

Requirements and Specifications (Part 2/2)

Martin Kellogg

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Today's agenda:

- **Reading Quiz**
- GroupThink Specification Exercise, part 2
- Requirements elicitation
- Formal specifications

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Re-form your groups from Tuesday

You have 20 minutes to go over the specifications again

- I have more copies at the front, for those that don't have one

After that, we'll play another round of the game, with a new rule:

- Answers that contradict the specification count for zero, even if you all answer together

If you were not in class on Tuesday, join a group (you choose).

Requirements and Specifications (Part 2)

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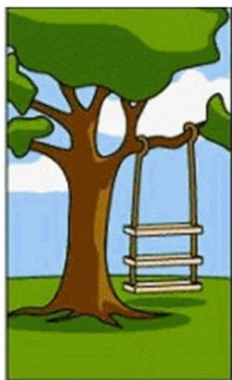
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Requirements

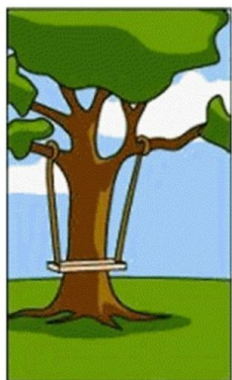
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Requirements

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 - **where** do requirements come from?
 - **what kinds** of requirements are there?
 - **why** is this related to specification?



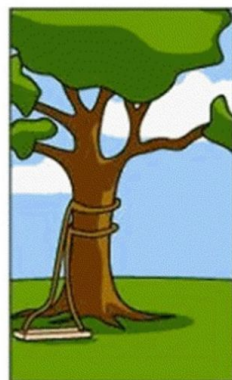
How the customer explained it



How the project leader understood it



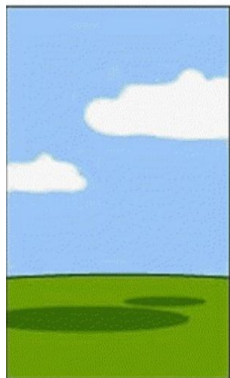
How the engineer designed it



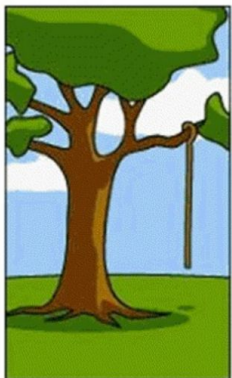
How the programmer wrote it



How the sales executive described it



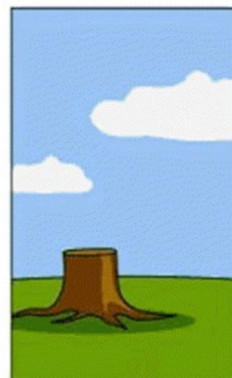
How the project was documented



What operations installed



How the customer was billed



How the help desk supported it



What the customer really needed

Requirements elicitation

- Option 1: **users tell** developers what they want
 - Client determines the problem and the solution
 - Requirements might be formally provided in the form of a contract or statement of work
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Not always possible: clients often
don't know what they want

Requirements elicitation

- Option 2: **direct research**
 - Interview users, ask questions about their problems, propose potential solutions, examine those solutions
 - Embed your client in your design team, or better yet, become an **anthropologist** in your client's environment
 - Build requirements documents that demonstrate your understanding of the requirements, iterate

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 - Empowers your team with **credibility and authority**

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- **Precision:** No ambiguity in requirements

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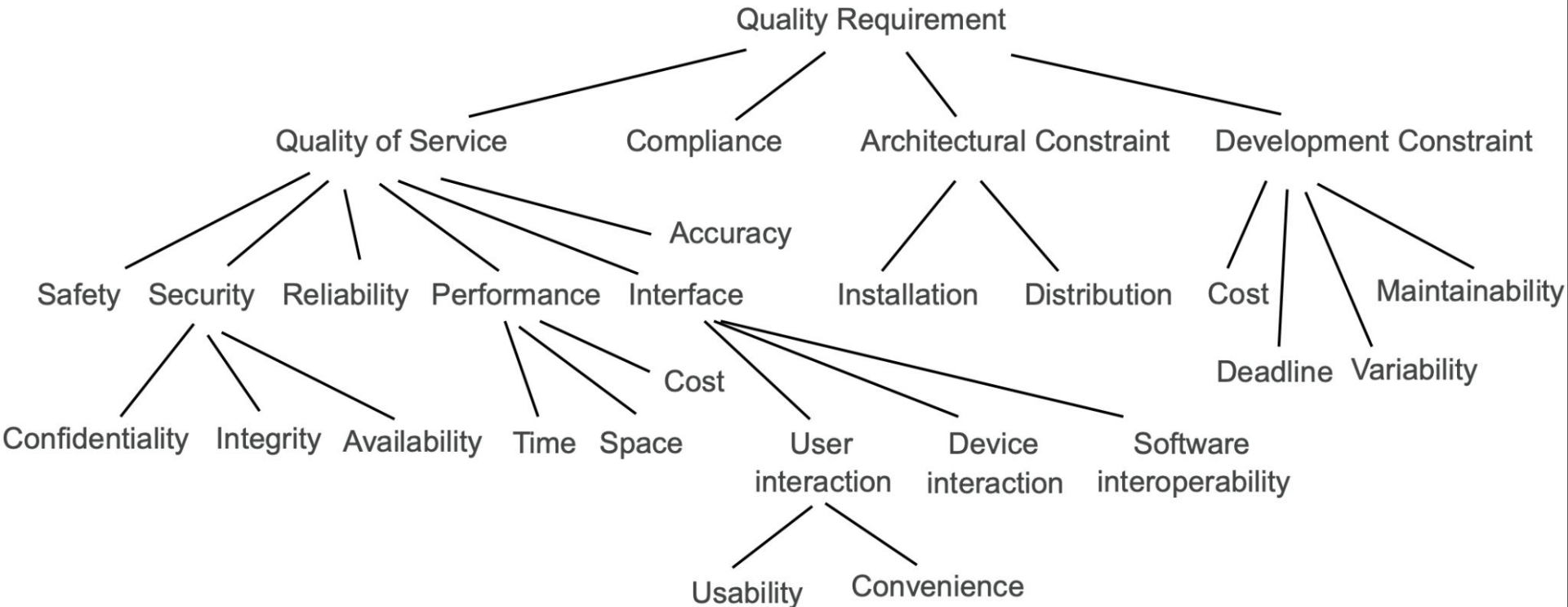
Definition: A *quality requirement* specifies not the functionality of the system, but the manner in which it delivers that functionality

Quality requirements can be more important than functional requirements:

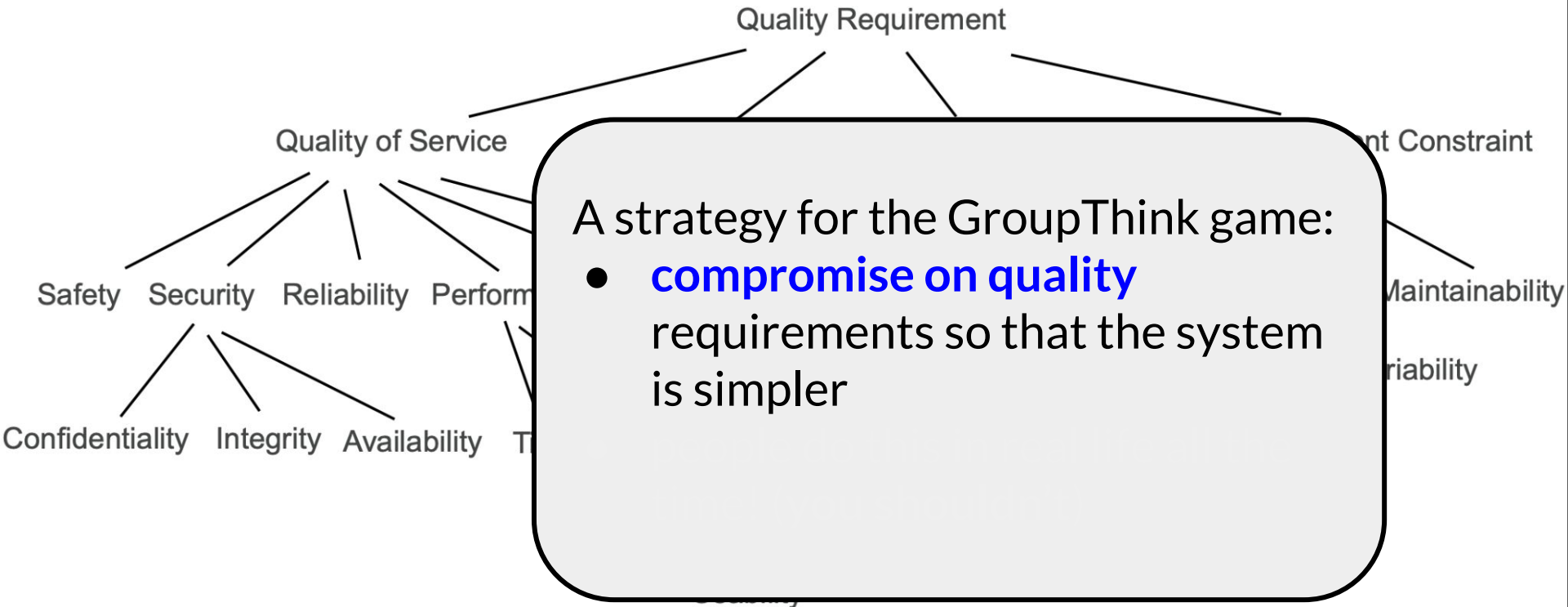
- Can work around missing functionality
- Low-quality system may be unusable

Examples of quality requirements

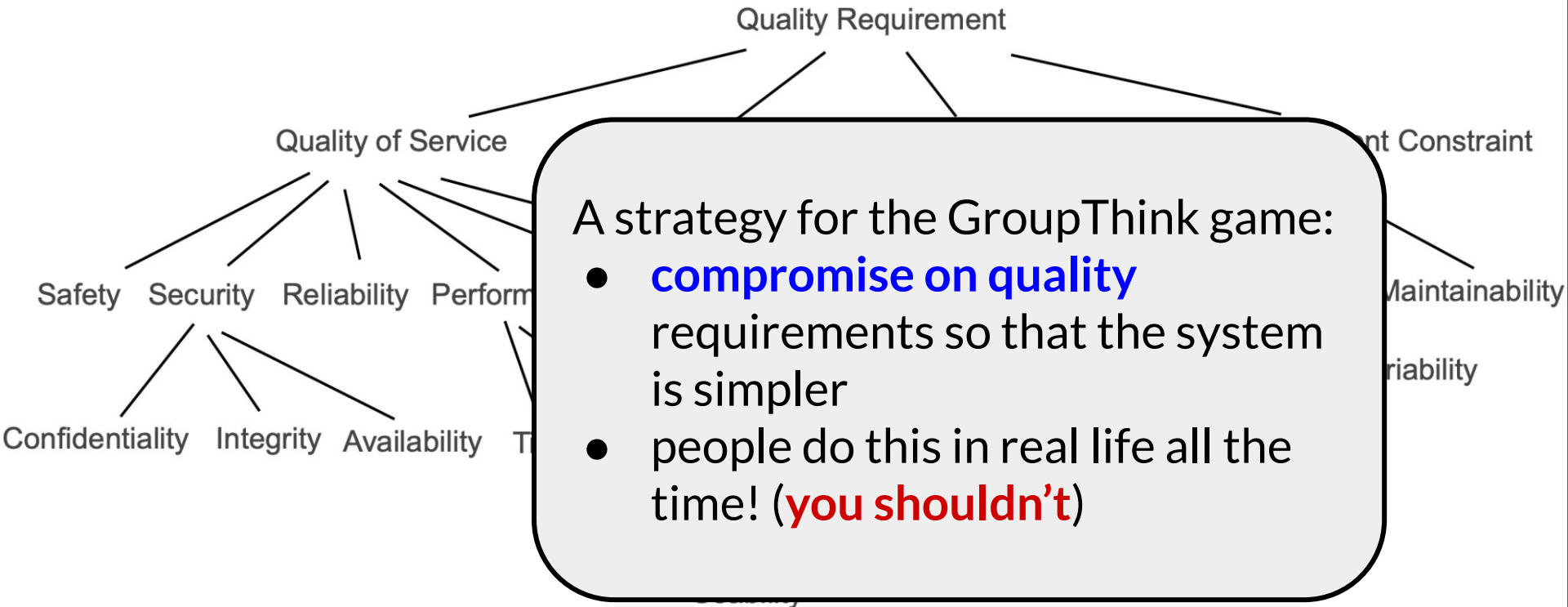
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Trade-offs!

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Advice: when possible, make your quality requirements verifiable

Informal vs. Verifiable Example

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Informal vs. Verifiable Example

- **Informal** goal: “the system should be easy to use by experienced controllers, and should be organized such that user errors are minimized.”
- **Verifiable** non-functional requirement: “Experienced controllers shall be able to use all the system functions after a total of **two** hours training. After this training, the average number of errors made by experienced users shall not exceed **two** per day, on average.”

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How to write specifications

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Technical writing courses
should cover how to do this

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User stories

“As a <role>, I can <capability>, so that I can <receive benefit>.”

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- also requires a *condition of satisfaction*, which is the measurement you will use to decide if the user story has been completed

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User stories: examples

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- “As a **computer user**, I want to **backup my entire hard drive** so that **my files are safe**”
- “As a **typical computer user**, I want to **specify folders to backup**, so that **my most important files are safe**”
- “As a **power user**, I want to **specify subfolders and filetypes NOT to backup**, so that **my backup doesn't fill up with things that I don't need to preserve**”

Writing user stories: INVEST principles

User stories should be:

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User stories should be:

- Independent
- Negotiable
- Valuable
- Estimable
- Small
- Testable

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Formal specifications

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- today's reading mostly was focused on formal specifications
- formal specifications are common in some safety-critical domains (e.g., aerospace, automotive software)
- to build one, you typically need to invest in learning a formal specification language (e.g., [TLA+](#), which is the only one I've seen used in industry)

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- today's reading mostly was
- formal specifications are common (e.g., aerospace, automotive)
- to build one, you typically need a specification language (e.g., used in industry)

This class doesn't cover formal specifications in any detail, but you should be aware of their existence: writing a model of your system (in any specification language, or none at all) is a good way to catch **design errors**.

How to write specifications

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Executable formal specifications

It is sometimes possible to *refine* a formal specification into a program.

- such specifications are usually written in a special-purpose programming language (*interactive proof assistant*)
- allows you to write proofs that directly apply to your executable code
- much, much more labor-intensive to develop than a standard software project
- area of active research!

Takeaways: requirements and specifications

- Make sure you build the right thing (spend time gathering requirements)
- Specifications can help to:
 - increase understanding of system requirements between engineers and customer
 - document what the system does/will do
 - improve code quality
- Writing good specifications and getting everyone to understand them is hard and therefore worth spending time on