Lecture 12
Communicating the Requirements
Rationale

mountvernon.org

Com S/SE 4090/5090

Robyn Lutz

rlutz@iastate.edu

Office hours:

Robyn: 11 Tues, 230 Atanasoff; 3 Fri (https://iastate.zoom.us/my/rlutz), & by appointment

Carter: cwunsch@iastate.edu,12 Tues (0112 Pearson); 12 Thurs (https://iastate.webex.com/meet/cwunsch), & by appointment

Arushi: arushi17@iastate.edu, 1 Wed (0112 Pearson) & by appointment

HW 2 due today, Oct. 3

1352 Gilman

Exam 1: Next Thursday, Oct. 10

Review: Tues, Oct. 8

Robertsons' Formality Guide

Rabbit project is agile, with a small team & small increments
Less time writing requirements
Still must understand requirements & rationales
Often uses scenarios (stories) & rapid prototypes

Horse project has longer release cycle & many stakeholders
Needs some formal documentation since requirements are passed between distributed groups

Elephant project is larger and longer
Many developers, often distributed/subcontractors
Requirements are contractual so must be documented
Many developers, often distributed/subcontractors
Often safety-critical; may need certification by regulators

Rationale answers: “Why this requirement??”

Def’n: The rationale is the **reason**, or justification, for a requirement.” (Chap. 12, p. 282)

Q: why include rationale when documenting a requirement?

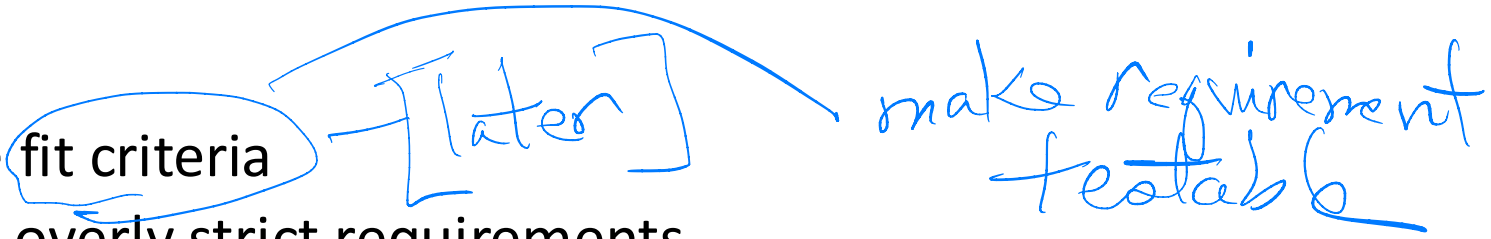
It's useful to know why a requirement is needed

- Def'n: The rationale is the **reason**, or justification, for a requirement." (Chap. 12, p. 282)

Q: Why include rationale when documenting a requirement?

A:

- Helps developers find the fit criteria
- Helps developers identify overly strict requirements
- Helps developers decide among trade-offs
- Helps testers understand priority of requirement
- Helps maintainers understand change impact



NASA Study on Flight Software Complexity
Dan Dvorak, Editor, 2009

"2.2 Emphasize Requirements Rationale

2.2.1 Finding

Requirements that are unnecessary or that specify unnecessarily stringent performance targets cause extra work and add complexity, whether in analysis, design, software, testing, operations, or some combination thereof. **The standard defense against unnecessary requirements is a statement of rationale that substantiates why a particular requirement is necessary.** However, the study found that rationale statements are often missing or superficial, or even misused in the sense of providing more detail about a requirement (rather than substantiating it).

Ex 3.

In one mission a scientist levied a requirement for "99% data completeness," implying that science results would be greatly diminished by any interruptions in science observations. The flight software team took the requirement seriously and designed and developed a system with redundant elements and fast onboard fault detection and response, making for a more complex system. Later in the project, somebody questioned the value of 99%, and the scientist—realizing that it was **overly stringent**—quickly relaxed the requirement. Unfortunately, the damage was already done; an unsubstantiated requirement had spawned an unnecessary cascade of time-consuming analysis, design, development, and testing, not to mention the dismay of the software team who had worked so hard."

NASA Study on Flight Software Complexity

"2.2.2 Recommendation 1

Project management should emphasize the importance of requirements rationale to the people who write requirements and ensure that they know how to write a proper rationale. "

A more recent study confirmed that missing, inadequately documented and incorrect requirements rationales contributed to defects during integration & testing of spacecraft software [Lutz et al., 2013]

Reducing the Risk of Overly Strict Requirements

- Consider easing it
- Consider removing it
- Consider variations and alternatives
  - Ex: some delivery drones need less precise location info than others
- Consider relaxing it at runtime

Some requirements are infeasible → ease them

too strict = no good rationale & not feasible

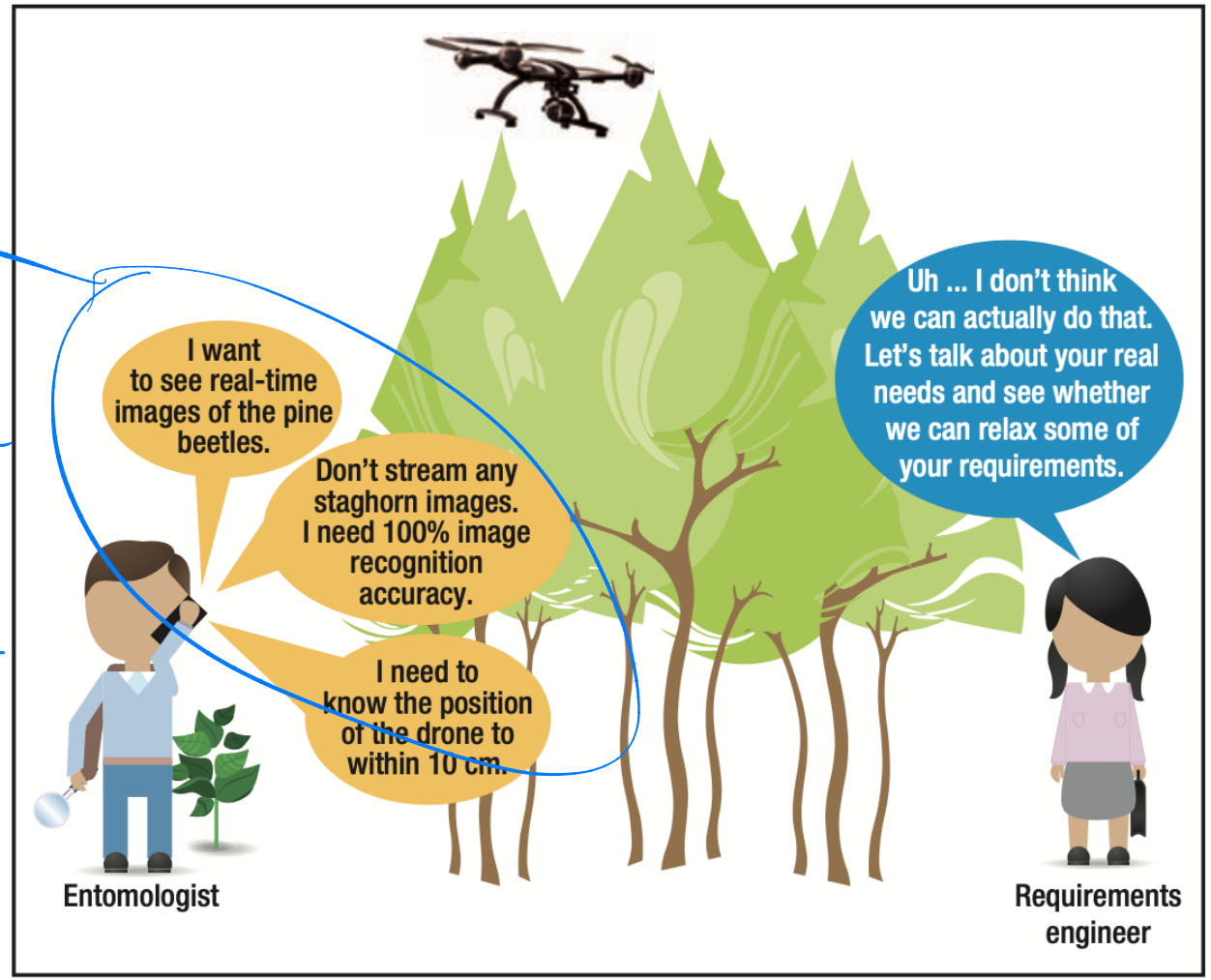


FIGURE 1. The essential and sometimes unenviable role of the requirements engineer in reducing the risk of an overly strict requirement.

[Lutz and Cleland-Huang, IEEE Software, 2017]

fault-protection software

Some requirements are inconsistent with project's budget and schedule → remove them

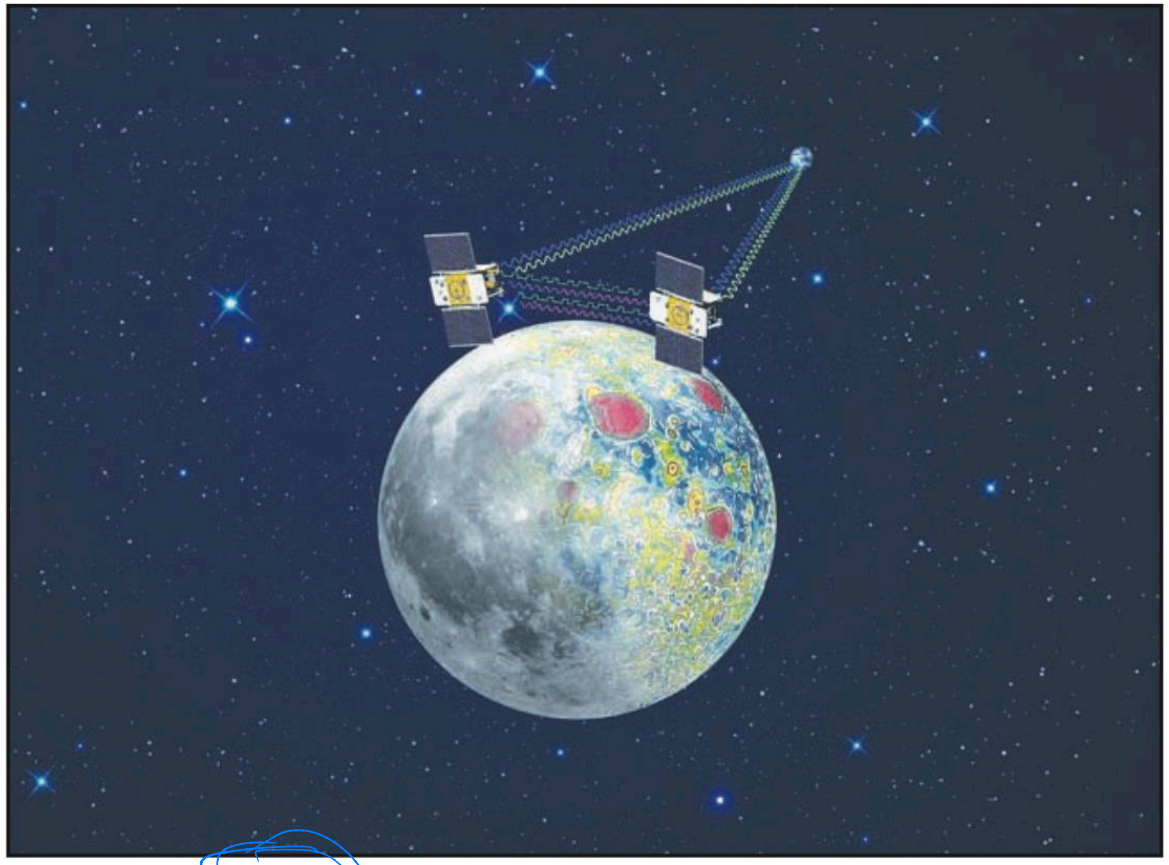


FIGURE 2. The GRAIL (Gravity Recovery and Interior Laboratory) spacecraft, which was launched to do gravity-field mapping of the moon. Such Discovery Program missions have smaller development budgets and shorter development timelines than flagship spacecraft projects. So, some requirements typical of larger spacecraft weren't justified for inclusion on GRAIL. (Image courtesy of NASA/JPL-Caltech.)

[Lutz and Cleland-Huang, IEEE Software, 2017]

Some requirements are too strict → which might be too strict for a smart pillbox?

https://cacm.acm.org/news/275744-teens-pill-tracking-device-attracts-interest-from-cvs-pharmacy/fulltext

The World Health Organization estimates pharmacies' use of the tracker could improve medication adherence, prevent intensified medical conditions, and reduce deaths due to forgetting to take a prescribed drug or misusing it.

Credit: Archishma Marrapu

Teen's Pill-Tracking Device Attracts Interest from CVS Pharmacy

U.S. pharmacy chain CVS is among those interested in a pill-tracking device created by Virginia-based high school student Archishma Marrapu.

Her Project Pill Tracker includes three-dimensionally-printed prescription bottles outfitted with ultrasonic sensors to monitor the pills dispensed, a mobile application to detect skipped doses and misuse via pattern analysis, and the ChatGPT chatbot to supply information to users.

The bottles feature light-emitting diodes and buzzers that go off when it is time to take pills; the app allows users to scan bar codes and autofill usage information about the prescription, and gives users reminders on their phone.

The World Health Organization suggests Marrapu's tracker could enable pharmacies to improve medication compliance, prevent worsening medical conditions, and reduce fatalities attributed to skipped or misused drugs.

Some requirements are too strict → which might be too strict for a smart pillbox?

https://cacm.acm.org/news/275744-teens-pill-tracking-device-attracts-interest-from-cvs-pharmacy/fulltext

The World Health Organization estimates pharmacies' use of the tracker could improve medication adherence, prevent intensified medical conditions, and reduce deaths due to forgetting to take a prescribed drug or misusing it.

Credit: Archishma Marrapu

Teen's Pill-Tracking Device Attracts Interest from CVS Pharmacy

U.S. pharmacy chain CVS is among those interested in a pill-tracking device created by Virginia-based high school student Archishma Marrapu.

Her Project Pill Tracker includes three-dimensionally-printed prescription bottles outfitted with ultrasonic sensors to monitor the pills dispensed, a mobile application to detect skipped doses and misuse via pattern analysis, and the ChatGPT chatbot to supply information to users.

The bottles feature light-emitting diodes and buzzers that go off when it is time to take pills; the app allows users to scan bar codes and autofill usage information about the prescription, and gives users reminders on their phone.

The World Health Organization suggests Marrapu's tracker could enable pharmacies to improve medication compliance, prevent worsening medical conditions, and reduce fatalities attributed to skipped or misused drugs.