

# Technical Debt

## New solutions for an old problem

Prof. dr.ir. Paris Avgeriou - [paris@cs.rug.nl](mailto:paris@cs.rug.nl)

Software Engineering and Architecture Group

<http://www.cs.rug.nl/~paris/>

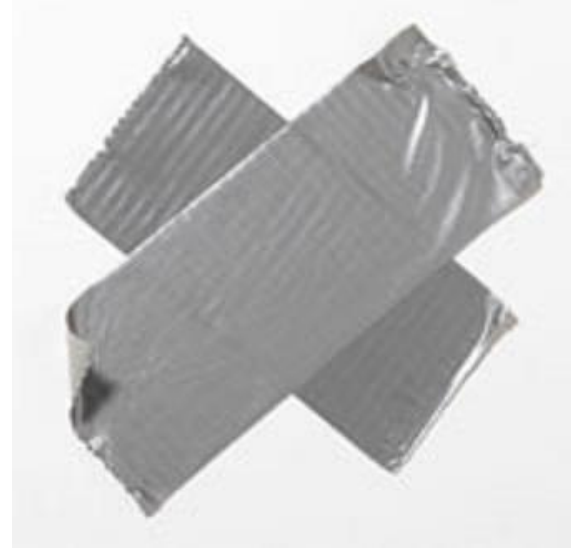
## Technical debt (TD)

Technical compromises\*

that can yield short-term benefit

but may hurt the long-term health of a software system

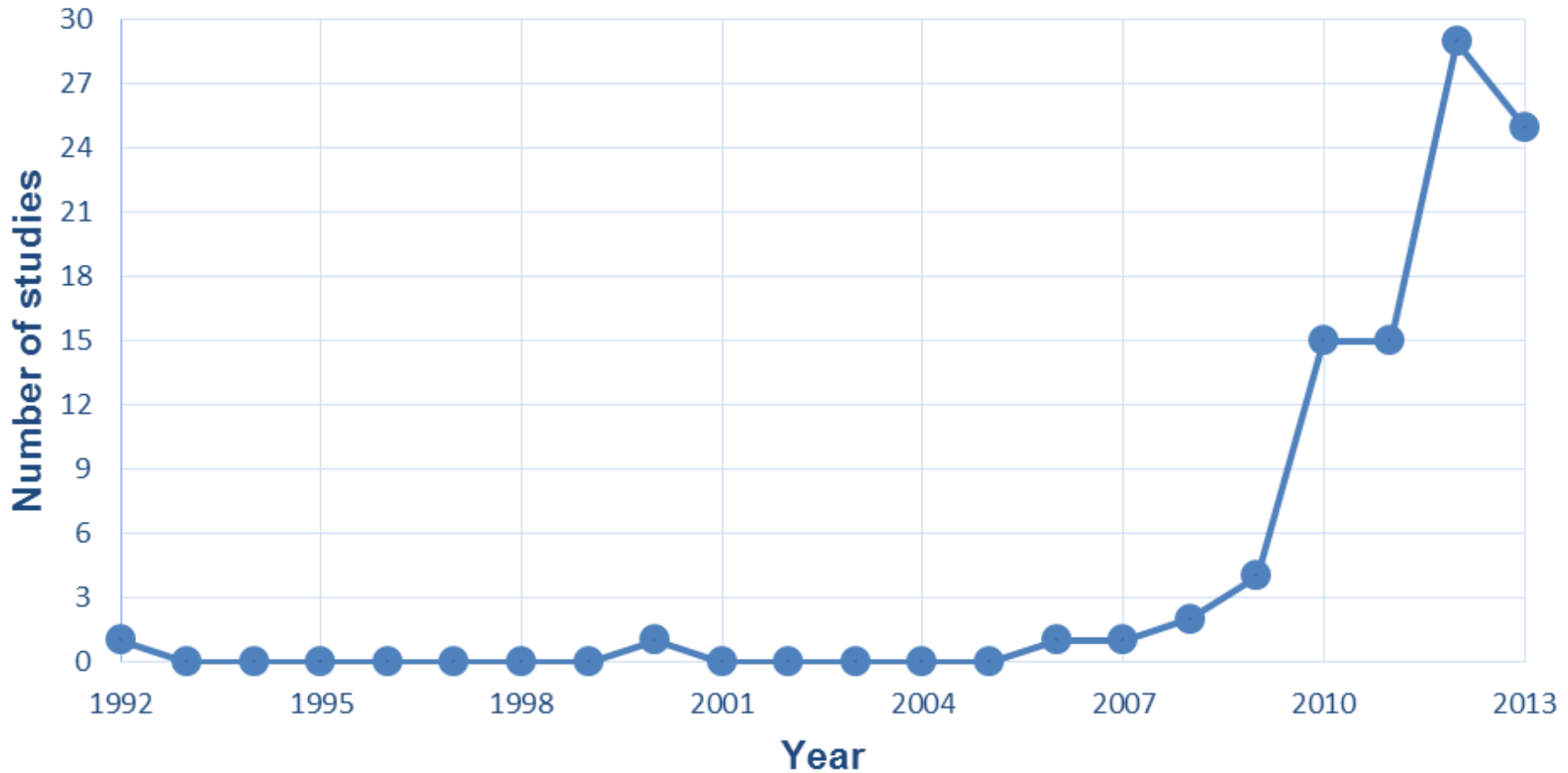
- \* 1. Immature artifacts
- 2. Postponed tasks



- › Debt is a necessary tradeoff
  - **Loan** for **investment**
  - **Quality--** for **business value++**
- › Pay back *capital* (fix TD) + *interest* (maintain SW)
- › Complete payoff may be unrealistic
- › Debt should be monitored and managed
  - Risk – keeping debt into control

Caveat: Metaphors have limits

- › People who collect TD  $\neq$  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



- › A lot of literature
  - Not much consensus
  - Not much evidence
  - Gray literature aggravates things
- › A state of the art in 2 secondary studies
  - Concept of TD and management (94)
  - Financial aspects of TD (69)
  - Both excluding gray literature

# Study 1

## Concept of TD and management

*“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



Not quite right

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

...

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

Complex dependencies  
Architecture smells  
Architecture drift

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



Duplicate code  
Code violations  
Complex code

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

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

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



Insufficient/incomplete/out of date  
Lack of code comments

Is TD everything detrimental to SW product & process?

- › Internal focus
  - Defects
  - Low external quality
  - Unimplemented features
- › Sub-optimal process

If you are not incurring any interest, then it probably is not a debt

McConnell 2013

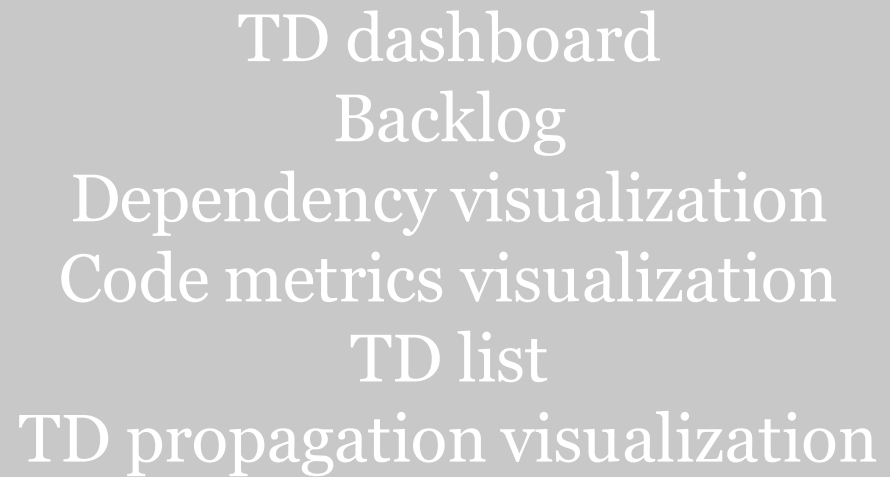
- › TD prevention
- › TD identification
- › TD measurement
- › TD prioritization
- › TD monitoring
- › TD repayment
- › TD representation/documentation
- › TD communication

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

Code analysis  
Dependency analysis  
Solution comparison  
Reverse engineering



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



TD dashboard  
Backlog  
Dependency visualization  
Code metrics visualization  
TD list  
TD propagation visualization

# Study 2

## Financial aspects of TD

TD is not just an economics metaphor used in SE

It is a **financial overhead**

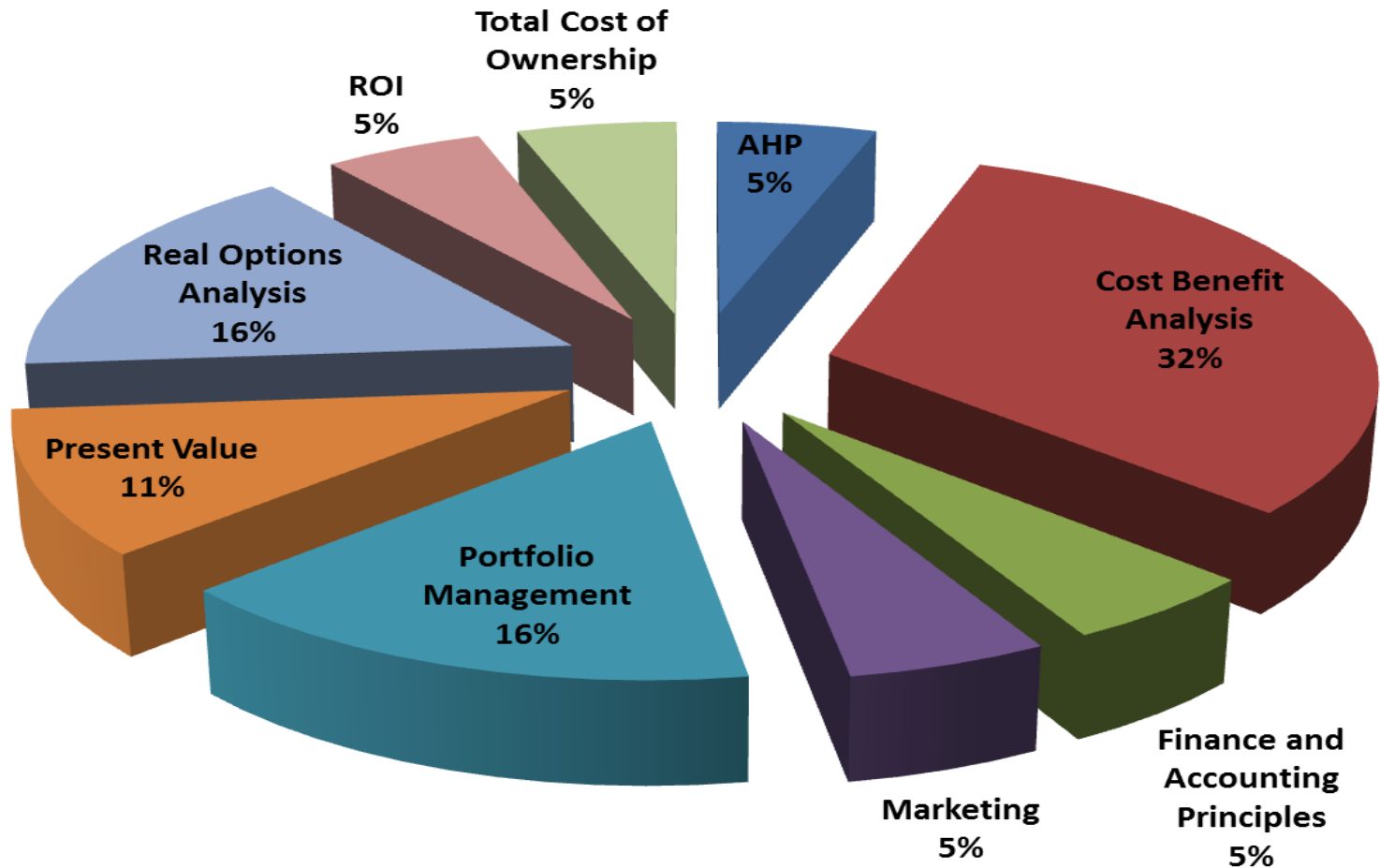
**Communication bridge**: engineers vs. management

Interest	business value	compound interest
Principal	Option	Effort
Cost	interest rate	financial leverage
Repayment	present value	future value
return on investment (ROI)	Revenue	Hedging
Asset	Capital	loan shark
Investment	Benefit	opportunity benefit
Value	Bankruptcy	voice of market
Risk	cash flow	Savings
Liability	by-product	value-added
Productivity	total cost of ownership (TCO)	voice of business
opportunity cost	Depreciation	voice of customer

Interest	business value	compound interest
Principal	Option	Effort
Cost	interest rate	financial leverage
Repayment	present value	future value
return on investment (ROI)	Revenue	Hedging
Asset	Capital	loan shark
Investment	Benefit	opportunity benefit
Value	Bankruptcy	voice of market
Risk	cash flow	Savings
Liability	by-product	value-added
Productivity	total cost of ownership (TCO)	voice of business
opportunity cost	Depreciation	voice of customer

Missing: debtor/creditor, debt instrument, maturity date, liquidity

Measured Term	Measuring Approach			
	Portfolio Management	Real Options	Software Economics	Value Based
Amount of debt	0	1	7	1
Compound Interest	0	0	1	0
Interest	1	0	5	0
Repayment	0	0	1	0
Principal	1	0	3	0
ROI	0	0	0	1
Simple Interest	0	0	1	0
Future Value	0	1	0	0
Present Value	0	1	2	0
<b>Total</b>	<b>2</b>	<b>3</b>	<b>20</b>	<b>2</b>



Asset

By-product

Bankruptcy

Compound Interest

Financial Leverage

Future Value

Interest

Interest Rate

Liability

Present Value

Principal

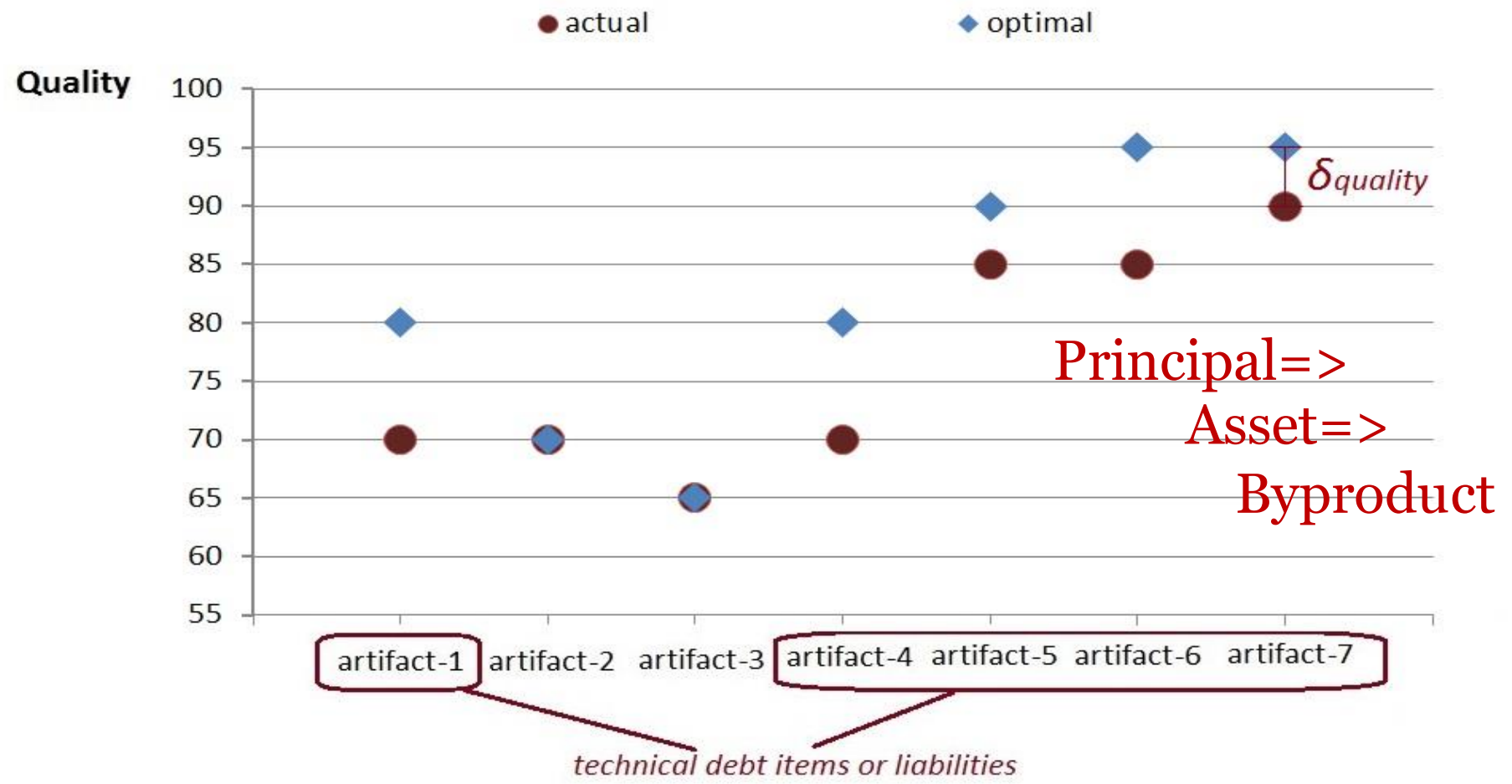
Repayment

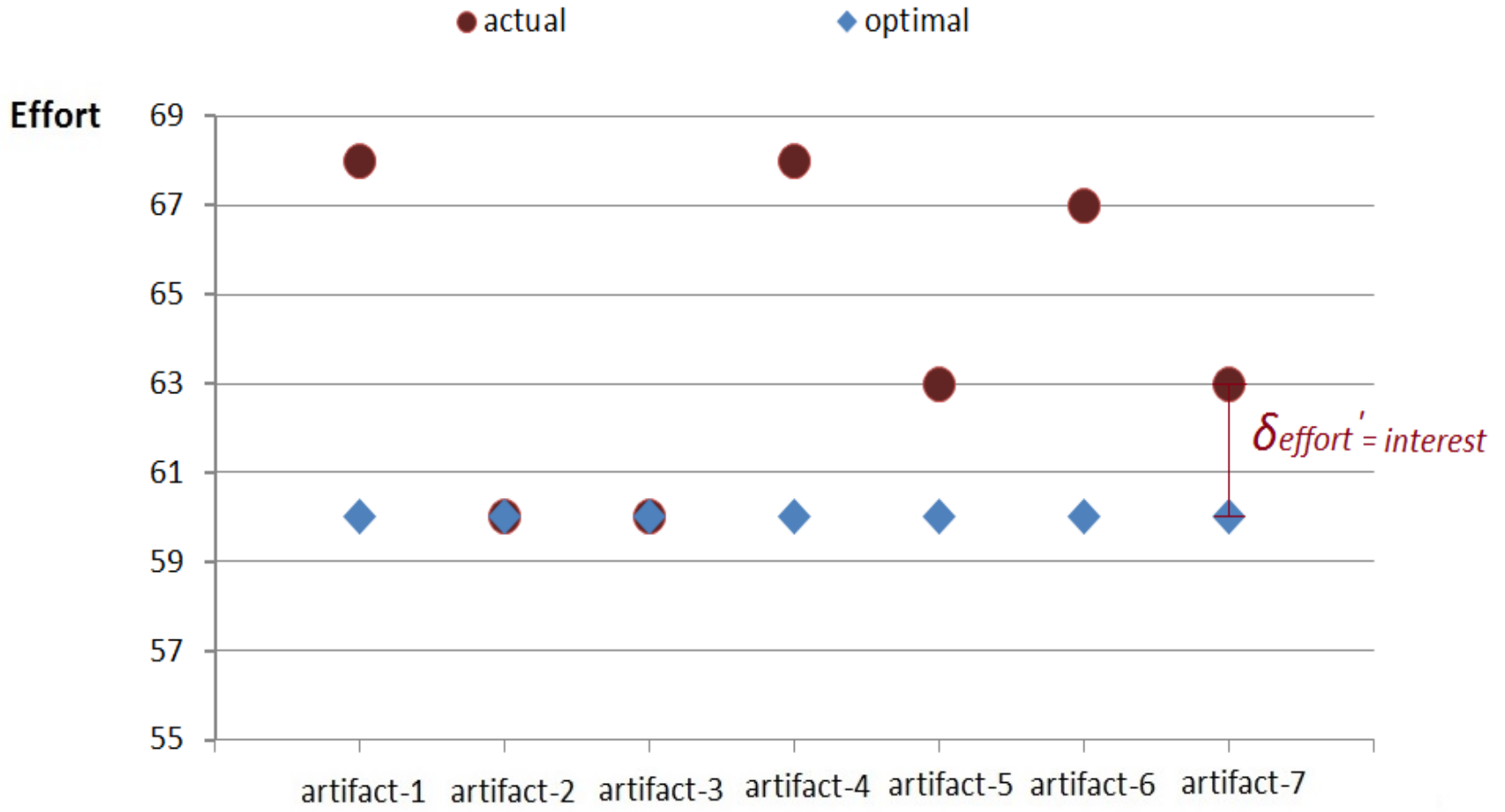
Risk

ROI

Value-Added







- › Managing business constraints
  - External decisions, acquisitions, market ecosystem
- › Measuring TD
  - Which TD items have the highest cost?
  - Assigning business value to intrinsic qualities
  - Quantifying cost and benefit of refactoring
- › Lack of underlying theory
- › Tooling mostly for code and design TD
- › Dependencies between TD items
- › Traceability between TD and related artifacts



Cunningham

1992

This talk

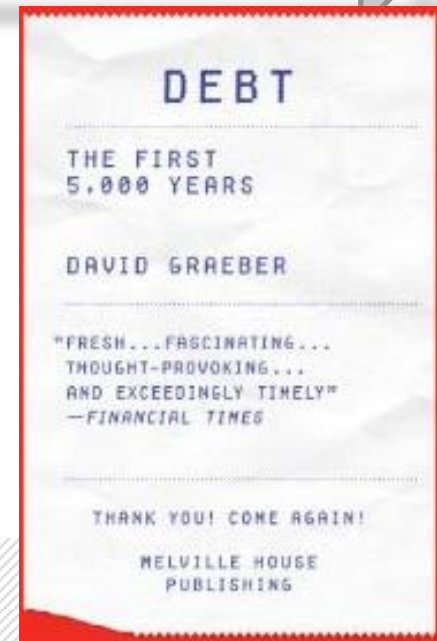
2014

TD re-heated  
& re-served

2036

SE Ideas recycling iterations

- › TD is not a fashion or buzzword
- › Seize the momentum
- › Stick with the problem
- › Work with economists



## Credits:

**Zengyang Li**

**Areti Ampatzoglou**

**Peng Liang**

**Apostolos Ampatzoglou**

**Alexander Chatzigeorgiou**