Sustainability Debt: A Metaphor to Support Sustainability Design Decisions

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Motivation

• Sustainability design
  • Is a systemic concept
  • Trade-offs need to be considered

• Current situation
  • Increased awareness
  • Challenging to identify and communicate

• The metaphor helps to identify, communicate and document the dimensions, effects, and trade-offs
Foundations

• **Debt**
  - Financial tool
  - **Economic transactions over time**
    - debtor, a creditor, and a contract
  - Financial and economic models can be applied to identify, measure, prioritize, repay, and monitor debt [Z. Li, P. Liang, and P. Avgeriou2014]
  - **Intentional** actions
  - **Unintentional** consequences [M. Fowler2015]

• **Technical Debt**
  - **Invisible result of past decisions** that negatively affect its future [M. Fowler2015, P. Kruchten, R. L. Nord, and I. Ozkaya2012]
  - Unintentional versus intentional debt
    - Short term versus long term debt
  - Helps to **understand trade-offs** and **communicate** about them
  - Helps to **identify temporal effects**
Related Work

- **Ecological debt** [I.-R. de Guzman, M. Piattini, and R. Prez-Castillo 2015]
  - Resource usage of delivering and maintaining a system with a greenability degree
  - Measuring the power consumption

- **Social debt** [D. Tamburri, P. Kruchten, P. Lago, H. Van Vliet et al. 2013]
  - Unforeseen project costs connected to strained social relationships
  - No exact definition
  - Intertwined with technical debt

- **“Sustainability debt”** [B. Ojameruaye and R. Bahsoon 2015a,b]
  - Decision support framework for choosing the best software architecture with respect to sustainability
  - Quantifies the gap between the level of sustainability achieved with a specific architecture and an ideal environment
  - No clear definition
  - No consideration of the levels of effects
Metaphor Sustainability Debt

• **Working Definition:** “Sustainability debt is the hidden effect of past decisions about software-intensive systems that negatively affect economic, technical, environmental, social, and individual sustainability of the system under design. Effects in these dimensions can manifest themselves on three different levels: (1) the direct effects of the software system production and use; (2) enabling effects that arise from the ongoing use of the software system, and (3) systemic changes caused by the use of the software system on a larger scale over time“
Sustainability Debts

• Economic Sustainability Debt
• Technical Sustainability Debt
• Environmental Sustainability Debt
• Individual Sustainability Debt
• Social Sustainability Debt

• More than just the sum of the five dimensions debts because of the interdependencies
Key Limitation and Open Questions

- No quantifiable contract between debtor and creditor
  - Only able to quantify the debt to some extent (if at all)
  - Creditor generic and removed in space and time
  - No mechanism of repaying debt

- Questions
  - How to identify causes?
  - Quantifying it in requirements engineering?
  - Use it intentionally? Do we want that?
  - Right metaphor to use at all?
References


