The Cost and Benefit of Technical Debt Reduction

IWSM Mensura 2019

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Move fast and break things

“As developers, moving quickly was so important, we would even tolerate a few bugs to do it” – Mark Zuckerberg

“Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.” – Agile Manifesto

- Functionality represents *direct* business value
- “Break things” → lower priority to work with *indirect* business value

We moved fast, now things are broken…

79% of CIOs interviewed worldwide by CGI indicate that their ability to change is slowed significantly by technology and agility constraints*. Technical debt is causing real economic, societal and ethical problems.

Possible causes:

- KPIs (Key Performance Indicators) prioritizing short-term success over long-term investments
- Overinflated stakeholder expectations (created by short-term velocity that cannot be kept up)
- Cargo cult: mimicking Internet giants' methods without considering specific context
- Misapplication of agile practices, e.g.:
  - WSJF (Weighted Shorted Job First) prioritization mistakenly applied to enablers
  - MVP (Minimum Viable Product) used as architectural basis (edge cases will get you!)

*CGI's Global Insights, interviews with more than 1,400 executives across CGI's major regions and the 10 industries we serve

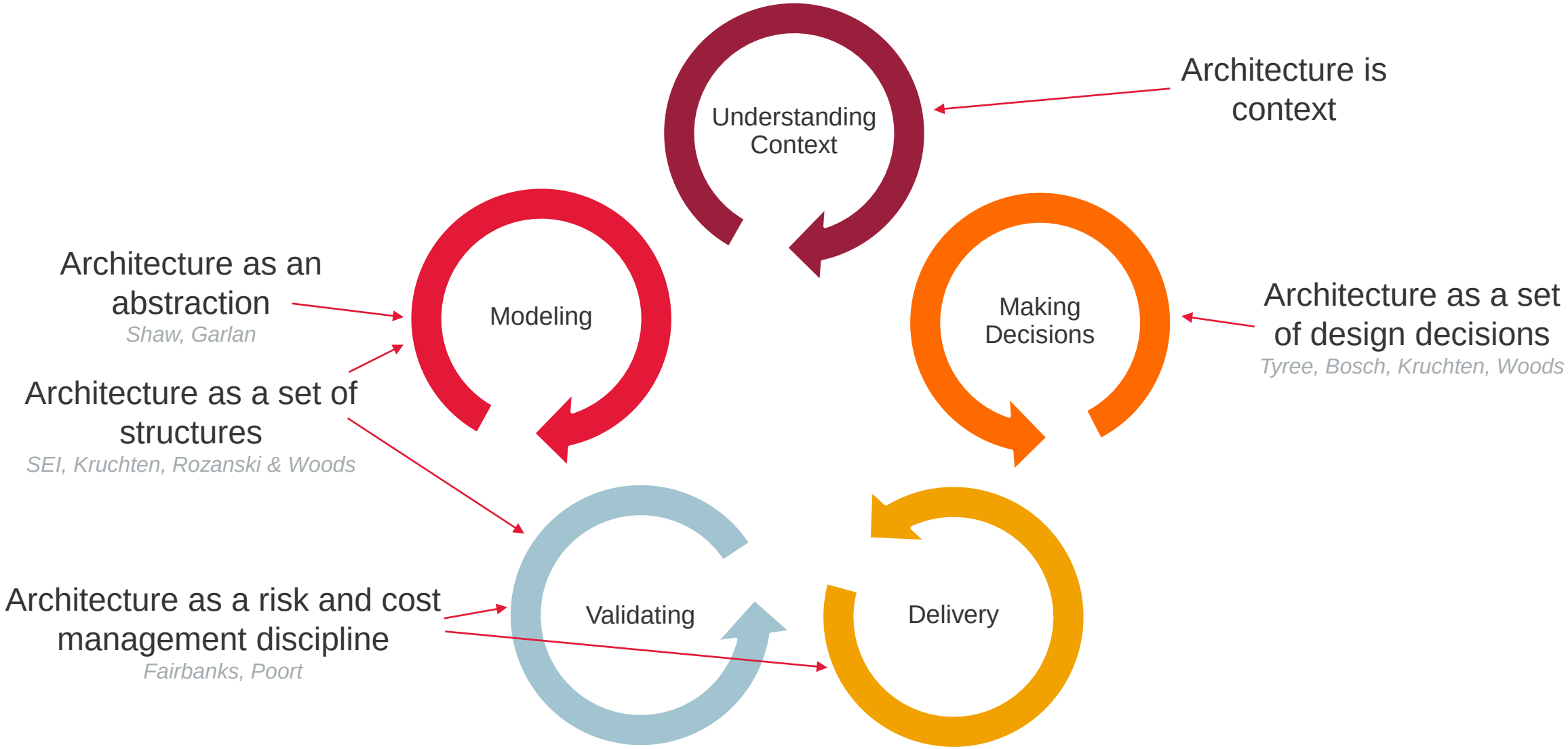
Cargo cult

Mimicking practices that led to desirable results for others, without fully understanding the underlying mechanisms or realizing the difference in context with your own situation.

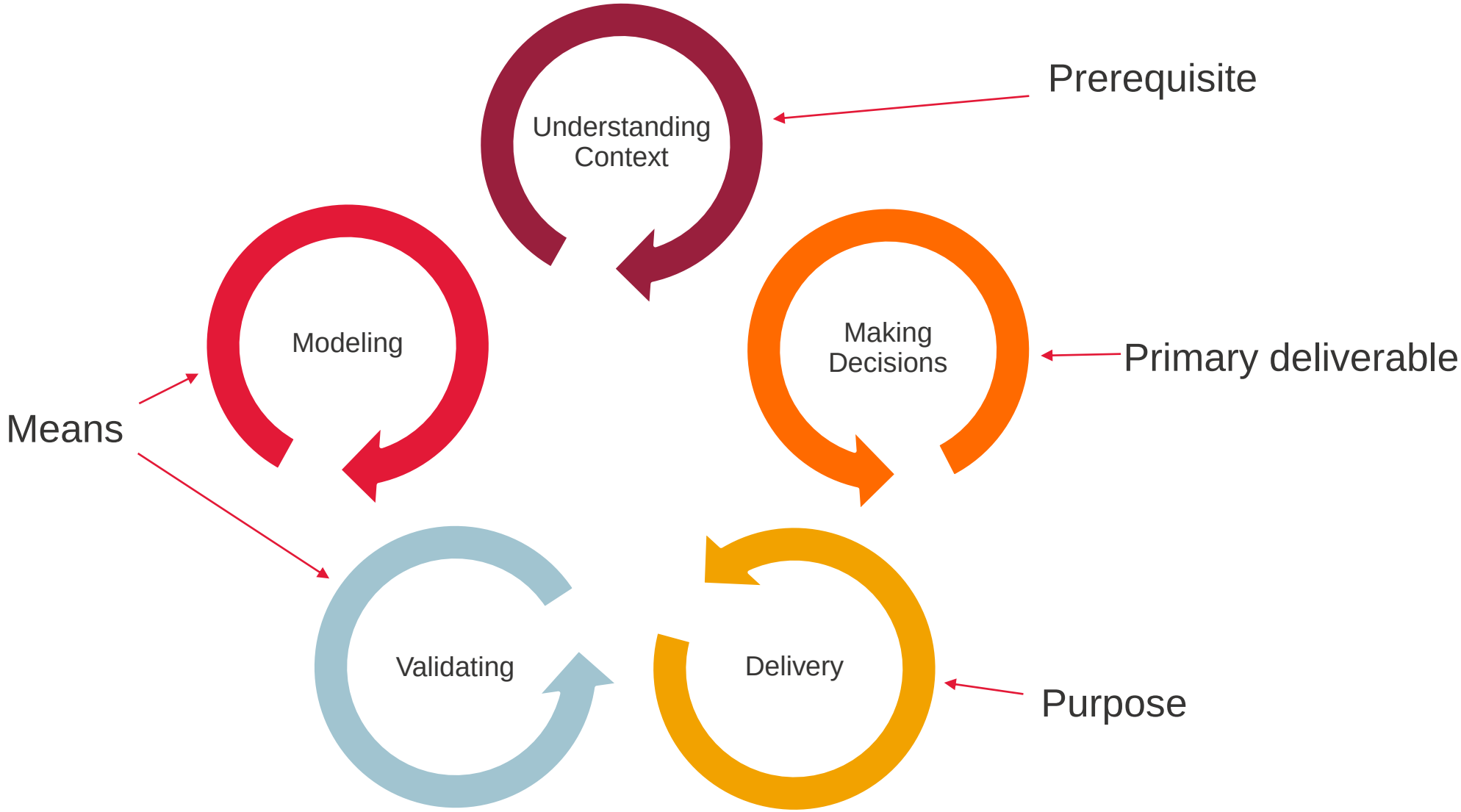
In attempts to get cargo to fall by parachute or land in planes or ships again, islanders imitated the same practices they had seen the soldiers, sailors, and airmen use... In a form of sympathetic magic, many built life-size replicas of airplanes out of straw and cut new military-style landing strips out of the jungle, hoping to attract more airplanes.

(Wikipedia)

Architecture responsibilities



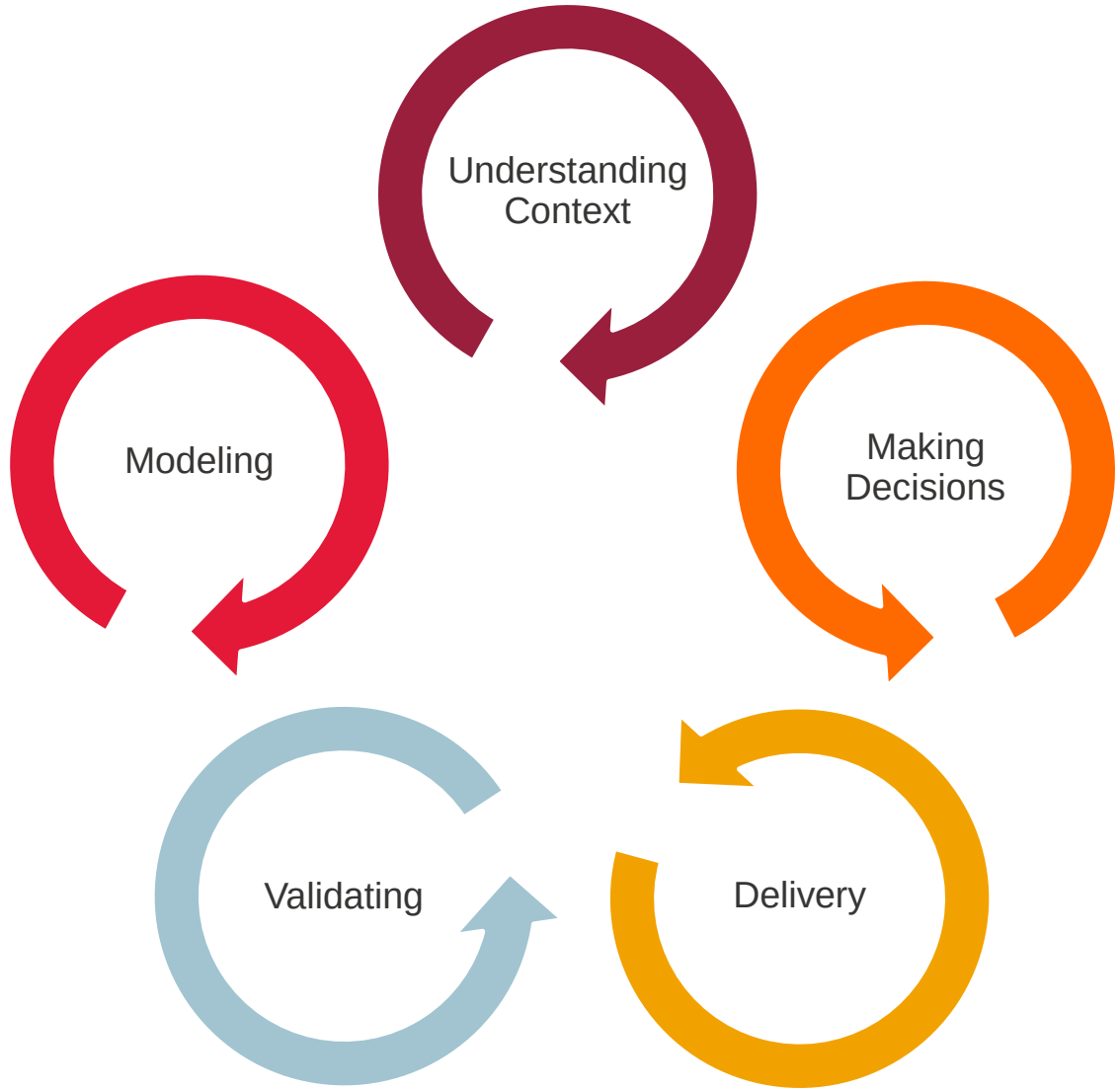
Architecture responsibilities



Architecture maturity

An organization's architecture function is mature if:

- It pays balanced attention to all five responsibilities
- Activities in the five responsibility areas are coherent and related to each other



Excessive technical debt is usually a sign of an imbalanced architecture function, leading to an unsustainable pace of development.

Combining Architecture with Agile working

Conflicting paradigms?

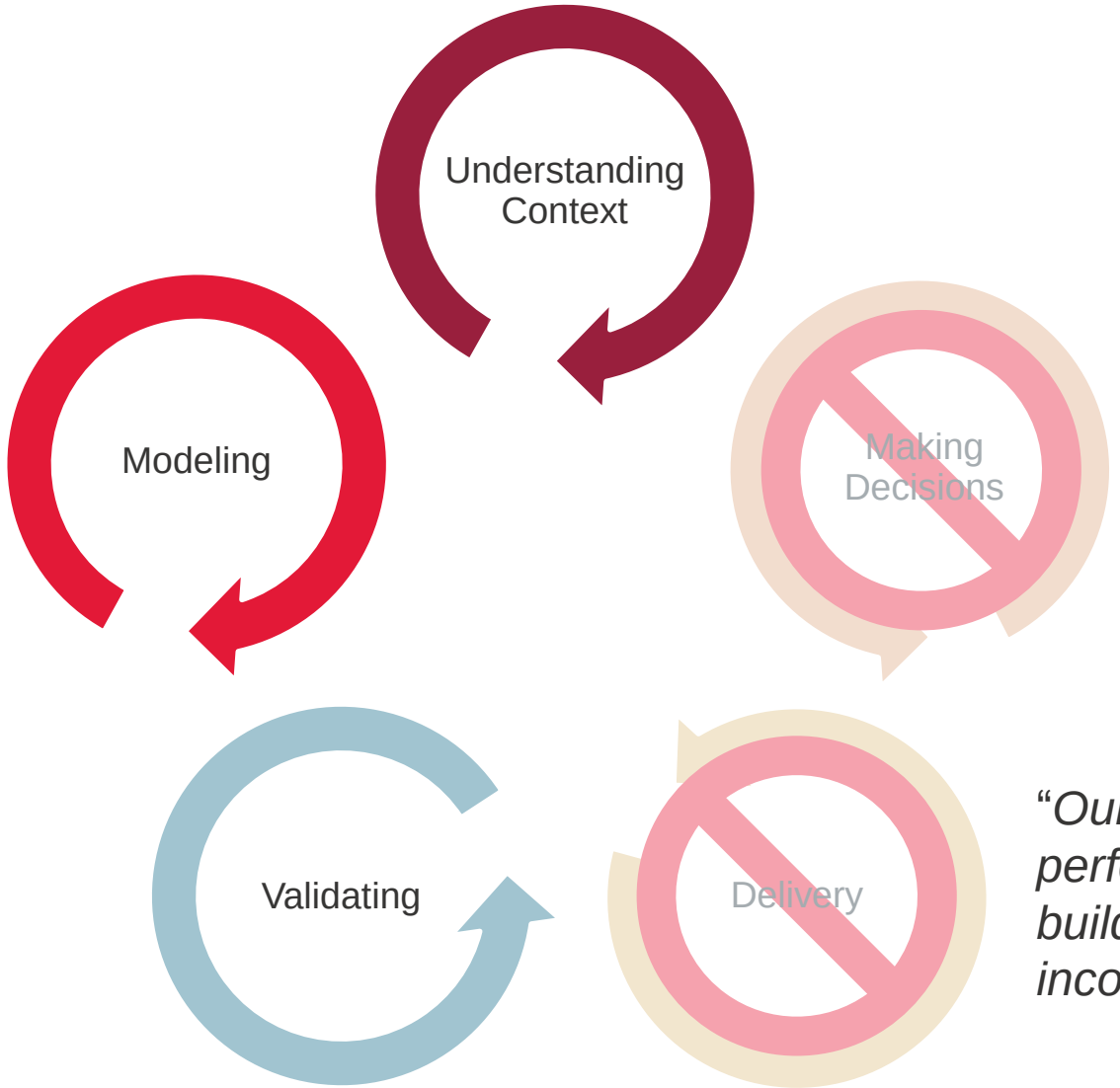
Too much **architecture** leads to…

- Late business value delivery?
- Trouble responding to change?
- Slow learning from experience?
- Wasted design effort?

Too much **agile practice** leads to…

- Ill-considered, inconsistent choices?
- Re-inventing the wheel?
- Technical debt accumulation?
- Short-lived solutions?

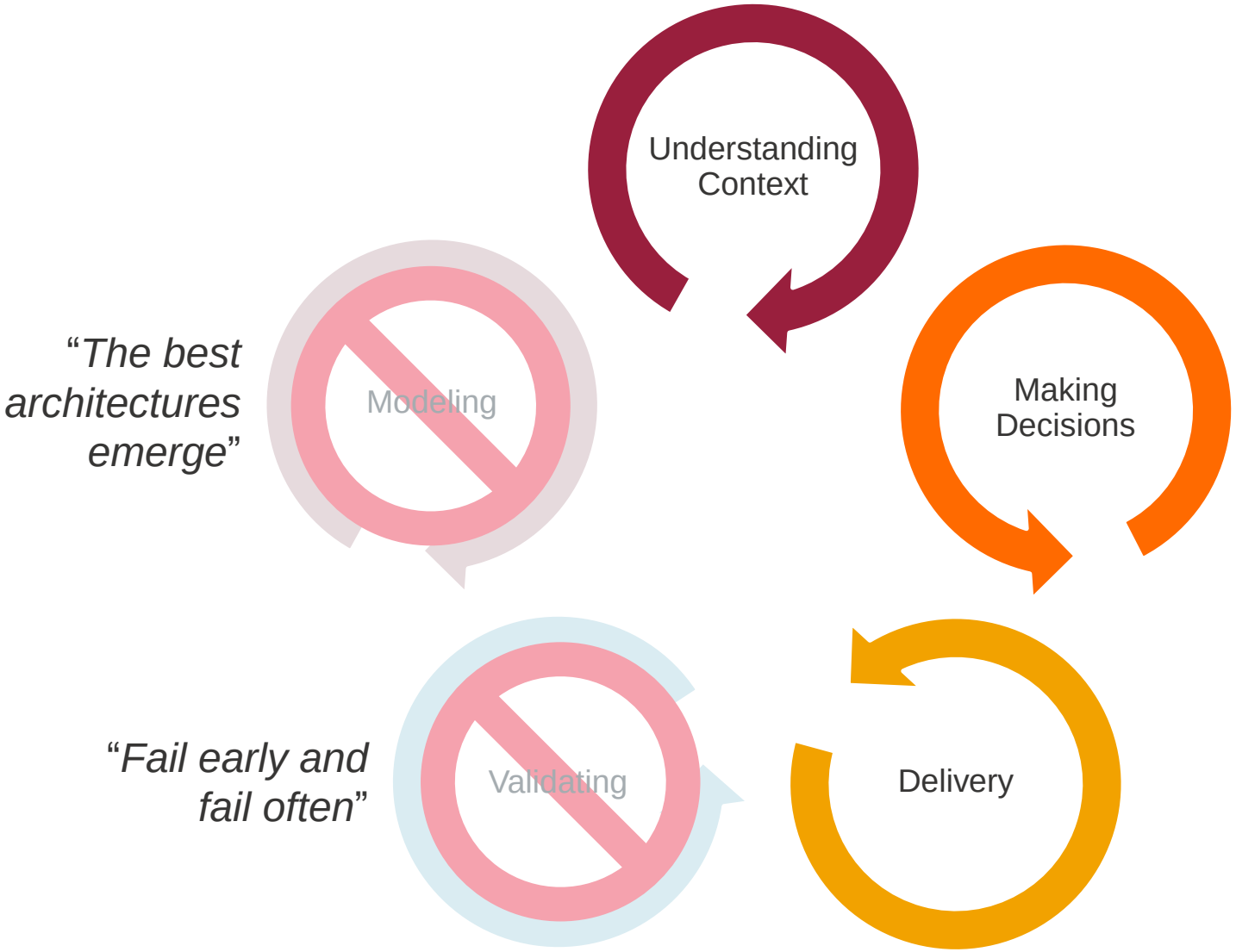
The Waterfall Wasteland



"*We don't take decisions, we only advise management*"

"*Our design was perfect, but the builders were incompetent*"

The Agile Outback



Benefits of combining Agile and Architecture

Architecture

- Up-front design
- Structural stability
- Standardization
- Stability
- **Risk and cost control**

Balance

- Shortening the learning cycle
- Just enough anticipation
- Decentral if possible, standards if necessary
- Architectural design with a short feedback loop
- Based on business rationale and not on dogma

Agile

- Experimentation
- Business features
- Local optimization
- Flexibility
- **Quick business value**

Technical Debt

Key Architectural Concern based on financial metaphor

Cost

- Interest: increased cost of maintenance due to debt
- Principal: cost of future work to eliminate debt

Risk

- Technical Debt accumulates until Solution breaks down

Technical Debt
Types

Test debt

Architectural debt

- structural debt
  - introduced by choices of architect
- technology gaps
  - known up front or emerging

Implementation debt

- low internal quality
- code complexity
- code smells
- coding style violations

Documentation debt

Code analysis tools (e.g.. SONARQube) *only* find this type of technical debt!

Technical Debt
Examples

Business critical solution runs on AS400 platform no longer supported *(technology gap)*

- principal: cost of migration
- interest: expensive maintenance, additional cost of changes
  - risk exposure: increased probability + impact of failure

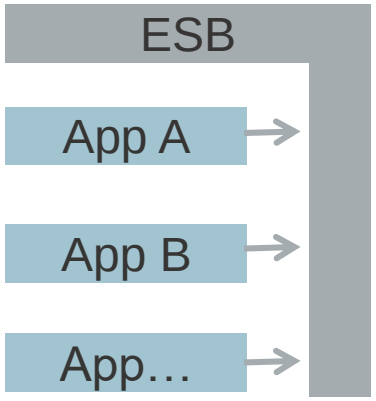
Developer duplicates code to make release deadline *(low internal quality)*

- principal: cost of refactoring
- interest: double maintenance
  - Risk exposure: duplicate bugs remain

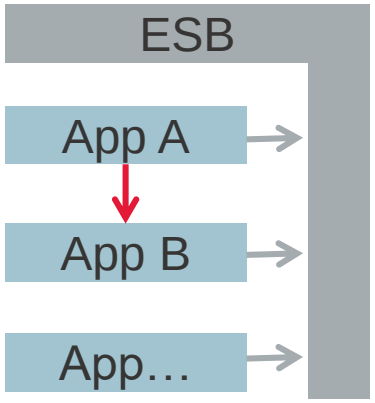
Bypass ESB to obtain data directly from other system *(architectural debt)*

- no time to expose data through ESB
- miss delivery deadline ←→ violate enterprise architecture
- principal? interest?

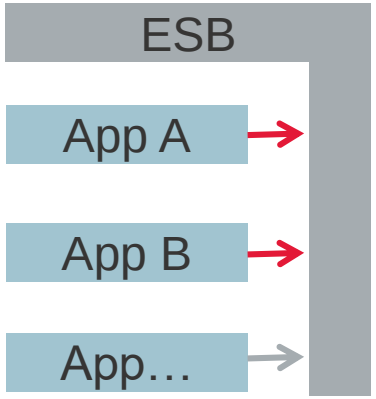
Structural Technical Debt example



Architectural decision:
Apps communicate over ESB



Take on technical debt:
A contacts B directly

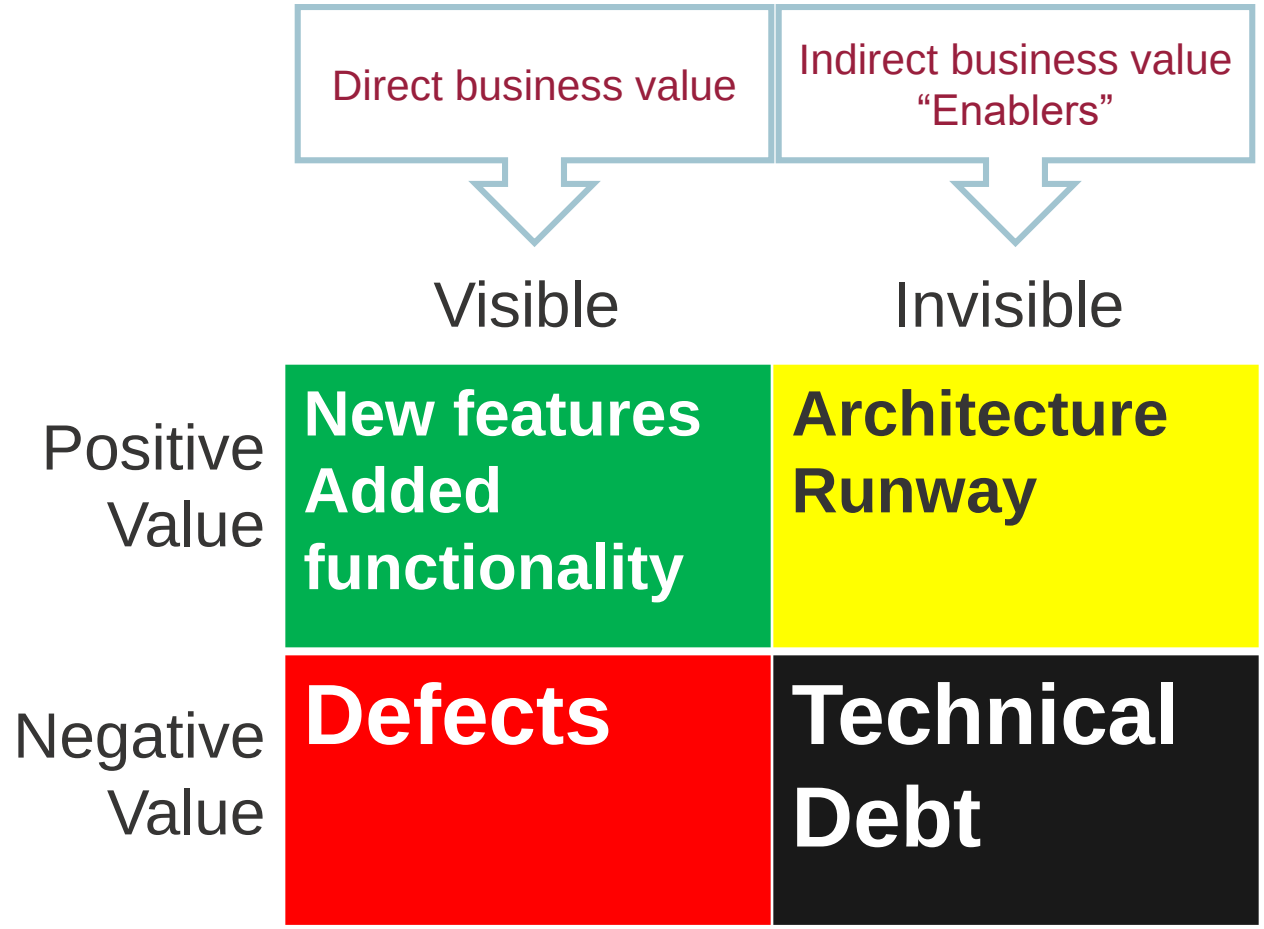


Repay technical debt:
refactor A & B

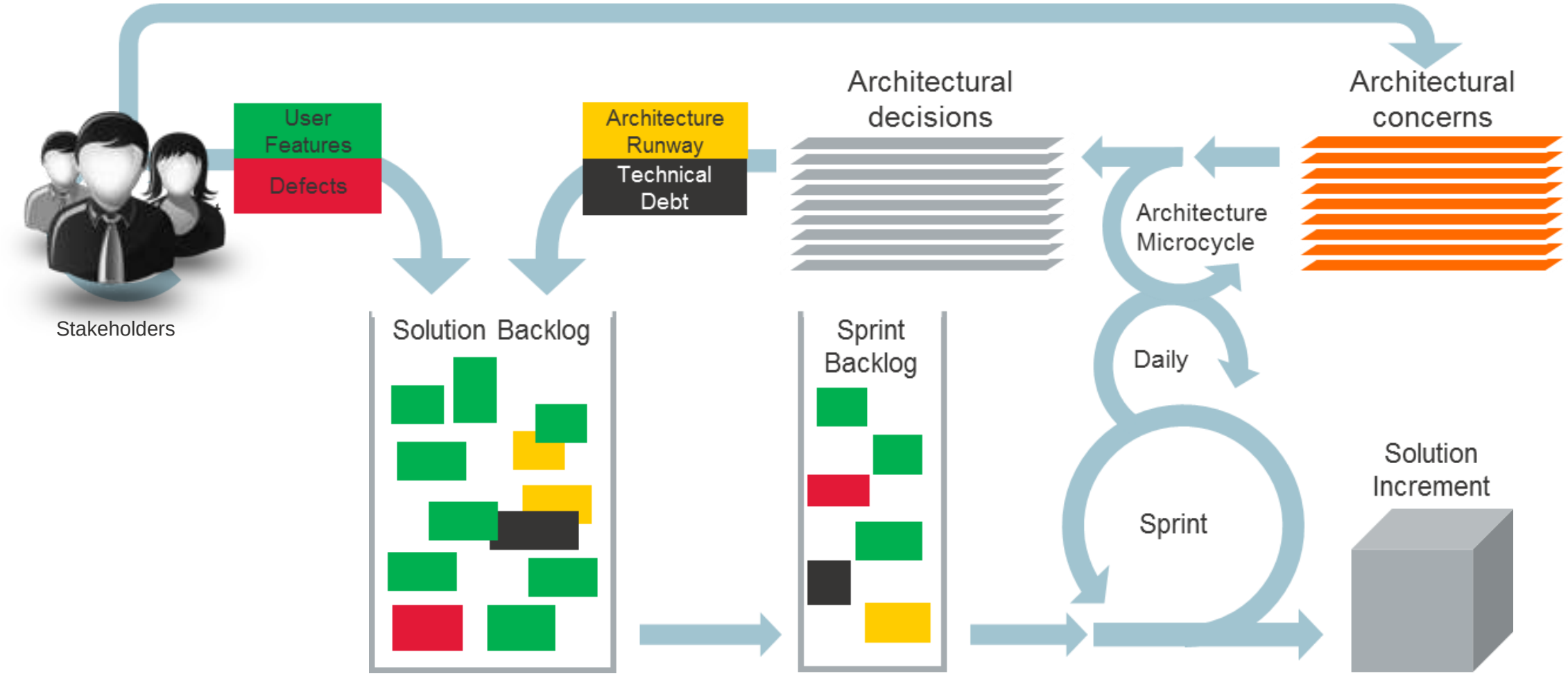
Technical Debt
What's in your backlog?

Debt remediation in product backlog:

- "Under the hood" improvement
- Not directly visible to end-users (but to architects, delivery, operations team)
- As long as the remediation is not done, stakeholders pay some kind of interest (lower velocity, higher risk,…)



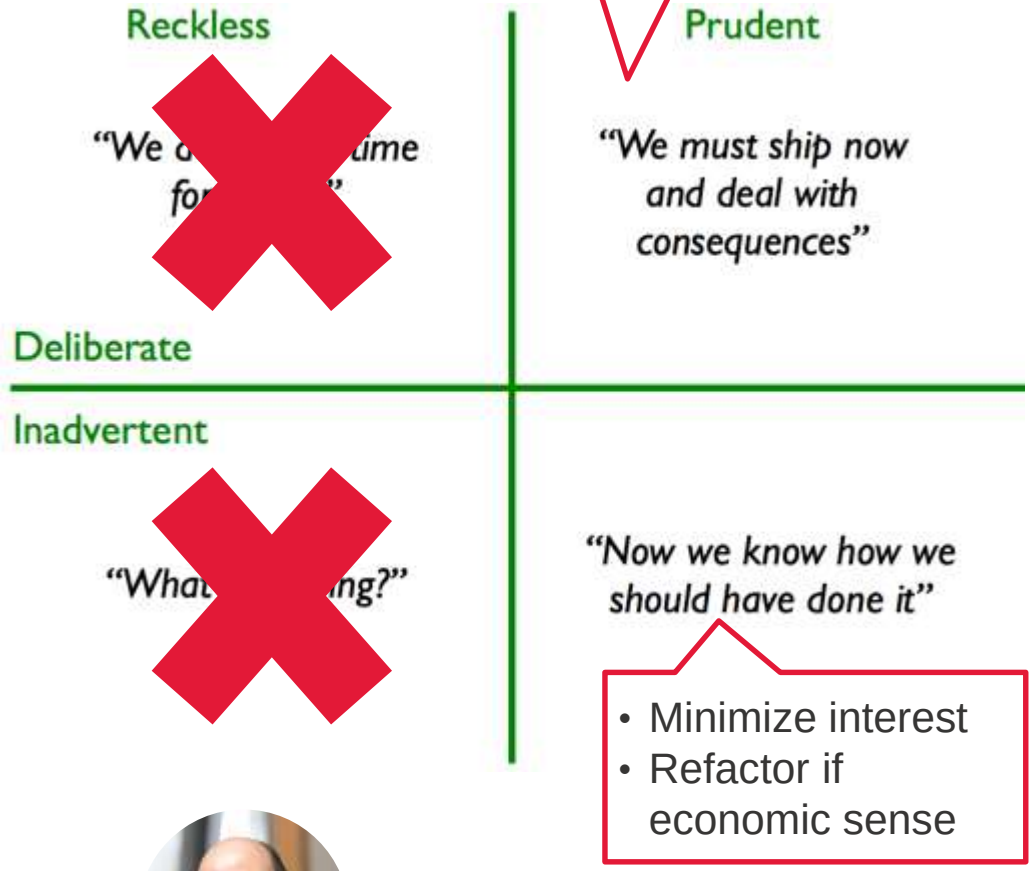
Balancing your backlog in Scrum



Technical Debt Control
Step 1: Identify Technical Debt

Schedule pressure

Carelessness, ignorance



- Minimize interest
- Execute as if 1st class choice
- May be permanent

- Minimize interest
- Refactor if economic sense

Source: Martin Fowler

Technical Debt Control
Step 2: Quantify in Business Terms

Determine cost

- Principal: one-time cost of removing debt
  - migration, refactoring,…
- Interest: increased recurring cost
  - less efficient modifications, more testing, more expensive h/w,…
  - interest stops when principal repaid

Determine risk

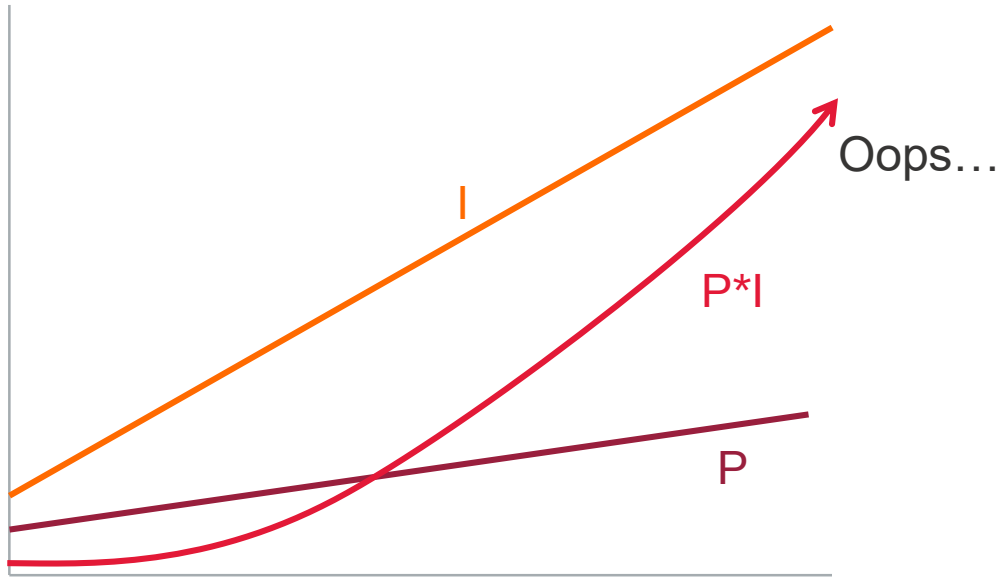
- higher probability of failure (not fulfilling requirements, esp. NFRs)
- higher impact of failure (more expensive to fix)

Why Technical Debt Ambushes Us

Over time, technical debt risk tends to grow:

- Probability of failure increases due to e.g. overlooking old shortcuts, aging technology
- Impact of failure increases due to growing system size & complexity

If probability and impact grow linearly, risk exposure grows parabolically



Technical Debt Control

Step 3: Manage Technical Debt Explicitly

Use Architectural Concern & Decision Register

- *all* technical debt → Architectural Concern Register
- deliberate technical debt → Architectural Decision Register

Make Technical Debt visible as business risk

- Put on risk register
- Find business owner(s) who feel the pain of the risk (and can do something about it)

Consider putting Technical Debt on balance sheet

- deduct remaining technical debt from project result/product value
- take away incentive for project managers to incur debt
- fairer starting position for maintenance team

Technical Debt Control

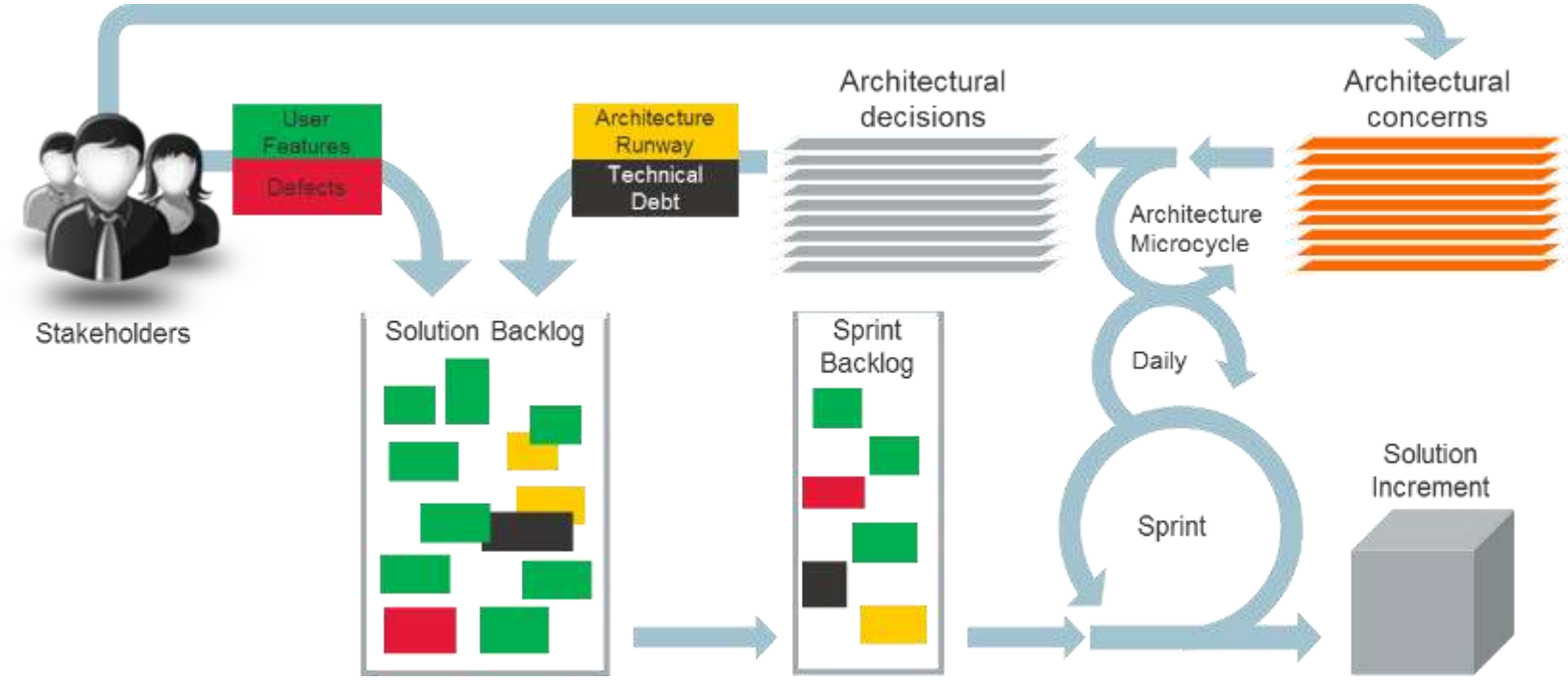
Balance your backlog – reserve capacity for enablers

Reserve 20% of each sprint for enablers?

- …but when do the bigger enablers get done?

Reserve 1 in 4 sprints for enablers!

- Great for expectation management
- Tip: rotate enabler sprint duty among teams (great for collaboration)

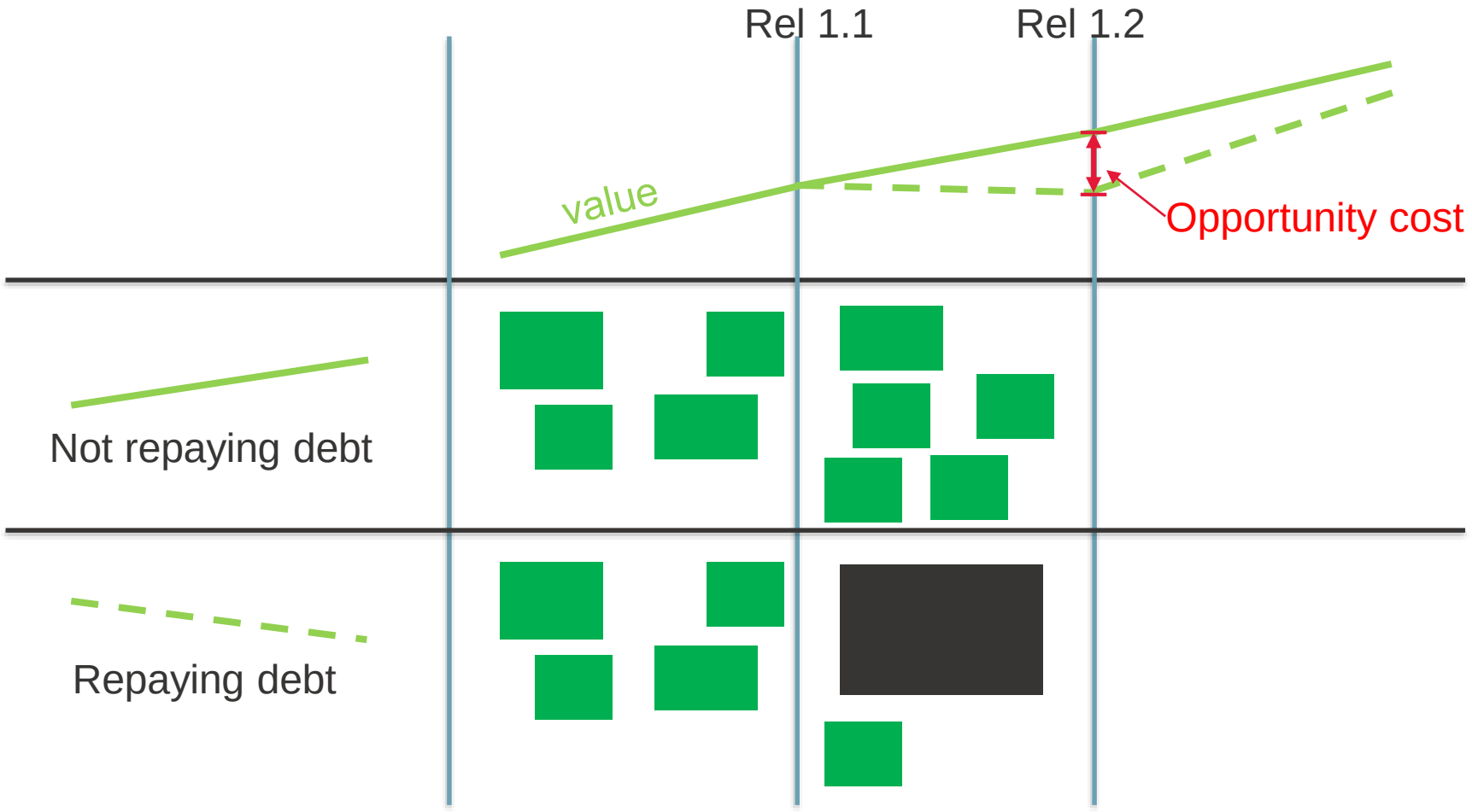


A Simple Business Case for Debt Reduction

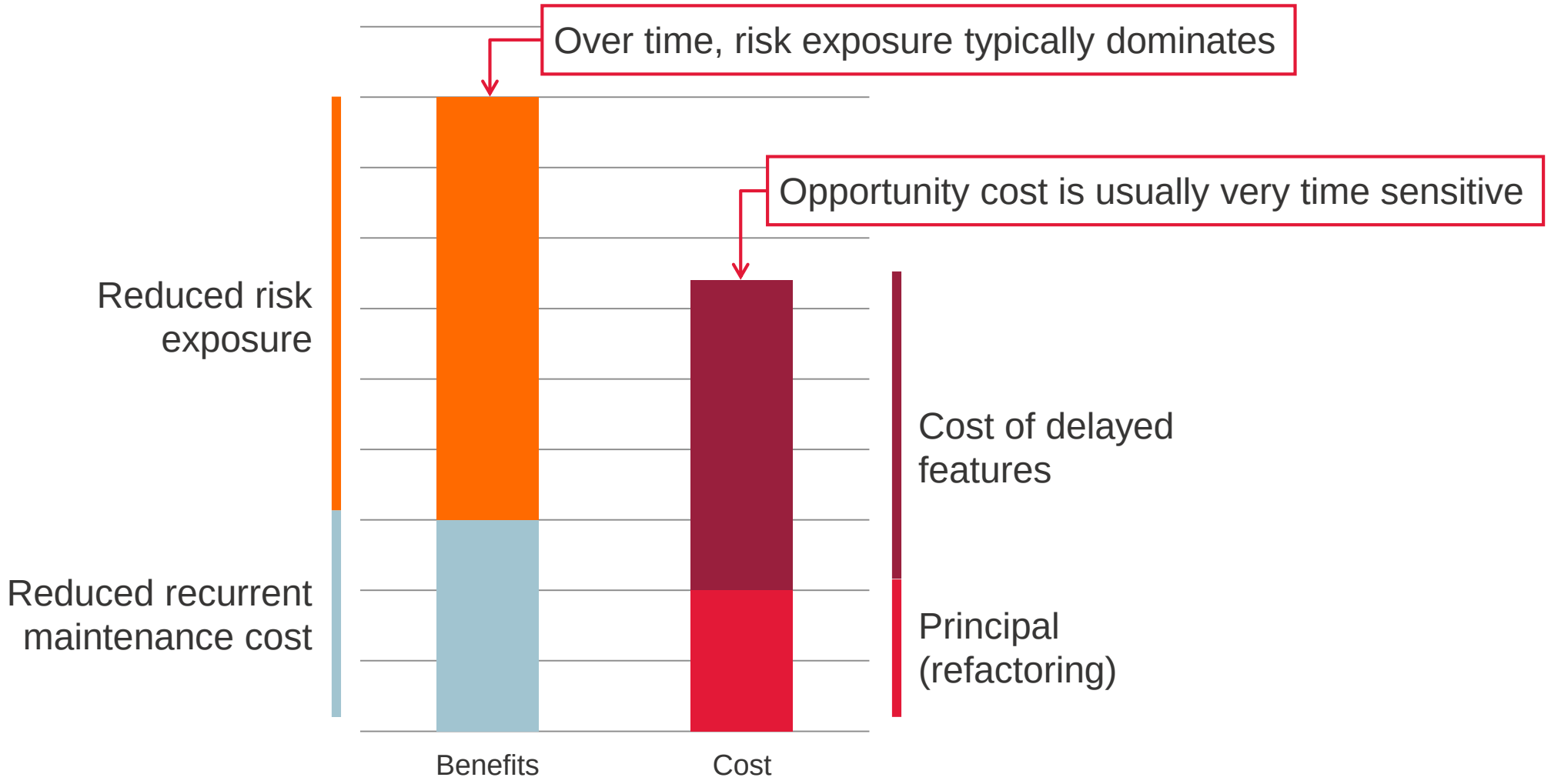
Item		Total
Benefits		
Reduced recurrent maintenance cost	M/yr	
Reduced risk exposure	R/yr	
Total benefits per year	M+R	M+R
Cost		
Principal: effort of migration/refactoring/…	P	
Opportunity cost (delayed features)	F	
Total cost	P+F	P+F
TOTAL RETURN ON INVESTMENT (1 YEAR)		(M+R) – (P+F)

Opportunity Cost of Technical Debt Reduction

Cost of delayed value delivery



A Simple Business Case for Debt Reduction



Technical Debt Control

Example business case

Your travel booking system's front-end uses an old web-app platform called Comanche 2.0 that does not support encrypted communication (SSL / https protocol). This violates European privacy law.

- Upgrading to Comanche 3.0 is estimated to cost 2 sprints (1 month), €32K labor and €10K hardware upgrades [principal]
- Comanche 3.0 has some functionality that will make your team of 4 DEVs 10% more productive [interest – maintenance cost]
- Not supporting SSL runs the risk of a substantial fine, estimated at €500K with a 10% annual probability [interest – risk exposure]
- Product management estimates that delaying their must-have feature delivery by 1 month will cost 2% market share, which translates to €20K [opportunity cost]

Technical Debt Control

Example business case

Principal		
1	Upgrade (2 sprints)	32K
2	Extra Hardware	10K
3		
	Total	42K

Maintenance cost reductions		
1	10% productivity	40K/yr
2		
	Total	40K/yr

Opportunity cost		
1	Must-have feature	20K
2		
	Total	20K

Risk scenarios		p (%)	Impact	Exposure
1	Privacy regulation violation fine	10/yr	500K	50K/yr
2				
3				
			Total	50K/yr

Technical Debt Control

Example business case

Item		Total
Benefits		
Reduced recurrent maintenance cost	M	40K/yr
Reduced risk exposure	R	50K/yr
Total benefits per year	M+R	90K/yr
Cost		
Principal: effort of migration/refactoring/…	P	42K
Opportunity cost (delayed features)	F	20K
Total cost	P+F	62K
TOTAL RETURN ON INVESTMENT (1 YEAR)		28K
TOTAL RETURN ON INVESTMENT (2 YEARS)		118K

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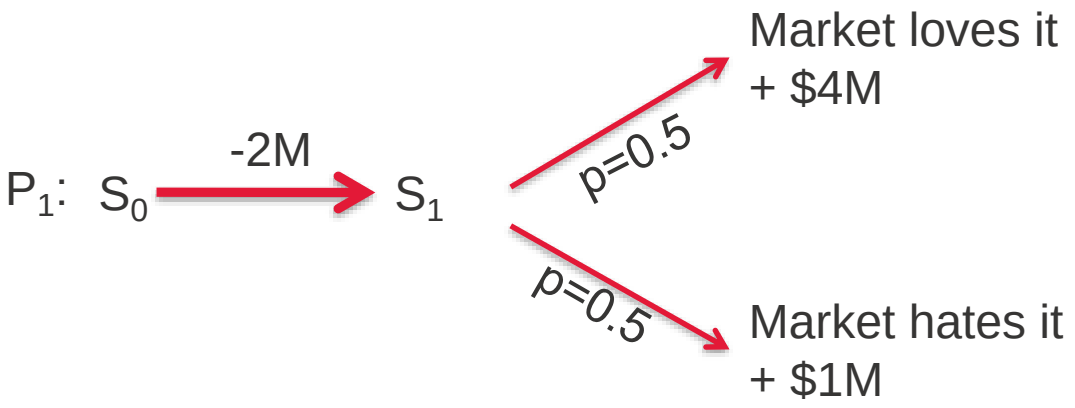
Architecture Roadmapping

Just Enough Anticipation

Architecture Roadmapping
Economic impact: real options & NPV

Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time.

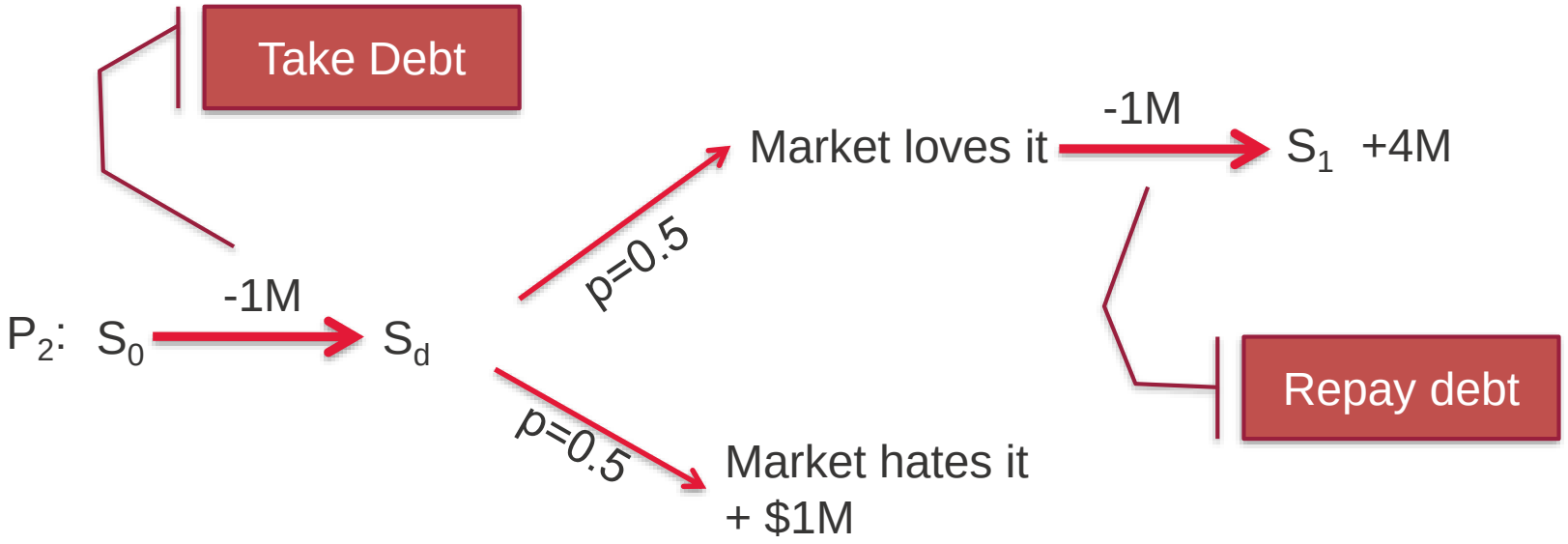
NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project



$NPV\ (P_1) = -2M + 0.5x4M + 0.5x1M = 0.5M$

Source: Kevin Sullivan

Architecture Roadmapping
Economic impact: real options & NPV (2)

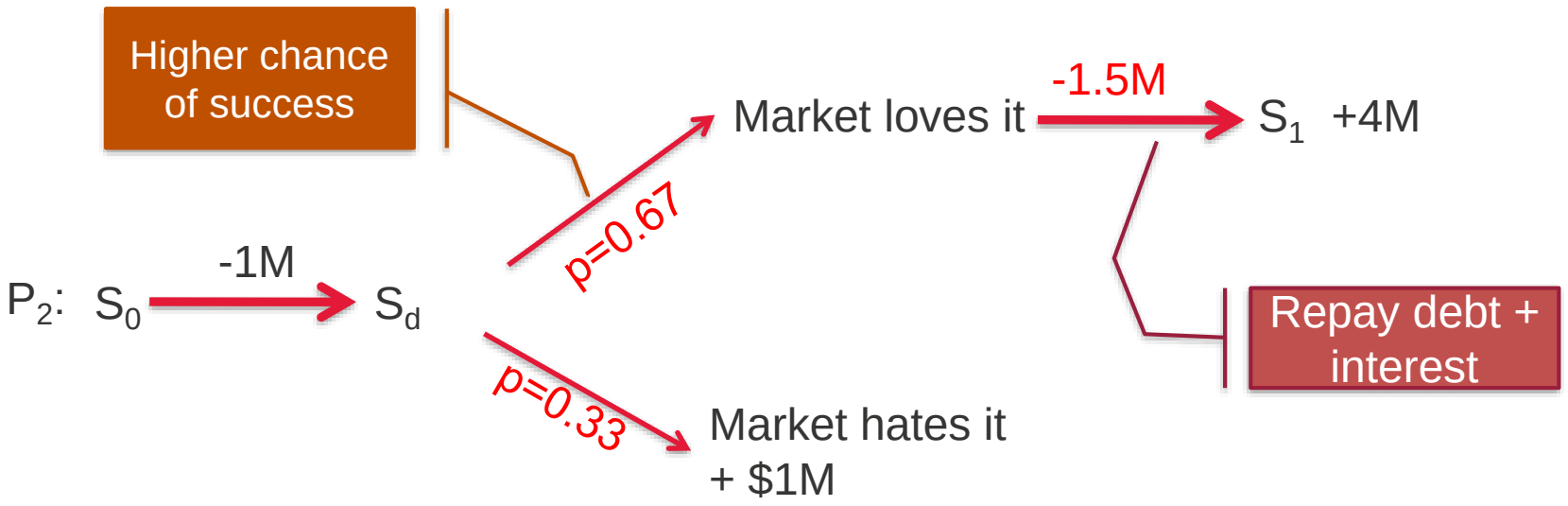


NPV (P_2) = -1M + 0.5x3M + 0.5x1M = 1M

Taking Technical Debt has increased system value.

Source: Kevin Sullivan

Architecture Roadmapping
Economic impact: real options & NPV (3)

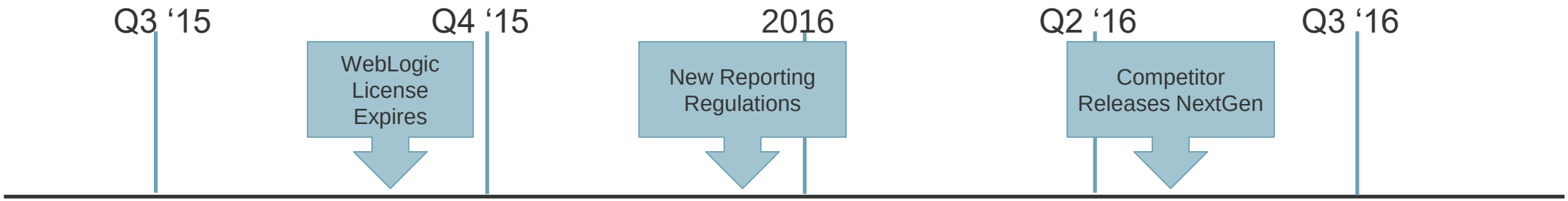


NPV (P_3) = -1M + 0.67 x 2.5M + 0.33 x 1M = 1M

More realistically:
Debt + interest
High chances of success: beat competition, early user feedback

Source: Kevin Sullivan

Architecture Roadmapping
Identify external architectural events

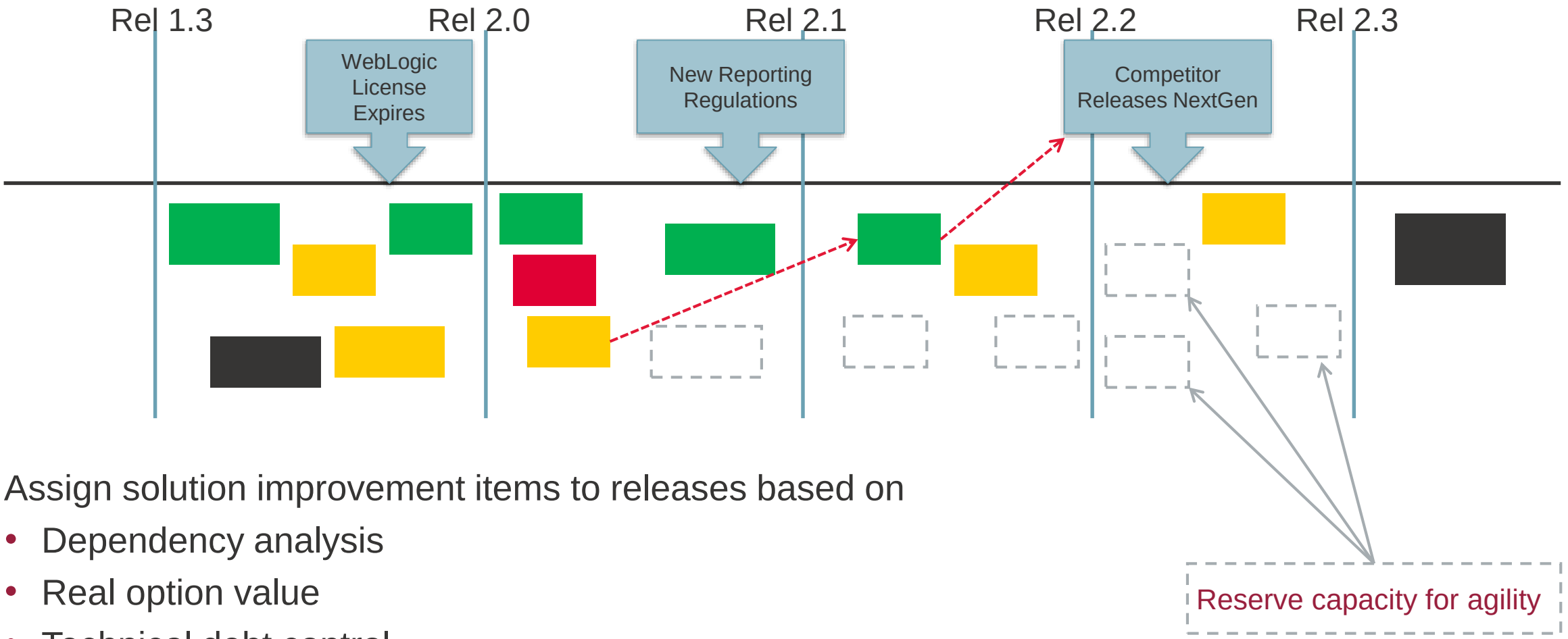


Events that influence risk, cost and value of improvement items, e.g.:

- competitor’s release plans
- legislation into effect
- expiration of licences, warranty, support
- new release of COTS component
- change in vendor pricing strategy
- quality threshold exceeded due to technical debt

Architecture Roadmapping

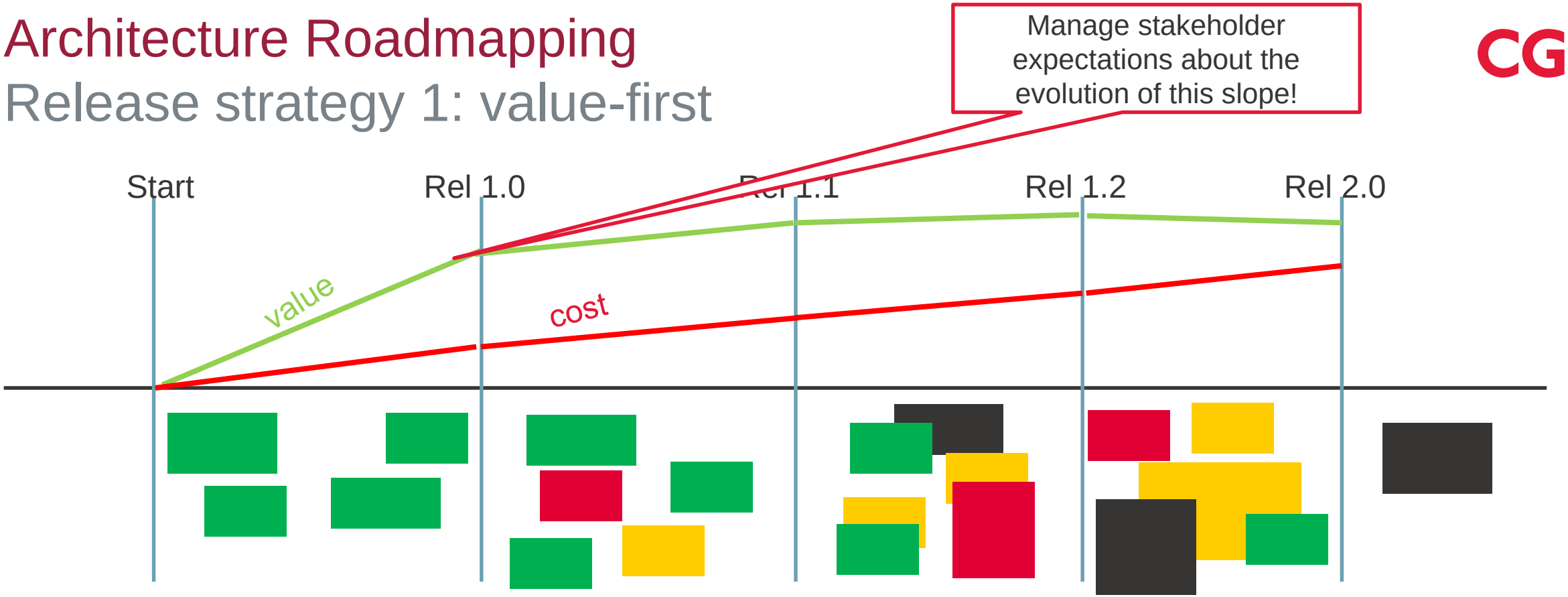
Create and compare release paths



Assign solution improvement items to releases based on

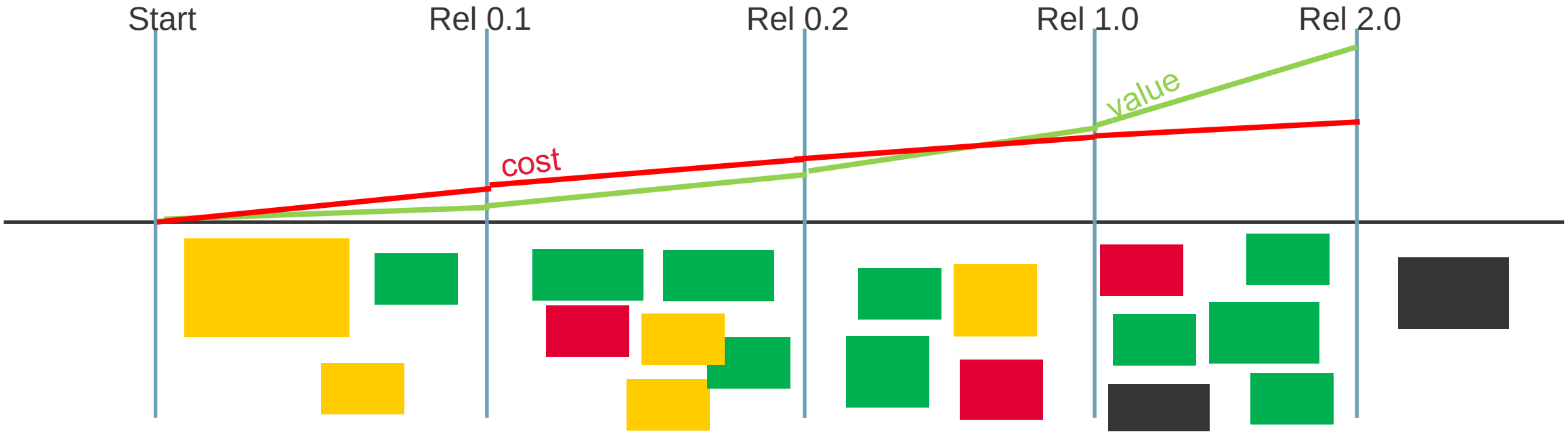
- Dependency analysis
- Real option value
- Technical debt control

Architecture Roadmapping
Release strategy 1: value-first



- In line with Agile philosophy
- May increase TCO (more refactoring)
- Too “greedy” algorithm may run project into wall (complete rebuild)
- Good in volatile environments

Architecture Roadmapping
Release strategy 2: architecture-first



- In line with plan-driven philosophy
- Late delivery of value → risk of cancellation
- Risk of building wrong architecture (if context changes)
- Good for complex solutions

Architecture Roadmapping
Real-life experiences

Significant benefits observed

- Improved (more realistic) stakeholder expectations
- Better prioritization of required architectural improvements
- Helps architects articulate business impact of roadmapping scenarios
- Helps architects discuss timing of architectural improvements
  - based on business impact rather than generic (dogmatic) “rules” like YAGNI

Image: Transavia, Rik Farenhorst

Summary

- Excessive technical debt is often a sign of an imbalanced architecture function, leading to an unsustainable pace of development.
- Risk and opportunity cost usually dominate the business case for technical debt reduction.
- The key to long-term technical debt control is timely involvement of business stakeholders in achieving just enough anticipation.

The term technical debt is misleading: this is a serious business concern that requires continuous leadership attention.

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Section slide

Subtitle, if required