

# Short Term Scientific Mission – Final Report

---

*TU Delft, November 02th – November 20th 2015*

## STSM Information

Visitor: Name: Mira Conci  
Affiliation: TU Darmstadt  
Country: Germany  
Host Name: Tillmann Klein  
Affiliation: TU Delft (Delft University of Technology)  
Country: The Netherlands

## Overview of the scientific mission

This STSM was framed into the activities developed as part of the on-going PhD project “DRiEMS - District Renovation through integrated Energy Management Platform” and the EnEff:Stadt pilot project “SWIVT: District energy modules for existing residential areas - Impulses for linking energy efficient technologies”. The experience was evaluated as positive both in terms of the progress made in research content, as well as in terms of exchange, considering networking and the possibility to discuss and get relevant feedback from peers and experts.

## Objectives

### Within COST Action TU1403

The research developed during this STSM contributes to *WG3 Whole building integration and whole-life evaluation methods of adaptive facades*, and fulfils deliverable *D.3.1 Annual STSMs for PhD students and Early Stage Researchers on integration requirements and current and post-occupancy evaluation methods*. The main aim of the STSM is to write a scientific paper, whose audience and journal are still to define. The proposed paper will be based on Task 3.1. *Requirements for building integration and user interaction for adaptive and multifunctional facades*.

The paper may contribute to:

- *D.3.2. Report on the requirements for building and user integration.*
- *D.3.4. Input for the annual Training School for dissemination of expertise to Early Stage Researchers,*
- *D.3.5. Contribution to Education pack,*
- *and D.3.6. Contribution to Industry Workshop,*

### Within the PhD project DRiEMS

The elaboration of Task 3.1 presents the requisites for implementation of adaptive facades in:

- whole building integration
- user interaction
- whole-life evaluation methods

The topics coincide with following specific areas of research of the visitor’s PhD project:

- *From passive to connected: development in physical networks*
- *From personal to shared: development in digital networks*
- *From product to service: development in the economic networks*

The objective of this STSM within the PhD project DRiEMS is therefore to provide a basic theoretical framework to the visitor's own in-depth research

#### **Within the EnEff:Stadt pilot project SWIVT**

The objective of this STSM within the EnEff:Stadt pilot project SWIVT is to provide base research for the development of different working areas of the pilot project SWIVT:

- *Task 1.1: Strategy, planning, integration and coordination of sub-projects*
- *Task 2.1: Concept development on district level*
- *Task 3.1: Concept development of storage and connectivity*
- *Task 4.3: Development of a business model for the energy system*

The outcomes of the STSM will flow into SWIVT's project report.

## **Activities**

Several activities were carried out in order to achieve the proposed objectives. Some of them were planned ahead while others were included later in order to respond to new developments.

- Activity 1: Problem statement definition.
- Activity 2: Identification of a structured approach to answer the problem definition.
- Activity 3: Identification of key contacts from the side of the visitor university and of the host university.
- Activity 4: Completion of edX MOOC *Circular Economy: an Introduction* (Oct 20. – Dec 15. 2015)
- Activity 5: Participation in IFSS Supplier design session (3-6pm Nov 19, 2015. TU Delft, Delft)
- Activity 6: Participation in Climate-KIC Event *Innovation Building Block – Leadership for Sustainability* (Dec 7, 2015. Imperial College, London)
- Activity 7: Writing of the scientific paper.

## **Outcomes**

#### **Activity 1: Problem statement definition.**

As follows is the definition of multifunctional and adaptive façade according to the Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action TU1403: Adaptive Facades Network.

*“This next generation of facades [...] is able to change its functions features or behavior over time in response to transient performance requirements and boundary conditions with the aim of improving the overall building performance. [...] a façade is considered to be fully adaptive if it can respond to all the transient conditions in such a way that it maintains occupant satisfaction without imposing additional loads on the building services.”*

Further, the Action defines the type of facades that will be addressed:

*“[...] façades with a high degree/range of adaptiveness that can be achieved by means of self-adaptation (smart materials), or active control (intelligent systems).”*

The report of this STSM will mostly deal with energy active facades. These include both energy generating components as well as highly responsive façade components, such as window-mounted heat exchangers. Energy active envelopes can be installed on any orientation of the external wall, as well as on flat or tilted roofs.

**Activity 2: Identification of a structured approach to answer the problem definition.**

The identified structure could be subject to reviews or changes during the writing of the paper.

- I. Abstract
  1. Adaptive Façade Integration
    - a. Structural and architectural integration
    - b. Integration with building services
  2. Adaptive Façade Interaction
    - a. User interaction through monitoring and control (Smart House)
    - b. Component interaction through local network (Smart Districts)
  3. Adaptive Façade within multidisciplinary perspective
    - a. Stakeholders map
    - b. Socio-political decision-making process
    - c. Business cases for adaptive facades
  4. Lookout and further research

**Activity 3: Identification of key contacts from the side of the visitor university and of the host university.**

The identified list of contacts could be subject to changes or additions during the writing of the paper.

<i>Research topic</i>	<i>Contact through TU Darmstadt</i>	<i>Contact through TU Delft</i>
<b>Adaptive Façade Integration</b>		
Structural and architectural integration		Thaleia Konstantinou, Tillmann Klein
Integration with building services	David Bewersdorff	
<b>Adaptive Façade Interaction</b>		
User interaction through monitoring and control (Smart House)	Luka Lackovic, Robert Irmeler	
Component interaction through local network (Smart Districts)	Mira Conci	
<b>Adaptive Façade within multidisciplinary perspective</b>		
Stakeholders map	Mira Conci	Juan Azcarate
Socio-political decision-making process		Alexandra Den Hejier
Business cases for adaptive facades		Juan Azcarate

**Activity 4: Completion of edX MOOC *Circular Economy: an Introduction* (Oct 20. – Dec 15. 2015)**

© edX Inc. is the only leading MOOC provider that is both nonprofit and open source. Founded by Harvard University and MIT in 2012, edX is an online learning destination and MOOC provider, offering high-quality courses from the world's best universities and institutions to learners everywhere. Among more than 85 global partners, EdX university members top the QS World University Rankings®. edX mission is stated as:

*“Increase access to high-quality education for everyone, everywhere  
Enhance teaching and learning on campus and online  
Advance teaching and learning through research”*

*Circular Economy: an introduction* is a course led by TU Delft and co-created with the Ellen MacArthur Foundation and the Leiden-Delft-Erasmus Centre for Sustainability. The course explores how businesses can create value by cycling products and materials, how designers come up with clever solutions, and how it is possible “to contribute to make the Circular Economy happen.”

The objectives are to learn to re-think the linear economic system, act upon it and become a leader in the major paradigm shift towards a circular economy. The course is organized around a series of themes, based on the 'butterfly diagram' developed by the Ellen MacArthur Foundation. In each episode, the student learns about one of the circular loops in the diagram. The course runs over a period of 7 weeks.

The aims of the course are stated as:

- *Develop a general overview of the principles and ideas behind a Circular Economy.*
- *Explore business models that are conducive to a Circular Economy, and analyze the barriers and opportunities for transitioning to these circular business models.*
- *Investigate what it takes to create products that are easy to repair, remanufacture or recycle.*
- *Discover how natural systems can provide inspiring solutions to human problems.*
- *Develop a more solid understanding of the systemic effects of the transition to a Circular Economy.*<sup>iii</sup>

Each episode has a similar structure and grading policy. The non-graded contributions, such as contributions to the discussion forum, are optional. Participation in optional contributions, however, was extensive, and determined a fair share of the ca. 5 hours of workload per week.

- EPISODE 1: What is the Circular Economy?

Contents: What is wrong with our current Linear Economy? What benefits can a Circular Economy bring? This episode explores the roots of the Circular Economy together with experts in the fields of industrial ecology, cradle to cradle and biomimicry.

- EPISODE 2: Business Value in a Circular Economy

Contents: Which new opportunities for business are created through closed loop supply chains and reverse logistics? This episode explores value creation and new business models in a Circular Economy.

- EPISODE 3: Longer Lasting Products

Contents: Learn how to look at product life extension through the eyes of designers and entrepreneurs. Join sessions with the online Disruptive Innovation Festival (DIF), which runs from the 2nd to 20th November. The DIF brings together thought-leaders, entrepreneurs, businesses, makers, learners and doers to focus on system-level change for a future economy

- EPISODE 4: Remanufacturing

Contents: Remanufacturing enables companies to recapture value at a product or component level. It is currently being rediscovered as a promising business opportunity. This episode explores the topic together with researchers and entrepreneurs.

- EPISODE 5: Waste Equals Food

Contents: This episode discusses how we can take inspiration from nature, when redesigning the way we deal with waste. It presents the circular case study of Interface.

- EPISODE 6: Thinking in Systems

Contents: In this episode the extent and duration of the transition from linear to circular economy is discussed and the sustainability of the Circular Economic model is analyzed.

- EPISODE 7: Full Circle

The course ends with a webinar with the course instructors and a final exam.

The course was completed with a degree of 92/100. An ID-verified certificate available for €50 has been requested. The verified certificate is an official credential from the Delft University of Technology (TU Delft) and is signed by the course instructor. The certificate is issued after the official end of the course, on the 15<sup>th</sup> of December 2015.

#### **Activity 5: Participation in IFPSS Supplier design session (3-6pm Nov 19, 2015.TU Delft, Delft)**

The ongoing research project "Integrated Facades as a Product-Service System" (IFPSS) lead by TU Delft's Departments of Architectural Engineering + Technology and Management in the Built Environment, is attempting to develop a technical and business strategy for the implementation of circular, integrated facades. With the involvement of over a dozen companies, from system and technology suppliers to large real estate managers, the team is researching changes to the current design and engineering process for developing commercial facades, and the impact these might have on the collaboration between suppliers and operators of building components.

The meeting attended was one in a series of design sessions organized by the IFPSS team, and with the participation of industrial suppliers. During this meeting, representatives from the companies that make up the consortium presented their façade-integrated products (such as air-handling units, heat exchangers, LED facades, automated solar-shading units, among many others) and discussed their potential for “service-delivery”. A circular business model, based on the long-term collaboration between suppliers and clients, as opposed to a linear model based on the direct sale of products, requires a re-design of components to make them more accessible, resilient, reliable and easy to maintain and operate. The consortium discussed the current state-of-the-art of the products they offer, and set the basis for future research on the re-engineering of such components and their live digital integration through internet connectivity, their “internet of things”.

The practical approach of the IFPSS project, and the constant input received from companies with diverse levels of understanding of circular economic models, provides highly relevant insight into the potential bottle-necks to be found when implementing energy- and resource-efficient technologies. The technical approach of the DRiEMS and SWIVT project can build on this knowledge to propose shifts in industrial and business thinking, and the involvement of a wider range of potential stakeholders, to impulse the upscaling process of the district renovation strategies developed. Likewise, the COST Action’s WG3 can be enriched by the stakeholder map presented as part of this report, as it displays the wider system perspective into which all façade-integrated technologies must fit in order to maximize their market integration impact.

**Activity 6: Participation in Climate-KIC Event *Innovation Building Block – Leadership for Sustainability* (Dec 7, 2015. Imperial College, London)**

Climate-KIC is Europe’s largest public-private innovation partnership focused on climate change, consisting of dynamic companies, the best academic institutions and the public sector. Climate-KIC is one of three Knowledge and Innovation Communities (KICs) created in 2010 by the European Institute of Innovation and Technology (EIT). The EIT is an EU body whose mission is to create sustainable growth.

Climate-KIC’s activities are driven by eight climate change themes:

- Greenhouse gas monitoring
- Adaptation services
- Making transitions happen
- Sustainable cities
- The built environment
- Land and water
- Resource efficiency
- Developing a bio-economy

Vision for the future: to provide the people, products and leadership to address the challenge of global climate change.

Mission statement: to create opportunities for innovators to address climate change and shape the world’s next economy.

Leadership for Sustainability is part of Climate-KIC’s Innovation building blocks program to enhance project management skills and maximize project output. The Innovation Building Blocks program offers one day courses about a wide range of topics, participants select to develop or build on the skill set that is most meaningful to them and their project.

The program was aimed at learning how leaders are responding to global social and environmental challenges and what makes the leaders for sustainability more effective. The objective of this course was to explore the changes in leadership theory and practice that are occurring as a result of sustainability challenges. Participants were introduced to the latest research, case studies from business, governments, civil societies and theoretical frameworks on sustainability leadership. The role of transformational leaders as change agents were examined and participants were guided through a reflection on their own leadership type.

The mode of instruction was a combination of slide presentation, video content and in site group research, discussion and sharing by the participants. The course gave participants a number of thinking tools or frameworks.

After following the Building Block, I was able to answer the following:

- Think critically about the why we need transformational leadership, what good leadership is, and what makes an effective sustainability leader.
- Identify different strategic approaches taken by leaders to address sustainability.
- Information about what makes leaders for sustainability effective change agents.
- How the typology of purpose-inspired leadership applies to participants.

The presenter was Dr Wayne Visser, Director of the think-tank and media company Kaleidoscope Futures, holder of an academic Chair in Sustainable Business at the Gordon Institute of Business Science in South Africa and Senior Associate at Cambridge University's Institute for Sustainability Leadership.

#### **Activity 7: Writing of the scientific paper.**

This activity is currently under way.

As stated in the introduction of this report, the objective of this STSM is the delivery of a scientific paper on the requirements for building integration and user interaction for adaptive and multifunctional facades. However, given that the length of the STSM is not enough to carry out the entire process, the STSM served to define the boundaries and set the working method. The STSM enabled the two authors, Mira Conci and Juan Azcarate, to create a shared body of knowledge between their specific scientific researches, which constituted a necessary framework for the writing of the paper. This exchange was successfully accomplished and already resulted in the TU Delft application for a 3TU Lighthouse project proposal entitled "*A digital integration platform for multifunctional façades*". If granted, the project will further extend the collaboration between both projects and research teams on the topic of smart, integrated and responsive multi-functional facades.

The level of information gathered during the STSM is deemed sufficient to fulfil the preset aim. Contacts have been taken with possible contributors and the defined framework structure is deemed satisfactory. More time is although necessary to complete the writing, referencing and especially peer reviewing. Because of the validation and feedback process, it is difficult to estimate the time of completion of the scientific paper. It is in any case in the interest of the authors to publish the results within the early months of 2016.

---

<sup>i</sup> [Memorandum of Understanding.pdf](#)

<sup>ii</sup> <https://www.edx.org/about-us>

<sup>iii</sup> [https://courses.edx.org/asset-v1:Delftx+CircularX+3T2015+type@asset+block/Syllabus\\_CircularX.pdf](https://courses.edx.org/asset-v1:Delftx+CircularX+3T2015+type@asset+block/Syllabus_CircularX.pdf)