MEETING THE SUSTAINABILITY CHALLENGE IN RESEARCH AND EDUCATION

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ABSTRACT

HU University of Applied Sciences Utrecht (HU) initiated a sustainability program in 2010. A compelling vision, collaboration with external partners, interdisciplinary research and interweavement of research and education are important elements in this program. The scope of this paper is sustainability in research and education, and does not include corporate responsibility. The global concept of sustainability has been applied to a regional context by presenting the vision of a *Smart Sustainable City*.

This city is the translation of the Bruntland definition (World Commission on Environment and Development, 1987) to an energy neutral, high quality urban environment, that makes smart use of technology and infrastructure. The mission of HU is to enable students and professionals to participate in the execution of this urban transformation. For this purpose a new form of collaboration is introduced: research developed and conducted in co-creation with partners from enterprises, citizen groups, knowledge institutions and local government. The research is conducted in interdisciplinary teams, in which students are junior researchers. The student research is part of the regular bachelor program. On the basis of a recent pilot study, the outcome of this approach is described in terms of client satisfaction, knowledge development and educational value.

INTRODUCTION

In 2010 the board of HU University of Applied Sciences Utrecht (HU) launched a five-year sustainability program. The aim of the program is to incorporate sustainability in the core business of the University. Some highlights can be noted already: a patent application (Huisman et al., 2013), winning various sustainability awards (Rutten, 2012; Morgen, 2013) and an opportunity to present vocational training in the Netherlands at the Holland Pavillion at Worldskills in Leipzig in 2013 (HU University of Applied Sciences Utrecht, 2013a).

This paper presents achievements and ambitions of the HU sustainability program, in order to exchange lessons learned and explore possibilities for collaboration. Though the ambitions of HU cover on the one hand sustainability in research and education, and on the other hand corporate responsibility, the scope of this paper is restricted to sustainability in research and education. The paper first gives an introduction of HU and the Utrecht region, then describes the HU Sustainability program and the research group *New Energy in the City*. Subsequently the vision of the Centre of Expertise *Smart Sustainable Cities* is presented, and followed by a pilot study on student research in accordance with this vision. The paper concludes with the results of the sustainability program.

HU UNIVERSITY OF APPLIED SCIENCES (HU)

HU is situated in the town of Utrecht, and is the third largest University of Applied Sciences in the Netherlands. The University has approximately 37000 students, offers 75 bachelor programs and 27 master programs. Research at HU is practice-oriented by nature and is performed in close collaboration with partners, such as enterprises, knowledge institutions and regional government. Research programs follow four themes: 1) Sustainability, 2) Creative Industries, 3) Health and Technology, and 4) Learning and working in the district (van Veenendaal, 2012) and are thus in line with the big societal challenges presented in Horizon 2020 (European Union, 2012).

UTRECHT REGION

HU is firmly embedded in the region, as HU has strong regional partnerships, and most students are living in the Utrecht region. The Utrecht region is an attractive, densely populated urban area with high service levels, which accounts for environmental pressure . In a sustainability assessment of the Utrecht region greenhouse gasses, sustainable energy and energy reduction were among the pressing issues (Provincie Utrecht, 2010). In line with an

investigation by Rifkin et al. (2010), the regional government of Utrecht has formulated the ambition of an energy neutral province in 2040. This paper uses the definition of net-energy neutrality formulated by Opstelten (2007 cited in Opstelten, 2013:3): “on an annual basis, the built environment is able to generate the same amount of energy within its own physical domain as the amount used in that same period for living and working”. Although a good energy performance of individual buildings is an essential aspect, the goal of energy-neutrality is considered on the scale of an area and not of individual buildings. The ambition of an energy neutral province by 2014 underscores the sustainable ambitions of the regional government of Utrecht.

SUSTAINABILITY PROGRAM

The initiation of a sustainability program illustrates the commitment of the board of HU to the sustainability goal. In this program the Brundtland definition of sustainable development is used to describe the concept of sustainability: "development which meets the needs of current generations without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987:online).

The program can build on a range of achievements from the preceding years. Research groups in the field of engineering and built environment had already embraced sustainability and executed research projects in collaboration with companies. An illustrative example is the project “Sustainable upgrading of living quarters in a district”, which was executed in collaboration with 42 companies and in which 400 students and 25 members of teaching staff were involved. One of the tangible results of this project is the “Sustainable Energy Test Garden” Rietbergen (2009 cited in Rietbergen, 2012: 70) : on a 500 m^2 experimental area on top of one of the University buildings an experimental set-up for energy conservation and sustainable energy generation is installed. This experimental set-up is being used in research and training of students as well as professionals. The lab is part of a series of five experimental sustainable energy labs, installed on roofs in the Utrecht region. Another example of the close collaboration between enterprises and knowledge institutions is the project “Smart Grid: Efficiency for everyone” (Economic Board Utrecht, no date), a project in which students of HU made an inventory of the energy requirements in the Utrecht quarter of Lombok and assessed how many solar panels were needed to cover this need.

The staff involved in these projects is committed to practice oriented research. With the start of a dedicated sustainability program the focus has shifted from individual projects to a programmatic approach. The sustainability program has the four following ambitious goals (Eweg, 2010: 6 translated form Dutch):

1) Sustainable development is an obvious criterion for students and staff in professional thinking and acting;
2) Practice oriented research generates knowledge applying sustainable development in professional practice;
3) HU is a recognized center of expertise on sustainable development in the relevant fields, regionally as well as nationally;
4) HU is regionally recognized as a strategic partner on sustainability.

To achieve these ambitions collaboration of teaching staff and students is indispensable. The following examples illustrate what has been done to focus the attention on the sustainability challenge:

- A conference was organized with Michael Braungart, which attracted 250 visitors, mostly students and staff. McDonough and Braungart (2002) are the inventors of the Cradle to Cradle concept, .
- As sustainability is being integrated in all student programs at the University, a sustainability training was offered. The training was based on The Natural Step framework, developed by Robert (2000).

RESEARCHGROUP NEW ENERGY IN THE CITY

The installation of a research group *New Energy in the City* (HU University of Applied Sciences, 2013) in 2012, consolidates the research on sustainability. In his public lecture Opstelten (2013) demonstrated the necessity of an energy neutral built environment, from a climatologic as well as an economic point of view, and argued that in the Netherlands "the built environment has the potential to become energy-neutral by the middle of this century". Opstelten (2013:30) presented the following three lines in his research agenda:

1) **Energy & Behaviour**: This research area deals with willingness. The stakeholders, and in particular the owners and users of buildings and districts, need to commit to, or

be tempted to, implement the necessary changes at the level of buildings, districts and possibly even own (organisation) behaviour. '…'

2) **Building Energetics**: This research area concerns itself with ability. The stakeholders need to be able to implement the necessary changes in an economically sound manner. '…'
3) **Upscaling**: All stakeholders, property owners (social, public, private and proprietary) up to and including construction parties and government institutions, must entirely take on the task of scaling up to the built environment by means of a rollout of building and district concepts with the desired (energy) performance level. '…'

The research group *New Energy in The City*, complements the available expertise on built environment, microsystems technology, co-design, behavioral change and economics. To make full use of all available expertise, research will be organized in a, possibly virtual, Centre of Expertise *Smart Sustainable Cities*. The Centre is a public-private collaboration, in which HU will collaborate with enterprises, citizen groups, knowledge institutions and local government.

SMART SUSTAINABLE CITIES

Dot on the horizon for all research and education is the vision of a Smart Sustainable City. The draft vision reads as follows: *Living and working in a smart sustainable city is attractive to all its inhabitants. The standard of living is economically sustainable and viable and indoor and outdoor air quality is good. The energy neutral city is full of economic and social activities, by making smart use of technology and infrastructure. There are no negative effects passed on to the environment, not now and not in the future.*
The Smart Sustainable City as a model for real life cities is the ultimate goal.

The realization of a Smart Sustainable City is a fundamental change, as de Haan and Rotmans (2011) state: "if a societal system goes through such a fundamental change it is said to go through a transition". The mission of HU is to equip students and professionals to give shape to the transition to a Smart Sustainable City.

The vision of a Smart Sustainable City is shared by regional partners. In order to shape public-private collaboration, an active contribution of regional partners in research and education is indispensable. Therefore regional enterprises and knowledge institutions with

whom HU has partnerships, are invited to participate in research agenda setting. In a first round, partners were interviewed and this resulted in a draft research agenda for the coming years:

- energy neutrality on the scale of an area;
- business cases for circular economy and energy neutrality: private homeowners, social housing, public and private utility buildings;
- optimization of energy consumption, in particular energy consumption in relation to the reuse of raw materials and building products;
- sustainable building and health of inhabitant and employee;
- sustainable mobility in the city in the context of living and working;
- sustainable urban distribution and logistics;
- interaction between technology and the user of the technology.

HU and partners will fine-tune this draft research agenda in the next months. Although the agenda emphasizes the importance of energy-neutrality, the broader context of a Smart Sustainable City is always taken into account, as can for instance be seen by the incorporation of behavioral change, material use and economy. To realize the Smart Sustainable City, new concepts, products and services need to be developed. Therefore knowledge and skills from a wide variety of disciplines have to be brought together. In order to equip tomorrow's professionals, students are offered the possibility to experiment and innovate in interdisciplinary teams.

Student teams use a design research approach in which " '…' the students get three assignments: a problem, competence development and a knowledge question." (Nijhuis, 2012). The problem results from a market-demand and the knowledge question contributes to the research agenda. While a professor supervises the research, research and teaching staff coach students on a regular basis. Active participation form the market party is required, as it is the client who seeks a solution for a problem. The following example illustrates the approach.

At the end of 2012, a startup company approached HU, and asked assistance in developing an offer for building renovation of privately owned land-based homes. The offer includes that after renovation, the building is guaranteed to be energy neutral and that the renovation is net

cost effective. In this context *net cost effectiveness* is defined as follows: the cost of renovation is equal to the saved energy costs. In order to address this market demand, the first student team started in the beginning of 2013.

This market demand corresponds with the research agenda of *Smart Sustainable Cities*, so a team of eleven students from the building department was formed, and worked during five months on this assignment. Students were coached on a regular basis, and where necessary, additional knowledge transfer and training was offered. As an illustration the knowledge question addressed by one of the students is given: "Which engineering techniques can be applied to detachably connect a renovation module, that can be produced in a series of one, to different constructions in the existing building stock in the Netherlands." (Huisman, 2013: 7)

Five out of eleven students finished the assignments on time, and received excellent grades. Two of them also received stars in the HU excellence program. The other students needed more time to complete the assignment or got another assignment. An evaluation was carried out among students and professors by means of an open questionnaire. Seven out of eleven students and three out of seven professors, returned the questionnaire. The outcome was discussed in the team of professors. A separate meeting with representatives of the company was organized. The next paragraph describes the results of these evaluations in terms of client satisfaction, knowledge development and educational value.

The company highly valued the student research, as it had: accelerated their business development , resulted in a patent application (Huisman et al., 2013) and given access to human capital , actually three students were offered a job. The company intends to continue this collaboration with HU. The patent application, which has the status of a pending patent, offers evidence for the value in terms of knowledge development. From an educational point of view, the assignment was challenging. This resulted on the one hand, in a substantial part of the student team not being able to complete the assignment. On the other hand, the educational value for the other students was clear. The outcome of the evaluation will be used to improve this assignment.

Although the outcome of this pilot study cannot be generalized, it does indicate that close collaboration with companies and the use of students, as junior researcher in a research program, should be explored further.

RESULTS OF THE SUSTAINABILTY PROGRAM

Three years after the initiation of the five-year sustainability program, results of the programmatic approach are already visible. At the faculty of Life Sciences and Technology, a faculty with approximately 5000 students, the percentage of student programs that have incorporated sustainability competences, increased from 43 % in 2012 to 69% in 2013. The research group *New Energy in the City* was installed in September 2012. HU participates in important networks, such as the Economic Board Utrecht (Economic Board Utrecht, 2013) and Utrecht 2040 (Provincie Utrecht, 2013). HU presented the possibilities for innovation and excellence in vocational education in the Netherlands in relation to sustainability, using the theme of smart sustainable cities at Worldskills 2013 in Leipzig (Hogeschool Utrecht, 2013).

In obtaining the above successes, some enablers and stumbling blocks can already be determined. Enablers are: the compelling vision of a Smart Sustainable City, starting from a societal challenge, regional orientation, close collaboration with enterprises and knowledge institutions, strong support from board and management, dedicated staff, and interdisciplinary (student) research. Stumbling blocks are: the traditional structure of student programs, influencing the courses of the whole university.

In the coming months the research agenda for the Centre of Expertise *Smart Sustainable Cities* will be established in co-creation with our regional partners. The ambition is to collaborate with international partners who share the same vision.

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