

Iterative Sustainability Impact Assessment: When to propose?

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Abstract—In this paper, we propose when and how to perform sustainability assessment during software product and service inception, development, and evolution.

We explain the challenge of right timings for sustainability assessments, how they are often delayed due to missing focus on values during the early development phases. We refer to a current solution, called SusAF, and discuss some of its challenges.

We wrap up by advocating for a legal regulation supporting the actual implementation of sustainability assessments alike with how they are required in civil engineering.

I. CONTEXT

Sustainability assessment is a widely accepted practice in impact assessment [6]. Major civil infrastructure projects are generally required to complete an Environmental Impact Assessment process before they are permitted to be constructed. An example of a required process is documented in the EU directive 2014/52/EU on the assessment of the effects of certain projects on the environment [9]. Large data centre construction projects have already been required to follow this process, for example Apple's application to build a new data centre in Ireland in 2015 [5]. In the case of projects with transboundary impacts, the Espoo Convention [10] applies and there are many states where citizens have a right to involvement in decision making about environmental matters under the Aarhus Convention [11]. Software systems can have very significant environmental and social impacts, particularly when considering the 2nd and 3rd order impacts [7]. Can we predict a regulatory environment in which major software systems will have to complete a similar impact assessment before software release, particularly when scaling beyond national borders?

In the software engineering context only few approaches exist. One of them is SusAF [3]. While in our previous publications we have been careful in calling it a Sustainability Awareness Framework to make clear that it is not intended to perform a full-on quantified assessment (as in life cycle assessment [4]), it does serve to assess an IT product or service as used in technology assessment [2].

II. THE CHALLENGE

Sustainability is often not a main concern early on during product conception, nor necessarily later, but that can lead

to unintended impacts. Let's consider the development of a typical project:

The conceptualization of an IT product or service often starts from the identification of a "problem" and a possible solution. This initial vision is normally an optimistic one, focused on the intended benefits of the product or service. However, the intended benefits are hard to predict (and communicate), let alone doing so for the potential negative effects. Businesses are not yet prepared to foresee those.

After the product or service is finally released, it seems perfectly reasonable to wait for the consequences to start playing out and then extrapolate further. Also, at such early stages, businesses have many other more urgent things to worry about: Does the IT product/service work properly? Are people using it? Will it generate the expected financial returns? Can we survive as a business until then? While these pressing uncertainties must absolutely be dealt with, this also gives time for systemic effects to occur and have far-reaching effects that are difficult to mitigate. How to find the balance between short-term company/user needs and long-term company/societal needs? How to explore the potential systemic effects of a brand-new product or service? Who to involve in such explorations? How and when to revisit the results of such an exercise?

After a while, the product or service has crossed the chasm of the adoption curve. It has been around for a bit and its user base and income are growing or at least stable. The business has good understanding of its context, some effects are known and a few have been successfully dealt with. In the maintenance phase, the company has to evolve its product or service, and further investigation of the potential effects is needed - especially as the usage scales and therefore responsibility for its effects increases. How can IT companies leverage their knowledge and experience to anticipate the effects of their planned product/service evolution? How often should they do it? How to follow up and integrate learning from previous analyses on future ones?

III. CURRENT SOLUTION

The Sustainability Awareness Framework (SusAF) aims to anticipate the effects of IT products and services. It consists of a set of questions, a process, a workbook, a reporting

template, a moderation guide and examples. This material is freely available in <https://zenodo.org/record/3676514>.

The application of SusAF helps stakeholders to anticipate positive and negative effects of an IT product or service, as well as to identify actions for avoiding, mitigating and exploiting these effects. SusAF structures the conversation around five sustainability dimensions—environmental, economic, social, individual and technical—and explores how anticipated effects play out at scale, over time and across dimensions.

The framework has been applied with 200+ students and 60+ practitioners in 5 countries. Among them, the following companies:

- **Partneur**, USA: a company in their startup phase
- **DataMatrix**, India: a hybrid project on water management in the kick-off phase
- **Visma**, Finland: an existing cloud based service
- **PremierPark**, Finland: an IT services project at proposal stage
- **Jeppesen**, Sweden: existing large-scale simulation system

As a vision of when we would like to see SusAF used, we propose: (1) Before you start building, during the initial RE phase. (2) Once the first version is released and first impacts have been observed. We add different stakeholders, e.g., regular users. (3) Once impacts of actions taken after the second SusAF have been observed. (4) Before major evolution steps take place. (5) At end of lifetime to understand what effects have transpired.

IV. DISCUSSION

Strengths of the Approach: (1) All these experiences show that SusAF can be applied to different types of IT products and services and is an accessible approach to anticipate their effects (i.e. can be used independently and without previous knowledge).

(2) It allows a diverse set of stakeholders (e.g. users, technical developers, domain experts) to bring their viewpoints into the discussion.

(3) Potential system impacts in all dimensions are made visible and all participants reported new insights.

(4) The data collection happens fairly quickly within half a day and in friendly discussion.

Challenges arising in Application: (1) A number of stakeholders need to buy in and put time aside, as the workshop takes at least half a day.

(2) It is sometimes challenging for stakeholders to bridge from the abstraction levels of the question topics to an implemented system, because they are not used to doing that on a daily basis.

(3) It is hard to extrapolate future impacts if the project is at an early stage with no such product or service on the market.

(4) The synthesis of the workshop results is not necessarily easy as participants have found it challenging to differentiate second and third order effects.

(5) Finally, it is not yet clear when the “best” time is to use SusAF and when to repeat it. Follow-ups are required for a number of reasons; e.g. to make sure that actions are

taken after the initial assessment, to follow up the effectiveness of such actions, to consider new knowledge about the product/service, its context and use in the anticipated effects and implementation of actions, to anticipate other effects, including ones derived from planned product/service evolution.

V. CONCLUSION

When you want to build major infrastructure, like a bridge or larger building, under law you have to do an environmental impact assessment (EIA, as mentioned in Bieser and Hilty [1]) - so, let's up the stakes. What if we had to do a sustainability impact assessment before developing any IT product or service?

Data Protection Impact Assessments are already required before processing commences for systems which present a “high risk to the rights and freedoms of natural persons” under Article 35 of the EU General Data Protection Regulations (GDPR) [8]. Whilst the scope of GDPR is in relation to data rights, it is a trend towards Impact Assessment regulation of systems which could be extended to environmental and social impacts.

We acknowledge that not all challenges discussed in this paper are solved by adding a legal requirement to perform sustainability assessments, but it is a step in the right direction.

REFERENCES

- [1] Jan CT Bieser and Lorenz M Hilty. Assessing indirect environmental effects of information and communication technology (ict): A systematic literature review. *Sustainability*, 10(8):2662, 2018.
- [2] Michael Decker, Miltos Ladikas, Susanne Stephan, and Friederike Wütscher. *Bridges between science, society and policy: technology assessment-methods and impacts*. Springer, 2004.
- [3] Leticia Duboc, Birgit Penzenstadler, Jari Porras, Sedef Akinli Kocak, Stefanie Betz, Ruzanna Chitchyan, Ola Leifler, Norbert Seyff, and Colin C Venters. Requirements engineering for sustainability: an awareness framework for designing software systems for a better tomorrow. *Requirements Engineering*, 25(4):469–492, 2020.
- [4] Göran Finnveden, Michael Z Hauschild, Tomas Ekvall, Jeroen Guinée, Reinout Heijungs, Stefanie Hellweg, Annette Koehler, David Pennington, and Sangwon Suh. Recent developments in life cycle assessment. *Journal of environmental management*, 91(1):1–21, 2009.
- [5] Galway County Council. Planning application details ref: 15488, Apr 2015.
- [6] Jenny Pope, David Annandale, and Angus Morrison-Saunders. Conceptualising sustainability assessment. *Environmental impact assessment review*, 24(6):595–616, 2004.
- [7] Maria J Pouri and Lorenz M Hilty. Conceptualizing the digital sharing economy in the context of sustainability. *Sustainability*, 10(12):4453, 2018.
- [8] The European Parliament and the Council. REGULATION (EU) 2016/679 General Data Protection Regulation, Apr 2016.
- [9] The European Parliament and the Council of the European Union. Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, 2014.
- [10] United Nations Economic Commission for Europe. Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991), 1991.
- [11] United Nations Economic Commission for Europe. Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus, 1998), 1998.