Technical debt, refactoring, and maintenance (2/2)

Martin Kellogg

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C. your team is more experienced and more professional
D. none of the above

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Technical debt: when is it worth it?

- Key consideration:
  - What are the **qua**
    ultimately satisfy?
    - e.g., safety, pe
  - And how do our a utes?
    - i.e., will we be able to reach our goals using this design?
- The choice to take on technical debt is always a **tradeoff**:
  - give up some flexibility later, gain something now
  - whether this is worthwhile varies **case by case**

Whether to take on technical debt is often one of the **most consequential** choices you get to make as an engineer. **Take it seriously!**

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- Best practice (especially for relatively risky debts): **write everything down**!
  - that way, you know what you need to fix before releasing

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  - **immediate benefit**: saves hard disk space (expensive in 1980)
  - **long-term cost**: if the program is still being used in 2000, need to fix it!
    - "I just never imagined anyone would be using these systems 10 years later, let alone 20."

[Philippe Kruchten, Robert Nord, Ipek Ozkaya: "Managing Technical Debt: Reducing Friction in Software Development"]

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  - e.g., if your ***bus factor*** (= "number of people who need to get hit by a bus before no one understands the system") is low and parts of the system are undocumented…
    - the amount of technical debt you have is higher than if your bus factor was very high
- Other examples include having **high staff turnover** (which systematically lowers bus factor) or few senior engineers

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  - You **do not gain** the benefit: the benefit was immediate, but you're reaching the code too late to see it

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- dev 2 is now responsible for paying the debt on the system :(

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  - If the code's structure does not also evolve, it will "rot"

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Other similar choices include:
- middleware frameworks
- deployment pipeline
- major dependencies

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  - "Hack enables us to dynamically convert our code one file at a time" - Facebook Technical Lead, HipHop VM (HHVM)

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  - but if you don't pay down the debt quickly…

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- However, early signs are **not promising**:
  - LLMs seem to be easily confused by atypical code patterns, quirks of leaky abstractions, etc. (all hallmarks of tech debt)
  - LLMs can **introduce technical debt** themselves
    - e.g., recent studies have shown that with an LLM assistant, devs are more likely to write insecure code [1]

[1] *Do Users Write More Insecure Code with AI Assistants?* Neil Perry, Megha Srivastava, Deepak Kumar, and Dan Boneh. CCS 2023.

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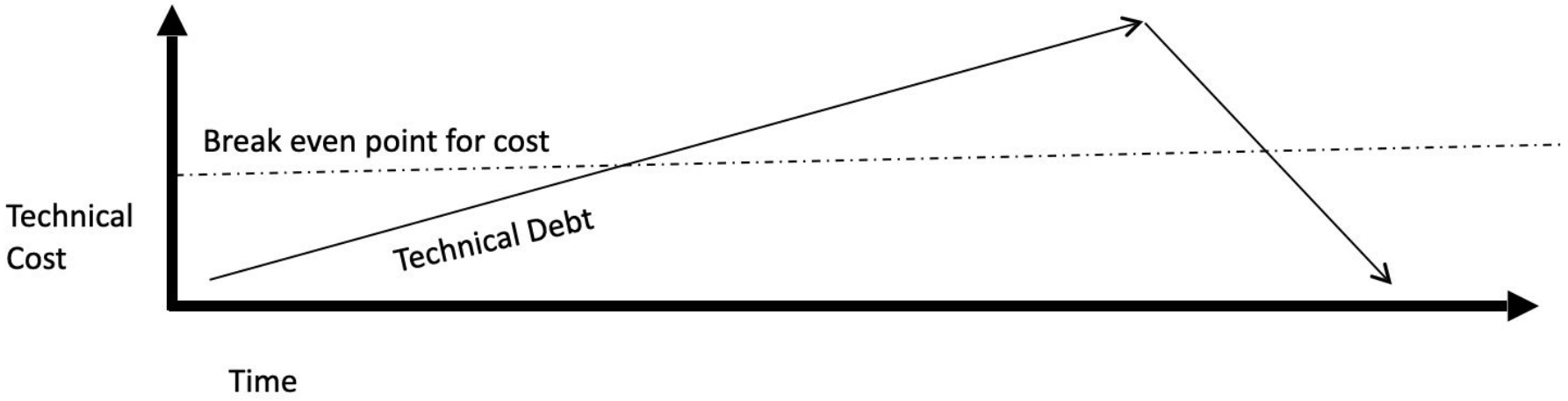
  - one option: **rewriting** the whole system (but think about today's Spolsky reading!)
  - more common: **refactoring** the code
- ***refactoring*** is the process of applying behaviour-preserving transformations (called ***refactorings***) to a program, with the goal of improving its non-functional properties (e.g., design, performance)

Paying down technical debt



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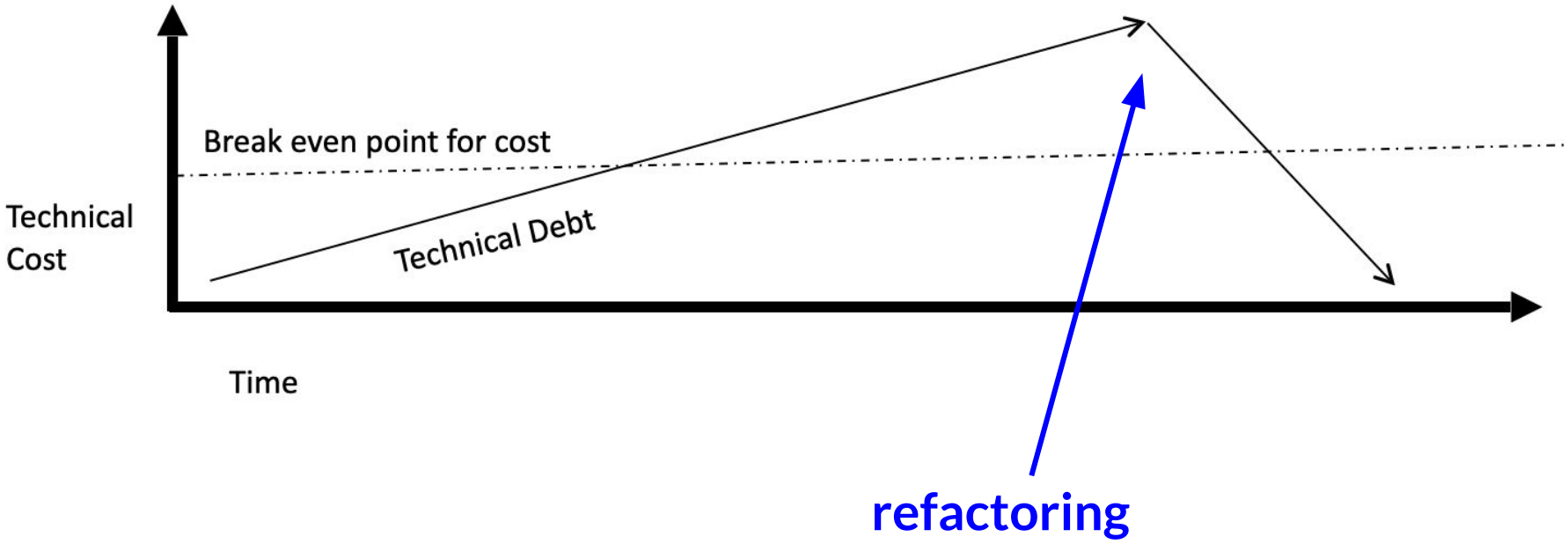

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- Have a plan: **don’t put off dealing with technical debt indefinitely**
  - When a crisis hits, it’s too late
  - Hasty fixes to unmaintainable code likely to multiply problems!
  - Eventually, mounting technical debt can bury a team

Tech debt, refactoring, and maintenance

Agenda:

- Finish design pattern slides
- Technical debt: the costs of bad design
- **How to pay off technical debt: refactoring**

Refactoring

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What refactoring is **not**:

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What refactoring is **not**:

- rewriting code
- adding features
- debugging code

Refactoring: motivation

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- If the code does not do one or more of these, it ***is*** broken.
- Refactoring should improve the software's design:
  - more extensible, flexible, understandable, performant, …
  - every design improvement has costs (and risks)

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- a good refactoring often fixes more than one code smell
    - sometimes many more than one

Refactoring: when to refactor

Examples of **common code smells**:

Refactoring: when to refactor

Examples of **common code smells**:

- Duplicated code
- Poor abstraction (change one place → must change others)
- Large loop, method, class, parameter list; deeply nested loop
- Module has too little cohesion
- Modules have too much coupling
- Module has poor encapsulation
- Dead code
- Design is unnecessarily general
- Design is too specific

Refactoring: “low-level” refactoring

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- “***low-level***” refactorings are small changes to the code that mitigate or remove one or more code smells. Examples:
  - Renaming (methods, variables)
  - Naming (extracting) “magic” constants
  - Extracting common functionality (including duplicate code) into a module/method/etc.
  - Changing method signatures
  - Splitting one method into two or more to improve cohesion and readability (by reducing its size)

also see https://refactoring.com/catalog/

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- they automate:
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  - extraction of methods and constants
  - extraction of repetitive code snippets
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  - warnings about inconsistent code
  - …

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My advice/opinion: don’t rely on your IDE too much. It’s useful for auto-complete, simple refactoring, red squiggles, etc. But, if you let it control the build process you’ll have a bad time.

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  - Clarifying a statement that has evolved over time or is unclear
- Compared to low-level refactoring, high-level is:
  - Not as well-supported by tools
  - But much **more important**!

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- When you identify an area of your system that:
  - is **poorly designed**, and
  - is **poorly tested** (even if it seems to work so far), and

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  - is **poorly tested** (even if it seems to work so far), and
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These are a good set of criteria for deciding to refactor code

- especially “needs new features”, because if you don’t refactor you’ll be **paying interest** on the tech debt!

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  - Add any **new features**.
  - As always, keep changes small, do code reviews, etc.

Takeaways: tech debt and refactoring

- Technical debt accrues when you take a shortcut for some immediate benefit that makes a system harder to maintain
  - tech debt is inevitable in large systems
  - but you should be thoughtful about when/how you take it on!
- When and how you take on technical debt is one of the biggest judgment calls that you will make as a low-level engineer
- Refactoring is the process of improving a codebase's non-functional properties while maintaining its behavior
  - refactoring is a useful way to reduce tech debt
  - you often want to pair refactoring with adding new features