Chapter 4

Transformative learning and leadership for a sustainable future: Challenge Lab at Chalmers University of Technology

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Many universities are struggling with the change processes they must implement to stay relevant in the societal transition toward sustainability (Blaze Corcoran and Wals 2004, Ferrer-Balas *et al.* 2004, Hopkinson 2010, Jansen *et al.* 2005, Kamp 2006, Sterling *et al.* 2013). Good ambitions and goals seem hard to achieve, e.g. implementing sustainable development in education, research and innovation or even integrating these three aspects. The difficulties are due not only to the complexity of the issues but also to the traditions in which universities are mired and the power structures they uphold.

This chapter describes Chalmers University of Technology's strategy for transforming the university toward sustainability. The description focuses on the integration of education, research and innovation in what we call 'Areas of Advance', and the efforts to create collaborative structures – regional knowledge clusters – for academia, business and society to jointly approach complex societal challenges. This strategy includes developing the Challenge Lab, launched in January 2014, a missing link that has the potential to be an important 'bonding agent' for the various stakeholders and a natural vehicle for transformative learning, leadership and change. For a brief overview of Chalmers' journey toward sustainability, see the selected milestones listed in Table 1.

Chalmers' strategy for change

Universities have strong traditions and a high degree of autonomy. Implementing new ideas and achieving change is therefore often a difficult mission, especially change as complex as embedding sustainable development at the university. This complex task is in everybody's interest but is often nobody's responsibility.

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Table 1. Selected milestones in Chalmers' journey toward sustainability.

1985	Environmental courses required for all students at Chalmers	Instead of introducing a specific educational programme on environmental science, in 1985, Chalmers launched a policy whereby all students are required to take environmental courses in the first years. Furthermore, all students should be able to choose an environmental profile toward the end of the programme.
1989	A virtual School of Environment is founded	In 1989, a virtual School of Environment was founded jointly with the Faculty of Mathematics and Science at the University of Gothenburg. The virtual School of Environment created formal structures for establishing environmental research and offering PhD programmes in environmental science at Chalmers and supported the environmental course requirements.
2000	Centre for Environment and Sustainability, GMV, is founded	In 2000, the virtual School of Environment became the Centre for Environment and Sustainability, GMV, which covered Chalmers and all faculties of University of Gothenburg. GMV was assigned the task of generally supporting and developing research and education in environment and sustainable development at both universities and in close collaboration with the external stakeholders.
2000-2008	Chalmers Environmental Initiative, CEI (SEK 100 million)	The Chalmers Environmental Initiative, CEI, was launched at almost the same time as GMV was founded. CEI was a research strategy focusing on the environment and sustainable development. The aim was to incorporate an environmental and sustainability perspective into research and education throughout Chalmers. The initiative led to the setting-up of seven new sustainability-related chairs. These were deployed at the seven different schools in order to ensure a good spread and thereby potentially influencing all of Chalmers.
2001	Chalmers became a member of the Alliance for Global Sustainability (AGS)	AGS is an international partnership between Chalmers, MIT (Cambridge, USA), ETH (Zürich, Switzerland) and Tokyo University (Tokyo, Japan) with the aim of pursuing research and development within complex global issues, focusing on environmental science and sustainable development.
2003	The equivalent of five weeks of courses in environment and sustainable development required for all students	In 2003, the President decided to launch a requirement of the equivalent of five weeks of courses in environment and sustainable development for all students in all bachelor programmes. Furthermore, all students should be able to choose a sustainability-profiled master's programme.

Table 1. Continued

2006-2009	Project: Education for Sustainable Development, ESD	The project Education for Sustainable Development, ESD, was started in 2006 in order to adopt a comprehensive approach to education for sustainable development. (Holmberg *et al.* 2011). This was also linked to Sweden's first UNESCO chair in Education for Sustainable Development, established at Chalmers the same year.
2008	Chalmers vision: 'Chalmers – for a sustainable future'	Sustainability is the driving force for the university. Based on the on-going mainstreaming process, it has been widely accepted at the university that sustainability is the driving force for education, research and innovation and hence for the Areas of Advance (see below).
2009	Chalmers launched a matrix organisation, with eight so-called Areas of Advance for transition toward sustainability	Areas of Advance: Energy, Transport, Built Environment, Life Science Engineering, Nanoscience and Nanotechnology, Materials Science, Information and Communication Technology, and Production. In an Area of Advance, education, research and innovation activities at Chalmers that are linked to the theme of the Area become 'visible' to each other and to the surrounding world. This makes efficient collaboration within Chalmers, with other universities, and with industry and other external groups much easier. The individual faculty members are still members of their departments but also active and visible in the Areas of Advance (the same idea as for GMV, above).
2011	Five knowledge clusters were launched in the region West Sweden	Knowledge clusters: Urban Future, Marine Environment and Maritime Sector, Green Chemistry and Bio-based Products, Sustainable Mobility, and Life Science). These five clusters were identified by leading representatives from academia and the private and public sectors in the region. At present, these clusters are being shaped with involvement from academia and the public and private sectors in order to build trust and create engagement, creativity and attractiveness for real change toward sustainability.
2014	The Challenge Lab was launched	In the Challenge Lab, students become change agents by taking on complex societal challenges together with industry, academia and the public sector (related to the five clusters mentioned above). The concept behind Challenge Lab affirms that students have abilities that go beyond what any actor in society can do alone and therefore can become change agents that can bring about transformative societal solutions.

One way to get around this dilemma is to use a top-down demand-and-control strategy, more often used in business organisations. This seldom works at a university since it requires very effective incentives in order to profoundly affect everyday university practices. Such incentives are difficult to construct for complex issues. Another way to get around this dilemma is to assign the task to a certain team/department or for such a unit to simply take on the mission. This can work to a certain degree, but often leads to lock-in effects[22] in the long run. For instance, the rest of the organisation may not make sufficient effort to achieve change since they can leave the concern to the responsible department. Correspondingly, the responsible department may feel that it could lose control if initiatives come from other departments or individuals. When the responsibility has funding attached, the risk of this kind of lock-in effect is even greater.

At Chalmers, a third method for achieving change has been identified. The strategy has been tested for many years on different scales and is behind most of the positive results (Table 1). Chalmers' strategy for achieving change has three important building blocks (Holmberg *et al.* 2011):

1. *Create a neutral arena/organisation*: some kind of neutral arena that can facilitate the change process is needed. This arena/organisation must work across research groups (and other university organisational units) to avoid lock-in effects. It can be used as a platform for cooperation and information exchange. This arena/organisation needs to be open and inviting, operate through service-oriented leadership (not building its own empires), build trust and lower barriers, maintain the memory of the change process, and give feedback to relevant stakeholders, thereby sustaining the change momentum.
2. *Build on individual engagement and involvement (bottom-up)*: universities, with their core values of scepticism, curiosity and freedom of speech, have a high degree of autonomy, which must be respected in a change process. Good teachers are life-long learners, but they don't like being lectured. The change process must therefore build on the engagement and involvement of individuals. Our experience is that the only way to achieve lasting involvement is through a patient dialogue process based on listening. The features of the neutral arena/organisation and the methods used to bring about change must meet these requirements.
3. *Communicate the clear commitment of the management team*: the change process must be in line with the overall strategy of the university. Ideally, it should be an essential part of the vision of the university. It is, of course, also important that the university clearly explains the reasons for change. The

[22] In this text 'lock-in effect' refers to a situation in which the ideas and momentum for change are locked within a limited group of the organization. This prevents the rest of the organization from becoming involved in the change process.

systematic implementation of incentives and design of structures that cohere with the change process is key to accelerating the transition.

Integrating education, research, and innovation

Integrating the three drivers of a knowledge-based society – the three corners of the *knowledge triangle*: education, research and innovation – is a challenge that forms the core of entrepreneurial universities and the purpose of the 2008 launch of the European Institute of Innovation and Technology[23] (EIT). In January 2007, Chalmers appointed three new vice presidents for this same purpose, to increase collaboration and lower barriers within Chalmers and between Chalmers and external stakeholders, guided by the principle of sustainability subsequently articulated in the Chalmers vision, 'Chalmers – for a sustainable future'. The result of these appointments and the new vision is a new matrix structure for the university based on eight 'Areas of Advance'. For each Area of Advance, all education, research, and innovation activities at Chalmers that are linked to the Area become 'visible' to each other and to the surrounding world. This enables more efficient collaboration within Chalmers and with other universities and business and society. The individual faculty members are still members of their departments, but also active and visible in the relevant Area of Advance. Each Area constitutes a neutral arena (as described above) for transformation, with two service-oriented leaders for each area. This new dimension creates a virtual matrix organisation and enables an operational bottom-up process to powerfully combine with a strategic top-down process. The Areas of Advance thereby create inspiring cross-boundary meeting places and challenges for interdisciplinary research. The Areas of Advance are: Built Environment; Energy; Information and Communication Technology; Life Science Engineering; Materials Science; Nanoscience and Nanotechnology; Production; and Transport. The Areas are firmly rooted in the basic and applied sciences and driven by innovation, entrepreneurship, and the overall vision for a sustainable future.

The complex challenges of a sustainable future translate into new challenges for universities. Traditional paths, industrial branches and mental models will be questioned. For Chalmers, the research corner of the knowledge triangle has traditionally been the focus of the university's collaboration with industry and society; the education corner will need more attention in future interactions. We will come back to this, but first a short description of regional knowledge clusters.

[23] The European Institute of Innovation and Technology (EIT) is a body of the European Union based in Budapest, Hungary. The European Parliament and the Council established it in 2008.

Collaboration between academy, society and business in regional knowledge clusters

The Areas of Advance give Chalmers better possibilities to work with business and society in regional knowledge clusters. These kinds of triple helix constellations[24] – academia, business, and society – will be needed to solve the complex grand challenges ahead. Regional knowledge clusters are important parts of the socio-technical transition, cf., Geels (2002); also König (2013), on 'Living Laboratories.' In order to work together effectively, the helix units must understand not only their own roles but also the roles of the others. The university is often a more stable presence in the region than the industries and the only actor with all three components of the knowledge triangle: education, research and innovation. Therefore, the university naturally takes on a special role in building these clusters in a neutral, open and inviting way.

In West Sweden, Chalmers has helped bring stakeholders together through a series of meetings among top management of the two universities (Chalmers and the University of Gothenburg), the city of Gothenburg, the region Västra Götaland, and the West Sweden Chamber of Commerce and Industry, starting at the 2009 Globe Forum event in Gothenburg. In January 2011, the leaders of these five organisations proposed that West Sweden could be a 'Test Arena for the Future', i.e. a region where future sustainable products and services are developed and tested in reality (Andersson *et al.* 2011). Since today's trends are part of the problem, business as usual is not an option. Existing mental models have to be challenged and new ways of thinking are necessary. Transdisciplinary collaboration across traditional industrial branches will also be important. The leaders outlined the requirements for success: Our values must be based on *trust* so that people are trained how to dare think outside the box and even make mistakes. We have to have *low barriers* that welcome and affirm commitment and initiatives. We need to build *willingness to cooperate* among organisations to the point where we even become each other's ambassadors. *Openness to the outside world* runs deep in the region since way back and has to be acknowledged even more. Sustainable development is the joint driving force.

Recently, the group has identified five knowledge clusters in the region: Life Science; Urban Futures; Bio-based Products; Mobility Solutions; and Marine and Maritime. In order to train ourselves in building trust, each of the five organisations will take

[24] The concept of the Triple Helix of university-industry-government relationships, initiated in the 1990s by Etzkowitz and Leydesdorff (1995), interprets the shift from a dominating industry-government dyad in the Industrial Society to a growing triadic relationship between university-industry-government in the Knowledge Society.

responsibility for describing the landscape of one of the five knowledge clusters and the role the different organisations are playing in developing the cluster.

Challenge Lab

As the Areas of Advance and the regional knowledge clusters are established, we are now in the process of enhancing the attraction, i.e. adding the 'bonding agent', to deepen the collaboration and co-creation. Students are recognized for their unique features that position them to become powerful change agents and take on the sustainability challenges within the regional knowledge clusters, using the Science Parks as bases. We call this student-driven transition arena the 'Challenge Lab' (Figure 1).

The Challenge Lab mission is to:

- Strengthen the educational dimension in the knowledge triangle within the Areas of Advance.
- Provide a natural hub for the triple helix actors within the five regional knowledge clusters, where all parties are drawn because of the students, as they all have a stake in the students.
- Build trust within the clusters through students. A defining feature of students is that they are simultaneously non-threatening and challenging, a feature crucial to the kind of change society greatly needs, positioning the students to be powerful change agents.
- Give the students the opportunity to develop unique skills in working across disciplines and from a challenge-driven perspective.

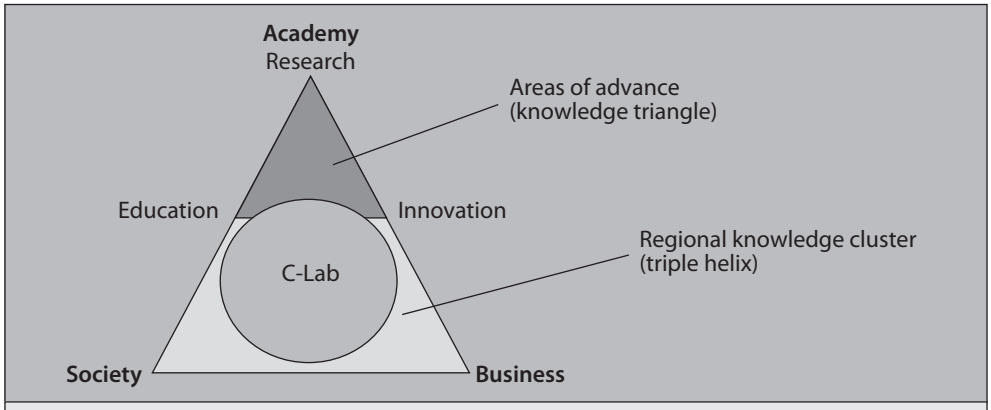

Figure 1. Challenge Lab in the centre of the regional knowledge cluster.

In the long term, Challenge Lab has the potential to transform how universities, collaborating partners, and funding agencies operate. The transformative powers of Challenge Lab have three roots: a focus on students that matches the focus on researchers; a common – shared – ground for work rather than separate home grounds; and a focus on sustainability challenges rather than technological opportunities or market needs.

The core of the first Challenge Lab at Lindholmen Science Park, spring semester 2014, is built around 12 master's student theses. The students are from six different master's programmes, representing seven nationalities. The Lab work prepares students to become change agents within the regional knowledge cluster (the system). This preparatory work is evaluated by the students and is developed over time. The preparatory work consists of two parts: *Outside-in*, including knowledge, methods and tools to understand and deal with the requirements global sustainability will put on the system; and *Inside-out*, including knowledge, methods and tools to understand and cope with the students' own values, strengths and visions as well as to understand and manage the interaction with and between the different stakeholders within the system.

Backcasting[25] (Holmberg and Robèrt 2000) is a central feature throughout the Challenge Lab process. Backcasting from sustainability principles is also the starting point in the *Outside-in* part. Backcasting is particularly useful when the problem to be studied is complex; there is a need for major change; dominant trends are part of the problem; the problem to a great extent is a matter of externalities; and when the scope is wide enough and the time horizon long enough to leave considerable room for deliberate choice (Dreborg 1996).

Backcasting is also helpful to free the mind from today's system, dependent on an unsustainable path, and start from a desirable sustainable future. In the *Outside-in* part, the students start from a global perspective to describe the principles and indicators for a sustainable future and the unsustainable challenges of today (Holmberg 1995). The multi-level perspective framework is used to characterize the system and understand how systems change (Geels 2002).

The power of C-Lab lies in its potential to bring people together for co-creation in processes where existing mental models and beliefs of how systems work and should work are challenged. In order to make this happen, the students have to be equipped with certain leadership skills. In the *Inside-out* part, leadership is in focus, mainly self-leadership and tools for dialogue. In the self-leadership module,

[25] Backcasting starts with defining a desirable future and then works backwards to identify policies and programs that will connect the future to the present.

the students' own values, strengths and visions are identified. In this process, the students are open to each other, which enhances the trust within the group while helping the students gain greater awareness of their own values.

Ryan and Deci (2006) describe four levels and depth of motivation and engagements:
1. Incentives, consequences ('If – so') 'I recycle in order to earn money for each can.'
2. Avoid guilt, strengthen self-esteem ('I should') 'I recycle because I should, if I want to feel good and avoid feelings of guilt.'
3. A sense of meaning ('I want to') 'I recycle because it is important with a clean environment.'
4. Values congruence ('I am') 'I recycle because it expresses who I am, my deepest values and beliefs.'

In order to transform a complex system it is helpful to reach level (iv). This is also the essence of the U-theory Schramer (2009):

successful leadership depends on the quality of attention and intention the leader brings to any situation. Two leaders in the same circumstances doing the same thing can bring about completely different outcomes, depending on the inner place from which each operates.

Wendelheim (1997) found that if a group wants to solve a complex task, there must be trust within the group; otherwise they will fall back to an easier task. Openness and active listening build trust. Dialogue – the art of thinking together – is key (Issacs 1999). Jewell-Larsen and Sandow (1999) claim that in a high-trust environment, active listening and deeper understanding are a continuous, generative process that is repeated as those in the network continue to reflect on how they perform together (Figure 2). Social capital is improved by collaboration. The converse is also true. Social capital diminishes as collaboration diminishes (Figure 3).

The Global Cluster Initiative Survey, including almost 250 clusters around the world, came to the same conclusion. Trust is a key to success. Cluster initiatives are more successful in countries in which companies have trust in government initiatives, business relationships are trusting, strong science and innovation policy are included, and local decision-makers play an important role (Sölvell *et al.* 2003).

After this preparatory work, the students begin to engage with the regional knowledge cluster in two phases. In the first phase, they enter the cluster from a strategic level. They read strategic documents and invite stakeholders from

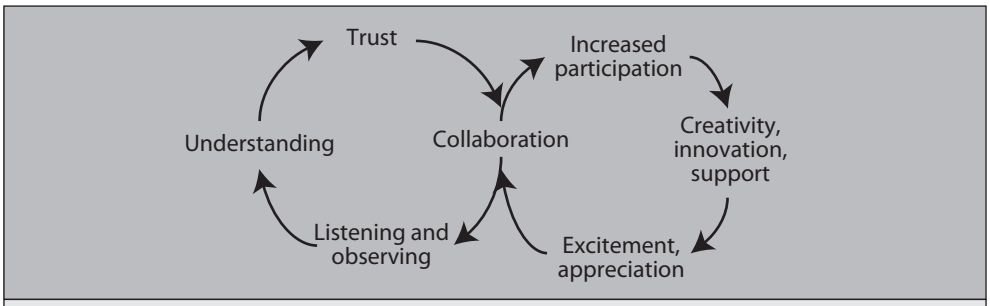

Figure 2. Collaboration begins with listening, based on Jewell-Larsen and Sandow (1999).

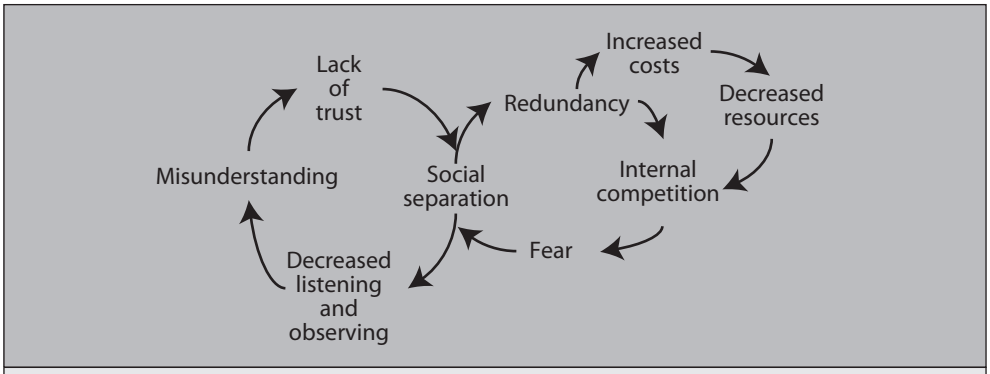

Figure 3. The cost of not listening, based on Jewell-Larsen and Sandow (1999).

academia and the public and private sectors to understand the political goals, business strategies and science that may be important for the development of the cluster. In these interactions, the students use their understanding of what the sustainable future will require and of a good dialogue to reach behind and challenge existing mental models to identify the true drivers and barriers. They also try to identify the most promising activities and projects that they want to have emerge and grow. By studying the interplay between their growth through their studies and through their interaction with stakeholders, the students search for critical leverage points to intervene in the system (Meadows 1997). Based on this understanding, the students formulate questions that become the theme of the second phase. In the second phase, the students dig deeper into these questions by interacting with stakeholders from academia and the public and private sectors more directly linked to these questions. This second phase uses a multi-

level design process (Joore 2010), dealing with the questions at the societal level (e.g. sustainability goals), within the socio-technical system (the actual cluster, e.g. the transport system in Gothenburg), within the product service system (e.g. public transportation), and maybe even within the product technology system (e.g. electric buses).

The students are presently in-between the first and second phases of the C-Lab process. It has been an interesting journey in intergenerational sustainability learning and leadership. There has been great interest among stakeholders in academia, business and society in coming to the C-Lab and interacting with the students. As the external stakeholders bring their expertise to the C-Lab, they learn from the students, both from their challenging questions and from the knowledge and perspectives the students transfer among the different stakeholders. Through this interaction with external stakeholders, the students are able to build trust among the stakeholders while analysing the challenges, drivers, and barriers of the complex Gothenburg-area transport system, with its challenges, drivers and barriers. They have identified leverage points for transitioning toward sustainability and have also formulated questions into which they will dig deeper. However, this process has not been without worries. To be successful, Challenge Labs have to be able to balance these worries. Worries mean that the students are challenged to leave their safe comfort zone and enter new domains. In order to challenge existing mental models and escape unsustainable path-dependent trends, this will be needed. However, the worries must not prevent the students from proceeding. To find a balance, the Challenge Lab's learning process and its methods and tools are continuously evaluated in a double-loop learning process (Argyris 1991).

In parallel with the on-going work at the C-Lab, external activities will be implemented in the city of Gothenburg and links will be built to existing courses at Chalmers. A preparatory course will be launched this autumn and additional C-Labs will be developed at the two other Science Parks in Gothenburg.

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