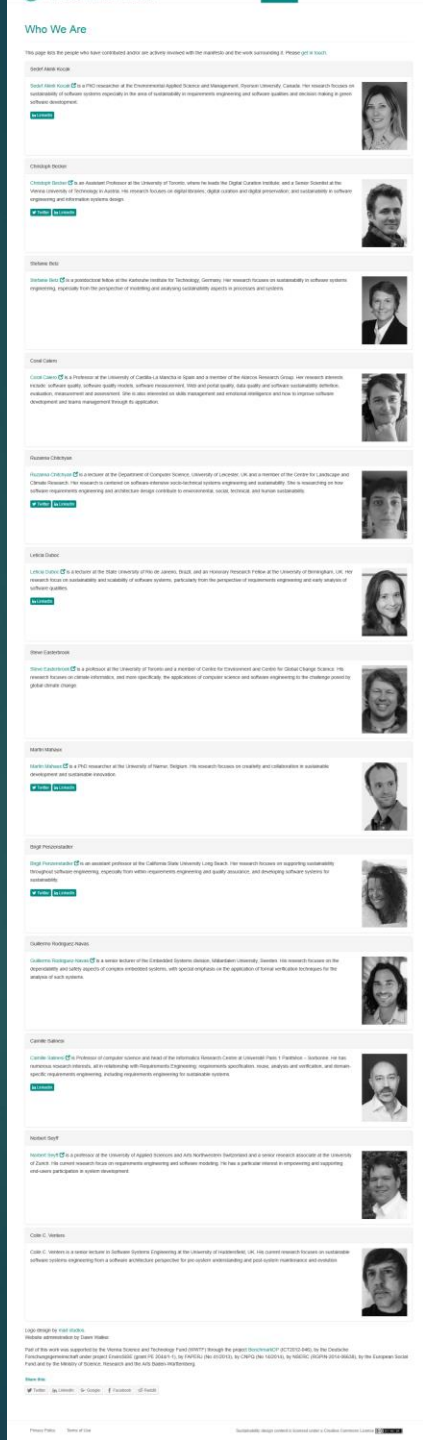
Sustainability design

CHRISTOPH BECKER
FACULTY OF INFORMATION, UNIVERSITY OF TORONTO
VIENNA UNIVERSITY OF TECHNOLOGY
DAGSTUHL 16252

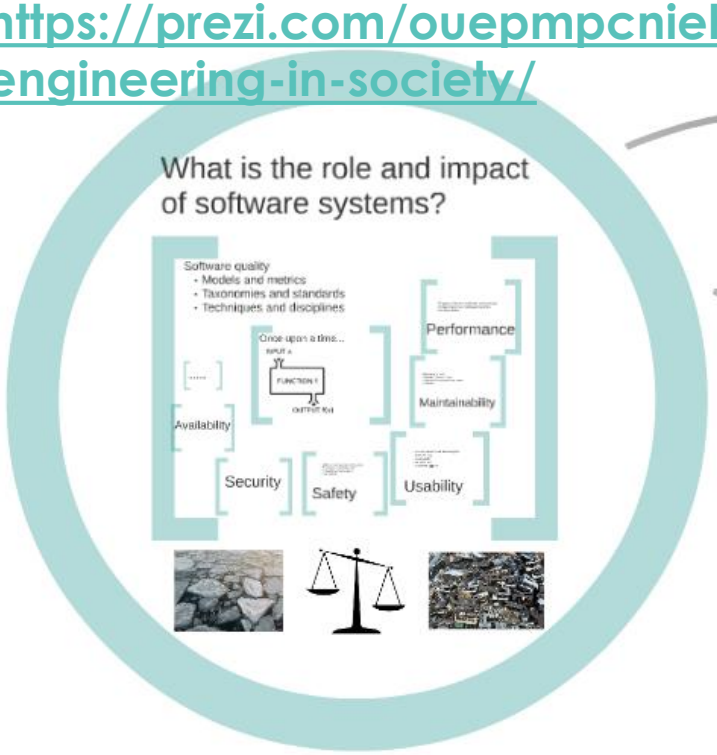
Sustainability design

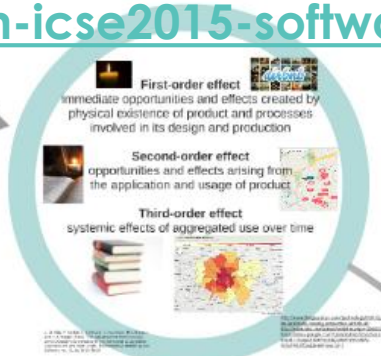
- Software increasingly central to the fabric of societies and industries
- Opportunities and goodwill, but few good outcomes
- Initiative started at Requirements Engineering for Sustainable Systems workshop, RE4SuSy 2014, following a suggestion in a position paper
- Aim to provide a common ground for thinking about **sustainability in systems design** across disciplines related to software



http://sustainabilitydesign.org/who-we-are/

https://prezi.com/ouepmpcniehi/sustainability-design-icse2015-software-engineering-in-society/

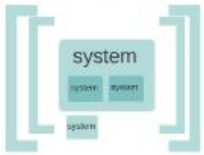




Sustainability in systems design

sustainability: the "capacity to endure"

sustain what? for whom? for how long?



Christoph Becker
christoph.becker@utoronto.ca
UNIVERSITY OF TORONTO
FACULTY OF INFORMATION
Digital Curation Institute

Selected (mis)perceptions & practices 4

Individuals

- Sustainability as environmental or financial
- Sustainability as separate from software engineering
- Sustainability as a nice-to-have quality

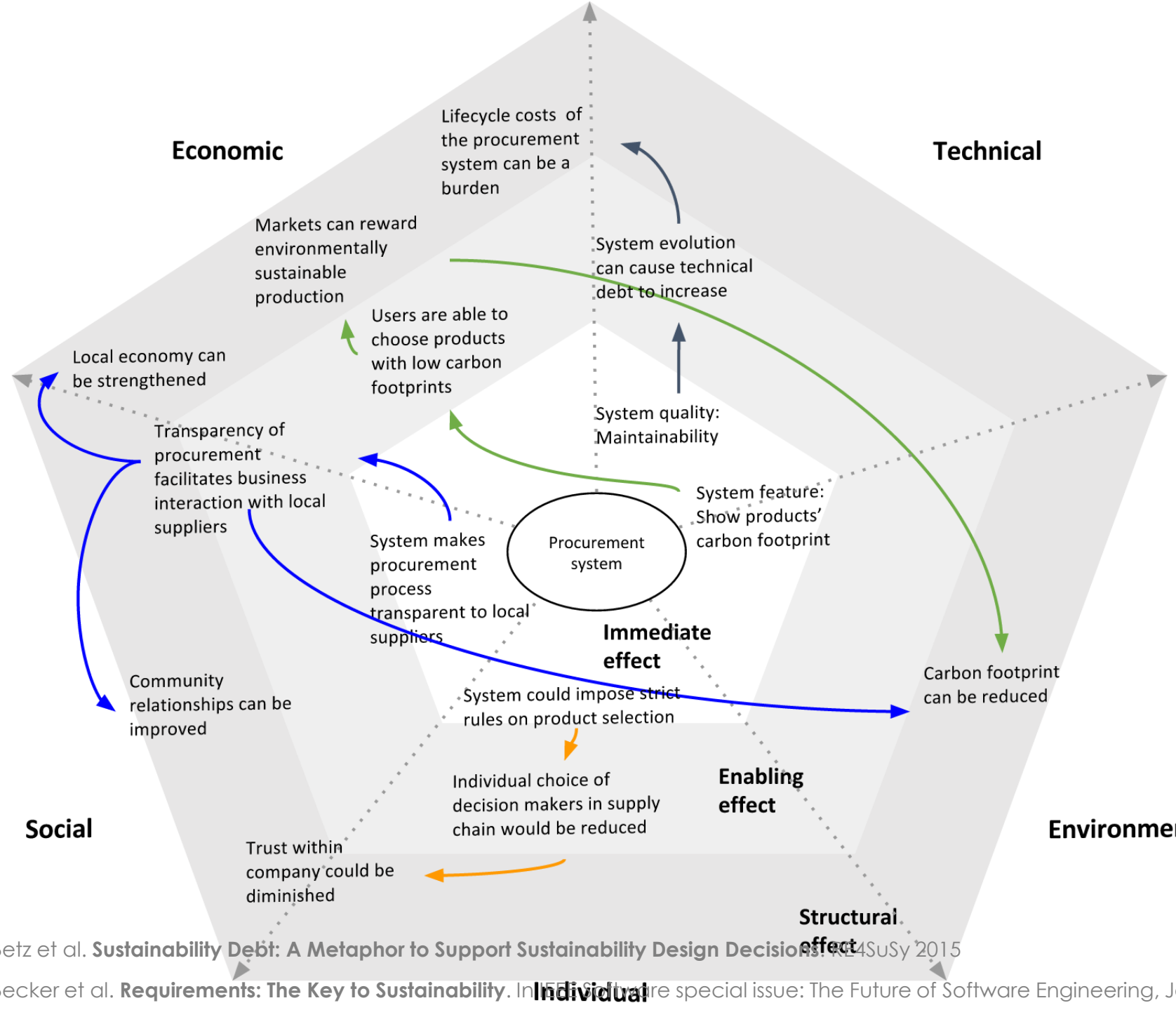
Professional environment

- Lack of methodological support
- Roles & responsibilities of customers, engineer & managers
- Management support
- Assumed costs and perception of trade-off

Norms in engineering practice

- Project success assessed at delivery only
- Poor communication of sustainability values
- Regulations are drivers for sustainability

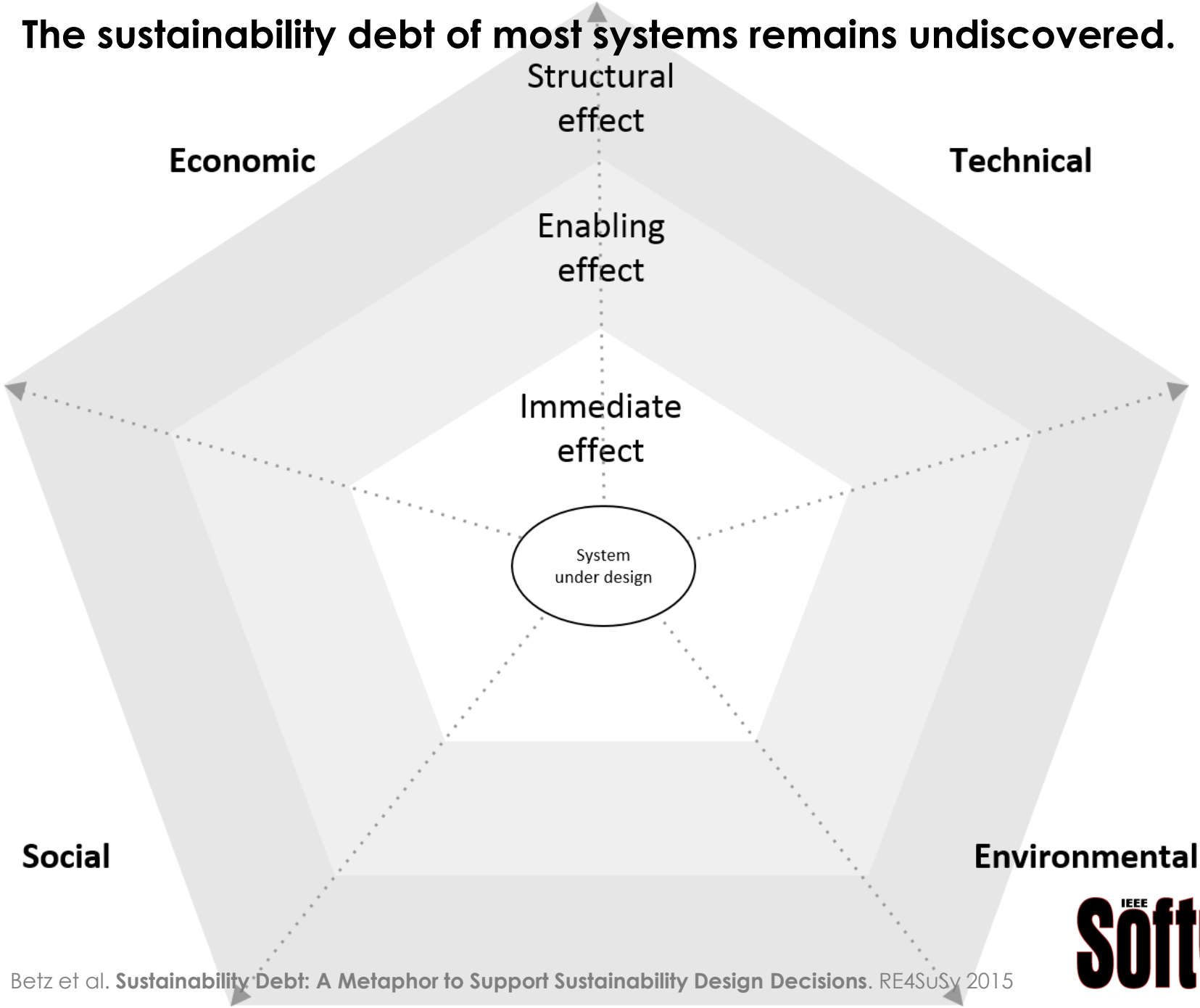
Chitychyan, Becker et al (2016). Sustainability Design in Requirements Engineering: Theory and Practice. ICSE SEIS 2016



Betz et al. **Sustainability Debt: A Metaphor to Support Sustainability Design Decisions**. RE4SuSy 2015

Becker et al. **Requirements: The Key to Sustainability**. In IEEE Software special issue: The Future of Software Engineering, January 2016

The sustainability debt of most systems remains undiscovered.



Betz et al. **Sustainability Debt: A Metaphor to Support Sustainability Design Decisions.** RE4SuSy 2015

Becker et al. **Requirements: The Key to Sustainability.** IEEE Software special issue: The Future of Software Engineering, January 2016

KARLSKRONA MANIFESTO FOR SUSTAINABILITY DESIGN

- Strive to advance not just technical and economic, but also social, individual and environmental goals simultaneously
- Need for new approaches:
  - Context
  - long-term interactions
  - socio-technical
- Need to counter pervasive misperceptions
  - 11 misperceptions and counterpoints

Becker et al (2015). Sustainability design and software: The Karlskrona Manifesto. ICSE'2015. http://dl.acm.org/citation.cfm?id=2819009.2819082

11 misperceptions and counterpoints such as…

- **There is** a tendency to focus on the immediate effects of a new system in terms of its functionality and how it is used.
- **Whereas** the following orders of effects have to be distinguished:
  1. **Direct**, first order effects are the immediate opportunities and effects created by the physical existence of a system and the processes involved in its design and production.
  2. **Enabling**, second order effects are the opportunities and effects arising from its application and usage.
  3. **Structural**, third order effects, finally, are aggregate effects from wide-scale use of a system over time.

Adapted from Karlskrona Manifesto, http://www.sustainabilitydesign.org/karlskrona-manifesto/

FOCUS: THE FUTURE OF SOFTWARE ENGINEERING

IEEE Software

Requirements: The Key to Sustainability

Christoph Becker, University of Toronto

Stefanie Betz, Karlsruhe Institute of Technology

societies that the resulting sociotechnical systems' boundaries and interactions are often hard to identify. For example, communication, travel booking, and procurement systems influence the socioeconomic and natural environment through far-reaching effects on how we form relationships, how we travel, and what we buy. The engineering process rarely makes these effects explicit. Their lack of visibility makes assessing a software system's long-term and cumulative impacts difficult.

- Requirements set the foundation for the impact of systems.
- Sustainability Design
  - Requires an appreciation of '**wicked problems**' in systems design
  - favors **integrated understanding** over a divide-and-conquer approach to systems analysis.

Requirements: The Key to Sustainability. In IEEE Software special issue: The Future of Software Engineering, **January 2016**

Decision gates

- Project purpose
- System boundary scoping
- Stakeholder identification
- Requirements elicitation
- Success criteria definition
- ….

Challenges

- Barriers on individual, business & disciplinary levels
- Discourse reveals
  - Reductionist perspective
  - Solutionist mindset
  - Techno-determinism
  - Misperceptions & blind spots
  - Assumptions about the engineering process

Who can help?

- Socio-technical systems
- Social informatics
- Values in design
- Behavioural economics
- …
- …
- …
- Critical Systems Thinking
- Social Construction of Technology
- …

What can we do?

- The conceptual toolset of SW engineering is inadequate for understanding what we normally call "software sustainability"
- We've barely begun to articulate, within the engineer community, some thoughts about sustainability design
- SD requires a paradigm shift, but the engineering community is unlikely to get that shift going.
- SSH research has commonly remained in a position of critique
- SSH needs to engage - **constructively**.
- Interesting threads exist, but most either on macro-level ("the bicycle") or micro-level (one person's experience).

What do I plan to do?

- I'm interested in empirical research that helps us understand what exactly is happening when people take trade-off decisions between current & future benefits in software projects
  1. Case studies of systems design projects
     - Understand path-dependent decision making
     - Question assumptions about trade-off decisions
     - Identify leverage points for intervention
  2. Tools to make sustainability debt visible
  3. Action Research with software teams
- use that insight to develop design methods and tools to support more responsible choices, and translate that into practice

- www.sustainabilitydesign.org

- dci.ischool.utoronto.ca
- christoph.becker@utoronto.ca
- @ChriBecker

KARLSKRONA MANIFESTO
FOR SUSTAINABILITY DESIGN