CONSTRUCTION CLIMATE CHALLENGE

Developing innovation for change

Enablers for sustainability

Åsa Ericson & Johan Holmqvist

2015-09-30

Sustainability includes ecological, economical and social aspects of growth and development. Selecting and deciding on sustainable paths in innovation activities are continuous and collaborative processes among several stakeholders. This report illustrates results concerning the creation of sustainability awareness in innovation projects.

Table of Contents

Executive summary

Innovation projects are often intentionally mixed in terms of expertise, experiences and responsibilities. Making use of differences is confirmed to inspire newness in thinking and thus provides a core base for innovative outcomes. Innovation is a key to a more sustainable future, but the concepts are relationally complex. The understanding of them relies to a large extent on people's subjective knowing and perspectives. Conventional product development approaches are established upon the saying; *what can be measured gets done*, this guiding principle has proven successful in engineering. But, immaterial characteristics, such as perspectives and values, are nowadays part of modern product development. Perspectives are not easily expressed and demonstrated in a tangible way; consequently, they are seldom assessed and intentionally put into innovation practise to enable sustainable development.

The Construction Climate Challenge (CCC) initiative aims to support a dialogue between industry, academics and society to jointly address actions to save the climate. From our point of view, being researchers in engineering design and building our expertise on conventional product development processes and its related challenges, we had the idea to bring in new theories to develop, or as it turned out, extend the standpoints to help engineering projects innovate sustainably. The pre-study started from previous research on experience sharing and teamwork in innovation projects, like R&D or advanced engineering, in which the challenges of dialogues and the creation of a common language have been emphasised. The main challenges in a dialogue are, not only related to contents and vocabulary, but also to acknowledging each other's perspectives.

The pre-study presents results from (1) a literature study on sustainability, i.e. a problematization of the area in light of product development, and (2) an exploration of a conceptual model that intends to reveal individual perspectives and to operationalize them purposefully. Problematization is an analytical scrutiny to confront the conventional with the intention to push forward reflections – it should not be mistaken for criticism.

Background

Sustainable development is a must in industry today. During the last decades, legislation has forced industry to find strategies for ecological sustainability, from end-of-pipe approaches, e.g. controlling pollution through decreased emissions, to preventing pollution and waste already at the source. Such strategies are today established in most companies, but the results are not sufficient for balancing development and climate changes.

Today, a few industry clusters address the climate challenges and environmental issues more seriously, hence going beyond legislations, e.g. extending forced strategies towards voluntary strategies for sustainable development. When doing so those manufacturing industries are leading the way for incorporating sustainability awareness throughout the industry sector. Going beyond the expected requires profound changes in how products are designed, produced, used and reused or recycled. There are several stakeholders involved in such value chains collaborations, each one of them having particular expertise, and consequently promoting best practice from their perspective. The climate challenges can be met by radically new or improved technological innovations, the incremental progress of today is not enough. One central aspect of achieving a radical change is that all involved in the processes apply 'green thinking' throughout all activities, i.e. change from conventional thinking about products to new thinking about combined, better and more sustainable solutions.

When manufacturing companies change point of view they, by the same token, are challenging the core business idea. Conventional businesses include developing and offering engineered products in transactional relationships, while a future scenario also include development in customer relationships and service offers. A change from tangible standalone products to addressing such value creation in collaborations is not straightforward, however the product perspective must be challenged to implement new types of innovation work resulting in more holistic sustainable solutions.

In sum, innovation increases in importance, there are several perspectives in action and understanding them is critical to enable sustainable development.

Objective

The pre-study addresses innovation activities caused by a shift, or extension, towards 'soft products', e.g. solutions that intends to increase the customer's experience and satisfaction other than the sale of, e.g., equipment. Soft products, it seems, are a key to create value for stakeholders, but also to address sustainability challenges by meeting customers' direct needs and requirements. Establishing the relation between customer value, technology maturity and market readiness are important perspectives in the development of such solutions. The management of social elements, e.g. perspectives, that have a great impact on both innovation activities and sustainable development is thus of particular interest for the pre-study.

The objective for the pre-study has been to address innovation activities by investigating how perspectives can be concretized and to demonstrate an approach for how to identify

stakeholder values in order to visualize how those support, or does not support sustainable development.

Project realization

The pre-study has applied three types of approaches to reach its results. They are:

1. A literature study addressing sustainable development and innovation methodologies in relation to contemporary product development literature. This was done to achieve an overview of the state-of-art in traditional product development, but also to theorize knowledge gaps between the areas.
2. Analyses starting from previous research of advanced engineering teams and combining results from literature study. This was done to conceptualize the knowledge gaps and suggest an initial framework for operationalizing several stakeholders' perspectives.
3. Seminars and discussions with researchers from expertise areas in environmental management and construction and engineering management. This was done to inform about the CCC initiative, evaluate the project's ideas and results, and to investigate possible future collaborations.

Results

Sustainability is often explained by using systems science terminologies. System theories manage different types of systems, for example natural or designed. One important feature of systems is that they have boundaries, i.e. hard or soft ones[1]. The boundary creates interfaces between different types of systems. A socio-technical system, for example, is not *one* system but *two* interacting systems, one is biological and the other is designed[2]. The interplay between these systems is then given attention in, for example product development. Stability, called equilibrium, between the systems provides a good design or solution. Systems that are put out of a state of equilibrium breaks down or changes behaviour. System theories are often used in engineering, but mainly as a systems *engineering* approach. Systems engineering is a problem solving process seeking optimal solutions to complex technical problems, while simultaneously building upon the core systems theory message, i.e. to understand the whole problem before addressing it[3]. Technical systems are complex, but they can be controlled. Sustainable product development is commonly described as efforts of addressing a complex system[4], meaning that the complexity resides in both knowledge relationships and interrelated human activities. Beholder

A socio-ecological system, like mankind and our planet, is complex and not simply controlled. Even though, the ecosystem stability is critical to preserve. If the ecosystem's

[1] This is often stated as the difference between, e.g. technical systems and human activity systems. Hard refers to the possibilities of separating an object from its environment, while soft refers to boundaries that adapts to the beholders' viewpoint.

[2] Checkland, P. 1999. Systems thinking, systems practice: a 30 year retrospective: Soft systems methodology. John Wiley & Sons, Ltd. Chichester.

[3] Systems engineering, www.incose.org. Accessed 2015-09-24.

[4] See for example: H. Ny. 2009. Strategic Life-Cycle Modeling and Simulation for Sustainable product Innovation. Doctoral dissertation. Blekinge Institute of Technology, Sweden.

resilience[5] is disturbed gradual or disruptive changes will happen to our planet, i.e. the planet has lost its self-organizing capacity to maintain equilibrium. This is exactly what is happening right now, we have moved from a stable era (called Holocene) and started another one (called Anthropocene). The new era includes, for example, a tenfold increase in human population and a forty times growth in industrial output, simultaneously human actions of life and business have been identified as the main disturbance of the Earth system's capability to maintain stability[6], Figure 1.

We would need 3,7 planets to continue consuming like we do today[7]. The largest single component of the ecological footprint is carbon emissions. There is no doubt that the climate challenges are global, as should also the solutions be. The solutions does not only addressing stopping waste products that pollute the environment and quitting plundering the Earth's resources, but also to rapidly address radical technological innovations. Crutzen[6] conclude that our contemporary technologies are 'primitive' and that we need to develop a worldwide accepted strategy leading to sustainability of ecosystems.

A framework of planet boundaries[5,8] has been developed to better understand the climate challenges, thus also understanding what feedback that would keep the ecosystems self-organized. The framework establishes thresholds and control variables for a 'safe operating space', hence offering the possibilities to pursue long-term social and economic development. However, this requires that we change our thinking and doing. To achieve growth and development in the future, and with respect for future generations, we have to put the environment as our first priority in our models of reality, Figure 2. Seeing sustainable development as a systemic holistic entity clarifies that a change in mind-set is needed[9].

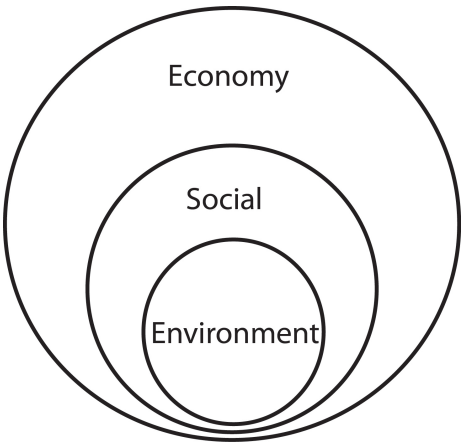

Figure 1. An economy first perspective.

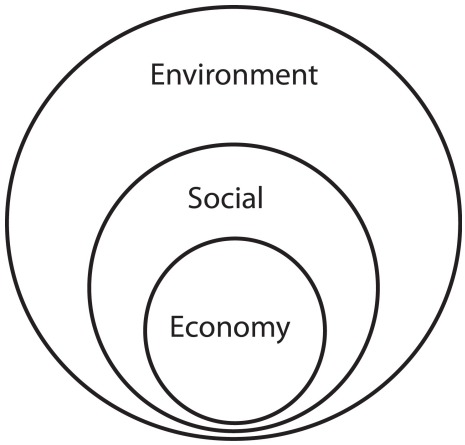

Figure 2. An environment first perspective.

[5] Stockholm Resilience Centre, www.stockholmresilience.org. Accessed 2015-09-24.
[6] Crutzen, P.J. 2006. The "Anthropocene". In Ehlers, E. and Krafft, T (Editors): Earth system science in the Anthropocene – emerging issues and problems. Springer-Verlag Berlin Heidelberg: 13-18.
[7] Living Planet Report 2014. Species and spaces, people and places. 10th edition. ISBN 978-2-940443-87-1. WWF International.
[8] Rockström, J. et.al. 2009. A safe operation space for humanity. *Nature*, 461 (24), September: 472-475
[9] Adams, W.M. 2006. The future of sustainability: Re-thinking environment and development in the twenty-first century. Report of the IUCN renowned thinkers meeting.

One grand challenge when confronted by a complex problem is to define it to ensure that the 'right' problem will be solved. After this, solving it can be fairly straightforward[2]. A problem is *"a mismatch between intention or expectation, and the outcome"*[2]. To be able to make sense of the mismatch humans apply cognitive models of a perceived reality. The models are simplifications and not blueprints, but useful to enable us to design 'a new reality'. Yet, the models we apply bring with them the perspectives we think are best and most suitable (a) to define the problem, (b) to solve it and, (c) apply when designing a better or new solution. Models have always been tools for the design and development of engineered products (e.g. 'hard products'), while those models have more in common with blueprints than with value creation, thus has limitations for soft product design and sustainable development.

Checkland[2] describes a difference between hard systems thinking, which label the world to *be a system,* and soft systems thinking, which considers the world being multifaceted and problematic, but our models to understand it are tools for systemic inquires. Applying systemic inquires about the world offers a possibility for better understanding the complexity of the world's intertwined relations with human life and business. Frankly, soft systems thinking intend preventing the use of a single perspective when framing and solving complex problems.

Stepping back momentarily, what do we mean by 'perspective'? Checkland[2] explains that our cognitive models of the world are aggregations of our beliefs, our norms and our attitudes. All together those postulates are the base for our interpretation of the world and subsequently have an effect on how we interact with it. Perspectives can originate from the individual but are also socialised from, e.g. family and friends, as well as from our educational background and employment. Education and employment bring with it a certain perspective, but also responsibilities. When the perspective and the responsibilities align they are explained as having a sphere of sovereignty[10], simplified it is the concept of a specific role, a certain expertise and the possibilities to self-government. This implies that, e.g. a researcher's perspective is research not administration and that a nurse's perspective is caregiving not cleaning.

Cooperating in value chains is common for industry today. The 'links' in a value chain all apply different perspectives, i.e. creating value to each other and jointly to a customer. Value chain as a cognitive model originates from business management[11]. Initially the model was built mainly on a business perspective where maximizing revenue and decreasing costs were in focus. Today, it often demonstrates the input, output and transformation of all kind of resources – money, operations, materials, equipment and alike. Yet, still its effective management aims to lower costs and consequently increase profits. The basic format of a value chain comes from seeing organisations as *a system* consisting of sub-systems, thus each sub-system should have an effect, positive or negative, on the whole. The value chain model implicitly gives an impression of sharing knowledge, joint decision-making and mutual

[10] Mirijamdotter, A. 1998. A multi-modal systems extension to soft systems methodology. Doctoral thesis, 1998:06. Luleå university of technology. Universitetstryckeriet; Luleå, Sweden.

[11] Porter, M. 1985. Competitive advantage: creating and sustaining superior performance, Simon and Schuster, NY. USA.

rewards[12]. Theoretically, the possibilities for one single company in the chain to radically change exist, but in practice this could be difficult. Being the first to "break the chain" takes courage[12].

In a simple illustration of a value chain, see Figure 3, customer represents the organisation that consumes, uses or benefits from the chains' solutions, supplier represents the organisation that delivers and/or develops the solution, sub-supplier represents several organisations that delivers and/or develops parts of the solution, enabler represent the allocated resources to facilitate the delivery of value, e.g. knowledge, expertise or innovation capabilities. Applied in industry a value chain, often also called supply chain, usually represents the production of 'hard products'.

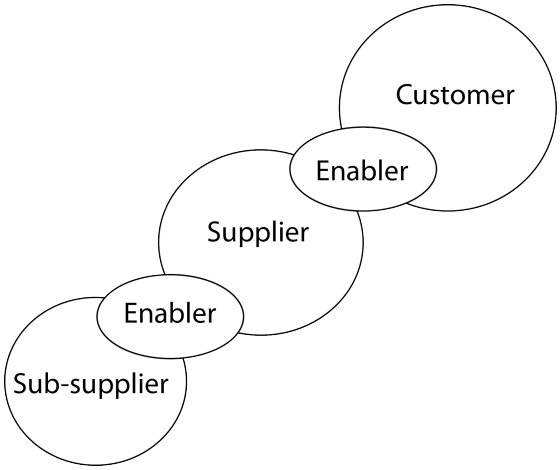

Figure 3. Value chain and enablers.

The supply chain is often described as starting with raw materials, followed by each activity needed to produce the product, and the chain ends with delivery to the customer. Value chain models rarely describes value in other respect than e.g. organisational levels (sub-supplier to customer) or a production process (raw material to delivered product), as such it does not reveal stakeholders' different perspectives of value. Yet, this type of model has proven to be effective for traceability of sustainability, i.e. measuring each stakeholders' emissions in the production processes from raw material to final product[13].

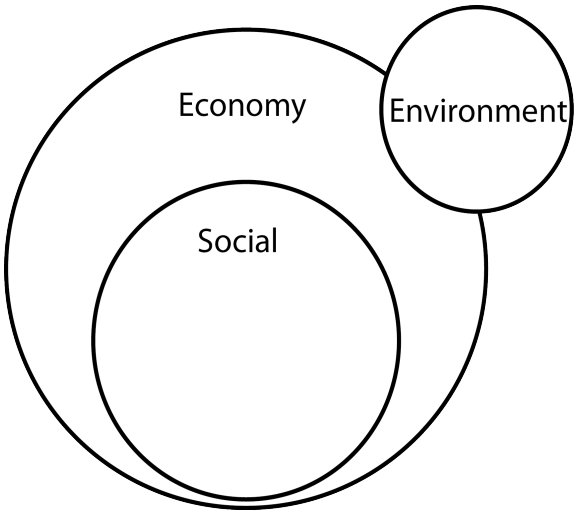

Figure 4. Environment as add on.

More importantly, since the cognitive model of a value chain is based on a business perspective (cf. Figure 1) it does not contribute to the change into an "environment first" perspective (cf. Figure 2). Normally, the business perspective is not challenged, but rather environment is added on as an aspect focusing on minimizing the effects[14]. This perspective describes a type of a cognitive model that preserves conventional thinking, see Figure 4. Changing all steps, or replacing the model, is needed to promote radical and sustainable innovations, i.e. instilling sustainability awareness on all levels.

[12] Tomkins, C. 2001. Interdependencies, trust and information in relationships, alliances and networks. Accounting, Organizations and Society. Vol. 26: 161-191.

[13] Germani, M, et.al. 2015. Investigating the sustainability of product supply chains. ICED 2015, 27-30 July 2015, Milano, Italy.

[14] See for example: Hassini, E., Surti, C., Searcy, C. 2012. A literature review and a case study of sustainable supply chains with a focus on metrics. International Journal of Production Economics, Vol. 140: 69-82.

Product life cycle models[15] are also suggested to implement sustainable development. A common idea is that life cycle models could support integration of product and service design, and thereby contributing to reduce environmental loads[16]. Customers are supposed to use the products more consciously and to increase the productivity of the product in their processes, since they are now simultaneously offered, for example training in Eco driving and contracted maintenance services[16]. The product life cycle model, simplified, describes the start from idea and concept development, via production and use, to recycle or reuse. The product life cycle model thus encourages reconsidering the so-called downstream knowledge and information to support a more sustainable design from start. It is anticipated that a life cycle model brings in real customer situations and needs into the conceptual development. However, it can be argued that the (hard) product perspective prevents the design of radical and innovative soft products. From a system theory standpoint the feedback from downstream stages could be criticised to carry only information about the technical solution, e.g. when it is functioning or when it is not functioning. Such information would be considered as 'positive feedback', but system theory denotes positive as 'more of the same'. To radically change, 'negative feedback' is needed, e.g. more information of customers' use of the solution, more information of what they value, and more information about their intentions. Nevertheless, product life cycle models are built upon similar expectations as value chains, i.e. that the stakeholders jointly address sustainable development.

Corporate social responsibility (CSR) is a framework[17] taking all the needs of all stakeholders into consideration. The framework suggests seven core subjects in an holistic approach, i.e. organisational governance, human rights, labour practices, the environment, fair operating practices, consumer issues and community involvement and development[17]. The frameworks' international integrated reporting (IR) are explained as being *"a force for financial stability and sustainability"*[17]. However, a key foundation in IR is value creation for the organization and for stakeholders. A stakeholder is defined in stakeholder management as any group or individual who can affect or is affected by the accomplishment of the firm's goals[18]. Ranängen and Zobel[19] discuss stakeholder management and CSR within a firm and conclude that a first step towards creating value would be to identify, list or map all stakeholders, in parallel with the work of identifying and analysing their needs.

Checkland[2] proposes a method to identify stakeholders, but also to reveals their perspectives (worldviews) and to clarify the transformation that creates value for them. The approach originates from studies in manufacturing industry, especially from the design and development of complex products (i.e. the Concorde airplane). The method provides a root definition as part of a conceptual framework that aims to support making use of different perspectives. The approach has, over the years, been adapted to a number of different

[15] H. Tianfield, 2001. Advanced life-cycle model for complex product development via stage-aligned information-substitutive concurrency and detour. International Journal of Computer Integrated Manufacturing, 14(3): 281-303.

[16] Aurich, J.C., Fuchs, C., Wagenknecht, C. 2006. Life cycle oriented design of technical product-service-systems. Journal of Cleaner Production, 14: 1480-1494.

[17] ISO, 2010. Guidance on Social Responsibility (ISO 26000:2010, IDT).

[18] Freeman, R.E., 1999. Divergent stakeholder theory. Acad. Manag. Rev. 24: 233-236.

[19] Ranängen, H., Zobel, T. 2014. Exploring the path from management systems to stakeholder management in the Swedish mining industry. Journal of Cleaner Production, 84:128-141.

application areas, for example information systems[20]. The method, called CATWOE, include the term environment, but it originally did not address ecological sustainability. The transformation can be applied to highlight ecological, social and/or economical sustainability, but the power of the method is its use as a tool for better dialogues to create awareness and clarity for people's actions, i.e. actions that are already achieved or actions that are intended.

The mnemonic CATWOE represents:

Clients: *those or the one who benefits from or suffers from the change*
Actors: *those or the one who makes the change*
Transformation: *the change that the input has to go trough to become a desired output*
Worldview: *the particular perspective that makes the change meaningful*
Owner: *those or the one who has the formal power to stop the change*
Environmental constraints: *which are the external constraints that are taken for given*

As in all types of system theory, the transformation is not a magic box. This means, say that the input is "emission" the output is a changed form, e.g. "decreased emission". Output is thus the same but in a transformed state. Worldview is a key to the satisfaction of the change and clarifies the value for a particular stakeholder, e.g. financial (lower costs), human (doing good) or intellectual assets (best practice). The method includes, mapping stakeholders in more detail, i.e. those who own the process and those that are needed to execute the change (cf. stakeholder management definition). Thus, provides not only perspectives that govern the actions and the steps needed to jointly make the transformation, but also a refined map of actors. In respect of radical innovation it might be possible to say that the method delimits the disruptive paths we are searching for, the transformation of the input to another output follows more an incremental, stepwise path.

CATWOE could be one way to relate stakeholders', customers' and other actors' values to innovation for change, as well as enabling sustainability awareness on several company levels and across companies. However, since it delimits radical innovation it needs to be adapted or related to such a methodology. Radical innovation methodologies, in turn, need to be adapted to practice. Radical innovation rests upon 'playfulness'[21], which does not readily align to ordinary work approaches, instead often perceived as waste of time.

One major challenge for large companies is to bring sustainability awareness into daily practices at all company levels, a key to succeed is to implement the change in mind-set that starts from environment, instead of economy, and take social sustainability as a second frame (cf. Figure 2). Often in engineering an "either or" reasoning is applied, meaning that if we focus on one aspect, the others are not important. This is far from true for sustainable development. Holistic approaches include managing all aspects of life and business, and make informed decisions and implement continuous improvement of actions.

[20] Rose, J. 2002. Interaction, transformation and information system development–an extended application of Soft Systems Methodology. Information Technology & People. 15, 3: 242-268.
[21] Schrage, M. 1999. Serious play: how the world's best companies simulate to innovate. Harvard Business School, USA.

Deliverables

An international master student has been assigned to the project team and has presented an overview identifying important sources that support sustainable development in a seminar at Volvo Construction Equipment. Approximately 40 employees attended the seminar. The pre-study project and the CCC initiative have been presented for other researchers at Luleå University of Technology in two seminars, resulting in the interest and commitment for research collaboration from the two areas Environmental management and Construction engineering and management. The seminars resulted in a joint research proposal, which was awarded 200 TSEK because of being recognised as vital to one of the university's prioritized research- and development areas. Two academic conference publications have been accepted and published in proceedings, one journal manuscript is under development. Climate challenges and the aspects of the CCC initiative have been integrated in two courses, one on product development processes and one on sustainable product-service development. The students come from mechanical engineering, industrial design and digital service innovation. Training material, in form of a short reflective textbook, for "sustainability awareness" has been developed and will used for teaching in the courses.

A review searching for tools for interactive popular scientific presentations of the project idea and result concerning sustainable development has been conducted. Two types were found interesting, i.e. Infographics and iBook. As a test, the overview done by the master thesis student has been disseminated using Infographics (see attachment).

Conclusions and future research

The pre-study has had the objective to address innovation activities by investigating how perspectives can be concretized and to demonstrate an approach for how to identify stakeholder values. This has been done in an attempt to be able to demonstrate how those support, or does not support sustainable development.

The study indicates that the CATWOE method holds some promises to relate stakeholders', customers' and other actors' values to innovation for change. Also, it can be useful for enabling sustainability awareness on several company levels and across the value chain. In relation to this, a delimitation of CATWOE has been identified mainly as not supporting radical innovation. Hence, adaptations of radical innovation methodologies need to be done, both in relation to the method and in relation to established practice. CATWOE is one part in a fairly extensive conceptual model for soft systems thinking, further investigations are needed if integrating such an approach for the purpose of sustainable development.

This report highlights that conventional product development is in a state of change in which we have found radical innovation capabilities as important. The report also indicates that the stakeholders involved in modern product development will face changed requirements on close collaboration for achieving sustainable development. We have stressed that there is an on-going shift in manufacturing industry in which at least two aspects could have an affect on sustainable development, i.e. cultural (from provider to collaborator) and competence (from transactional products to continuous customer satisfaction and value). When the business environment is shifting 'de-learning' and 're-learning' are core challenge that confronts how products are made. Yet, sustainable development also confronts how businesses are made and by necessity expands beyond each single company's horizon.

Things we have not considered in the report, but found interesting are for example the different perspectives in relation to strategic, tactical and operational decisions. Typically, companies deploy long-term plans (strategic) as well as short-term plans (tactical) and in the end find that the operational decisions (what was actually done) deviate from those. An interesting question for further investigations would be if perspectives have something to do with this? Argyris and Schön[22] differentiate between 'espoused theory' and 'theory-in-use', simply the different between what we plan and intend to do and what we actually do. The similarities with sustainability plans and sustainability actions are interesting.

The assessment of whether or not the development has met the company's sustainable measures (sometimes only formulated as qualitative statements) is another interesting area of investigation. A review happens after the fact and adjustments are done to improve next time. This is part of becoming better in sustainable development and it is also a reality that creates an incremental approach. Today, we now know that stepwise improvements are too slow compared to the climate changes. Researchers from the field often describe the strategic features of sustainable development by comparing it to the strategic game chess, i.e. it is normally not possible to beforehand decide the endgame in detail. Backcasting, i.e. starting from a desired goal and trace actions back to the starting position, is recommended[23]. Yet, it can still be argued that disruptive sustainable paths will not be chosen, the approach as such does not fundamentally push such high degree of change in all levels that is actually needed. An investigation of goal establishment and CATWOE, or any similar method, in relation to a backcasting technique would thus be of interest to explore suitable measurement of qualitative statements. Such a study would complement quantitative approaches, which have received some criticism, for example Triple bottom line[24]. Triple bottom line measures relate to the economical ecological solutions of today and do not directly support sustainable game-changing technologies. An issue here is that sustainable development, by interlinking innovation and change, often lacks useful measures. In previous research we have experimented on Technology Readiness Levels (TRL) as useful for team innovation. Adaptations of TRL might turn qualitative measures of sustainable development more solid. Nevertheless, an "environment first" perspective would be supported by new sets of measures.

Coming from an engineering design research area, we find it interesting to make use of our perspective in transdisciplinary studies and investigate how engineering approaches can be integrated and/or improved to align with the paradigm of sustainable development. Engineering work is considered as knowledge intensive work, as well as global. We find it interesting to investigate the influence of cultural (in terms of different engineering principles) and hierarchical (in terms of engineering leadership and empowerment) dispersion of sustainable development, in particular how requirement specifications are built based on experience sharing in teams. How to close knowledge gaps are also an

[22] Argyris, C., Schön. D. 1978. Organisational learning: A theory of action perspective. Reading, Mass: Addison Wesley.

[23] See for example: Bratt, C. 2014. Integrating a strategic sustainability perspective into eco-labelling, procurement and supply chain management.

[24] Norman, W., MacDonald, C. 2004. Getting to the bottom of "Triple Bottom Line". Business Ethics Quarterly, 14 (02): 243-262.

interesting area of inquiry. Knowledge inventory in relation to key performance indicators and maturity (market and technology) are of particular interest. From a practical standpoint, such studies could support finding answers on:

- Which categories of standards requirements are relevant for sustainable development?
- How does stakeholder perspectives contribute to the formulation of new requirements for sustainable product-service offers?
- Which are the consequences for different stakeholder's development processes?
- What impacts do sustainable development put on the specifications of innovation projects?
- How can sustainable value development be integrated into established procedures?

Overview: activities and deliverables

- *Related:* PhD thesis, Dissertation March 18 2015, Johan Holmqvist.
    - Presentation at Volvo Construction Equipment in Eskilstuna April 16 2015, approximately 40 persons attending.
- Project seminar on Sustainability in relation to the CCC-initiative:
    - Presentation at Volvo Construction Equipment in Eskilstuna April 16 2015, approximately 40 persons attending.
- Publications:
    - Ericson, Å., Holmqvist, J. (2015) *Advanced engineering: How to sustainability for innovation operations.* In Proceedings of the 5th International Workshop of Advanced Manufacturing and Automation (IWAMA): Shanghai, China.
    - Ericson, Å., Holmqvist, J. (2015) *Meeting Sustainability Challenges: Soft Systems Thinking as an Enabler for Change.* In Proceedings of the 20th International Conference on Engineering Design (ICED15): Design for Life, Milan, Italy.
    - *Related:* Holmqvist, J. (2015) *Conversation in engineering teams: turning experiences into actions*. Doctoral thesis, Luleå University of Technology, Sweden.
- Dissemination:
    - Participation in CCC Summit, June 24, 2015
        - One out of four pre-study projects. Panel discussion and poster session.
    - Participation in CCC Seminar, October 8, 2014
        - The pre-study projects were officially announced.
    - Participation in discussion-session during the ICED 2015 conference under the theme: *Design for a Sustainable Life - Dimensions of Sustainability*
- Overview – infographics
    - Presented at project seminar in Eskilstuna.
- One short textbook: a general introduction to sustainable development and the CCC-initiative, aiming for educational purpose in master-programs.

Research grants:

- SAMSARA – Sustainable and attractive environments: a stakeholder requirement approach. Awarded 200 TSEK from LTU prioritized area Attractive built environment. A direct spin off idea from the project, collaboration between different research areas connecting innovation, environmental management and construction engineering.

Infographics: overview master thesis student study