

RE@21: Time to Sustain!

Birgit Penzenstadler

Donal Bren School of Informatics and Computer Science
University of California, Irvine
Irvine, CA, USA
bpenzens@uci.edu

Henning Femmer

Software & Systems Engineering
Technische Universität München
Munich, Germany
femmer@in.tum.de

Abstract—The requirements engineering (RE) conference is turning 21, our conference is “grown up” now. We take this as a motivation to rethink our responsibility for this conference, and to prepare the path for sustainable RE conferences for future generations.

Although sustainability has been broached as conference topic in RE’08, hardly any long-lasting consequences followed. We consider this as vital for improving the research community experience while minimizing especially the environmental impact of the conference.

We contribute a model for improving the sustainability of the RE conference by systematically analysing the different dimensions of sustainability and their corresponding impact with regards to this conference. On that basis we define actions that improve a specific aspect of sustainability and describe how the actions are implemented at RE’13 in Rio.

Our envisioned long-term impact for the conference is that by providing a hands-on case study every conference participant can actively support, this paper can lay the foundation for a sustainability guideline for further improving the sustainability of the RE conference series.

Keywords—requirements engineering; sustainability; generic model; case study; conference organization;

I. INTRODUCTION

This year, the requirements engineering (RE) conference is celebrating its 21st birthday. We consider this an adequate moment to show the maturity by taking responsibility for the sustainability of the conference: to maximize its benefits and to allow positive experience while reducing its negative impact on the environment, for this conference as well as for future iterations. This issue was already identified at ICSE a few years ago [4] and chosen as topic at RE’08, but not dedicatedly continued and therefore led to only little change and no long-term effect.

To achieve an actual long-term effect, it is necessary to define an explicit goal and to assign a responsibility, as a goal will only be realized if it has an actual stakeholder. This stakeholder must take care of a systematic approach, which includes defining sustainability, understanding what sustainability means for this conference, defining and starting actions, and finally understanding if these actions were a success.

Consequently, for the first time in this conference series, the general chair defined a role within the organization committee and thereby created an explicit stakeholder for sustainability: the *sustainability chair*, which the first author of this paper was asked to fill this year.

For identifying the goal, we have to create a tangible definition for sustainability in our context. The first author defined sustainability for software systems (based on the definitions by Brundtland [16] and Goodland [5], and the frameworks by Burger and Christen [3] and Robèrt [14]) as not only conserving the environment but also satisfying individual, social, economic and technical needs [11].

Definition: In the context of the requirements engineering conference, we define sustainability as finding a good balance between technically sound and inspiring research, a socially enjoyable community gathering, and an environmentally sustainable event with a positive spirit.

Goal: The aim of the sustainability chair is to optimally support this perception of sustainability at the International Conference on Requirements Engineering 2013 (RE’13) and to provide the basis for continued optimization at the following conferences.

Problem: Sustainability is not an issue completely new to the RE conference series. The theme of RE’08, the conference giveaway, and two out of three keynotes of that year were targeted to sustainability. However, since then the topic has likely circled the minds of some organizers but, amongst all the challenges an organization chair has to face, was not an explicit objective, nor supported with concrete actions.

Contribution: The contribution is to make sustainability more tangible for the RE conference and to be able to systematically analyse and effectively support the objective within the conference preparation and realization. Therefore, we provide a sustainability model that covers the different aspects of sustainability, define actions for RE’13 and indicators that help to assess their impact, and describe the implementation of a subset of these activities along with the evaluation plan.

Impact: This paper provides a means of communicating that we as the RE community should consider sustainability as an important objective. It is the basis for a conference sustainability guideline that will enable the future organization chairs to build upon previous knowledge and lessons learned to further pursue the goal. Furthermore, the case study provides an illustration for engineers of how to use the generic

sustainability model to systematically analyse and implement sustainability measures in a specific context.

Outline: The remainder of this paper is outlined as follows: Section II presents related standards and previous work on the topic, Section III describes the generic sustainability model, and Section IV proposes the instantiation for the requirements engineering conference 2013 and the actions taken towards implementation. Section V discusses the model and the approach and Section VI concludes the paper with an outlook on future work.

II. BACKGROUND & RELATED WORK

A. Standards

The ISO 14000 [1] is a family of standards related to environmental management that exists to help organizations minimize how their operations negatively affect the environment, comply with applicable laws and regulations, and continually improve in the above. The ISO 26000 standard [2] offers guidance on socially responsible behavior and possible actions; it does not contain requirements and, therefore, in contrast to ISO management system standards, is not certifiable. Both have been considered in our work.

B. Related Work

Related work includes modelling sustainability for software systems and for conferences as well as previous initiatives at the RE conferences.

1) *ICSE i* Sustainability Model:* Cabot et al. [4] report on a case study for sustainability as a goal for the organization of the ICSE'09 conference with i*-models to support decision making for future conference chairs. Stefan et al. [15] extend that work for managing environmental sustainability with quantitative goal modelling techniques. Both works provide model instances for specific case studies while our work also provides a generic reference model.

2) *Software System Sustainability Goal Model:* Mahaux et al. [9] assess how well some current RE techniques support modelling of specific sustainability requirements in that case study. In contrast, our aim is to provide modelling means explicitly for integrating sustainability into the organization process as a major objective.

3) *RE'08 Theme:* The theme of the RE conference in 2008 was sustainability. The efforts of communicating the topic were a matching conference giveaway (reusable water bottle) and specifically targeted keynotes, held by van Ypersele [17] and Piñón [13].

4) *RE4RE and RE Interactive:* At RE'11, Martin Mahaux and Alistair Mavin started a process of collaborative requirements gathering for the requirements engineering conference (see also <http://re4re.cetic.be/>). At RE'12, a half-day workshop led to a validation of the goal model and over 200 requirements and solution ideas. As a consequence of the ideas most voted for, the new initiative "RE interactive" launched by the RE'13 Program Chair seeks to make the RE conference more engaging. The purpose of those initiatives is to foster social interaction, one major aspect of social sustainability.

5) *Common Cause:* The Common Cause Handbook [8] presents a framework for a movement towards a more sustainable, equitable and democratic world that serves as one of many inspirations for our work.

III. THE SUSTAINABILITY MODEL

We present a reference model for sustainability that decomposes sustainability into five dimensions: environmental, individual, social, economic, and technical sustainability (longevity of technical infrastructure) [11]. The model provides activities and relates them to the values, which they support, and to assessable indicators.

The generic sustainability model is intended to serve as a reference model for a *process engineer*, who instantiates the model for organization processes or development processes, and for a *requirements engineer*, who instantiates it for a specific system under development. Our proposed method comprises the generic sustainability reference model, the respective metamodel behind it, and instances derived for specific processes and systems.

A. The Metamodel

The metamodel is comprised by the types *Dimension*, *Value*, *Indicator*, *Regulation*, and *Activity* and their relations [12]: A $\langle \text{Dimension} \rangle$ is a viewpoint, represented by a set of values that express the abstract objectives of the dimension. Each dimension is represented by a set of values. A $\langle \text{Value} \rangle$ is a rationale that is rooted in itself, and is approximated by indicators. An $\langle \text{Indicator} \rangle$ is a qualitative or quantitative metric and is related to a value. A $\langle \text{Regulation} \rangle$ is an optional element that affects a value. An $\langle \text{Activity} \rangle$ is a means to support and influence a value.

B. The Generic Sustainability Model

The model consists of three levels, see Fig. 1: the top level contains the dimensions; the middle level contains values, indicators, and regulations; and the lower level contains activities. Each element in the generic sustainability model is of a type from the meta-model explained before. For example, for the dimension *social sustainability*, the spirit of the *community* is an important value that can be decomposed in different values such as *trust* or *education*. The education value is regulated, amongst others, by *human rights*. This value can only be assessed roughly and individually by indicators, where one indicator contributing to that assessment is the *level of graduation* of a person. Education is fostered by different activities, such as *knowledge management*, *education programs* or *mentoring*.

The generic sustainability model is intended to serve as a reference for the instantiation of process- or system-specific instances, for example, the value *education* can directly be reused, while the activity *knowledge management* must additionally be instantiated in the application context, e.g. into *use the company-wiki in the intranet* for a concrete company. Further details and the generic instantiation process are explained in [12], where instantiations for various case studies are described.

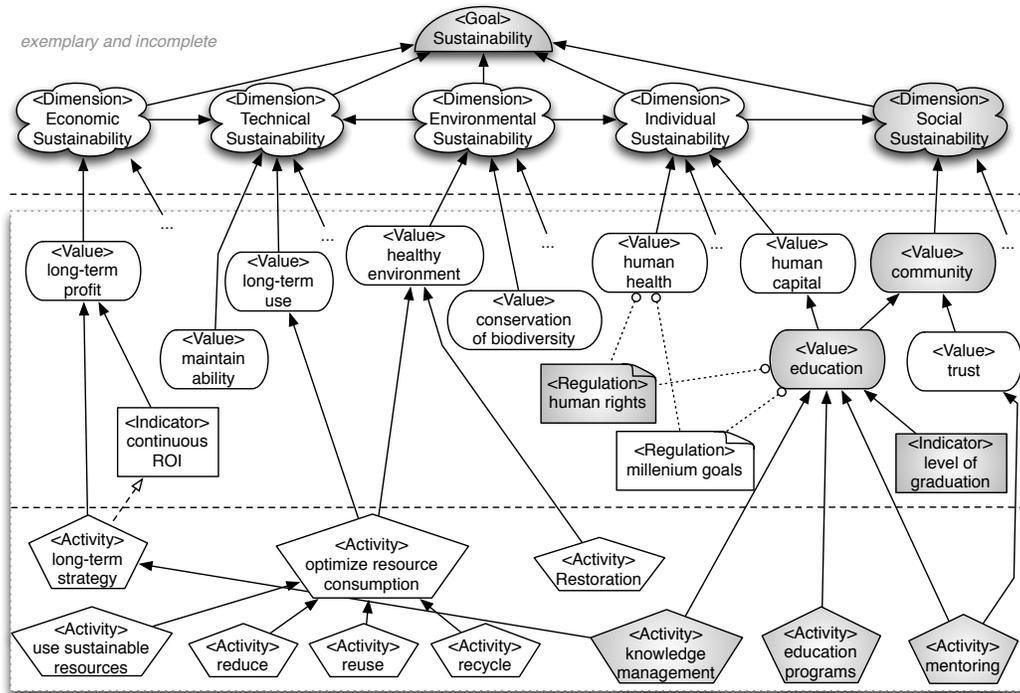


Fig. 1. Excerpt of the generic sustainability model. Discussed examples are marked.

IV. INSTANTIATION FOR THE RE CONFERENCE

This section reports on the development and the implementation of the explicit support of sustainability at RE'13. The methodical approach for the usage of a sustainability model consists of analysing the sustainability dimensions and constructing the model, applying identified actions, and assessing the defined indicators.

At RE'12, the organizing committee (OC) informally talked about the effect that emphasizing sustainability as an objective for the RE conference could have in its different dimensions, e.g., environmental impact, economic balance, and knowledge management. However, every objective needs a stakeholder, so before starting to develop the sustainability model in depth, the OC decided to create an explicit stakeholder by naming a role: the *sustainability chair*. The first author of this paper was asked to take on that role and the following sections describe our systematic approach to not only improve the sustainability of RE'13 but of all following RE conferences in the hope that we might be able to provide an example for other conferences.

A. Analysis: The RE Conference Sustainability Model

The RE conference sustainability model evolved in a initial brainwriting sessions on the basis of the generic sustainability model, a few additional short brainstormings (for various levels of change acc. to [10]), and a number of iteration cycles between members of the organizing committee who provided feedback.

The model was decomposed into five submodels, based on the five dimensions of sustainability as defined in Sec. III. For

simplicity, we removed relations between multiple dimensions of sustainability, but placed activities and values where they fit best. These submodels, as depicted in Fig. 2-6, were used by the organizing committee of RE'13. The legend of Fig. 2 is also used in the later ones.

The dimension *individual sustainability* (Fig. 2) focuses on the personal sustainability over the course of a person's lifetime. Values for individual sustainability that can be associated with the setting at a conference are development & growth, dignity, curiosity, and health. Some of the activities we derived for these values are to provide sufficient time and space for discussion (in the sessions and also separately for new collaborations), to provide a continuous forum for how people can make the most of the conference (see the RE4RE initiative), to enable and improve the access for people with disabilities (hearing impaired, etc.), to enable people who cannot travel to follow the conference, and to digitalize the discussions for follow-up and knowledge management.

For the *social* dimension (Fig. 3), the values rated most important were community building, fairness, trust, and tolerance. These values can be supported by enhancing and establishing the conference culture, and by ensuring that the conference has a positive impact on the local community and their relation with the conference participants.

The *environmental* dimension (Fig. 4) analyses where we can save resources by dematerialization [7] and avoid waste, from water and air to energy, emissions and garbage. Clearly the biggest environmental impact of the conference is having people fly in from all over the world for a few days of

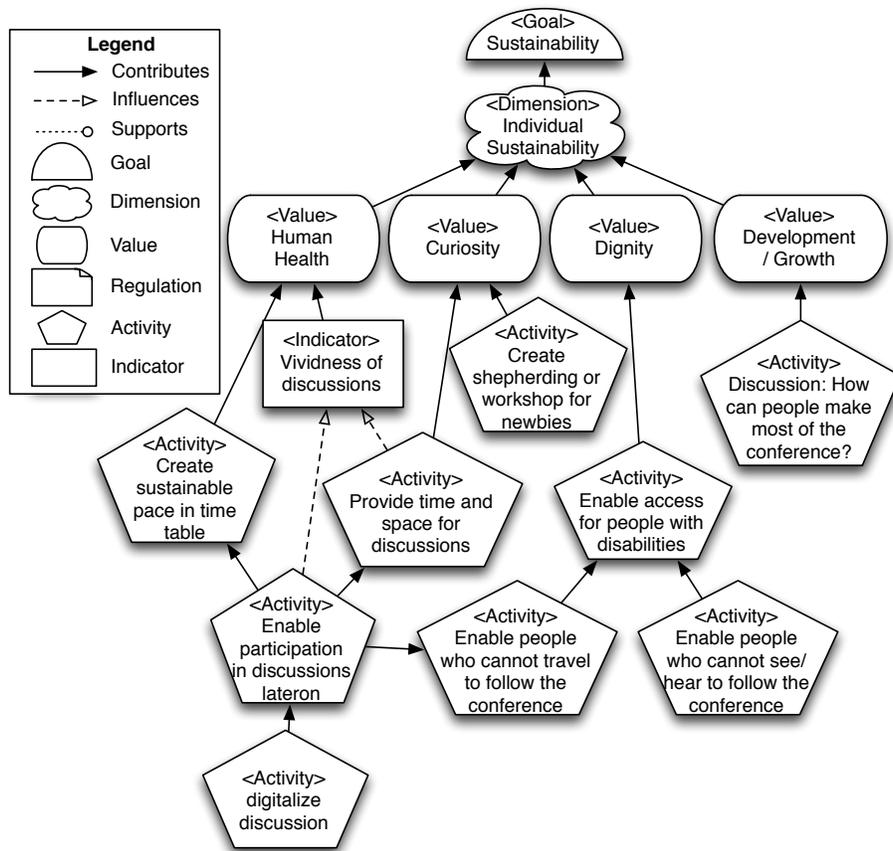


Fig. 2. Example instance for the individual dimension of the Requirements Engineering Conference.

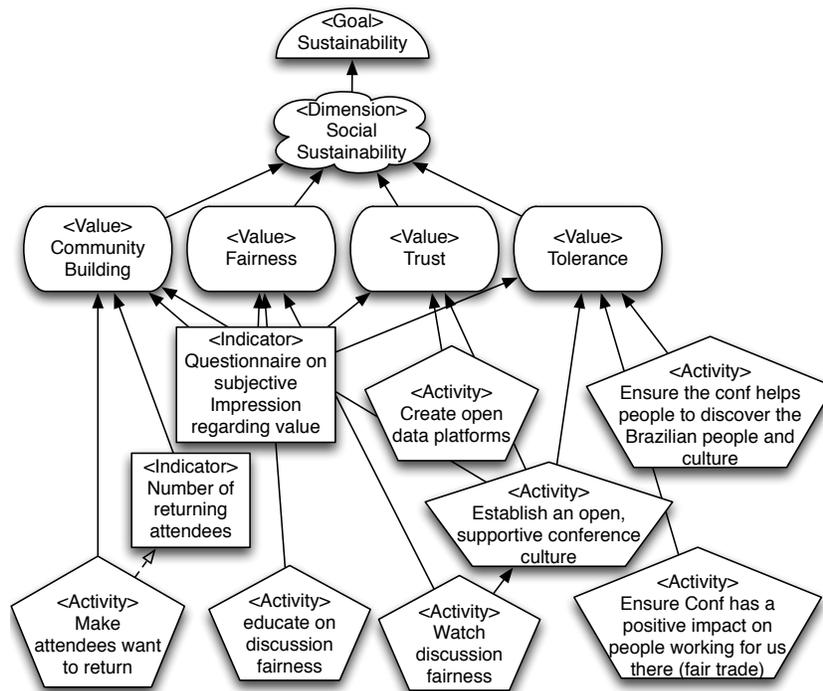


Fig. 3. Example instance for the social dimension of the Requirements Engineering Conference.

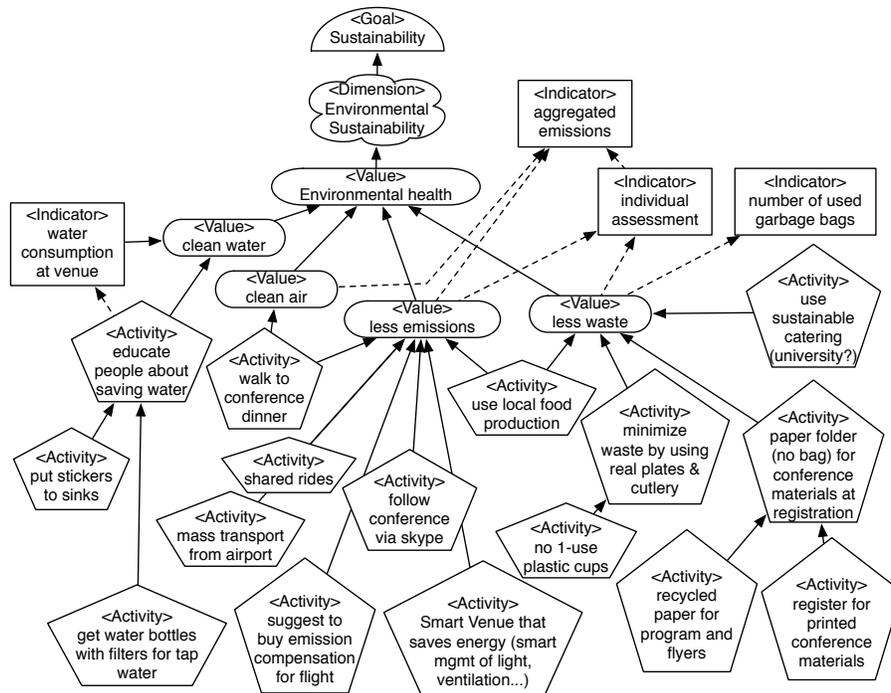


Fig. 4. Example instance for the environmental dimension of the Requirements Engineering Conference.

conference. This is also the most obvious goal conflict in the model, i.e., researchers are aware that they cause bad environmental impact by having global conferences, but at the same time the informal networking at these conferences is the most common spark for new research ideas and collaboration.

Economic sustainability values can be differentiated in saving money for the organization, saving money for the attendees, in economic fairness, and long-term break-even. For each of them, the submodel in Fig. 5 provides at least one supporting activity.

Technical sustainability (Fig. 6) is reduced to the aspect of knowledge conservation, as we wanted to abstract from the specifics of technical platforms.

B. Implementation: Realizing Actions

On the basis of these models, we selected a number of actions according to the practicability we estimated for them. Target areas were the preparations of the conference, sensitizing participants for travel impact (analysed in [6]), the conference giveaways, the advertising by sponsors at the conference, the conference venue and its catering, interaction, and lastly knowledge management.

1) *Conference Preparations*: Communicating with the organizing committee, especially the program chair, the local chairs, and the homepage team involved mainly email exchange. We agreed on the chosen subset of the actions with the program chair, addressed the respective organization committee members with our suggestions and asked for their opinion and support in realizing them as described below. The efforts are also summarized on the conference website.

2) *Sensitizing participants for travel impact*: To communicate to participants how they can make their travel to Río more (environmentally and economically) sustainable, we added some information to the conference website.

- Hostels along with the hotels, so that participants can choose a more economic option for accommodation that is likely to produce less environmental impact than a middle-to-high class hotel.
- Eco-tourism providers in the “Explore Brazil” section, so participants can plan trips before or after the conference in a sustainable way.
- Information on public transport (airport, venue) and a suggesting note on flight emission compensation.

The option of enabling online participation at the conference was briefly discussed with members of the organizing committee. There has to be found a business model that balances a reduced fee that is adequate for participation via a web conference with being able to provide a specific service level agreement at the same time for an online participation that provides less social interaction than a physical presence.

3) *Conference giveaways*: We contacted two manufacturers of reusable water bottles with a built-in filter and asked them to act as sponsors for the conference giveaways. Although filtered water is available at the venue, these bottles provide a useful accessory for traveling after the conference or back home. One of them agreed to our proposal and expressed their enthusiasm for helping us make the conference more sustainable.

4) *Advertising*: For other sponsors, for example IEEE Computer, we invented new ways of advertising to avoid shipping great amounts of printed magazines where it was not feasible (environmental and economic sustainability). We

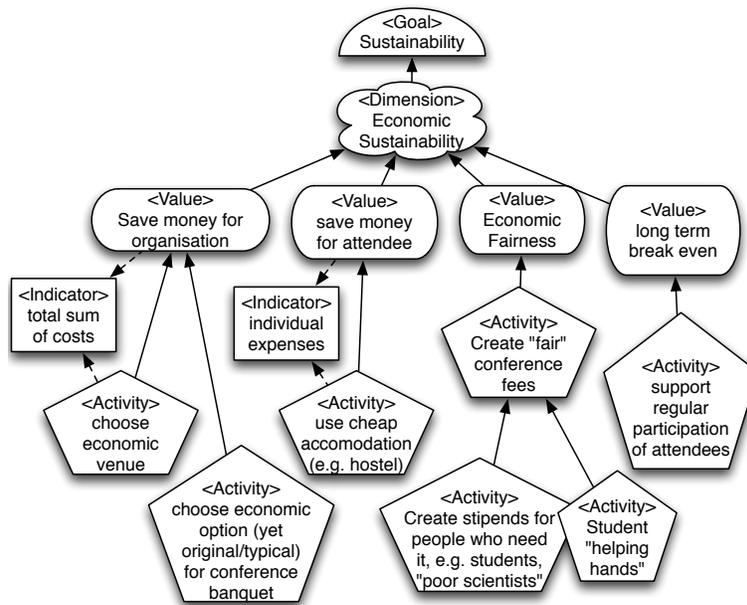


Fig. 5. Example instance for the economic dimension of the Requirements Engineering Conference.

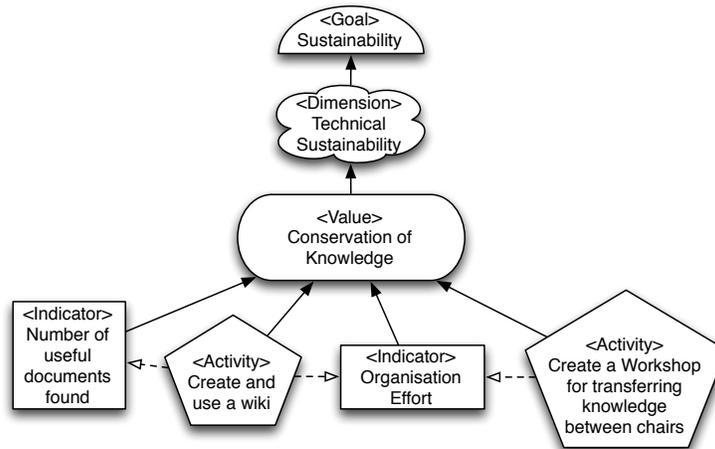


Fig. 6. Example instance for the technical dimension of the Requirements Engineering Conference.

did this by proposing to put up a poster with the offer of free downloads and using Quick Response (QR) codes, which are two-dimensional barcodes that can be scanned by smart phones, so conference participants can access the content online.

5) *Venue*: The venue for a conference dinner with Brazilian specialties and cultural background was already chosen by the time the model was developed. However, a local caterer was chosen and we agreed not to use plastic dishes/cups/cutlery, and to provide water to refill the reusable glasses and conference giveaway bottles instead of providing small plastic water bottles.

6) *Interactive Sessions*: The initiative “RE Interactive” mentioned in Sec. II implements some of the social sustainability actions, e.g., to provide sufficient time and space for discussion and interaction between the participants.

7) *Conference News and Knowledge Management*: In social media, the RE conference is already present on Facebook and Twitter. In order to provide better reporting during the conference, we reflect the tweets on the website. For RE’14, we envision to add a blog to the website that keeps track of the discussions during the conference as well to improve information for people who cannot attend the conference.

For new committee members (whether organizing or other), there is always the question of how to get the information from the people who filled the role before them, and for the ones leaving the roles, the question is how to conserve their knowledge and lessons learned for their successors. The answer is knowledge management, but the implementation remains to be chosen. At RE, knowledge transfer happens mainly via email, so that the knowledge is distributed and likely to get lost. This year, we attempt to collect the most important information in a draft *RE OC guide*, most likely in

a wiki. Naturally, this includes information for preparing the RE'14 conference by the future sustainability chair.

8) *Summary of Actions*: When trying to quantify how many activities we tried to realize and which ones we had to skip for this conference, we have to look back at the submodels presented in the last section. In the submodels, there are also activities included that have been worked on before at the RE conference, for example, to “create a sustainable pace in the timetable”. In the individual and the social dimension, we are working on all activities. In the environmental dimension we initiated 14 out of 16 activities — following the conference via Skype and registering for printed conference materials were omitted. In the economic dimension, we have not created stipends yet, but student volunteers are the best opportunity without significantly more budget.

C. Assessment: Plan for Measurement and Improvement

The assessment of the model is two-fold: First, we need to evaluate the indicators to understand the impact of the activities on sustainability. Second, we need to understand and improve the quality of the model itself.

1) *Measurement of Indicators*: The effectiveness of the activities will be measured via a number of indicators (see submodels in Fig. 2 - 6), quantitatively where possible and qualitatively, throughout and after the conference. The main aspects are listed in Table I. We are interested in the percentage of people who made use of our suggestions and offers, and especially how many people used these suggestions the first time.

TABLE I
INDICATOR ASSESSMENT

Indicator	Assessment
Vividness of discussions	Questionnaire & comparison
Number of returning attendees	Questionnaire
Subjective impression on social values	Questionnaire
Costs of conference	Accountancy
Individual expenses for Conference	Questionnaire
Water consumption	(Prob. not measurable)
Aggregated emissions	(Prob. not measurable)
(New) Usage of emission compensation	Questionnaire
Used garbage bags	Feedback from caterer
Organisation effort	Feedback from chair
Number Knowledge Documents	Counted after conference

2) *Feedback for Improvement*: We understand that the sustainability model is just a first step that needs to continuously improve and be adapted. As such, it heavily depends on the support and feedback of the conference participants. Hence, we not only welcome, but need suggestions and critics from chairs and attendants of the conference. As visibility is a key success factor, we will advertise the on-going process by awarding the best improvement suggestions (in terms of importance and applicability) during the conference.

The sustainability model gives a well-structured form for finding new feedback: The feedback will assess existing activities, and furthermore focus on finding new values, activities and indicators.

V. DISCUSSION

In this section, we discuss the completeness of the model, cost estimation, success approximation, problems and limitations, and dissemination to future conferences.

A. Completeness of actions and impact

An interesting question is the completeness of the model with respect to the possibilities of action and with respect to the impact the conference actually has.

The model relies on the generic reference model, which provides a basic selection of activities and indicators. However, due to the goal of being generic, there is still a lot of room for exploration of the specific context and its possibilities. We cannot claim that the model is complete and therefore neither that it would absolutely maximize the sustainability of the conference.

B. Cost estimation

The costs for implementing the actions are rather low. It required personal effort to gather information, to email and convince people by new ideas, and to organize logistics and technical platforms. Consequently, there is no reason against supporting the initiative — it just needed a stakeholder.

C. Success approximation

To estimate what we can actually achieve by implementing these activities at the conference, we have to rely on a number of indicators that shall provide measures for their successfulness. However, the choice of indicators always reduces a goal to just that number or qualitative measure and it is hard to actually approximate a value by such reduced means. Therefore, we are aware that the indicators can only roughly approximate the effectiveness of the activities and we have to rely on mainly qualitative data, such as personal opinion and individual impression by the conference participants.

D. Problems & Limitations

There is a number of problems and limitations to our initiative: There are inherent goal conflicts between some of the objectives in the submodels. For example, there is the ever-present trade-off between the most environmentally sustainable choice with minimized environmental impact and the most economic choice. Furthermore, there is a trade-off between making the conference a great experience for all participants and the budget limits. There is no actual solution to the problem — as in standard goal modelling, we can only opt for a good balance.

Travelling to the conference is definitely the biggest environmental impact that is caused, but following the conference via Skype or webcast as indicated in Fig. 5 is currently not supported in the registration process.

Furthermore, as measuring is difficult due to the reasons named above, reduction to indicators and the necessity to rely on individual feedback, actual proof of the effectiveness of the activities and their impact is limited.

However, the most important limitations are acceptance and support by the community. We do not know how successful we will be in establishing a culture of sustainability at the RE conference, how willing participants are to adapt some of their behaviour, for example, with regard to traveling. The idea cannot be to impose rules and constraints but has to be to convince and motivate people so they feel inspired and voluntarily initiate change.

E. Dissemination to future RE & other conferences

Comparing our work to Cabot et al. [4], we can only assume that their goal model is still used as inspiration by the general and local chairs of the conference. According to a private conversation with a recent former ICSE chair, sustainability is being taken into account to some extent, but there is no explicit strategy and no explicit stakeholder for it, as a conference organization in that dimension already holds a huge number of challenges to be mastered.

For disseminating the initiative to future RE (and other) conferences, we have to show the actual benefits and to establish a culture of sustainability at the conference, including an explicit stakeholder in the organizing committee.

VI. CONCLUSIONS

This paper presented a sustainability model tailored to the RE conference and described how it was developed and implemented for and at the current RE'13. This included the definition of activities for the different dimensions of sustainability and the selection of indicators to measure their impact as well as the communication and logistics to realize them at the venue. We furthermore discussed limitations and trade-offs that had to be made.

a) Next steps: We will update and assess the indicators to report on the effectiveness and impact of the implemented activities. On this basis, the future pursuit of the initiative will be shaped.

b) Appeal: We want to encourage participants to take part in the activities and contribute new ideas. We hope to carry this forward throughout the “grown-up” RE conference series.

c) Future Work: The proposed model is a bottom-up approach to improve the sustainability of the conference. More fundamental questions that need to be discussed in our research community are:

- Is the RE conference sufficiently supporting research about sustainability in RE?
- Is the process of the RE conference sustainable? Do current review mechanisms and closed access publication support or hinder good research?
- Does the RE community have a positive impact on the real world? Is the effect of the scientific contribution greater than the negative environmental impact?

ACKNOWLEDGMENT

The authors would like to thank Martin Mahaux for suggesting the explicit role of a sustainability chair at the RE

conference and his feedback on drafts of this paper, Olly Gotel and Alistair Mavin for feedback on proposed activities, to the local organizing committee for their support in implementing the activities, and Jonas Eckhardt for feedback on a draft version of this paper. This work is part of the EnviroSiSE project (grant number PE2044/1-1) funded by the DFG in Germany.

REFERENCES

- [1] ISO 14000 - Environmental management, 2004. <http://www.iso.org/iso/home/standards/management-standards/iso14000.htm>.
- [2] ISO 26000 Guidance on social responsibility, 2010. <http://www.iso.org/iso/home/standards/iso26000.htm>.
- [3] Paul Burger and Marius Christen. Towards a capability approach of sustainability. *Journal of Cleaner Production*, 19:787–795, 2001.
- [4] J. Cabot, S. Easterbrook, J. Horkoff, L. Lessard, S. Liaskos, and J.-N. Mazon. Integrating sustainability in decision-making processes: A modelling strategy. In *International Conference on Software Engineering*, pages 207–210, 2009.
- [5] R. Goodland. *Encyclopedia of Global Environmental Change*, chapter Sustainability: Human, Social, Economic and Environmental. Wiley and Sons, 2002.
- [6] Stefan Gössling. Global environmental consequences of tourism. *Global Environmental Change*, 12(4):283 – 302, 2002.
- [7] Lorenz Hilty. *Information and Communication Technologies, Society and Human Beings: Theory and Framework*, chapter 33: Information and Communication Technologies for a More Sustainable World. Information science reference, Hershey, New York, 2010.
- [8] Tim Holmes, Elena Blackmore, and Richard Hawkins. *The Common Cause Handbook: A Guide to Values and Frames for Campaigners, Community Organisers, Civil Servants, Fundraisers, Educators, Social ... Funders, Politicians, and Everyone in Between*. Public Interest Research Centre Ltd, 2011. <http://valuesandframes.org/>.
- [9] Martin Mahaux, Patrick Heymans, and Germain Saval. Discovering Sustainability Requirements: an Experience Report. In *17th Intl Working Conf on Requirements Engineering: Foundation for Software Quality*, 2011.
- [10] Karel F. Mulder. Innovation for sustainable development: from environmental design to transition management. *Sustainability Science*, 2:253–263, 2007.
- [11] Birgit Penzenstadler. Towards a definition of sustainability in and for software engineering. In *28th Annual ACM Symposium on Applied Computing (SAC)*, 2013.
- [12] Birgit Penzenstadler and Henning Femmer. A generic model for sustainability with process- and product-specific instances. In *International Workshop on Green In Software Engineering and Green By Software Engineering at AOSD*, 2013.
- [13] Helio Piñón. Architecture, computers and sustainability (keynote). In *16th IEEE Intl Conf on Requirements Engineering*, 2008.
- [14] K.-H. Robert, B. Schmidt-Bleek, J. Aloisi de Larderel, G. Basile, J.L. Jansen, R. Kuehr, P. Price Thomas, M. Suzuki, P. Hawken, and M. Wackernagel. Strategic sustainable development — selection, design and synergies of applied tools. *Journal of Cleaner Production*, 10:197–214, 2002.
- [15] David Stefan, Mark Barrett, Emmanuel Letier, and Mark Stella-Sawicki. Goal-oriented system modelling for managing environmental sustainability. In *Intl Workshop on Software Research and Climate Change (WSRCC)*, 2010.
- [16] United Nations World Commission on Environment and Development. Report: Our Common Future. In *United Nations Conference on Environment and Development*, 1987.
- [17] Jean-Pascal van Ypersele. Climate change: Challenges and opportunities for software requirements engineering (keynote). In *16th IEEE Intl Conf on Requirements Engineering*, 2008.