resulted from the consultation (Table 4). In this way the dynamic of professional practise is embedded into academic learning environments. Learners, in their role of delta water scientist, are confronted in the game assignments with the real regional experts, video interviewed on these issues. The learners acquire transboundary competence on water management, when they learn to handle these complex, workplace-based problems with

multiple perspectives (Hummel et al., 2011). Several key elements of transboundary competence - the boundaries and approaches to cross these boundaries (Lansu et al. (2010), section 1) - can be identified in the professional competence goal of the delta water scientist (Table 5).

6 Discussion

The design process could be used as a guided facilitation for other institutions considering development or renewal of a curriculum for sustainable regional development, but on this point we should made some critical remarks. The study was done in the context of major revision and novel design of curricula, were competence goals have to be set. For minor revisions of the curriculum goals, the method does not seem appropriate. Also, the study is biased to the quality of the network and how its geographic boundaries are perceived internally and externally. The regional innovation network in this study is internationally recognized as well functioning incubator of joint innovation projects on sustainable delta water management. Not always such an established innovation network will be at hand.

The role of academia and their curricula in regional sustainable development is not obvious, as incentives are outputs on (inter)national research within a disciplinary context, and less on regional sustainability initiatives (Zilahy et al., 2009) and transdisciplinary knowledge transfer between academia and stakeholders in regional development (Etzkowitz and Leydesdorff, 2000). This paper has focused on the design process of academic curricula for sustainable development, with its rapidly and continuously changing regional needs and professional demands. Core of this professional expertise is a frequent crossing of boundaries between disciplines and perspectives, which leads to what is called in this paper transboundary competence, a transferable competence that can be applied in professional situations different from the specific situation in which it is learned. What is to be learned is how to become a reflective and lifelong learner, while at the same time being a professional in

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sustainable development issues. Now, in times of crisis and demographical decline, universities are looking for more attractive and practice-inspired curricula. Changes driven by transboundary competence would increase the innovative capacity of study programmes.

Can curricula designed according to this methodology be expected to contribute to regional development? The design process analysed in this paper consults professionals from an existing regionally based innovation network, over private, public, science and NGO sectors. It shows that sustainable education is a highly attractive issue not only to keep curricula up to the global challenge, but also to the current views on the 'third mission' of universities, to stimulate regional economic and social development of knowledge resources (Etzkowitz, 2003). This design process of university curricula can be seen as a regional networked learning system according Clark's (2004) entrepreneurial university, in which the transfer of knowledge between university and the economic region (here: the Dutch-Belgian innovation network on Delta Water Management) is embedded within a well-endowed, academic curriculum framework.

In current studies, we will elaborate on the design process to evaluate the development of transboundary competence and implementation at the year-level learning experiences within a regional networked curriculum. This suits with trends in higher education to give attention to integration of transdisciplinary learning goals (Michelsen and Adomβent, 2012) and summative assessment of learning outcomes and individual academic learning outcomes in cooperative work (Wijnen and van Berkel, 2010). To ensure the national and global academic nature of such university curricula, the advent of social networking and learning technologies in curricula seems to redefine the boundaries of the regional hinterland affecting 'local' learning trajectories towards transboundary competence. This could not only support transboundary regional learning but also contribute to regional development by making economic activities more foot-loose, connecting the local to the global.

7 Conclusion

The problem faced in this article was how can a university incorporate transboundary competence for sustainable development in its view on learning and curriculum development; and how can the academic quality of learning be guaranteed. Transboundary competence, the ability to communicate and collaborate across traditional boundaries between disciplines and perspectives, while working in interaction with actors/stakeholders, is a multi-competence and mirrors the nature of sustainability science.

The two-step design process for open curriculum development, which was presented in this article, incorporates both the professional demands of stakeholders and the academic quality standards. The design process is illustrated on a water management curriculum in the Rhine-Scheldt Delta region. In the first step, the professional experts define, in consensus workshops, the challenges for future academic water managers. In the second step, the joint professionals outline the candidate profiles to tackle these challenges. A pre-structured job advert template, structured to the academic quality criteria for higher education (European 'Dublin' Descriptors), has been used to articulate desired qualifications and experiences. These resulted into a renewed definition of the professional, transboundary competences of the academic water manager within its regional, multi-disciplinary, multi-stakeholder contexts. The moderators of the process are able to incorporate 'invisibly' the complex (national) qualification framework for university programmes, often be seen as an obstacle for open curriculum development.

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