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Technical Debt

How Software Organizations Can Stay Solvent

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The Known Universe

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Rankings - Top 100 university

#80 Times Higher Education Worldwide

#72 Academic Ranking of World Universities

#86 U.S. News 'Best Global Universities Ranking'

Founded in 1614

Research Philosophy

- Core business: Software Architecture
- With Dutch & European industry (real problems)
  - Embedded Systems & Enterprise Applications
- Automated Software Engineering
- Evidence-based Software Engineering
  - Evidence matters - empirical research methods

IEEE Software

Outline

- **Introducing the metaphor**
- Emergence of TD
- Concepts of TD and management
- Present and Future

"Shipping first time code is like going into debt. A little debt speeds development so long as it is paid back promptly with a rewrite …"

"The danger occurs when the debt is not repaid. Every minute spent on not-quite-right code counts as interest on that debt. Entire engineering organizations can be brought to a stand-still under the debt load of an unconsolidated implementation, object-oriented or otherwise."

Ward Cunningham, The WyCash portfolio management system, OOPSLA '92

Technical Debt is a collection of design or implementation constructs*

that are expedient in the short term,

but set up a technical context that

can make future changes more costly or impossible

Dagstuhl April 2016

* 1. Immature artifacts
  2. Postponed tasks

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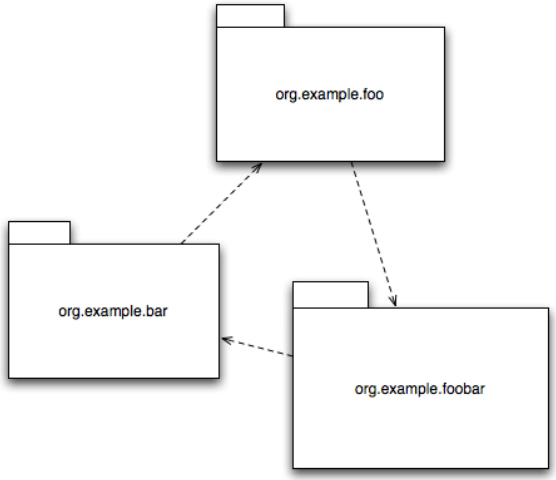
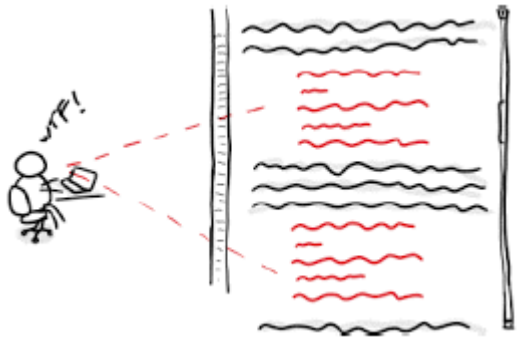
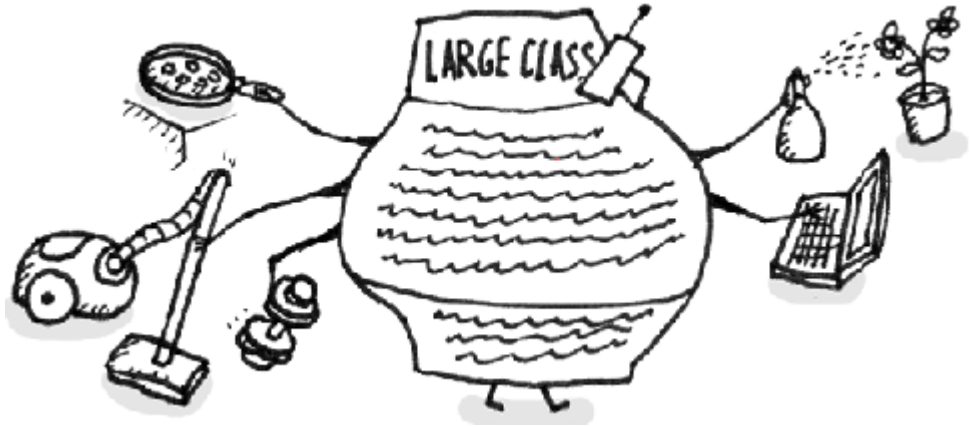
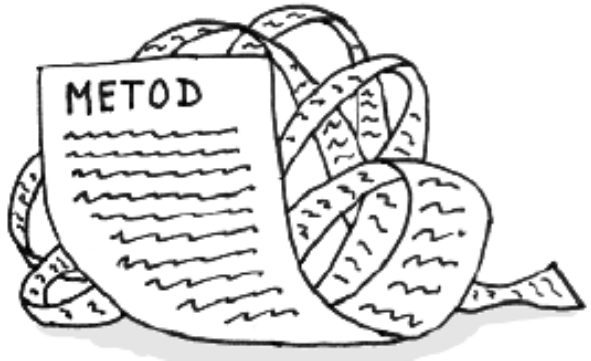
Technical Debt illustrated









Images from https://refactoring.guru/smells

Technical Debt metaphor

- Debt is a necessary tradeoff
  - Loan for investment
  - Quality-- for business value++
- Pay back *principal* (fix TD) + *interest* (maintain SW)
- Complete payoff may be unrealistic
- Debt should be monitored and managed
  - Risk – accumulation may spiral out of control

- Both a metaphor and a SW Dev artifact

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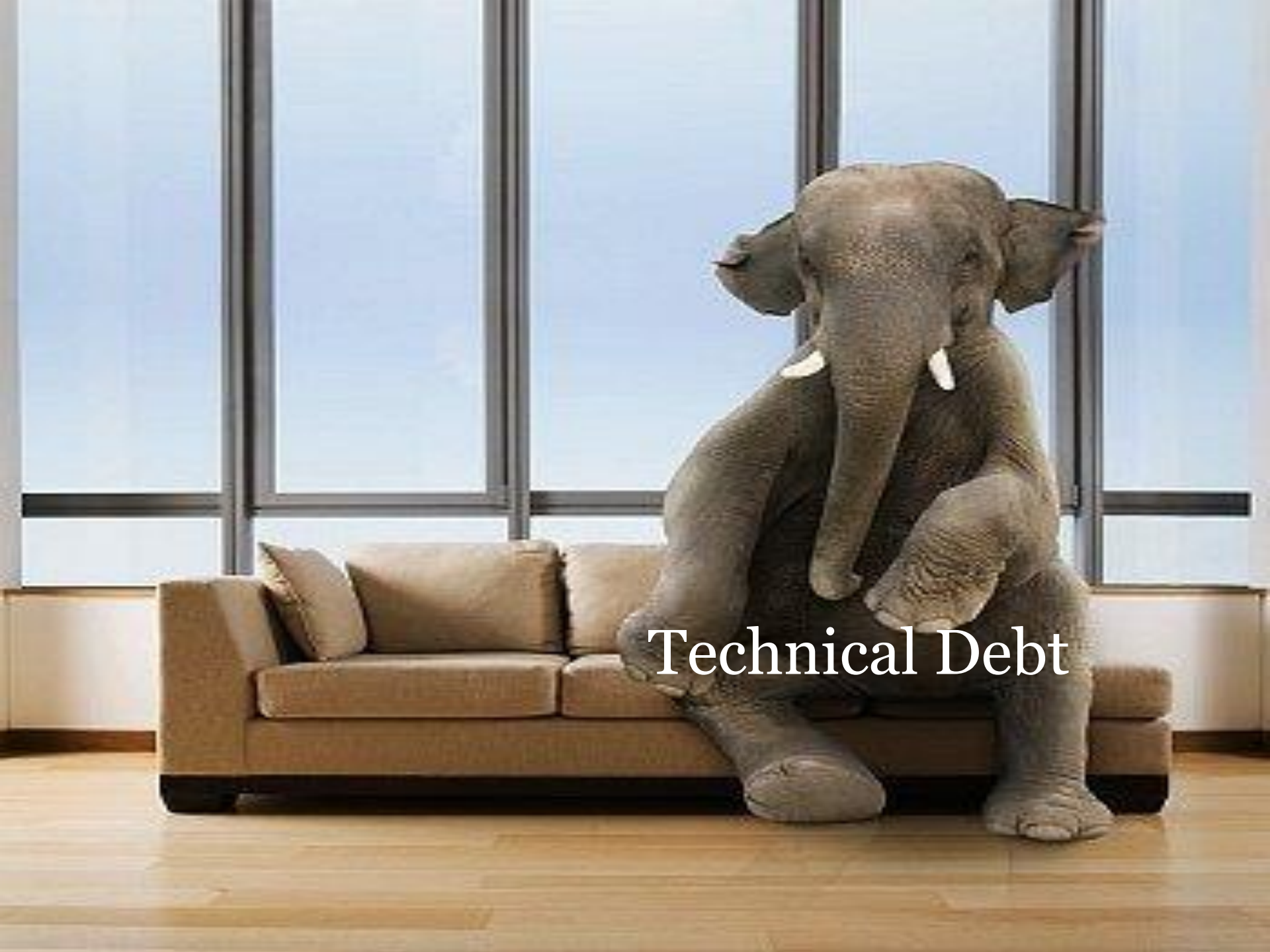
For every 100 KLOC an average software application had approx. US$361,000 of technical debt*

Curtis et al. “Estimating the Principal of an Application’s TD,” *IEEE Software* ‘12


Technical Debt

Is this really new?

Communities

- Maintenance & evolution
- Reengineering / refactoring

Terms

- Aging
- Decay
- Sustainability

- Little progress
- “Dull” topic

Convergence of SE disciplines

- Program analysis/comprehension
- SW Quality measurement
- Qualitative research methods
- SW risk management

MTD>sum of parts!

IEEE Software

SCHLOSS DAGSTUHL
Leibniz-Zentrum für Informatik

Z. Li et al., A systematic mapping study on technical debt and its management, JSS 2015

Outline

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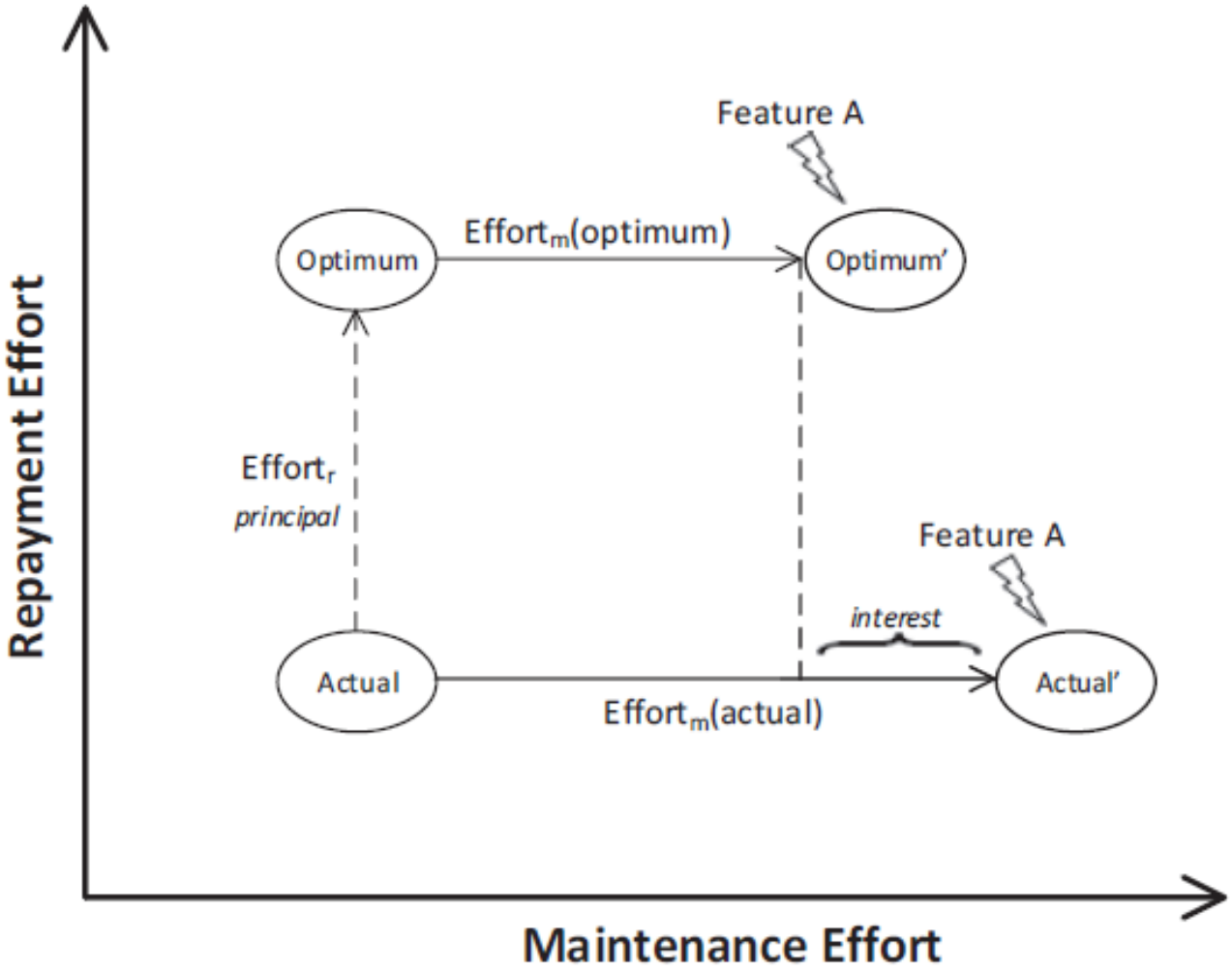
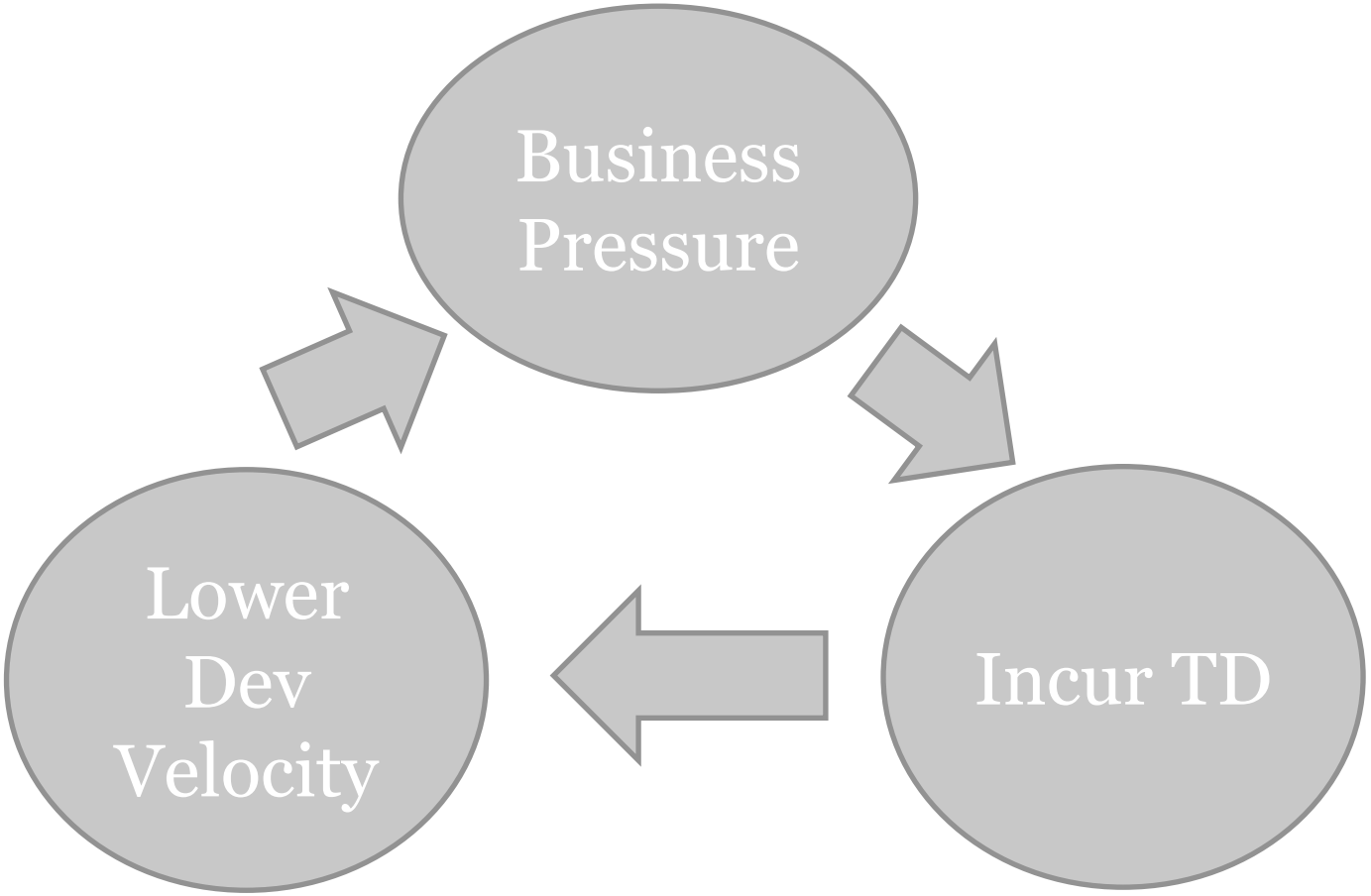
Debt=Principal+Interest

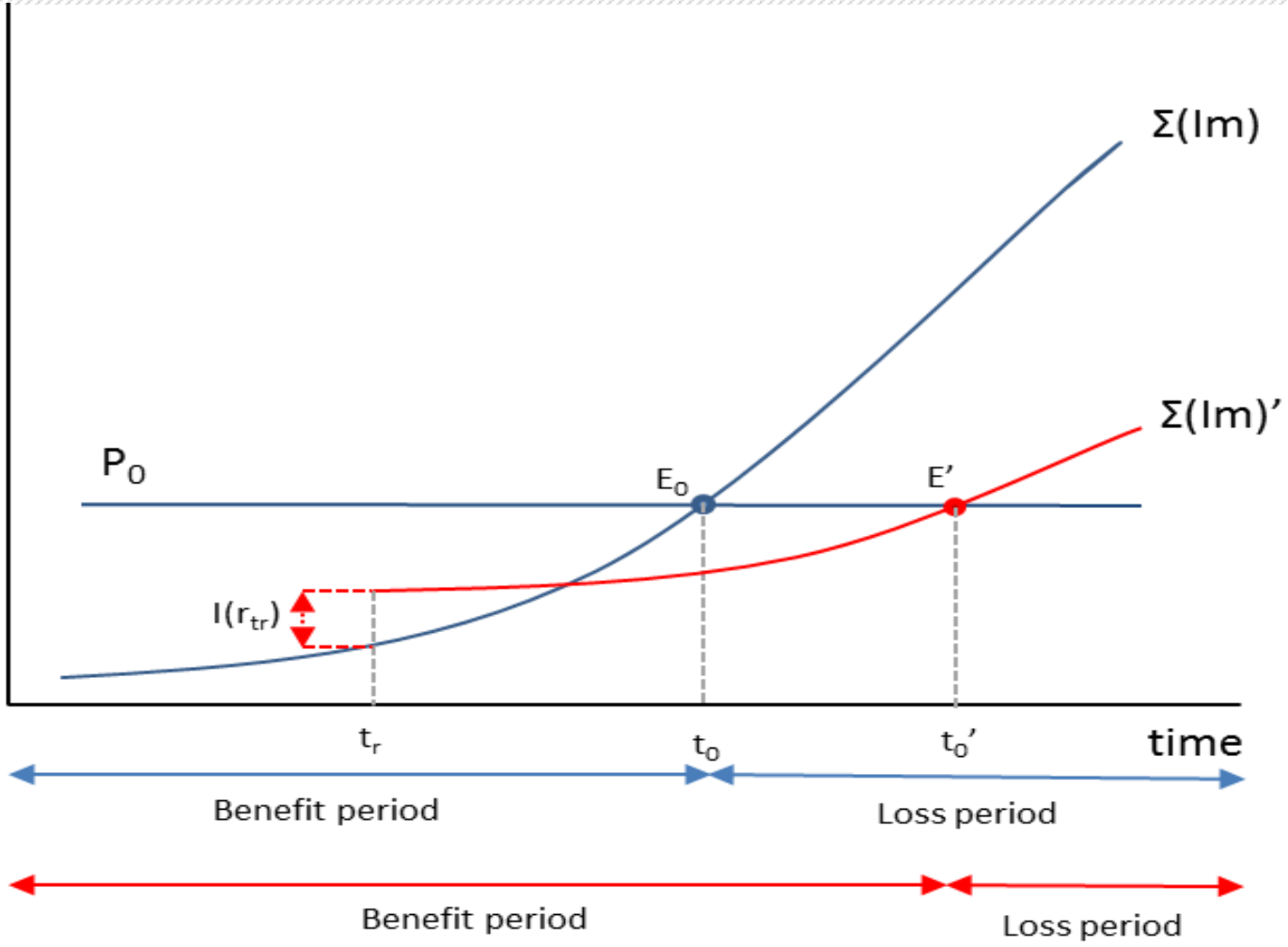


Ampatzoglou et al., A Financial Approach for Managing Interest in TD, BMSD '15

Vicious circle of technical debt

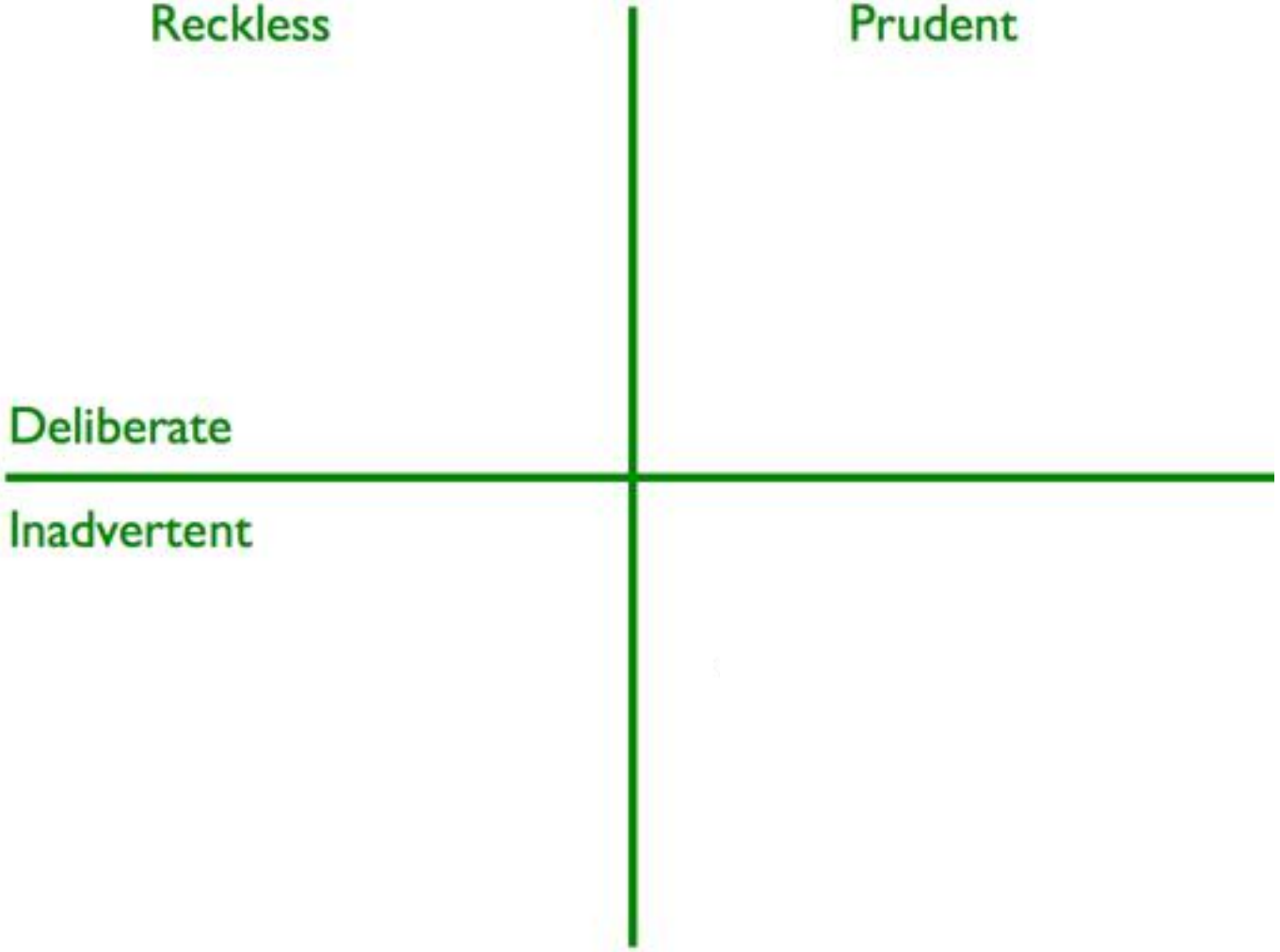


Breaking point: principal vs. interest



Ampatzoglou et al., A Financial Approach for Managing Interest in TD, BMSD '15

Types of TD



Martin Fowler 2009

Just the code?

Not quite right

- Code
- Requirements
- Architecture
- Design
- Test
- Build
- Documentation
- Infrastructure
- Versioning

...

Technical debt is pervasive

Just the code?

- Code
- Requirements
- Architecture
- Design
- Test
- Build
- Documentation
- Infrastructure
- Versioning

Complex dependencies
Architecture smells
Architecture drift

Just the code?

- Code
- Requirements
- Architecture
- Design
- Test
- Build
- Documentation
- Infrastructure
- Versioning

Low code coverage
Lack of test automation
Expensive tests
Residual defects not found

Just the code?

- Code
- Requirements
- Architecture
- Design
- Test
- Build
- Documentation
- Infrastructure
- Versioning

Insufficient/incomplete/out of date
Lack of code comments


Debt

Managing TD

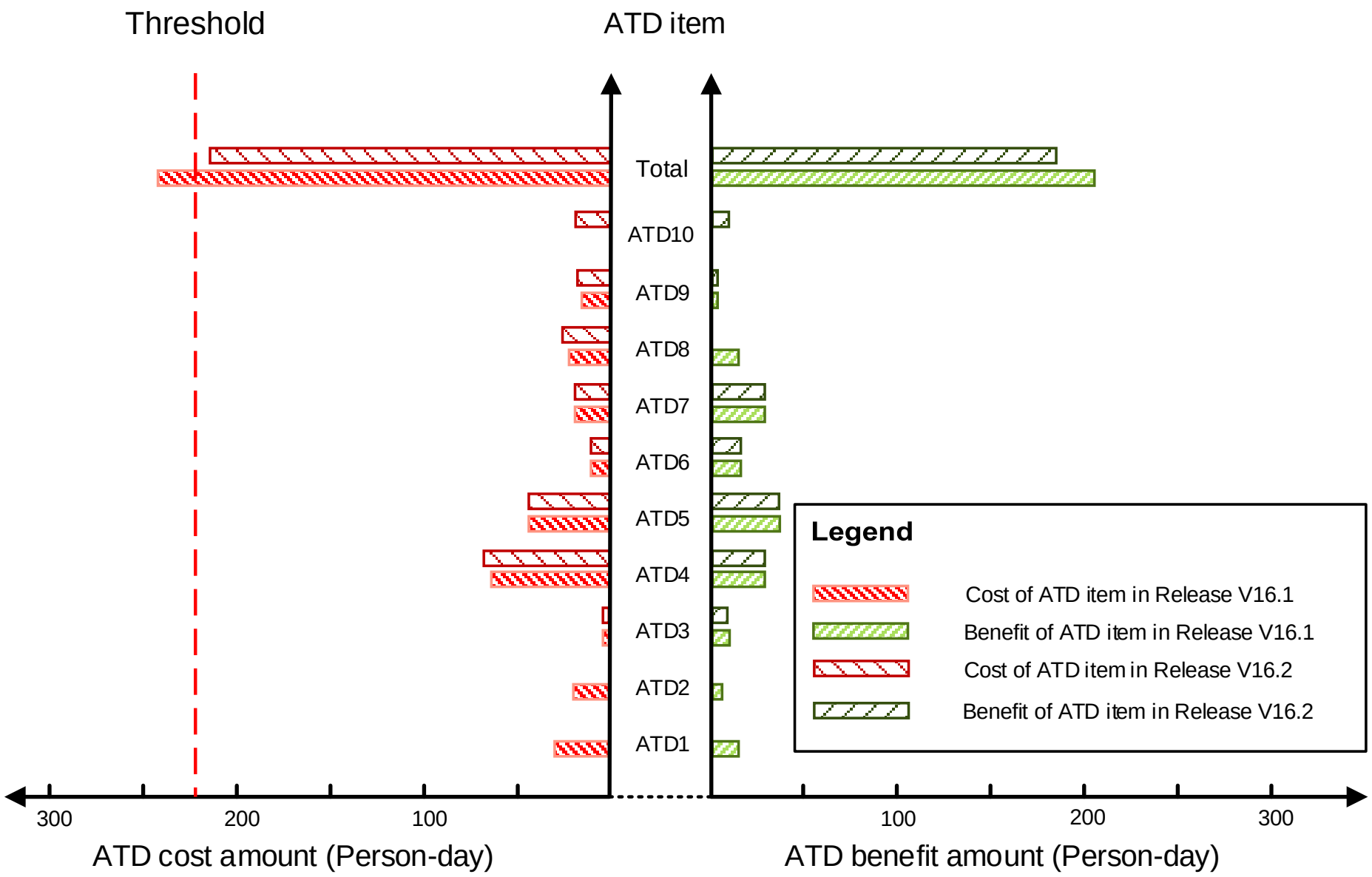
- TD prevention
- TD identification
- TD measurement
- TD prioritization
- TD monitoring
- TD repayment
- TD representation/documentation
- TD communication

Li et al., Architectural Debt Management in Value-oriented Architecting, Elsevier '14

Managing TD

- TD prevention
- TD identification
- TD measurement
- TD prioritization
- TD monitoring
- TD repayment
- TD representation/documentation
- TD communication

Mathematical models
Code metrics
Human estimation



Li et al. *Architecture viewpoints for documenting ATD*, Elsevier 2016

Managing TD

- TD prevention
- TD identification
- TD measurement
- TD prioritization
- TD monitoring
- TD repayment
- TD representation/docu tation
- TD communication

TD dashboard
Backlog
Dependency visualization
Code metrics visualization
TD propagation visualization

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Technical debt in Backlog

	Visible	Invisible
Positive Value	**New features Added functionality**	**Architectural, structural features**
Negative Value	**Defects**	**Technical debt**

Philippe Kruchten, Technical debt – From metaphor to theory and practice, IEEE SW2012.

Outline

- Introducing the metaphor
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Main thesis

- Technical debt grows
- Managing TD is **dominant** in SW evolution
  - Established as a core SE practice
- It's the next big thing

  ++ Investment

  -- Bankruptcy

State of the art

- From source code to the whole lifecycle
- Glossaries and ontologies (convergent)
- Tooling (industrial & prototypes)
- Economic theories

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Breaking the metaphor

- People who collect TD ≠ people who repay TD
- Relating TD to an interest rate or interest period
- TD can be unintentional
- TD does not always have to be repaid
- TD does not necessarily have a bad side

State of practice

SW engineers

- Understand the concept and challenges
- Deal with it during maintenance
- TD management in place but with constraints
  - Resource-intensive
  - Realistically only a portion managed


Short deadline
vs.
Long-term sustainability
SW Engineers don’t like TD
Managers don’t mind TD
Communication bridge
Investment opportunity

Join the community!

- Source code -> architecture
  - Automatic detection of (architecture) smells
- Economic theories for sound investments
  - Business value to intrinsic qualities/refactoring
- Automating identification and measuring
  - Data mining in SW repositories
- Benchmarking
- Teach TD in school
  - Throughout the curriculum

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Thank you

Credits:

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Zengyang Li

Peng Liang

Areti Ampatzoglou

Apostolos Ampatzoglou

Alexander Chatzigeorgiou