

Development of a Toolbox on Sustainable ICT across Industry and Academia: The goforIT project

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Abstract: ICT plays an important role in assuring both environmental, economic, individual, technical and social sustainability. While sustainability is commonly understood at the general level, it was realized at a joint academia-industry panel at the Norwegian ICT conference in November 2019 that ICT-professionals did not necessarily know *how* they work to develop sustainable solutions. This also applied at the time to academia: Lecturers and those responsible for study programs did not know what should be taught in the different subjects. On this background goforIT (Gønn omstilling for IT-bransjen) was established in February 2020 by a small group of companies and universities. The development and use of the Sustainability Competence Toolkit is one of the major undertakings of goforIT and is expected to be important both for practice and academia. Developing the toolkit is guided by ADR - action design research and service design methodology. The main results presented in this paper is results from service design within this frame and the current results in a sustainability toolbox. In future work we will investigate how this toolbox is developed through use, supporting the coordinated knowledge development in the area of sustainable ICT in academia and industry.

Keywords: IT and Sustainability, System development methods and practices

1 Introduction

Climate change will provide enormous challenges to society over the next decades [4,9]. Society needs to address these challenges, both by mitigating the changes and by adapting to them. At the same time, we need to assure that the resulting society is both economically viable and socially desirable.

ICT plays an important role in assuring both environmental, economic, and social sustainability. The need for the ICT field to address sustainability has been acknowledged for some time in areas such as Information systems [12], HCI, AI [13] cloud computing [15], and software engineering, as seen for instance in the Karlskrona manifesto [1] and work on software design [11]. The impact of information technology can be seen as both direct (first order) and indirect (second order) effects of the software and hardware [7]. Third-order effects are seen as long- and medium-term change in behavior and economic structures.

At the same time as ICT can be used to address sustainability issues, there are also issues with the sustainability of the ICT-systems in themselves [2,6]; The software development process can be seen as the most important enabler for a future where trustworthy software impacts the quality of people's lives in society.

Today, processes for designing and evaluating software are based on direct functionality, cost and value for industry or government, without sufficient focus on the wider societal and environmental impact of software, which is changing the way software is developed. A shift towards a focus on sustainable development constitute a major change in perspective.

For modern ICT-solutions, sustainability can be considered a key non-functional cross-cutting concern. Becker and colleagues [2] have developed a model structuring the effects of software systems into five dimensions. Three of them are used in several sustainability models and originate in [3]: The economic, the environmental, and the social dimensions. To this, Becker and colleagues add the individual and the technical dimension.

goforIT is a Norwegian initiative focusing on how to build knowledge and competence on sustainability among IT professionals. It started in the spring of 2020, and has currently around 50 organizational members, including around half of the higher education organizations (universities and university colleges) and main IT-solution providers (including the main consultancy companies) in Norway. Due to the urgency of the sustainability challenges, both academy and industry has realized that we need to align the methods and techniques used in practice and taught in higher education. Thus, an important ongoing task for goforIT is the development of a toolbox with common resources in supporting both academia and practice, also acting as a bridge between these different organizations. An important part of this is the vocabulary to be used. As also has been found when interviewing practitioners and academics in Norway as reported in this paper, 'Sustainability' has been defined and is

used in many ways, and it is important that different researchers and practitioners achieve a sufficient agreement on the central terms to be able to communicate efficiently.

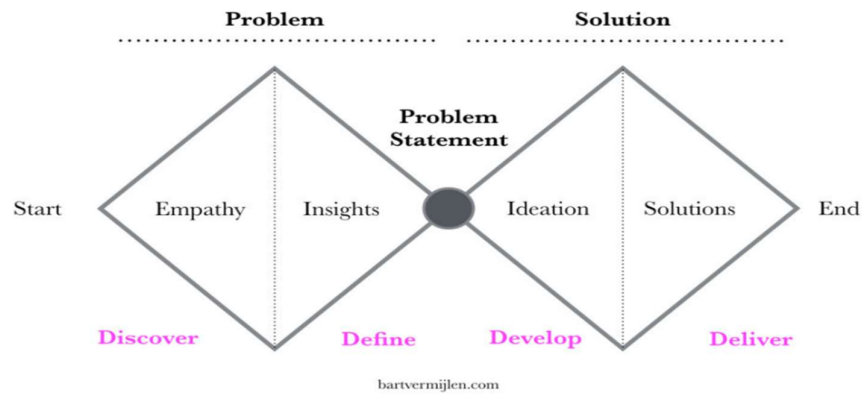


Fig. 1. Double-diamond service design

2 Methodology

The development of the toolbox can be regarded as a type of action design research (ADR) [14]. An ADR process consists of 4 inter-related stages where practitioners and researchers.

1. Engage in joint problem formulation,
2. Build, intervene and evaluate,
3. Reflect and learn.
4. Formalize learning from the effort.

Each stage is carried out in accordance with the principles specified by Sein et.al [14], thus ensuring a theory ingrained solution to a real-world problem as well as learning among all involved actors.

In this case, the formalized learning is in the form of an artifact called the sustainability toolbox where the researchers and practitioners involved in developing this are also representing important user groups. Joint problem formulation was originally done using a service design method, following a double diamond approach connected to the individual user profiles as illustrated in Fig.1. The need to add additional techniques to ADR to support this on the micro-level is well established [5]

In a workshop at NMBU in 2021, different user profiles were identified, and the most important ones was chosen. In order to understand how to best serve the user group, a

team of design professionals have undertaken depth interviews with people in many of our target audiences in the workforce and academia. We report here in particular input from two roles; Chief Sustainability Officers in companies and those who design Programs of Study at the university (studieprogramansvarlige). 4 representatives of these roles in different companies and universities were interviewed. This resulted in an internal report in Norwegian. This paper present main findings and how requirements identified from this has fed into the building of the first version of the toolbox.

This included development of a common vocabulary and other knowledge resources . The toolbox is in English since most work in the area has been published in English), and parts of this will also be the reported here. Other target audiences (profiles) such as system architects, leaders, project managers, lecturers, system designers and service designers have also been interviewed during workshops, and needed knowledge resources, methods/tools and success cases for these roles to be part of the toolbox are being identified.

When a need for a knowledge topic is identified (solution), a separate sub-group has worked on developing this iteratively. It is not meant in the first stage to produce new knowledge, but to summarize state of the art when it comes to relevant techniques and tools to support the development of sustainable ICT systems and using ICT for developing sustainable solutions in other fields. When the workgroup is satisfied with the current version, evaluation as part of step 2 has been done through a peer-review by other people in goforIT not being involved. The peer reviewers are from both academia and practice, and they have been asked to provide input on comprehensibility (for the expected users, i.e. pragmatic quality in the terminology of SEQUAL(REF)), aspects that is missing (completeness as part of semantic quality), or should be removed or changed (correctness as part of semantic quality), and if the report followed the overall structure (following a decided template as part of syntax quality).

Knowledge topics are related to profiles, marking if they represent core knowledge (a person identifying with the profile should be able to actively use the tool/technique that is described in the knowledge topic) or strengthening knowledge (the person having the profile should know about the area and know who in the organization is able to use the technique/tool in practice).

When using the material in the knowledge topic it is possible to add comments to it in the toolbox as part of reflection and learning, and also requesting further material on the topic. It is also possible to add experiences from the use of different techniques and tools. This is taken as input on later release of the part of the toolbox, further formalizing learning from the effort.

3 Overview of the Case

While it is commonly known what sustainability is, and why we need to change our ways, it was realized at a joint academia-industry panel at the Norwegian ICT conference in November 2019 that IT-professionals did not necessarily know how they should change their ways to develop IT-systems in a sustainable way. This also applied

at the time to academia: Lecturers and designers of study programs did not know what should be taught in the different subjects.

The same applies to procurement: Neither private nor governmental institutions knew what to ask for regarding sustainability, be it acquisitions of systems or hiring people on time and material contracts. Given that sustainability is to have 30% weight in public procurement from 2024, it is important to have agreement on what this is to mean in practice.

On this background goforIT (Grønn omstilling for IT-bransjen) was established in February 2020, by six enthusiasts from across academia and industry, and has since grown to a national network with around 10 universities, 35 IT organizations and 4 interest organizations, with a large number of private and public organizations standing in queue for membership.

The Sustainability Competence Toolkit (Hereafter “the Toolkit”) is one of the major undertakings of goforIT. The ambition is to solve the above two systemic problems for operational sustainability in the industry and the society at large.

The process of making organizations behave more sustainable, is arguably one of change management. If we want people to change their behavior, we need to communicate exactly what additional competence they need to have in addition to their existing professional knowledge. And in order for them to communicate precisely, we need to provide a common vocabulary, so that they are able to work in a cross-functional way.

Example: A CEO along with a CSO (Chief Sustainability Officer) needs to know how to produce and evaluate a Materiality Analysis. In other words, we consider it a *core competence* for people in these roles. An IT System designer needs to know that such an artifact exists and ask for it before he starts designing new IT-systems. Further, he or she should know how the priorities in the Materiality Analysis can be reflected into the design of the IT systems that support the operation. For he/she, being familiar about this is a *strengthening competence*.

As mentioned previously, the how’s of sustainability are relatively unknown, and most of the information we have is less than a decade old. So, in contrast to e.g., Information Security where a similar toolbox exists, we need to cater for that this is a field that can change rapidly. We are therefore focusing on finding concepts and frameworks that are essential for future IT-development and must be prepared to adjust the material as we gain more knowledge and get valuable feedback.

Many institutions have excellent competence descriptions for the profiles that we are targeting, and we only describe additional knowledge, exclusively related to sustainability. Thus, the toolkit should be considered as an add-on, and is not meant to be an exhausting description of the complete knowledge requirements for a profile.

4 Results of service design

Below we provide examples of the results we have got from the interviews and how it contributes to requirements to the toolbox.

4.1 Interviews with stakeholders

We have structured the results according to separate themes, which also was used within the semi-structured depth interviews.

4.1.1 The concept of sustainability

The concept of sustainability is understood and interpreted differently by the various respondents. The UN Sustainable Development Goals are often seen as the gateway to the topic, where climate and the environment are given the greatest focus by many. An interesting finding is that Norwegian IT companies not only look at sustainability in their own business (internally), but also towards customers (externally).

Academia includes the economic aspect of sustainability more explicitly than business where it might be taken for granted. Nevertheless, there are ongoing debates about how sustainability can be interpreted into the disciplines and activities of the departments. Sustainability as a topic is complex and comprehensive, and it is acknowledged that it requires a holistic approach.

The results within this area emphasize the need for providing a core terminology.

4.1.2 Motivation and drivers

The motivation to work with sustainability has changed in recent years. In the past, the work has been characterized by enthusiasts with a strong moral compass, while in recent times it has gained a stronger grounding in the various organization. The enthusiasts are still present but are now experiencing increasing support through clear demands and high expectations from customers, students, owners, authorities and not least their own employees.

At the same time as expectations and pressure from stakeholders are increasing, more and more companies are seeing the potential in sustainability. If the formal structures and frameworks are lacking, the organizations are largely dependent on personal motivation.

The results within this area emphasize the need for a way to externalize the knowledge of the enthusiasts into a kind of toolbox that we have developed to spread knowledge.

4.1.3 Measurements of sustainability

Findings show that measurements are made more often, at different levels and using more measurement points than before. The measurements are concentrated to the greatest extent on the environmental aspect, where recycling, electrification of vehicle fleets and emissions are mentioned as examples. At the same time as several measures are developed, sustainability is further integrated as part of the company's quality systems and core processes. In academia, systematic and pervasive measurements do not seem to be made on anything other than climate accounting, but areas both in

research and education that could have been measured are mentioned. Measurements in academia are a controversial topic in general.

The results within this area emphasize the need to provide measurement techniques and tools in the toolbox.

4.1.4 Competence

The development of sustainability competence in employees needs to go from occasional stunts to a more systematic approach. At the same time, many find it difficult to know what sustainability expertise will be required of the individuals in the future. When new expertise is to be brought in, there is a discussion about what should be prioritized. There is currently a lack of a common standard, and there are few with formal sustainability education in the market.

Nevertheless, there are opportunities for sharing expertise across units internally, but also between industry and academia. One may ask whether one should try to raise everyone's competence? Should you invest in the deep expertise of some people? Or do both?

The results within this area emphasize a need to specify competence needs, and the possible usefulness of differentiating between core and strengthening competence, and idea borrowed from an existing security toolbox.

4.1.5 Challenges and dilemmas

The business sector is experiencing challenges in that the pace of development is too slow and that the market moves too slowly, which means that the business value is so far limited. At the same time, Norwegian IT companies are relatively immature when it comes to expertise in sustainability, where the companies are largely dependent on individuals.

Academia, on the other hand, has dilemmas related to the pace of change that the business community wants. If sustainability is to become a large enough topic area, fast enough, it must take priority over other important areas with already limited resources. At the same time, the restructuring requires maturing and there is a lack of a joint effort across academia, politicians, and business.

The results within this area emphasize the need for providing links between sustainability and traditional IT competences.

4.1.6 Wants and needs.

Collaboration is highlighted as a common desire among both industry and academia. Academia, on the other hand, wants to collaborate to offer the most relevant course of study, while the business community sees collaboration as an important premise for success in its sustainability work. At the same time, cooperation is important in order to identify the real need for competence and provide a supply of candidates with the right educational background. Furthermore, the interviews show that there is a need for

more arenas, where a common knowledge sharing arena and an arena for political influence are highlighted. The business sector also needs more internal formalization of sustainability efforts, even though sustainability ambassadors have succeeded in paving the way forward so far.

The results within this area emphasize the need for a common framework where industry can tap into the latest research. One example is the SUSAF framework [2] which was suggested by one of the academic partners to one of the industry partners as a way of looking at sustainability requirements. This framework is now used both by academic partners in the education and in workshops held by industrial partners, including joint workshops.

4.1.7 The ideal situation

Norwegian IT companies describe a dream situation where attention to sustainability goes almost automatically and where customers choose the company as a strategic partner within sustainability. At the same time, it is important to be able to demonstrate real value, results and cases. Academia, on the other hand, is largely concerned with the scientific aspect, where in an ideal situation one has access to research resources backed up by various incentives and funding models. The interaction across studies and subjects is integrated into the teaching, and the students experience sustainability as a natural whole of the entire course of study.

The results within this area emphasize the need for describing techniques in way so it can be a basis for further research, which can be used to develop the techniques further. When it comes to SUSAF [2] some of the academic partners are linked to the originators of the technique, and is aiming to suggest improvements to the technique through experiences from case studies e.g., with the industry partners in goforIT.

4.1.8 The sustainability journey

The sustainability journey depicts the development an organization go through from where sustainability is not an issue, to the state where sustainability is a natural part of the company's value creation. The sustainability journey is based on the steps businesses and academia themselves have taken so far, as well as the steps they envisage taking to achieve the described dream situation. There are many commonalities in how the journey is experienced, where the overall journey is presented in the paragraphs below.

1. Absence of sustainability focus

The sustainability journey is initially characterized by a lack of focus and awareness of the sustainability theme. It is easy in retrospect to say that your own business has always been concerned with sustainability, as the core values are good, but the reality is often different.

2. Enthusiasts take lead

Gradually, more enthusiasts appear. These are champions of sustainability in their own organization, but they work often stand-alone without internal support. They navigate on their own, encounter a lot of resistance and get little traction.

3. Coincidences and small attempts

When the enthusiasts individually gain traction in their own organization, the first "official" sustainability projects are often implemented. The projects are characterized by uncertainty and chance, as the approach has to be established. The results vary, and the gains are not forthcoming.

4. Greater degree of anchoring

Companies are experiencing internal and external pressure and are being "pushed" in a more sustainable direction. Several organizations also see great opportunities. This means that new and more roles are established, and that sustainability is integrated into strategies and regular reporting.

5. Structured competence development

Businesses are now prioritizing competence development among employees, students, and the market. A common understanding of the topic is established, where the competence enhancement applies to different roles. There is still a need for the development of roles with specialist expertise.

6. Achieving results together

As more sustainability projects are implemented, companies can highlight the exciting projects and tell the good stories. Cooperation with customers and various other players is important and means that more people experience results.

7. Prioritized and integrated

Sustainability is now an integral part of all business processes and study programs and is measured in the same way as other factors. In the event of a scarcity of resources, sustainability will nevertheless be a priority. Sustainability is no longer "hair in the soup", it is something concrete and a reality for many.

8. Holistic and profitable

As more sustainability projects are implemented, companies can highlight the exciting projects and tell the good stories. Cooperation with customers and various other players is important and means that more people experience results.

Some have come further than others, but few have come further than step 4 - a greater degree of anchoring. Step 4 is therefore called the current situation, as this represents the condition the majority of the businesses are in as of today. The toolbox is made to support the next step, over into the structured competency development.

4.2. Toolbox Implementation

A Minimal Viable Product (MVP) of a web environment was released winter 2023, the front page of which is shown in Figure 2. This first materialization is primarily to be able to make early results more generally available for additional feedback on an early stage, to evaluate the approach, and reflect and learn before developing the first official

version where the learning is further formalized. Currently a separate design effort is undergoing for how to best present the knowledge sources to the different profiles, given the different needs and learning styles of different people.

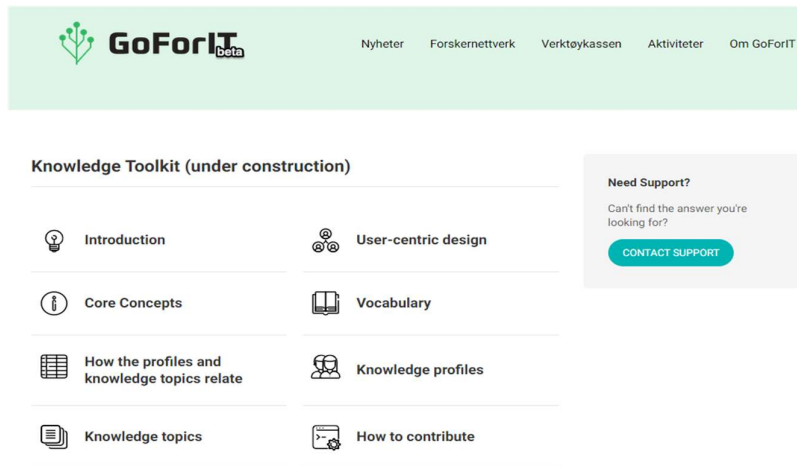


Fig. 2. Front page of the Toolbox prototype

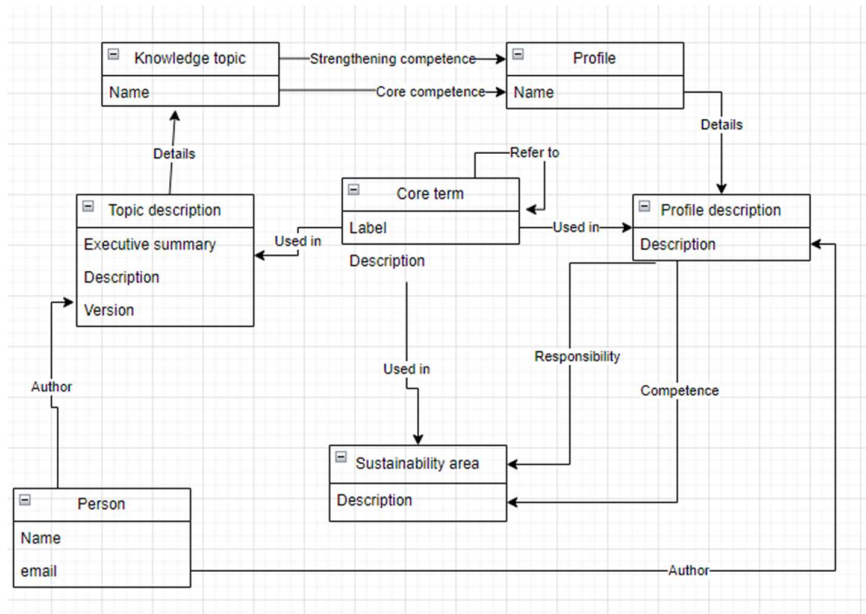



Fig. 3. The Toolbox meta-model

In figure 3 we have a metamodel of the content of the toolbox. One thing that is considered core knowledge for all profiles is the joint vocabulary, i.e., the core terms. The current version of the core terms was presented in [10]. These terms are used in descriptions of profile, of sustainability areas and topic descriptions. The persons collaborating on writing these bits, and the different versions of these bits are included. The profiles include descriptions of the sustainability areas where people having these profiles are responsible, and where they need competence. Knowledge topics that are core competence and strengthening competence of the profile is represented. Revisiting the example from section 3, we see how the knowledge topic of materiality analysis is core for certain profiles and strengthening for other.

Topic	Chief Sustainability Officer	Manager	Project Manager	System Designer/Developer
Materiality Analysis	Core	Core	Strengthening	Strengthening

Fig. 4. Link between knowledge topic and profiles

Sustainability analysis diagram

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Fig. 5. Table of content for the SUSAD knowledge profile

Fig.5 is part of the knowledge topic on SUSAD/SUSAF (Sustainability Analysis Diagram [2], being one of several techniques that we regard as core knowledge for project managers and systems designers, being involved in the development of requirements to an IT-solution that is to take sustainability into account.

5. Discussion

goforIT is a collaborative project with partners from both academia and industry, with the goal of aligning the necessary focus on the development of sustainability expertise in the IT industry. A toolbox for sustainability is being developed following Action Design Research and service design, where the insight work summarized in this paper lays the foundation for a common understanding of what needs exist and what challenges the target group faces. Many interesting discoveries have been made, but not all of them are equally relevant to the challenge we are about to solve. The most relevant findings are summarized below, and concern, among other things, the absence of a common conceptual framework and terminology, lack of expertise and the need for more cooperation and sharing, that needs common knowledge resources to be efficient.

A. Absence of a common conceptual framework

The UN Sustainable Development Goals have been the gateway to the topic for many, and the terminology is well known in the organizations. The environmental aspect often characterizes the companies' view of sustainability, but the social aspect is also mentioned frequently. Some relate to sustainability internally and externally, while others see sustainability in the context of their own field.

There are many ideas about how the concept of sustainability should be interpreted, but there is no consensus on a common approach and definition. For many, the concept of sustainability is difficult to relate to, and is often described as comprehensive and vague. At the same time, it is challenging to simplify sustainability too much, which means that the situation is perceived as unclear, characterized by debates about the way forward. The insight thus paints a picture of a lack of common terminology, which is one of the areas we are trying to address within goforIT.

B. Lack of collective competence development

The various players need to get a better understanding of sustainability issues more rapidly than today. The knowledge development that is being done today is based on sporadic measures and individual initiatives, which is not sufficient to reach the necessary pace of development we need.

There is a need for a collective increase in competence, both in the market and in own operations. This applies to expertise in sustainable procurement and ordering, but also expertise in the various disciplines and roles. There is a need for a systemic approach, which means that the green shift is happening faster and that businesses are less vulnerable to potential replacements.

C. Sustainability work requires organizational anchoring

Enthusiasts and sustainability ambassadors have largely paved the way until now. In order to succeed with further investment, there is a need for stronger anchoring in the organization. Management must set aside both money and resources, while at the same time the sustainability project must be able to demonstrate business value. Anchoring is a premise for businesses to achieve their dream situation of working holistically and profitably with sustainability. It is therefore important that there is predictability in the long-term economic indicators, and that those responsible are given tools that help them in their anchoring work internally and politically.

D. More need for collaboration and sharing

There is too little correlation between political guidelines, market demand and work being done in academia. A common understanding and a holistic approach are lacking. Expectations must be communicated so that business and academia can deliver on each other's requests and needs.

Among other things, academia needs access to real cases from the business community to increase the relevance of the studies, while the business community needs expertise in sustainability that suits their needs and focus areas. There is a demand for a sharing arena for collaboration and knowledge sharing, where you can learn from each other and be updated on what is happening in the different places. A system and ecosystem circling around the toolbox is hoped to be important to support this.

6 Conclusions and Further Work

goforIT started right before the pandemic and has been grown under a pandemic when it was not possible to meet physically. Given that the members have from the beginning needed to be able to work in a distributed fashion using collaboration tools, it has brought enthusiast together across academia and industry and across geographical boundaries, supporting a collaboration pattern across competitors that is not often witnessed, since it is a common understanding that there is a need to raise the competence level in the whole business area much more rapidly than we usually see to reach the goals of reduced emissions.

In this paper, we have presented early results from this work, in particular tapping into the work that a group of design professionals have done as part of a service design process undertaken interviews with people in various target audiences in the industry and academia.

The paper describes the result of the service design effort as part of Action Design Research, including early result of the application of the collected resources within the network, both in academia and industry. Also, other target audiences (profiles) such as system architects, leaders, project managers, lecturers, system designers and service designers has been interviewed during workshops, and needed knowledge resources, methods/tools and success cases to be part of the toolbox has been identified. A design effort of the physical toolbox is also being done, to replace the current MVP.

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All contributors to the current version of the toolbox, having participated in workshops, making material, or acting as informants and quality control.

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