Challenge4Impact

CO-DESIGNING STUDENT-BUSINESS SUSTAINABILITY CHALLENGES

Setup, Digitalization and Internationalization

Karl Eldebo and Olof Hjelm

With contribution from Klaus Fichter, Anne Seela and Alexandra Widrat (Carl von Ossietzky University of Oldenburg) and Frans Stel (Vennebroek Academic Services)

IMPRINT

Editor

Challenge4Impact
coordinated by Carl von Ossietzky Universität Oldenburg
School of Computing Science, Business Administration, Economics, and Law
Ad. Professorship Innovation Management & Sustainability
Ammerländer Heerstr. 114-118,
D-26129 Oldenburg, Germany
www.uol.de/en/innovation

Contact

Karl Eldebo
karl.eldebo@liu.se

Olof Hjelm
olof.hjelm@liu.se

Design & Layout

Alexander Kruschinski | alexanderkruschinski.de

Proposal for citation

Eldebo, K. & Hjelm, O. (2023) Co-designing Student-Business Sustainability Challenges – Setup, Digitalization, and Internationalization, Linköping: Linköping University

The creation of these resources has been funded by the ERASMUS+ grant program of the European Union under grant no. 2021-1-DE01-KA220-HED-000032242. Neither the European Commission nor the project's national funding agency DAAD are responsible for the content or liable for any losses or damage resulting of the use of these resources.

This publication is available at:

www.challenge4impact.eu

Challenge4Impact "Developing Partnerships for International Virtual Student-Business Challenges in Sustainable Entrepreneurship" is a research project funded through the EU Erasmus+ programme. The main goal of the project is to contribute to the development of sustainable innovations to help tackle the grand challenges by means of university-business collaboration. Specifically, the project focuses on student-business challenges in sustainable entrepreneurship that address sustainability-related challenges and target innovative solutions with the potential to create positive economic, environmental, and social impact and contribute to achieving the UN Sustainable Development Goals (SGDs).

CONTENTS

1 THE GRAND CHALLENGE

The trends of digitalization and globalization have led to both great advancements as well as great disturbances of balances in industries. Many educated people go to work today, using technologies which were not even on the market when they got their education, while competing with people all around the globe. At the same time, the world has been stage to both a global pandemic and terrifying environmental and social disasters. To answer to the fast-changing world and to build a more sustainable society, different approaches have been developed to tackle challenges and take advantage of opportunities. One example is EU's mission-oriented research and innovation. The SDGs from UN are another example of setting a desired course for research, entrepreneurship, and development.

"Entrepreneurship is when you act upon opportunities and ideas and transform them into value for others. The value that is created can be financial, cultural, or social." [1]

In the light of societal sustainability challenges, higher education needs to combine societal context and theoretical courses and subjects for students to develop understanding and skillsets for their coming work-life. One popular way of doing this is **Experiential Learning Pedagogics** which includes real-life problems in the curricula, where students apply theory to practical cases. Several educational approaches have been developed to serve this purpose including Problem Based Learning, Project Based Learning, Challenge-driven Education, Challenge-driven Learning and Challenge Based Learning.

With this handbook we want to share experiences of arranging educational approaches with real-life problems, with a focus on international collaboration and how the growing amounts of digital tools for developing students' knowledge and skills can be used. We aim to support teachers in higher education to further develop approaches where students and businesses collaborate on real life challenges to contribute to a sustainable development. We also want to inspire businesses (and other organizations) to make use of entrepreneurship and the transformative capacity of students.

[1] Vestergaard, L., Moberg, K., & Jørgensen, C. (2012). Impact of entrepreneurship education in Denmark–2011. Odense: The Danish Foundation for Entrepreneurship-Young Enterprise.

1.1 FOCUS OF THIS HANDBOOK AND TARGET AUDIENCE

This handbook is primarily focused on inspiration, frameworks, and guidelines for teachers in higher education. That said, the content can also be of interest for a variety of people, such as technology transfer officers looking to expand their offer to collaboration partners, and for collaboration partners (companies and other parties) looking for engagement with students in higher education.

If you are interested in how open innovation can support the transition to a more sustainable world, we think you will find this handbook interesting. You can use the full handbook or pick parts depending on your interest. The first chapters are relevant for anyone interested in **Student-Business Sustainability Challenges (SBSC)** irrespective if digitalization or internationalization is of interest. In the same way, an experienced teacher already working with SBSC can use the chapters on digitalization and internationalization as inspiration for further developments of current approaches.

This handbook does not contain a list of tools to use, as such lists are swiftly outdated. Instead, we aim for frameworks and theories which will be food for inspiration for a lasting time. Drawing from our and others' experiences, as well as existing frameworks and theories, we hope to supply the reader with knowledge and skills either to transform existing courses to a more international and digital format, or to start completely new courses which equip students with the knowledge and skills to tackle societal challenges in an international world.

1.2 BASIS OF THIS HANDBOOK

This handbook is based on our experiences from the projects Scaleup4Sustainability (S4S) [2] and Challenge4Impact (C4I) [3]. In C4I we have performed

- Literature studies including scientific literature and different handbooks published as reports or webpages.
- Interviews with fifteen higher educational institutes (HEIs) active in different types of student-business collaborations.
- Workshops within the project consortium and associated partners.
- Peer review before publication.

[2] https://www.scaleup4sustainability.eu
[3] https://www.challenge4impact.eu

CHAPTER-BY-CHAPTER INTRODUCTION

After this introduction the remaining chapters contain the following:

2 STUDENT-BUSINESS SUSTAINABILITY CHALLENGES

In this chapter, we present a framework for how to work with external stakeholders in challenge-based learning. The framework supports teachers in developing both new and existing courses, drawing from experiences and theories. We present tools and ideas for different educational setting, and deep dive in the roles of the teacher regarding both students and internal and external stakeholders. The chapter is aimed at teachers and other functions at the HEI which have interest in involving external stakeholders in education.

3 STUDENT-BUSINESS SUSTAINABILITY CHALLENGES AND DIGITALIZATION

Building on SBSC, this chapter presents inspiration and ideas for digital tools which can be used to enhance experiential learning courses. The section 3.5 focuses on pedagogics for an online or hybrid course. This chapter is aimed at both professionals and teachers who works with innovation and digital tools.

4 STUDENT-BUSINESS SUSTAINABILITY CHALLENGES AND INTERNATIONALIZATION

From both a strategic and operational view, this chapter includes tools and inspiration to make courses more international. The frameworks presented are of use for teachers, university staff, and other organizations which aim to connect students in higher education with international partners.

5 GUIDELINES & HANDBOOKS

In the final chapter we have collected prior manuals, handbooks, and reports which are of interest for further reading.

© NDABCREATIVITY, Adobe Stock

2 STUDENT-BUSINESS SUSTAINABILITY CHALLENGES

Student-business challenges has been around in various forms since the 1980s, when large consulting firms in USA started using case-based competitions to find talented students. As society faces growing sustainability challenges, the focus of student-business challenges is shifting to sustainable solutions. To equip students with understanding of societal problems and needs, the mixing of entrepreneurial education and societal challenges has proven to both generate new, innovative solutions and development of students' knowledge and skills.

The key stakeholder in these Student-Business Sustainability Challenges (SBSC) is the Challenge provider: a company that supplies students with a case to develop an innovative solution or an invention, which students then use to build a business plan. SBSCs come in a variety of settings, from full-semester mandatory courses to short, extra-curricular, event-based competitions. This manual is aiming at teachers in HEIs and will focus on longer, curricula-based courses and modules. This said, much can be applied to other learning activities as well.

2.1 STUDENT-BUSINESS SUSTAINABILITY CHALLENGE FRAMEWORK

The SBSC builds on the Challenge-Based Learning (CBL) framework [4], kickstarting the students' entrepreneurial journey with an idea from an external organization. The stakeholder – Challenge provider – supplies the students with a technology, market insight, or intellectual property on which to build a business case. A business case usually contains four facets: Technical feasibility ("can it be made?"), Desirability of the solution ("who wants it, and how?"), the economic Viability ("how do we make money?"), and the long-term, triple bottom line Sustainability of the solution. The SBSC usually do not emphasize the technical feasibility but focuses on developing analyzes regarding the other three parts. The relation between the different parts of the business case and the overarching sustainability analysis is demonstrated in Figure 1.

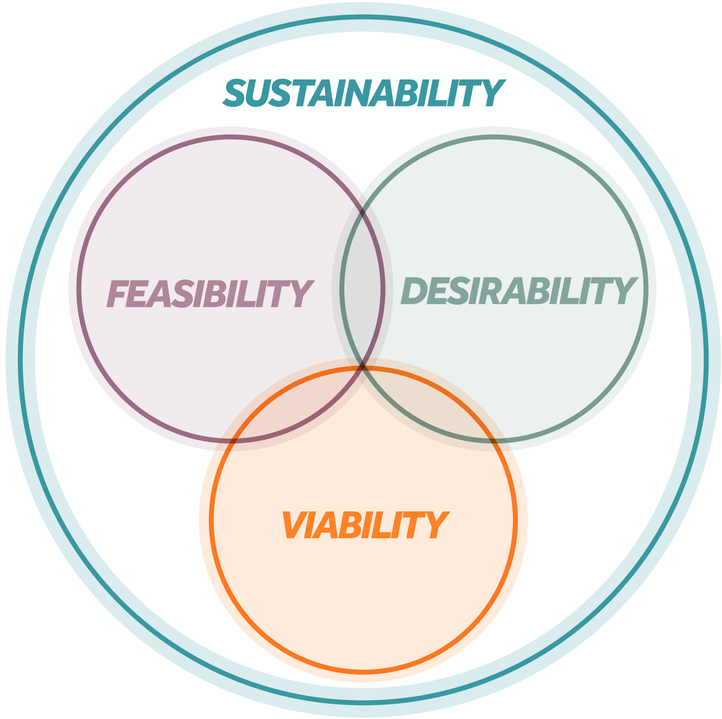


Figure 1: The four pillars of a business idea (Bocken et al., 2021) as investigated in SBSC

The CBL process consists of three phases, Engage, Investigate and Act. In the Engage phase, the societal need is analyzed, and corresponding challenges are formulated. Possible solutions for the challenge are then developed and tested in the Investigate phase. Finally, in the Act phase, selected solutions are operationalized and, if feasible, implemented by the Challenge provider. Outcomes of the SBSC is normally owned by the Challenge provider but can be transferred to the student group if the Challenge provider is not interested in pursuing discovered opportunities. There are also examples of SBSCs where the ownership at start is placed with the student group and might be transferred back to the Challenge provider for a fee, if the results are promising. Figure 2 demonstrates how the phases of CBL and SBSC correlates.

[4] A "hybrid CBL", according to the definitions in Gallagher, S.E., Savage, T., 2020. Challenge-based learning in higher education: an exploratory literature review. Teaching in Higher Education 0, 1–23.

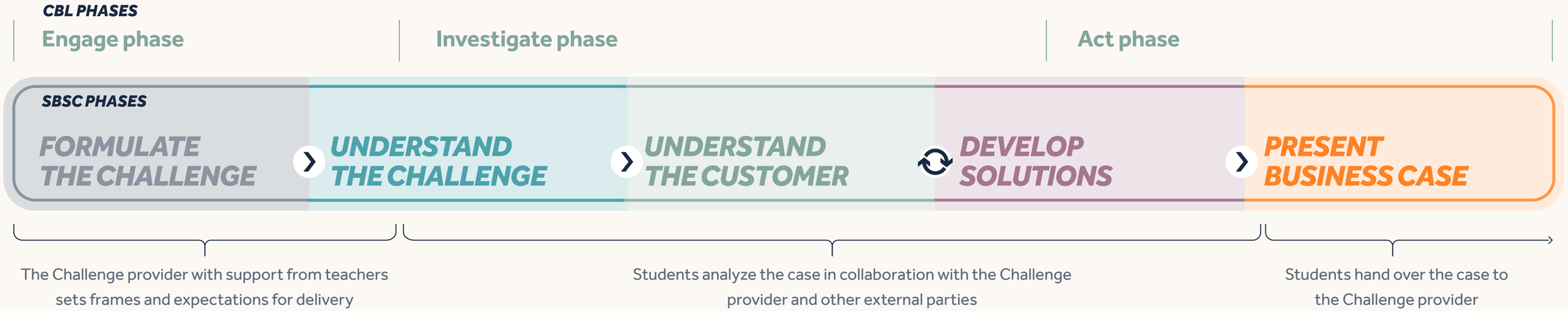
In the **Engage phase** the challenge is formulated, and an understanding of the challenge is built up by the Challenge provider with active support by the teacher. The Challenge provider has knowledge of its markets and technology development which students do not possess due to lack of experience and market knowledge. The Challenge provider has recognized some kind of opportunity in its operations or market and seeks to explore this market with "fresh eyes" – hence the collaboration with education.

As the Challenge provider concretizes and formulates the recognized opportunity, teachers use their experience to enrichen the challenge and deepen the understanding together with the Challenge provider. The task is formulated to suit the students and the educational setting, ensuring the students are equipped to answer to the task. The desired outcome is set, dependent on the course prerequisites. Finally, the challenge is presented to students who start their process in understanding the challenge. (The SBSC is an alternation of the full-CBL procedure, in which the students themselves formulate the challenge).

Now starts the **Investigate phase**, in which students deepen their understanding of the challenge, build up their understanding of the customer and its needs. Solutions are iteratively developed, as students create business artifacts to test with potential stakeholders. The **Act phase**, finally, is often limited to a presentation of the work in the end of the course. Depending on the course, this presentation can be in form of a business case or a business plan, supported by a mockup, prototype or sometimes a desktop example of a Minimal Viable Product [5] (MVP). Teachers support students throughout the process both as coaches and with their knowledge.

[5] Minimal Viable Product is a prototype which can be tested on customers for feedback and pre-sales. In SBSC these may rather be a technical specification validated by prospective customers.

Figure 2:SBSC in relation to the CBL steps (own design)



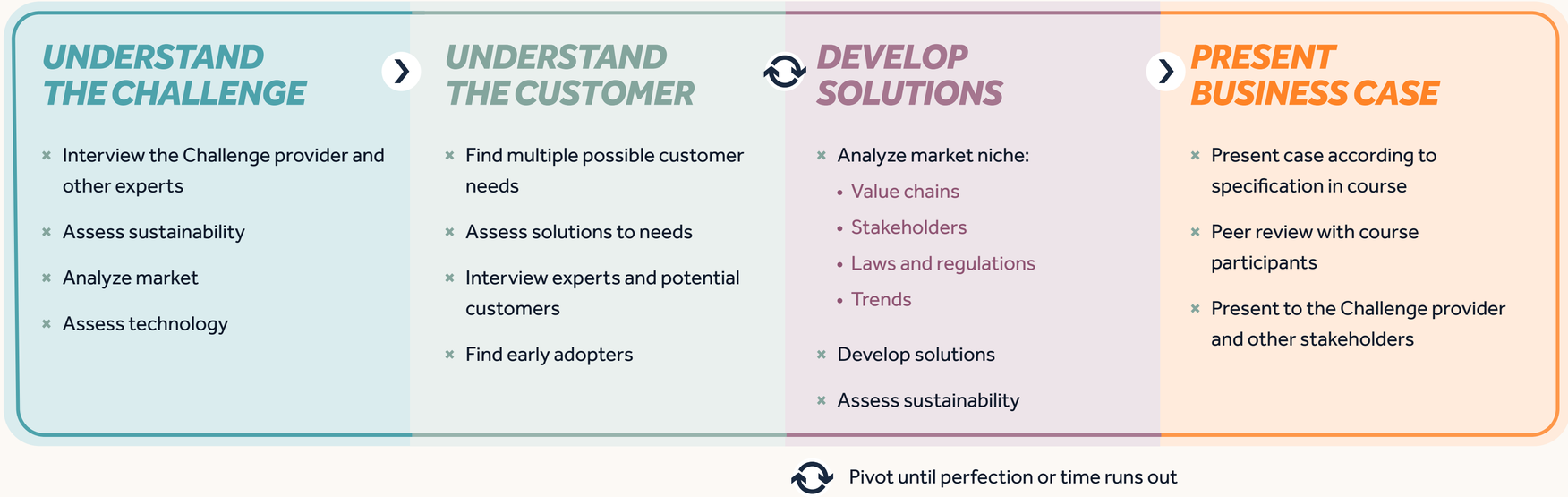


Figure 3: Process steps of the SBSC framework from a student perspective

Figure 3 breaks down the SBSC and the **students' work** in detail. Students iterate in the experiential cycle as described by Kolb and Kolb[6] where they move from observation and conceptualization of needs and barriers of markets to active experimentation on solutions, which they then test on the market, leading to experience and reflection. Through this process, students learn to assess technological solutions in the light of customer needs, economic reality, sustainability, using their own interests and knowledge. When comparing different HEIs and different courses, the framework is consistent, but components vary. Two main variables which influence the choice of components are the educational background of students and the timeframes of the course or module.

Students move through the SBSC framework, where they (in teams) understand the challenge and clarify it for themselves, they understand future customer needs and requirements, they develop plausible solutions (very experimental). Iteratively, students assess needs and ideas with external stakeholders, as future customers, suppliers, financers, and industry experts, and the Challenge provider. Students usually come from the same or similar educational background as SBSC courses often are in a program curriculum, in difference from multidisciplinary CBL courses.

SBSC courses usually includes several iterations between the process steps "Understand the customer" and "Develop solutions". The number of iterations varies depending on the length of the course. Inspired by Eric Ries's works on the lean startup [7], teachers vary the iterative part in the courses we have analyzed. Some courses have very open structure, where students only are encouraged to reach out to external stakeholders during their work. Some have very set iterations, with different models to be iterated in consequential steps.

[6] Kolb, A. Y., & Kolb, D. A. (2017). Experiential learning theory as a guide for experiential educators in higher education. Experiential Learning & Teaching in Higher Education, 1(1), 7-44.
[7] Ries, E. (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Crown Currency.

The following sections give details for each of the steps of the SBSC process. In connection to each step, we provide examples of tools and workshops to support teachers in their teaching activities. An extended list of tools and workshops can be found in the Appendix [8].

UNDERSTAND THE CHALLENGE

Students start the journey of innovative development by assessing the idea presented by the Challenge provider. Through interviews and existing information, students familiarize themselves with the technology, market, and needs of innovation. The sustainability challenges and needs are also assessed and discussed with the Challenge provider and with teachers.

For both students and teachers, this is also a period of teambuilding and boundary setting, which can be facilitated in various ways.

UNDERSTAND THE CUSTOMER

As students narrows down the focus on possible market niches and target groups, they need to deepen their understanding of market needs, sustainability challenges, possibilities for new solutions, and value chains.

Learning is primarily done by conducting interviews, surveys, and desk research. Interviews are made with potential customers, but also with others such as niche experts, business advisors, tech experts, and the Challenge provider.

DEVELOP SOLUTIONS

After interaction with the market and its needs and demands, students investigate possible solutions. This work is most often carried out in the assigned groups, with the support of teachers and the feedback from other course participants.

Solutions are developed in various ways, depending on the educational background of the students and the aim for the SBSC. Ideas for *digital tools* which can help in this step can be found in Chapter 3.

EXAMPLES OF MODELS AND WORKSHOPS	Alliance game, Competence matrix, Contribution to SDGs, PESTEL, Shitty Prototyping, Simplified Life Cycle Assessment (LCA)	Market analysis, NABC, Porter´s 5 forces, Resource flow analysis, Value chain mapping	Backcasting, Business Model Canvas, Functional Trees, Ideation Workshop, NABC, Prototyping, Simplified Life Cycle Assessment (LCA), Value Chain Mapping

[8] The list originates from: Fichter, K., Hurrelmann, K., Seela, A., Hjelm, O., Larsson, M., Sundberg, C., Wisdom, K. & Stel, F. (2020). S4S Report on evaluating leading approaches and tools in collaborative green venturing (Work Package 2). Oldenburg, Linköping and Zuidlaren.

PRESENT BUSINESS CASE

PIVOTING BETWEEN STEP 2 AND 3

After students have engaged with potential customers and experimented with solutions, they interact with potential customers and the Challenge provider again to test ideas and further understand the potential market – or to change the aim of their idea. The number of iterations usually is dependent on the length of the course.

One way for teachers to standardize the pivoting is to standardize the artefacts to pivot with customers. The first pivot could be an NABC, to present for stakeholders and receive feedback on. The next pivot could then be a full BMC or Value chain mapping to again interact with stakeholders and receive feedback on. And so forth.

PRESENT BUSINESS CASE

Presenting the business case to the Challenge provider, stakeholders, teachers, and course participants is an important part of the SBSC. For the Challenge provider, this is a perfect opportunity to invite stakeholders which have an interest in the future development of the proposed solution, both to receive valuable feedback and to secure desirability and stakeholder alignment.

For the presenters, it is a learning moment of feedback on the completed work. For the audience, it is a learning moment both in receiving the case but also in discussing the outcomes and ideas.

EXAMPLES OF MODELS AND WORKSHOPS

Idea Fairs, Pitching, Value Creation Forum

The main deliverable in an SBSC is a business analysis, usually including all or a selection of the following features:

- A description of the solution and its sustainability values (simple prototype, customer offering).
- Customer target group (early adopter analysis).
- Overall market analysis including landscape analysis (laws, regulations, trends etc.).
- Business case (as startup venture, corporate venture, NGO, or other).
- Recommendation for organizational structure, team members, and key partners.
- A plan for development to launch.
- An analysis of future growth potential, future developments, and financials.

2.2 SBSC, THE STUDENT, AND THE TEACHER

The **student** might engage in SBSC because it is part of the curricula for the chosen study program, or because of a personal interest in entrepreneurship (or business) in combination with sustainability. SBSCs run in all kinds of educational programs but are prominent in engineering and business education.

According to surveys made with students who have engaged in SBSC courses [10], students are most content with four things in the SBSC setup:

- The need to take responsibility for the learning process.
- The tools and methods for idea generation and business analysis.
- The procedural focus on learning.
- The interaction with companies.

For **teachers**, the SBSC challenges the traditional classroom teaching in the same way as other CBL initiatives. [12]

The major difference in setup between "strict CBL" and SBSC is the Challenge provider, which has impact on the roles of teachers as well as students. Together, students, teachers, and Challenge provider form a loose team to tackle the challenge in focus. SBSCs utilize the connection with a partner in industry to focus students on the tasks of iterating ideas and validating solutions.

As teacher, you will swiftly be overtaken by the students in regards of knowledge on the specific case. Your role then becomes a coach and a support for the students, to facilitate the learning and the process of the project rather than answering specific questions.

I n CBL the title of "Teamcher" is often given the teacher (or the teacher team) [11], presented in Figure 4.

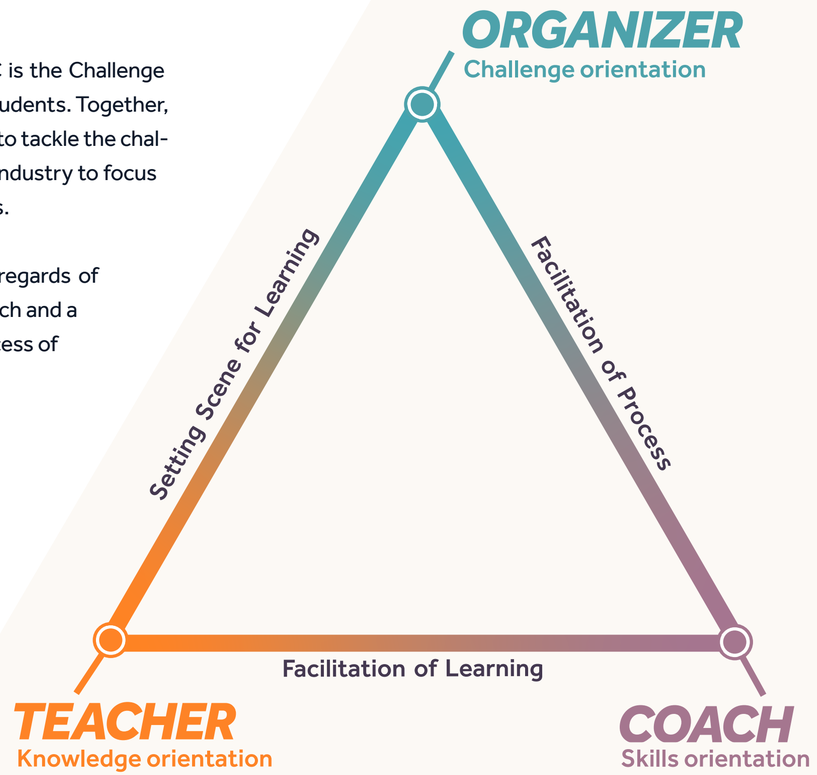


Figure 4: The three roles of the teacher in CBL (Eldebo et al. 2022)

[10] Fichter, K., Hurrelmann, K., Seela, A., Hjelm, O., Larsson, M., Sundberg, C., Wisdom, K. & Stel, F. (2020). S4S Report on evaluating leading approaches and tools in collaborative green venturing (Work Package 2). Oldenburg, Linköping and Zuidlaren.
[11] We would recommend the CBL Guide from Digital Promise, se Chapter 5
[12] Eldebo, K., Lundvall, C., Norrman, C. A., & Larsson, M. (2022). How to make good teachers great in challenge-based learning. 18th CDIO Conference June 13-15 2022, Reykjavik, Iceland.

THE ROLES OF THE "TEAMCHER" ARE:

TEACHER – Beeing responsible for the knowledgebase of the course.

ORGANIZER – Engage Challenge providers (and other external stakeholders if needed) and ensure the challenges are in line with course objectives.

COACH – Support students in the ongoing work, as well as in teamwork-related issues.

Many SBSC courses also engage coaches from stakeholders to support students. This eases the workload of the teacher team and provides valuable input for the students but demands more of the organizational skills and the time teachers spend on external collaborations with stakeholders.

2.2.1 SUPPORT FOR TEACHERS IN SBSC

A SBSC puts a high demand on the teacher team for coordination and industry contacts. There are several organization and partners which can support teachers in the work with both existing and new courses of SBSC. These actors are often called brookers or intermediaries.

In the C4I project we have developed an in-depth report on different types of intermediaries which might support you: "**Support Services for Student-Business Collaboration**" [13] which can be downloaded from the C4I website: www.challenge4impact.eu. Use this report for ideas and ask at your HEI for internal support opportunities.

There are three distinct types of intermediaries:

EXTERNAL INTERMEDIARIES

The intermediary operates as an independent actor such as an organization running a matchmaking platform for SBSC.

INTERNAL INTERMEDIARIES

The intermediary is integrated into an existing HEI facility such as the HEI's center for teaching and learning, or the HEI's innovation center, or has been set up as a separate HEI facility.

HYBRID INTERMEDIARIES

The intermediary is formed and operated as a partnership of HEI-external and HEI-internal actors, for example a joint organization co-financed by a regional business development agency and a HEI.

[13] Widrat, A., Fichter, K. (2023): Support services for student- business collaboration. Good practice collection of support services for challenge-based student-business collaboration in sustainable entrepreneurship. Oldenburg: Carl von Ossietzky Universität Oldenburg.

2.3 SBSC AND EXTERNAL CHALLENGE PROVIDER

The Challenge provider in SBSC is looking for something new. Given the outcome and nature of SBSCs, the Challenge provider needs to be interested in new angels, new ideas, and new facets on the challenge they provide. In the end, they will receive analyses on something they are quite familiar with, from a viewpoint they do not possess themselves.

There are several reasons for Challenge providers to get involved [9]. This need often, but not always, concur with the type of Challenge provider which is involved.

AN ESTABLISHED COMPANY

- looks for new ideas on existing technology.
- aims to meet students for future employment.

A SMALL COMPANY OR STARTUP

- uses SBSCs to get work done which they otherwise would not have the time for.
- looks for new markets, new applications, or new user bases.
- sometimes uses SBSCs to find new employees, or founders (if early-stage startup).

THE PUBLIC ORGANIZATION INCLUDING PUBLIC COMPANIES

- engages in SBSC for regional growth, goodwill and university relations.

Reasons behind engagement vary between Challenge providers depending on strategy, size of company, and internal needs. The engagement of the Challenge provider is key to make collaboration and co-creation between the Challenge provider and the student group happen. For teachers, securing this engagement (in accordance with the course setup) is the most important task. If commitment is there, the rest will follow.

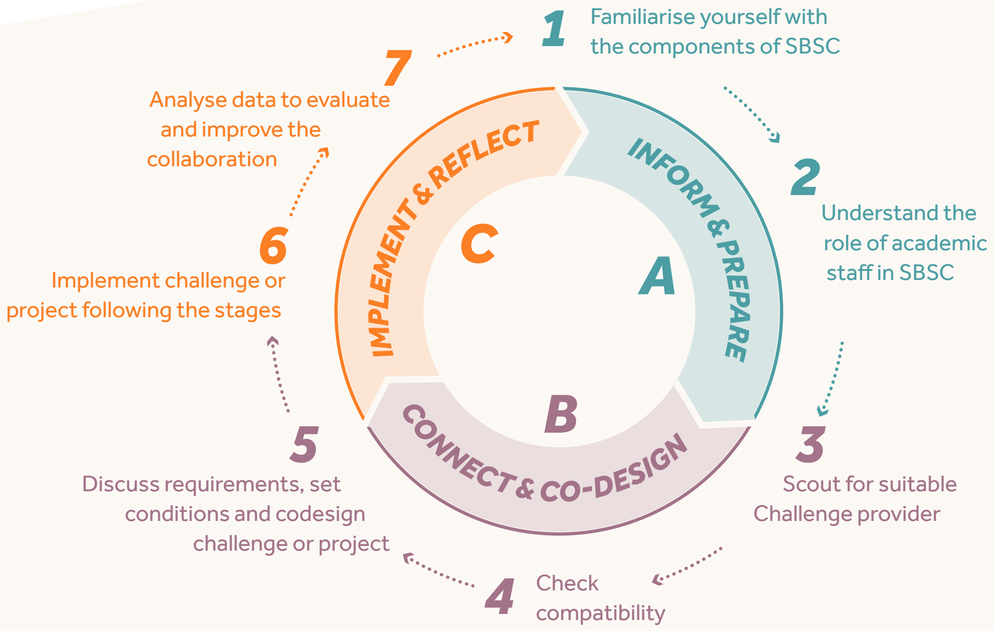
The most interesting question teachers can ask prospective Challenge providers is thus: "Will you be committed to engaging with the students throughout the course?" To facilitate this, teachers can guide and facilitate a set schedule of interaction between Challenge provider and students, depending on the course setup.

[9] See for a more detailed view on the strategic and operational engagement of a Challenge provider: Norrman, C., Lundvall, C., Eldebo, K., Boiertz, S., and Stel, F., (2022) Making good challenges great – engaging external parties in CBL-activities, 18th CDIO Conference June 13-15 2022, Reykjavik, Iceland.

2.4 SETTING UP A NEW SBSC

If you are thinking about starting up a new SBSC at your institution, great! In this section, we will support you with steps, strategies, and support for your endeavor. In the project Scaleup4Sustainability (S4S) the project partners developed a seven-step model for new SBSCs[14] as shown in Figure 5.

Figure 5: Seven steps to set up a new SBSC



1 Familiarize yourself – depending on your previous knowledge on CBL, your experiences in working with external Challenge providers, and your local setup with support there are different aspects you will need to heed to. This handbook and its appendix are a good start.

2 Unerstand the role of teachers – as described in Section 2.3, the teacher team in SBSC have diversified roles and responsibilities.

3 Scout for suitable Challenge provider – using your network or using the SBSC as an excellent reason to reach out to new collaboration partners. Engage internal support at your HEI if you need.

4 When including existing partners in SBSC, make sure to align their expectations of outcomes of the course. See Section 2.2 for ideas and examples of benefits for Challenge providers.

5 Discuss requirements, set conditions, and co-design with Challenge providers – don't forget to include the Challenge providers in aims and goals of the SBSC to ensure commitment.

6 Implement – SBSCs naturally span over different disciplines and touch upon the competences of your colleagues. Take this in account when starting to incorporate the SBSC into the frameworks on your institution. Involve your colleagues.

7 Analyze! Don't forget this very important step. We teach students to reflect and learn, make sure you also include the Challenge provider (-s) in the full picture, from strategy and aim to operative work in the course.

[14] Scaleup4Sustainability Consortium (2022). Collaborative green venturing: How students, business partners and academic staff benefi t from co-innovating for sustainability. Key results and learnings from the EU-funded Erasmus+ project "Scale-up4Sustainabiliy" - Linköping, Oldenburg and Zuidlaren.

3 STUDENT-BUSINESS SUSTAINABILITY CHALLENGES AND DIGITALIZATION

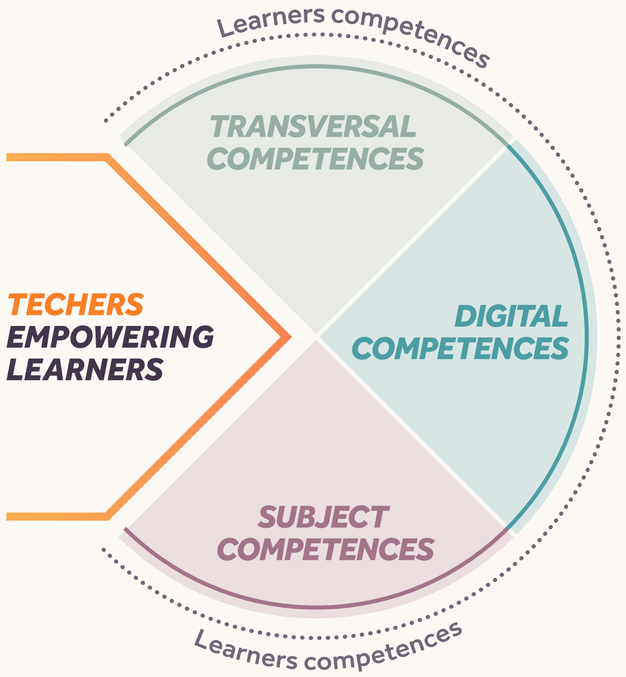


Figure 6: DigiCompEdu's visualization of the learners' competence development

This chapter aims to equip teachers and course coordinators with ideas and insights how digitalization can support SBSC activities. We have deliberately chosen not to present lists of tools, platforms, and services due to the fast development in this area, although we exemplify some cases with existing services. Please use the chapter for ideas and inspiration to search for suitable tools for your specific setting and requirements.

Section 3.5 is dedicated to the pedagogic setting of the fully online or hybrid course. The other sections of this chapter should be viewed as ideas and inspiration for both on-campus and online courses.

ON DIGITIZATION AND DIGITALIZATION

Digitization and digitalization are two concepts with different meanings, often used interchangeably as "digitalization". Digitization is the transformation of analog data to digital, while keeping processes and systems as they were. Examples from higher education is the use of digital learning materials, digital platforms for interaction with students, and digital exams. Much of the work in higher education is digitized today, to the extent that teachers see digital platforms as the new normal.

On the other hand, digitalization means transforming processes, actions, and systems using digital technologies. An example could be the difference in displaying information for students on a learning platform (digitization) and using the learning platform for pre-recorded lectures, information with interactive quizzes, and online QnAs with the teachers (digitalization). Another example could be the difference on accessing market reports on an online database versus uploading database information to an LLM [15] and letting students chat with it to gain information on the data. To facilitate the learning of adequate digital competences is essential in the work of HEI teachers today, as visualized in Figure 6 [16].

For the ease of the reader, we will use the word digitalization in the broader concept, encompassing both digitization and digitalization, except where the distinction is important.

[15] Large Language Model, one type of artificial intelligence. ChatGPT is a LLM, for example.
[16] For further information on developing digital competences, see the DigiCompEdu handbook from the European Commission: Redecker, C. European Framework for the Digital Competence of Educators: DigCompEdu. Punie, Y. (ed). EUR 28775 EN. Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-73494-6

FLEXIBILITY IN TIME AND SPACE

Digitalization provides educators in higher education in general with the opportunity to flexibility in geography and time. For teachers in SBSC, this means that students can work with cases and companies not situated in the physical proximity. The challenge and Challenge provider can originate from anywhere on the globe (as further described in Chapter 4). Students can analyze and understand markets anywhere using desk research and online interviews.

Digitalization also opens for asynchronous interaction with both people and data. A survey is one well known example of asynchronous information collection, as respondents can answer at the time it suits them within a certain time span. Digitalization has opened for online settings where discussions, coaching, workshops, and other tasks can be carried out asynchronously. An example is the discussion of a topic in a forum, where respondents can answer in different threads on different topics and build a conversation over time.

In the following sections we will, based on the process described in Figure 3, give ideas, inspirations, and examples of how SBSC can be enhanced by digital tools and skills.

ETHICAL ASPECTS OF GENERATIVE AI

Generative AI has grown exponentially the past few years in analyses and generation for both texts, images, and videos. There are several ethical aspects of using generative AI in business: Accuracy (are generated results accurate?), Honesty (is the process transparent and questions of plagiarism heeded to?), Safety (is data shared and processed in a secure manner?), and Autonomy (is the use of AI supporting human decisions or is the algorithm making the decision?). To support teachers in questions regarding generative AI, most HEIs have produced guidelines which are being frequently updated as technology advances.

This handbook looks positively on the use of generative AI and the possibilities the technology offers to students and teachers in SBSC. This said, we would also encourage teachers to include ethical discussions on the subject in the course curricula. Frameworks for inspiration to ethical discussions has been developed by, for example, Philip Brey [17] and Jack Stilgoe [18].

[17] Brey, P. A. (2012). Anticipatory ethics for emerging technologies. NanoEthics, 6(1), 1-13.
[18] Stilgoe, J., Owen, R., & Macnaghten, P. (2020). Developing a framework for responsible innovation. In The Ethics of Nanotechnology, Geoengineering, and Clean Energy (pp. 347-359). Routledge.

3.1 UNDERSTAND THE CHALLENGE

To understand the challenge, student will spend a lot of time understanding the ideas presented to them by the Challenge providers, and assess both technologies and markets, as well as sustainability aspects of the challenge. Due to the development of LLMs, there are several tools which might help students to assess the vast amounts of data available to them.

Digital tools which help students to understand the challenge

MARKET ASSESSMENT

Broad and fast market assessments are usually conducted through databases on the internet. Students often have access to pay-walled market databases through the HEI. Some industry organizations are also helpful in providing data to students, which normally would be restricted to members. Teachers can speed up the process by supplying relevant datasets on the learning platform.

Public data is often available through institutions, sometimes through open APIs[9]. Here, teachers might have to help students finding the right outlets or prepare datasets beforehand, to find information useful for challenges. Available public data can help both with market and sustainability assessments.

Chat-based PDF-analyzing LLMs can help students explore large datasets and digital market analyses. There are free tools available online to which you can upload large pdf files and chat with the program to find the data you are looking for. Some of these free tools also enables for cross-searches over different pdfs. One current example is ChatPDF.com.

TECHNOLOGY ASSESSMENT

Assessing technologies is often easier when supported by pictures or movies. On YouTube and other video platforms students can often find **illustrative walk-throughs of technological aspects** of both existing and developing technologies. There are several channels on these sites which are dedicated to testing new things in pedagogical and fun ways.

INTERVIEWS

Interviews are essential but takes time. Encourage students to record and automatically transcribe interviews using transcription software, with the consent of interviewees. This enables them to revisit interviews later in the projects, and to search and analyze interviews over time.

LLMs can also be used as **advanced search engines**, giving students a more diversified search than the usual google experiences, which are very dependent on the correct wording for searches. Chatting with the search engine might help students with fast answers, answering questions like “which is the largest company in this sector”, and “give me examples of other companies using this technology”. LLMs can help students develop their search prompts for other search engines, which might be better at providing a variety of verified sources.

[19] Application Programming Interface, communication protocols which enables databases to access and exchange data. Public institutions often share large amounts of public data through these protocols. It might take some work to set up access to these APIs.

3.2 UNDERSTAND THE CUSTOMER

To really understand the future customers and find needs (and early adopters) to solutions, students usually must interact with the potential market, and go beyond statistics and market data. This is done through interviews, surveys, testing ideas on people, and discussing early iterations of solutions with stakeholders. The development of LLMs has provided us with several tools which can help. But we must not forget social media as a source of information which can enable new ways of market assessments.

Digital tools which help students to understand the challenge

LLM SUPPORT

Again, recordings and automated transcriptions of interviews enable a more efficient market assessment. It allows for a student group to split up and do more interviews and interactions in parallel. Transcriptions and recordings can then be shared and analyzed within the group in a feasible manner. LLMs can support in automated coding of interviews which further speeds up the work, letting students focus on the analysis.

Teachers can also use prompts [20] for LLMs to create learning environments for interviewing. Using versions of the "role-playing prompt" helps students prepare before meeting live people. ChatGPT, for example, usually gives a good training conversation if you start with "Let us play a role-playing game. You are..." and then you specify the conditions for the conversation. Using phrases like "you are talkative" or "you are skeptical to new technologies" usually gives very good effect. Good prompts can turn out to be quite long, so the teacher can prepare and test the prompt on the LLM of choice beforehand and share them with the students.

SOCIAL MEDIA

Social media give possibilities for students to find large groups of people interested in specific subjects. In the right forums, students can share inquiries or find interviewees already engaged in the subject of interest. When you find the right subs in the right social media, surprisingly large surveys can be conducted in short time. The choice of social platform is very dependent of the subject: Encourage students to explore!

Finding the right people to interview can be facilitated by work-related social media like LinkedIn. People are surprisingly helpful if they have the time. Encourage students to pitch their questions briefly and politely in the "add connection" textbox – it is the fastest way of reaching out to unknown people.

Existing forums and websites for niche interests can be a source of information on its own. Online text analyzers can analyze large downloads or printouts of forums, and sometimes even access the material directly online. Possibilities are dependent on the website. Students will have to test what works for their analysis.

DIGITAL SHOWCASES

When iterating possible solutions with potential customers, digital tools can help students in presenting and sharing their ideas, see examples in the following section, 3.3. There are several free tools available online for digital mockups, depending on the solution which is to be exemplified. In addition, AI image creators (Like Dall-E or MS Copilot) can help in creating pictures of non-existing solutions in their environment.

FUTURE APPLICATIONS, SOON TO BECOME REALITY:

LLMs are developing to become more useful in interviewing test cases. Medical science is already using AI avatars to train students in interaction with patients with different diseases. The same technology can be used to discuss needs and constraints of existing users in several other cases.

Data-driven development will allow for Challenge providers and other stakeholders to equip students with digital twins to find bottlenecks, needs, and enable a broad system analysis. Digital twins are common in many industries already today, but secure data sharing is often a problem. Teachers can ask the Challenge providers if digital twins exist, and if they are able to supply students with access.

[20] A "prompt" is the input to the LLM, which guides the generative AI to the desired output.

3.3 DEVELOP SOLUTIONS

One of the best ways to create explicit feedback on your solution is to iterate clear concepts with the feedbacker. Digital technology enables us to create mockups, demos, and MVPs in different scales for little or no cost. There are varieties of possibilities for students to create mockups on their ideas. But do not forget that a simple NABC or BMC might be a good first paper demo of a solution.

Digital tools which help students to understand create early versions of solutions:

PHYSICAL SOLUTIONS

On a very early stage of iteration, an AI-rendered photo of the solution in mind might be a good way of exemplifying how students see the solution. There are several free or cheap alternatives online to render photorealistic images (Dall-E and MS Copilot for example), although there might be a certain learning curve to the services. If this is a good way for students to exemplify their solutions, point them to a specific service with good tutorials to experiment with.

3D-printing combined with video recordings is a way of exemplifying more specific solutions. Videos are more easily shared with a multitude of stakeholders and prospective customers to receive feedback, and the physical presence of a solution in a video builds a good case for feedback[21]. Although 3D-printing takes time and skill, many cities have Maker Spaces or similar places where students can receive guidance and help with printing their solutions.

Extensive data from important stakeholders might in certain cases provide enough information to do simulations and test runs on solutions. And publicly available data might be enough to make simulations and showcases of the flows in a value chain. Depending on the challenge students are addressing, teachers can prepare simulation rounds together with the Challenge provider before the course starts.

DIGITAL SOLUTIONS

There are several services for prototyping and making mockups of digital services and apps, most of them which can be tested for free. There is of course a learning curve to all new services for the students. One easy way of creating a click-able app or homepage with the least amount of work is to do it in MS PowerPoint (or similar software). Keep it simple in the beginning! Feedback is the important feature.

Another easy MVP to create for more action testing of a service can be to skip the "smartness" of the system and do it manually for the test round. A real-world example of this was a platform for matchmaking of circular exchanges in industry, which was tested through a simple form in Survey Monkey and then manually matched.

SUPPORTING SPECIFICATIONS OF SOLUTIONS

As previously mentioned, LLMs can be of assistance when there is specific data to be found in large amounts of information. Laws and regulatory constraints for a solution might be assessed this way, as well as Market analyses on costs of subsidiaries. This is only two examples of how to swiftly give students an approximation of the viability or feasibility of their solutions. On some cases this might be datasets which teachers can collect beforehand, when shaping the challenge with the Challenge provider.

FUTURE APPLICATIONS, SOON TO BECOME REALITY:

There are several upcoming services for generating AI videos. This technology provides new possibilities for showcasing and demonstrating innovative solutions, similar to the existing AI-rendered photos of today.

Easy testing of solutions in digital twins: Companies in manufacturing have extensive and detailed digital twins of both products and production systems, allowing for swift testing of prototypes. Municipalities are developing digital twins for traffic planning, electricity network capacity and similar. The field is growing and the access to existing models are often limited. But technical solutions for secure sharing of data is coming.

There are examples of interactive VR/AR[22]-simulations of prototypes already on the market, but existing software need extensive developing projects and specific hardware. Some easier AR functions can be rendered in an iPad or a smartphone, but the scope is limited at present. As the technology becomes more mainstream, so will development of mockups and prototypes.

[21] A note on this: If you look at Kickstarter or similar pre-purchase crowdsourcing platforms, the solutions they present are often 3D-printed mockups of the product.
[22] Virtual / Augmented Reality uses glasses to either enter a fully digital space, or add digital components to the physical world.

3.4 PRESENT BUSINESS CASE

All the mentioned ideas might be interesting in the presentation of the case. Especially prototypes, rendered pictures, and similar showcases of the solutions should not be underestimated in the final presentations.

Presentations should not be limited to synchronous events on campuses. Digital solutions present possibilities of asynchronous and interactive presentations to be shared with multiple stakeholders. In its simplest form, it could be a YouTube video with a comment section or a feedback survey. More advanced ideas would be more interactive and feedback-friendly collaborative spaces (there are several examples, free to use). Examples could be presentations in online whiteboard services (like Mural or Miro), presentations in Discord channels for discussions, or setting up simplified MVPs in certain online software where stakeholders can test and comment during a specified time-period.

Encourage students to share asynchronous presentations and feedback opportunities on social media platforms and in the right subs, to engage even a broader community and maximize feedback.

When students and Challenge providers who want to make ideas come real, an outlet for the project could be a crowd-funding platform. It might be suitable for only a few projects, but the opportunities are great for the right solutions. There are many different types of crowd-funding platforms, and many countries have local versions of international platforms. The choice of the right platform is almost as important as the solution, so teachers or TTO business coaches should support students in the choice and presentations.

3.5 ONLINE PEDAGOGICS – FOR ONLINE AND HYBRID COURSES

All teachers interviewed for this handbook have had recent experiences with online education, due to the pandemic. During these years, higher education experienced a trial-and-error session of digital tools and online pedagogics never before experienced. Digitization aspects of teaching and interaction with students was deployed in most institutes, and many platforms and systems have become permanent even after the pandemic. But regarding the online setting of teaching, most institutes which were campus-based before the lock-down have returned to campus.

The TPACK framework [23], summarized in Figure 7, specifies three important competences which teacher teams need to develop when running online courses: First, the Content knowledge, which is theoretical bases of the course, usually stays the same in regard to on-campus courses. Then there is the Technological knowledge, which includes all the aspects of learning platforms and software used to run the online course, but also a general skillset in managing online presence and content which is developed over time [24]. Finally it is important to have a clear strategy of developing and applying the Pedagogical knowledge, when moving courses into an online setting.

In this section we will give some advice and ideas for SBSC teachers who are running online courses or planning on moving courses online. SBSC courses are inherently experiential and action oriented, which makes them quite suitable for online settings and opens for interesting team formations, if students can join from different parts of the world.

The major difference between the online and on-campus learning experience is the spill-over. Students in a room involuntary copy the behavior of others, in workshops as well as in lectures. If you hand out a task in a room, students will heed to others as they start off with the assignment. Communication flows visually and verbally. When online, teachers can accommodate some of the spill-over effects by arranging digital tools to enable collaborative work and over-hearing between groups. Put assignments on large online whiteboards where students can see what others are doing.

Team building is a process which takes time. In a campus setting, students in SBSC starts off with their challenges in kickoff days, interacting with one another and the Challenge providers for one or several days over time. A one-day kickoff is eight hours of constant interaction, both professional and informal. For an online setting to be fruitful, teachers must take this into account: It takes hours of interaction for the students to become a team, and the presence of the Challenge providers and teachers is important during this "kick-off period".

Screens have built-in disturbances. This is a fact: There is no such thing as multi-tasking! Encourage dedication to the sessions you provide, by making students aware of the danger of doing other things "on the side". As much as possible, provide lectures and texts in an asynchronous setting and use the online sessions for workshops and interaction.

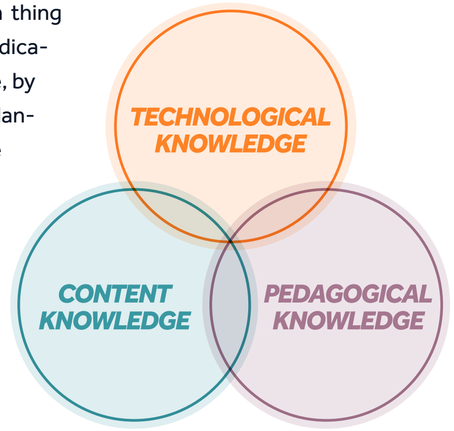


Figure 7: The TPACK framework

[23] Pereira, R. Q., Nasu, V., Nganga, C., & Nogueira, D. (2018). TPACK and Business Education: A Review of Literature (2008-2017). Revista de Informação Contábil, 14(0), 020001-020001.
[24] Many HEIs have funding opportunities for teachers which engage with new technological solutions in their teaching.

The "flipped classroom" comes with both advantages and drawbacks. Providing students with recorded lectures and texts to read before workshops opens for more time for qualitative interaction with the students. But the approach is dependent on students doing the work expected of them before the workshops. This can be facilitated by setting a detailed schedule outlining when and what they should be reading or watching. Other options are to recap swiftly in the beginning of each workshop and create online quizzes for each set of learning blocks. Encourage and facilitate online discussions about each assignment. An example is posting videos in your dedicated communication platform where students can write comments and questions directly connected to the video (think "comments on Youtube"). To drive interaction, find the most active students and encourage them to be the first to comment / write.

The experiential learning pedagogics of CBL is easily adapted to a feasible online setting, when considering these over-arching pedagogical challenges. In CBL, most of student work is done with the surrounding world and in the team. Now follows more explicit ideas and concepts with can be integrated in your SBSC.

IDEAS FOR A 100% ONLINE OR HYBRID SBSC COURSE

- If possible, have a dedicated space for both synchronous and asynchronous communication in the group (Like Teams, Slack, Discord, or other) where different topics can be discussed in different threads. Most students have lots of experience of "hanging out" online, facilitate that in the educational setting. Some students will complain about having a secondary app for course communication, ease the transition by using established apps/platforms which students will have use of in future work life.

- SBSC courses are unique in the way external stakeholders engage with students. To make them even more included, make sure they can access the communication platform you have selected.

- Make the first week "kick-off week" and fill it with both personal and professional interaction. Make students get to know their team members and Challenge provider from different angels. Games, collaboration challenges, social one-on-ones, and communication platforms are ways of facilitating this. If you have the proficiency, setting up games in free online platforms (like Roblox) might be a fun way of socializing and building teams.

- Social interactions outside the team are usually sparce in online courses. Set up online coffee dates, or form tasks or feedback sessions, or think of other ways where students must interact one-on-one with students from other teams throughout the course. In all SBSC courses, teams have a lot to learn from each other, some regarding the challenges but even more regarding the general process and the uncertainty the courses encompass.

- Teacher presence is crucial. Get to know the teams and set up regular meetings. Emails are usually not the best way of communication. Meet students on the dedicated communication platform.

- Challenge providers need to be well onboarded in a digital setting. Make sure there are enough meetings between teams and their Challenge provider to ensure that both parties stay dedicated to the course.

4 STUDENT-BUSINESS SUSTAINABILITY CHALLENGES AND INTERNATIONALIZATION

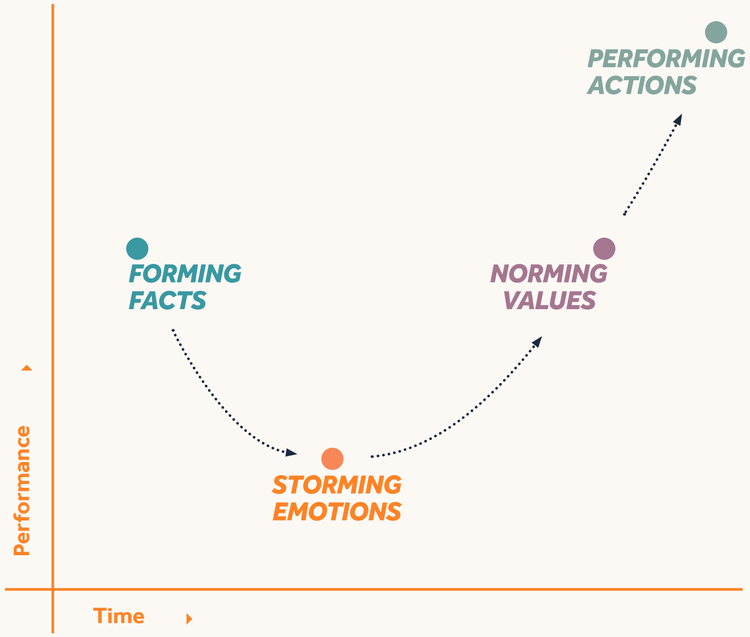


Figure 8: Tuckman's team stages

Digitalization and international student exchanges are both enablers for the internationalization of SBSC courses. This chapter builds on the possibilities with digitalization and focuses on strategies for the teacher in SBSC. The aim is to support you as a teacher who either want to start with internationalization or who needs ideas for how to develop your already international courses and modules.

DIGITALIZATION AND INTERNATIONAL STUDENT EXCHANGE AS ENABLERS

As discussed in the previous chapter, the digitalization of society enables flexibility in both time and space. It makes it possible for teachers to collaborate with Challenge providers from anywhere in the world, or for local Challenge providers to set their cases in any market on the world. Market research and interviews can be easily conducted online. The opportunities for more hands-on market studies will be limited, for example visiting stakeholders.

Although the world shrinks with digital connections, the matter of culture stays constant. Different markets and countries have different cultural codes and students who are to engage with new countries should be equipped with cultural understanding and procedural skills. Mixing students from different countries opens for new ideas and a multifaceted outlook on innovation, but it also comes with a cultural aspect of team building.

THE IMPORTANCE OF CULTURE FOR TEAM BUILDING

Any team will move through a couple of phases before becoming a functional team. Working with international teams implies adding cultural differences which will make the journey more challenging, but heterogeneity is also good for innovation and creativity. Here we have an example of a tool which can help teachers support their students in team building and in their contacts with the Challenge provider. If students are prepared with frameworks and concepts of possible challenges they might phase, the team will become functional more swiftly.

Tuckman's team development model[25] is one of the most wide-spread models in this area, and it divides the development of a small team into four phases (see Figure 8): The formation phase where team members get to know each other, the emotional phase where relations are tested, the value-based phase where team members find their role in the team, and at last the performance phase, where the team works at its best. Team members will not focus 100% on the task until the final stage is reached.

With multi-cultural teams, the storming and norming phases will be affected by the cultural background of the members, depending on how their culture is balanced. Hofstede divides the cultural setup in six cultural dimensions (see Figure 9), of which **three** affects the CBL pedagogic setting strongly[26]:

Power distance – Cultures with high power distance are managed top-down. Authorities are not questioned, and hierarchies are important. Cultures with low power distance on the other hand value flat organizations and high autonomy. Creating a group with people of different backgrounds will be challenging. But in the other hand, a team with both cultures will have an easier time understanding different power structures in markets and stakeholders.

Individualism / collectivism – This cultural aspect might vary between individuals from the same country, as it is formed by upbringing and values more than by geographical affiliation. Teams in HEI courses are limited to scope and time, and thus many of the more individual students just ignore the group consensus and go their own way. To analyze differences in this cultural aspect from the early start of a project might maximize the efficiency of the teams, using the right team members for the right tasks.

Uncertainty avoidance – This is one of the more difficult aspects of cultural dimensions, as it is hard for an individual to assess whether their cultural background makes them more or less at ease with uncertainties. There are examples of questions for discussion which the team can workshop on, to make individual notions on the uncertainty adaptiveness. Uncertainty is a major theme for SBSC courses, as neither the Challenge provider, teacher, nor the students ever hold the answer key to the task. Even as the projects come to an end, the solutions are usually not developed and implemented and therefore there is still an uncertainty of the outcome. Teachers can help students with the build-in uncertainty of SBSC by providing them with strict instructions on how to go about the task in the beginning, to set them on the right track. If the "how to do" is clear, the "what to do" might come easier.

Together, Tuckman's team development and Hofstede's cultural dimensions are important frameworks to discuss early in the team process and to address during the course. Teachers in SBSC can use these frameworks, or others of their choice. The key to opening team formation gridlocks is to give the team members models and frameworks to understand their process.

It might also be good for students to individually **examine their biases**, for example in the individual reflection which often is part of the CBL pedagogics. There are free tests which students can start off from. One is the Harvard Implicit Bias test. Visit https://www.projectimplicit.net/ for more information.

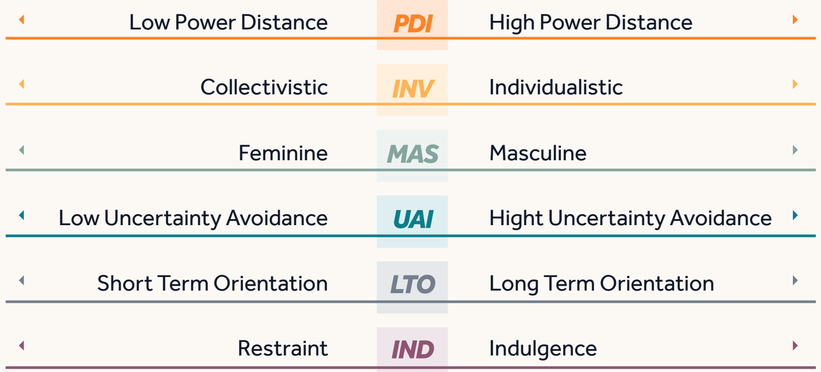


Figure 9: Hofstede's cultural dimensions

[25] Tuckman, B. W. (1965). Developmental sequence in small groups. Psychological bulletin, 63(6), 384.
[26] Wei, S., & Mehrabi, A., & Tan, L., & Ohland, M. W. (2023, June), Revisiting Tuckman's Team Development Model in First-year Engineering Multicultural Teams Paper presented at 2023 ASEE Annual Conference & Exposition, Baltimore , Maryland. 10.18260/1-2--44145

4.1 SBSC AND THE EXTERNAL CHALLENGE PROVIDER

The first step to make a more international SBSC course is for the teacher team to have a clear strategy. You might aim for challenges from other parts of the world, or you might have international students on your course, and you want to use their experiences. As stated, many of the SBSCs we have analyzed have international students attending the course. But we have also found, that without an outspoken strategy, the students do not make the aim of projects international.

Now follows inspiration and ideas from interviews and cases we have examined, related to the stages of the SBSC (from Figure 2).

4.2 FORMULATE THE CHALLENGE

The most common way of finding international Challenge providers for SBSC is using partners in research projects which the teacher is already involved in. For teachers to have an established contact with a company eases the burden of understanding settings, markets, and challenges involved with the company. Running an SBSC might be a good outcome of a research project, or a way of deepening the relation with and understand of the partner. As a teacher, it might be challenging to understand the market of an international partner and thus, to formulate challenges with international players might take time.

IDEAS FOR INTERNATIONALIZATION IN THE EARLY STEP OF CHALLENGE FORMULATION

- If possible, find commitment from the Challenge provider for a collaboration over several years, and look for public funding for the SBSC. Many countries have public programs for business exchanges with academia between regions and countries.
- When formulating research projects with international partners, add the aspect of student interaction. SBSCs can be of great value for Challenge providers, and interaction with international students is something many companies seek.
- Use connections to local universities and teacher colleagues. Local connections will have first-hand information on where to find data for the local market and connections to local publiv organisations of interest. This will also build your academic network.
- If you are looking for an international challenge but don't have previous connections which might help, we encourage you to contact a humanitarian organization in your country. They will have ideas and contacts to create "Designing for the bottom of the pyramid"-projects, which will indubitably equip your SBSC with cases which will change the way your students see the world.

4.3 FORMING THE TEAMS – WORKING WITH AN INTERNATIONAL STUDENT BODY

As previously stated, the team formation phases in international student teams should be carefully monitored and guided by the teacher team. Make sure students are equipped with the tools needed to understand the group dynamics in an international team.

IDEAS ON TEAM FORMATION IN INTERNATIONAL TEAMS

- Open discussions are a cornerstone to bring out individual thoughts an make them part of the team forming. For inspiration, se Gibbs' "Learning in Teams: A Tutor Guide" [27].
- As a teacher we encourage you to use the tools you are familiar with, and which works with your students. Some find Belbin's 9 team roles[28] an inspiring, research-based theory to start discussions among students.
- Using example drafts of team contracts is a good way of highlighting important questions which the team needs to address.

4.4 UNDERSTAND THE CHALLENGE AND UNDERSTAND THE CUSTOMER

After students have formed their teams, they meet with the Challenge provider and other stakeholders to understand the challenge. Students will be better equipped to handle the external relations if they have been working with the question of cultural dimensions and other ways of preparing them for the cultural background of the country they are interacting with. Videos will be more powerful than text, especially if the country is far from what students are used to interact with. This is of especially high importance when students from the Global north work with projects situated in the Global south.

IDEAS FOR THE EARLY STEPS IN THE STUDENTS' JOURNEY

- Statistics are easily translated today thanks to LLMs, but also most popular science as well as entertainment (movies, books, music, etc.) can be translated or subtitled. A social, teambuilding activity which also deepens the understanding of the country in which the project is set is watching a movie or reading the newspaper from the country, and then discussing it in the team.
- If they exist, interviews previously collected from the Challenge provider can be transcribed and translated (if recorded) to kick-start the students in the challenge. This applies especially if you have ongoing research projects with the Challenge provider.

4.5 DEVELOP SOLUTIONS AND PRESENT BUSINESS CASE

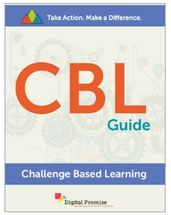
In our experience, these two steps in international SBSCs does not alter from traditional, local challenges. As said, the earlier steps are the most important and needs a clear strategy for the internationalization of the SBSC to be successful.

[27] Gibbs, G. (1995) Learning in teams: A tutor guide. Oxford Centre for Staff and Learning Development.
[28] Belbin (2010) Team Roles at Work, 2nd edition. Butterworth-Heinemann, Oxford. ISBN 978-1-85617-800-6

5 GUIDELINES & HANDBOOKS

For the interested reader, this chapter contains manuals, handbooks, and reports for deepening the understanding of certain topics. This list is not complete, but is to be regarded as a starting point for learning more about CBL and the underlying pedagogical frameworks.

ON CHALLENGE-BASED LEARNING



The CBL Guide

Mark Nichols, Karen Cator, Marco Torres, Digital Promise and The Challenge Institute (2016)

This handbook is the starting point for all teachers which aim to deepen their understanding of CBL. Contains the Challenge-based Learning framework 3.0 as proposed by the CBL Advisory Committee, consisting of educational leaders from around the world.

The handbook contains much of the groundwork on pedagogical and practical approaches in different settings of CBL, but is sparse in details on external interactions.

Guide to challenge driven education – ECE Teaching and Learning in Higher Education

Marie Magnell and Anna-Karin Högfeldt
https://www.kth.se/social/group/guide-to-challenge-d/

Puts the emphasis on the project-centered part of challenge driven education, and the engineering perspective. Practical guide for educators who aim to implement both CBL as well as Student-Business Collaborations in higher education – not only for engineering students even though this is the focus of the report. Emphasis on projects in the Global South.

Collaborative Green Venturing – How students, companies, and academic staff benefit from co-innovating for sustainability

Scaleup4Sustainability Consortium (2022)
https://www.scaleup4sustainability.eu

This booklet contains examples of courses and modules in green venturing. For the interested teacher, and other staff members at HEIs, the handbook also includes practical walkthroughs on how to set up and conduct education both for engineering and business students. The booklet contains tools for and examples on engagement of external stakeholders in CBL.

Implementing Challenge-Based Learning for University Teachers – Part A

Drs E.M.P. Hermsen & G.J. Ambrosi (2023)
https://www.utwente.nl/en/cbl/ &
https://www.eciu.eu

A very detailed teacher guide to setting up and implementing CBL for all students. Focus on the pedagogical aspects and experiences in the classroom. Many practical examples of tools and pedagogical puzzle-pieces which are of help both to develop new CBL courses and for the experiences teacher which seeks to develop existing CBL courses. Focus on the full CBL setting.

EXPERIENTIAL LEARNING

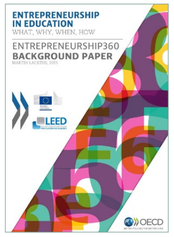
Experiential Learning Theory as a Guide for Experiential Educators in Higher Education

Kolb & Kolb (2017)

https://nsuworks.nova.edu/elthe/vol1/iss1/7

This handbook is the starting point for all teachers which aim to deepen their understanding of CBL. Contains the Challenge-based Learning framework 3.0 as proposed by the CBL Advisory Committee, consisting of educational leaders from around the world.

The handbook contains much of the groundwork on pedagogical and practical approaches in different settings of CBL, but is sparse in details on external interactions.

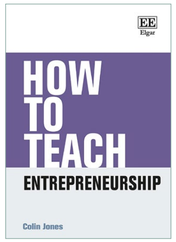


Entrepreneurship in Education – What, Why, When, How

Martin Lackéus (2015)

Extensive, theoretical background to the enterprising university and pedagogics. Groundwork on the European (i.e. Allan Gibb's) definition of entrepreneurial education: To foster individuals with 21st century skills. Includes frameworks for connections between academia and business and tools on how to modernize education in the light of societal needs and change of knowledge creation.

This guide serves well for teachers and educational leaders which look for frameworks and tools for developing teaching and educational initiatives.



How to Teach Entrepreneurship

Colin Jones (2019)

A practical teacher handbook on entrepreneurial education, with a multitude of tools, frameworks, and pedagogical settings in entrepreneurial learning. An extensive take on how we can encourage students to embrace uncertainty, and how teachers can teach students how to challenge boundaries and become self-guiding in their future work-life.

6 REFERENCES

- Belbin (2010) Team Roles at Work, 2nd edition. Butterworth-Heinemann, Oxford. ISBN 978-1-85617-800-6
- Brey, P. A. (2012). Anticipatory ethics for emerging technologies. NanoEthics, 6(1), 1-13.
- Eldebo, K., Lundvall, C., Norrman, C. A., & Larsson, M. (2022). How to make good teachers great in challenge-based learning. 18th CDIO Conference June 13-15 2022, Reykjavik, Iceland.
- Fichter, K., Hurrelmann, K., Seela, A., Hjelm, O., Larsson, M., Sundberg, C., Wisdom, K. & Stel, F. (2020). S4S Report on evaluating leading approaches and tools in collaborative green venturing (Work Package 2). Oldenburg, Linköping and Zuidlaren.
- Fichter, K., Hurrelmann, K., Seela, A., Hjelm, O., Larsson, M., Sundberg, C., Wisdom, K. & Stel, F. (2020). S4S Report on evaluating leading approaches and tools in collaborative green venturing (Work Package 2). Oldenburg, Linköping and Zuidlaren.
- Gallagher, S.E., Savage, T., 2020. Challenge-based learning in higher education: an exploratory literature review. Teaching in Higher Education 0, 1–23.
- Kolb, A. Y., & Kolb, D. A. (2017). Experiential learning theory as a guide for experiential educators in higher education. Experiential Learning & Teaching in Higher Education, 1(1), 7-44.
- Norrman, C., Lundvall, C., Eldebo, K., Boiertz, S., and Stel, F., (2022) Making good challenges great – engaging external parties in CBL-activities, 18th CDIO Conference June 13-15 2022, Reykjavik, Iceland.
- Pereira, R. Q., Nasu, V., Nganga, C., & Nogueira, D. (2018). TPACK and Business Education: A Review of Literature (2008-2017). Revista de Informação Contábil, 14(0), 020001-020001.
- Redecker, C. European Framework for the Digital Competence of Educators: DigCompEdu. Punie, Y. (ed). EUR 28775 EN. Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-73494-6
- Ries, E. (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Crown Currency.
- Scaleup4Sustainability Consortium (2022). Collaborative green venturing: How students, business partners and academic staff benefi t from co-innovating for sustainability. Key results and learnings from the EU-funded Erasmus+ project "Scale-up-4Sustainabiliy" - Linköping, Oldenburg and Zuidlaren.
- Stilgoe, J., Owen, R., & Macnaghten, P. (2020). Developing a framework for responsible innovation. In The Ethics of Nanotechnology, Geoengineering, and Clean Energy (pp. 347-359). Routledge.
- Tuckman, B. W. (1965). Developmental sequence in small groups. Psychological bulletin, 63(6), 384.
- Vestergaard, L., Moberg, K., & Jørgensen, C. (2012). Impact of entrepreneurship education in Denmark–2011. Odense: The Danish Foundation for Entrepreneurship-Young Enterprise.
- Wei, S., & Mehrabi, A., & Tan, L., & Ohland, M. W. (2023, June), Revisiting Tuckman's Team Development Model in First-year Engineering Multicultural Teams Paper presented at 2023 ASEE Annual Conference & Exposition, Baltimore , Maryland. 10.18260/1-2—44145
- Widrat, A., Fichter, K. (2023): Support services for student- business collaboration. Good practice collection of support services for challenge-based student-business collaboration in sustainable entrepreneurship. Oldenburg: Carl von Ossietzky Universität Oldenburg.

7 APPENDIX

TOOLS AND WORKSHOPS FOR SBSC[29]

[29] The list originates from: Fichter, K., Hurrelmann, K., Seela, A., Hjelm, O., Larsson, M., Sundberg, C., Wisdom, K. & Stel, F. (2020). S4S Report on evaluating leading approaches and tools in collaborative green venturing (Work Package 2). Oldenburg, Linköping and Zuidlaren.

	PURPOSE	SPECIFIC SUSTAINABILITY DIMENSION	MANUAL	REFERENCES
4P	The four Ps of marketing are key factors that are involved in the marketing of a good or service. They include product, price, place, and promotion.The 4Ps are used to pursue marketing objectives in the target market.		Manual	**Van Waterschoot, W., & Van den Bulte, C. (1992).** The 4P classification of the marketing mix revisited. Journal of marketing, 56(4), 83-93.
ALLIANCE GAME	An approach for building alliances in teams		webpage	
BACK CASTING	Backcasting is a planning method that starts with defining a desirable future and then works backwards to identify policies and programs that will connect that specified future to the present.	Specific: defining a desired sustainability future and working backwards to define concrete steps of action to take to acheive the set goal	website	**Holmberg, J., & Robèrt, K. H. (2000).** Backcasting—A framework for strategic planning. International Journal of Sustainable Development & World Ecology, 7(4), 291-308. **Ness, B., Urbel-Piirsalu, E., Anderberg, S., & Olsson, L. (2007).** Categorising tools for sustainability assessment. Ecological economics, 60(3), 498-508. **Karlstetter, N., Schattke. H., Hurrelmann K. (2014)** Methods and success factors in organisational adaptation to climate change, in Grit Martinez, Peter Fröhle, Hans-Joachim Meier (Hrsg.): Social Dimensions of Climate Change Adaptation in Coastal Regions. Findings from Transdisciplinary Research. München: oekom, S.145-158.
BUSINESS MODEL CANVAS	Business Model Canvas is a strategic management and lean startup template for developing new or documenting existing business models. It is a visual chart with elements describing a firm's or product's value proposition, infrastructure, customers, and finances.		template	**Osterwalder, A., & Pigneur, Y. (2010).** Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons.
BUSINESS MODEL INNOVATION GRID	The archetypes describe the main type of business model innovation: Technologically, socially and organizationally oriented innovations.	Specific: overview of sustainable business model archtetypes and business cases	website	**Bocken, N., Short, S., Rana, P., Evans, S. 2014.** A literature and practice review to develop Sustainable Business Model Archetypes. Journal of Cleaner Production, 65, 42-56
BUSINESS MODEL NAVIGATOR	The Business Model Navigator presents 55 business models that apply to 90% of the most successful companies worldwide.		website	**Gassmann, O.; Frankenberger, K. & Csik, M.** : The Business Model Navigator : 55 Models that will revolutionise your Business.Harlow : Pearson, 2014, - ISBN 978-1292065816

	PURPOSE	SPECIFIC SUSTAINABILITY DIMENSION	MANUAL	REFERENCES
BUSINESS PLAN	A business plan, is a "written document describing the nature of the business, the sales and marketing strategy, and the financial background, and containing a projected profit and loss statement."		website	**Sahlman, W. A. (1997).** How to write a great business plan. Harvard business review, 75(4), 98-109. **Abrams, R. M. (2003).** The successful business plan: secrets & strategies. The Planning Shop.
COMPETENCE MATRIX	A tool used to document and compare the required competencies for a position with the current skill level of the employees performing the roles.		website	
CRITERIA WEIGHTING MATRIX	A Weighted Criteria Matrix is a decision-making tool that evaluates potential options against a list of weighted factors. Common uses include deciding between optional solutions.		website	
FUNCTIONAL TREE	A diagram showing the dependencies between the functions of a system. It breaks a problem (or its solution) down into simpler parts.			
KLOFSTENS CORNERSTONES	A quantifiable , holistic and action-oriented instrument for assesing and assisting the development of young firms			**Davidsson, P., & Klofsten, M. (2003).** The business platform: Developing an instrument to gauge and to assist the development of young firms. Journal of small business management, 41(1), 1-26.
LEGO SERIOUS PLAY	Lego Serious Play is a facilitation methodology developed at The Lego Group. Its goal is improving creative thinking and communication. People build with Lego bricks 3-dimensional models of their ideas and tell stories about their models.		guideline	**Kristiansen, P., & Rasmussen, R. (2014).** Building a better business using the Lego serious play method. John Wiley & Sons.
LIFE CYCLE ASSESSMENT	Life-cycle assessment or life cycle assessment is a methodology for assessing environmental impacts associated with all the stages of the life-cycle of a commercial product, process, or service	Specific: a specific tool developed to asses the environmental impacts of products and services.	ISO Standard	**Guinée, J. B., & Lindeijer, E. (Eds.). (2002).** Handbook on life cycle assessment: operational guide to the ISO standards (Vol. 7). Springer Science & Business Media.
MARKET ANALYSIS	A market analysis is a quantitative and qualitative assessment of a market. It looks into the size of the market both in volume and in value, the various customer segments and buying patterns, the competition, and the economic environment in terms of barriers to entry and regulation.		website	

	PURPOSE	SPECIFIC SUSTAINABILITY DIMENSION	MANUAL	REFERENCES
MARKET POSITIONING DIAGRAM	Market positioning refers to the process of establishing the image or identity of a brand or product so that consumers perceive it in a certain way.		website	
MOM TEST	Talk to Customers & Learn If Your Business Is a Good		book	**Fitzpatrick, R. (2013).** The Mom Test: How to talk to customers & learn if your business is a good idea when everyone is lying to you. Robfitz Ltd.
NEED, APPROACH, BENEFIT, COMPETITION	The NABC model can help you define your idea and think through what really makes the idea valuable to your potential customers. It is also an excellent tool to use when preparing a pitch.		report	**Narduzzo, A. (2017).** The NABC approach to structure new business ideas. Luettavissa: https://www. unibz. it/assets/Documents/Applicants/unibz-econ-entrepreneurship-nabc. pdf Luettu, 4, 2017.
NEGOTIATION GAMES	Games for training the art of negotiating in entrepreneurship		webpage (University of Twente)	
PESTEL	A PESTEL analysis is a tool used to identify the macro (external) forces facing an organisation. The letters stand for Political, Economic, Social, Technological, Environmental and Legal.	Specific: Provides specific factors to access in relation to social, economic and enviornmental aspects of sustainability	webpage	
PHYSICAL PRODUCT TREE	The Product Tree helps product managers organize, prioritize, and tame the barrage of product feature inputs from customers and internal stakeholders.		website	
PORTERS FIVE FORCES	Porter's Five Forces is used for analyzing competition of a business. It draws from industrial organization economics to derive five forces that determine the competitive intensity and, therefore, the attractiveness of an industry in terms of its profitability.			**Porter, M. E. (2008).** The five competitive forces that shape strategy. Harvard business review, 86(1), 25-40.
PRODUCT MARKET MATRIX (ANSOFF MATRIX)	A marketing tool that outlines the different strategies a company can use in order to increase market share or introduce a new product. The strategy depends on whether or not a company or product is already present in a market. The four main strategies are market penetration, product development, market development and diversification.		webpage	**Watts, G., Cope, J., & Hulme, M. (1998).** Ansoff's Matrix, pain and gain. International journal of entrepreneurial behavior & research.

	PURPOSE	SPECIFIC SUSTAINABILITY DIMENSION	MANUAL	REFERENCES
PROTOTYPING	A prototype is an early sample, model, or release of a product built to test a concept or process. It is a term used in a variety of contexts, including semantics, design, electronics, and software programming. A prototype is generally used to evaluate a new design to enhance precision by system analysts and users.		webpage	**Floyd, C. (1984).** A systematic look at prototyping. In Approaches to prototyping (pp. 1-18). Springer, Berlin, Heidelberg.
RESOURCE FLOW ANALYSIS	A resource flow analysis examines the types and amounts of material that pass a given point over a set period of time.	Specific: a resource flow analysis can help identify critical waste generation data by tracking what materials go into a system, what materials go out, and what materials remain or are converted to waste and/or emissions.		**Brunner, P. H., & Rechberger, H. (2016).** Practical handbook of material flow analysis (Vol. 1). CRC press.
RESPONSIBLE INNOVATION WS-KIT	A set of tools and approaches to include responsible innovation (dealing with uncertanties associated with novel products, processes or business models for the enviornment and society in a responsible way) into companies.	Specific: dealing with uncertanties associated with novel products, processes or business models for the enviornment and society in a responsible way	webpage	**Stilgoe, J., Owen, R., & Macnaghten, P. (2013).** Developing a framework for responsible innovation. Research policy, 42(9), 1568-1580. **Owen, R., Bessant, J. R., & Heintz, M. (Eds.). (2013).** Responsible innovation: managing the responsible emergence of science and innovation in society. **John Wiley & Sons. Blok, V., & Lemmens, P. (2015).** The emerging concept of responsible innovation. Three reasons why it is questionable and calls for a radical transformation of the concept of innovation. In Responsible innovation 2 (pp. 19-35). **Springer, Cham.Brey, P. A. (2012).** Anticipatory ethics for emerging technologies. NanoEthics, 6(1), 1-13.
SHITTY PROTOTYPING	Using scrap materials within a limited time for visualization of idea, team building etc.			**Norrman, C., Bienkowska, D., Sundberg, A., & André, A. (2017).** Simple Mockups: Tool to Enhance Visualisation and Creativity in Entrepreneurship Courses. In 13th International CDIO Conference, University of Calgary, Calgary, Canada, June 18-22, 2017 (pp. 481-489). University of Calgary.
STAKEHOLDER-MANAGEMENT	Stakeholder management is used to identify the needs of key stakeholders. A stakeholder is any individual, group or organization that can influence a company, be affected by or feel affected by a company.		webpage	**Freeman, R.E. (2010).** Strategic management: A stakeholder approach. Cambridge University Press. Cited by 24540
SUSTAINABILITY ASSESSMENT	Sustainability assessment (SA) is a complex appraisal method. It is conducted for supporting decision-making and policy in a broad environmental, economic and social context, and transcends a purely technical/scientific evaluation.	Specific: several tools for sustainability assessment within the broader objective sustainability assessment from a particular perpective (e.g. environmental-focused or social-focused).		**Ness, B., Urbel-Piirsalu, E., Anderberg, S., & Olsson, L. (2007).** Categorising tools for sustainability assessment. Ecological economics, 60(3), 498-508. **Höjer, M., Ahlroth, S., Dreborg, K. H., Ekvall, T., Finnveden, G., Hjelm, O., ... & Palm, V. (2008).** Scenarios in selected tools for environmental systems analysis. Journal of Cleaner Production, 16(18), 1958-1970.

	PURPOSE	SPECIFIC SUSTAINABILITY DIMENSION	MANUAL	REFERENCES
SUSTAINABILITY ASSESSMENT OF START-UPS	A Manual for the sustainability assessment of start-ups. A practical tool for start-up teams, investors and funding organizations. Clear criteria and a transparent assessment process should provide an objective and transparent assessment.	Specific: The manual aims to provide entrepreneurs, investors, and other users with assured direction regarding the sustainability potential of a start-up.	manual	**Trautwein, C., Fichter, K. (2018).** Manual for the sustainability assessment of start-ups: A practical tool for start-up teams, investors and funding organizations, Berlin.
SUSTAINABLE BUSINESS MODEL CANVAS	The Sustainable Business Model Canvas supports the development of an idea into a viable business model. It follows a holistic approach regarding the relationships within and outside the business. Besides economic criteria it focusses on ecological and social consequences of the activity.	Specific: It aims to assist entrepreneurs maximize the positive and avoid negative impact on society and nature. Therefore, sustainability is integrated into the core business.		**Bocken, N. M., Schuit, C. S., & Kraaijenhagen, C. (2018).** Experimenting with a circular business model: Lessons from eight cases. Environmental innovation and societal transitions, 28, 79-95 **Manninen, K., Koskela, S., Antikainen, R., Bocken, N., Dahlbo, H., & Aminoff, A. (2018).** Do circular economy business models capture intended environmental value propositions?. Journal of Cleaner Production, 171, 413-422.
SWOT	SWOT analysis is a strategic planning technique used to help a person or organization identify strengths, weaknesses, opportunities, and threats related to business competition or project planning.		webpage	**Helms, M. M., & Nixon, J. (2010).** Exploring SWOT analysis–where are we now?. Journal of strategy and management.
VALUE CHAIN ANALYSIS	Value chain analysis is a process that allows a company to identify its primary and supporting activities that add value to its product and services.		Webpage	**Porter, Michael E. (1985).** Competitive Advantage: Creating and Sustaining Superior Performance. New York.: Simon and Schuster. ISBN 9781416595847. Retrieved 9 September 2013.
VALUE CREATION FORUM	When participating in a value creation forum, your company receives valuable feedback from a panel of individuals with different backgrounds. The aim is to strengthen your business and get some tips and advice. You get confirmation of what's good and a brief on what's missing or how to prioritise		webpage	
VALUE MAPPING TOOL	It is designed to support companies in crating value propositions as a part of sustainable business model. The dimensions are: captured, missed/destroyed or wasted, and opportunity value	Specific: The aim of the tool is to analyse the social, environmental and economic value of the business model from the perspective of the relevant stakeholders.	manual	**Bocken, N., Short, S., Rana, P., & Evans, S. (2013).** A value mapping tool for sustainable business modelling. Corporate Governance, 13 482-497. https://doi.org/10.1108/CG-06-2013-0078