Requirements

CSC 326



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1

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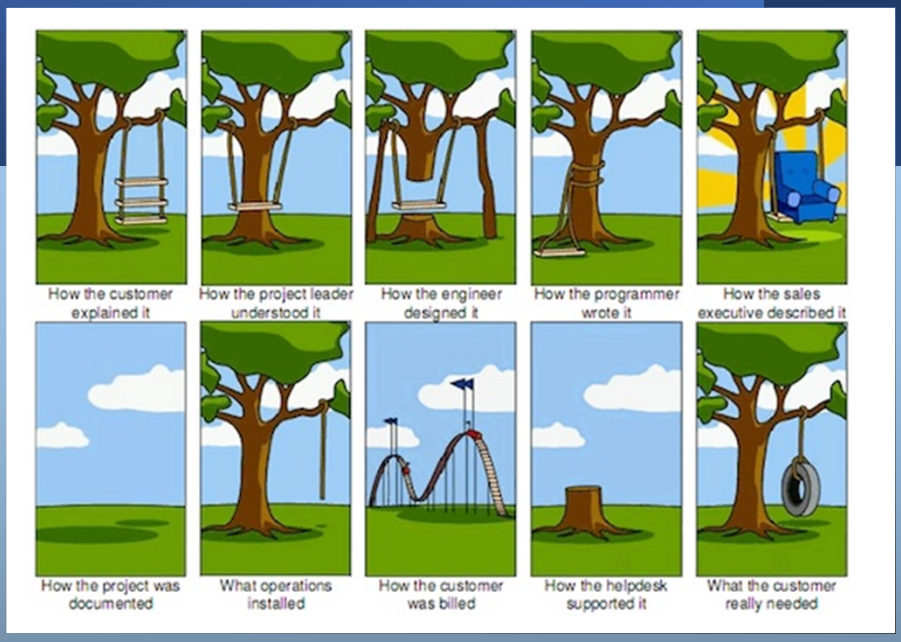

2

That seems extreme… how often does such miscommunication occur?

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3

A problem that stands the test of time

A 1995 survey of 8000 projects at 350 companies found: 31% of projects canceled before completed; 9% of projects delivered on time, within budget in large companies, 16% in small companies.

Incomplete Requirements	13.1%
Lack of User Involvement	12.4%
Lack of Resources	10.6%
Unrealistic Expectations	9.9%
Lack of Executive Support	9.3%
Changing Requirements & Specifications	8.7%
Lack of Planning	8.1%
Didn't Need it any longer	7.5%
Lack of IT Management	6.2%
Technology Illiteracy	4.3%



© NC State Software Engineering Faculty Jim Johnson, The Standish Group International Project Leadership Conference, May 1995, Chicago

4

Monumental Software Project Failures




Started	Terminated	System name	Type of system	Country or region	Type of purchaser	Problems	Cost *(expected)*	Outsourced or in-house?	Outcome
2007	2014	e-Borders	Advanced passenger information programme	United Kingdom	UK Border Agency	A series of delays.	over £412m (£742m)	Outsourced	Cancelled
2011	2014	Pust Siebel	Police case management	Sweden	Police	Poor functioning, inefficient in work environments.[9]	SEK 300m ($35m)[10]	Outsourced	Scrapped
2012	2014	Cover Oregon	Healthcare exchange website	United States	State government	Site was never able to accept online enrollments, so users were instructed to mail in paper enrollments instead.	approx $200m	Outsourced	Cancelled, then client and supplier both sued each other
2008	2013	Digital Media Initiative	Digital production, media asset management	United Kingdom	State broadcaster	By 2013, the project was judged to be obsolete (as much cheaper commercial off the shelf alternatives by then existed) and was scrapped by BBC management. The BBC Director General said it had been a huge waste of money.[7]	more than £98m *(£81.7m)*	Outsourced, then insourced, then outsourced again	Cancelled
2009	2013	The Surrey Integrated Reporting Enterprise Network (SIREN)	Crime & criminal intelligence logging system	United Kingdom (Surrey)	Police Force	Not fit for purpose[8]	£14.8m	Outsourced	Scrapped
2005	2012	Expeditionary Combat Support System	Military Enterprise Resource Planning	United States	Air force	No significant capabilities ready on time; would have cost $1.1bn more just to get to 1/4 of the original scope.	$1.1bn	Outsourced - including requirements	Cancelled
2007	2012	da:Polsag	Police case management	Denmark	Police	Did not work properly, technical problems with contractor.	DKK 500m ($70m)	Outsourced	Cancelled

https://en.wikipedia.org/wiki/List_of_failed_and_overbudget_custom_software_projects

5

Getting requirements wrong is expensive

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6

Relative Cost to Fix an Error

TIME ↓

ERROR FOUND DURING….	COST RATIO
Requirements	1
Design	3-6
Coding/Implementation	10
Development testing (unit)	15-40
Acceptance testing	30-70
Operation (field)	40-100

Source:
Barry Boehm's *Software Engineering Economics,* 1981
Data based on 63 plan-driven projects



Barry Boehm
(1935-2022)

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Ford Pinto – Design Error!

- Manufactured in the 1970s
- The position of the fuel tank mounting bolts was a good design based on an assumption:
  - *There will be no rear impact collisions!*
- Assumption proved to be false.
- Ford spent $100 million in litigation & recall services





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Tesla in fatal California crash was on Autopilot

31st March 2018, 06:24 EDT

Share

Reuters

The driver of the Tesla Model X died shortly after the crash

"It led the company to introduce new safety measures, including turning off Autopilot and bringing the car to a halt if the driver lets go of the wheel for too long."

In other words, new requirements were introduced

9

Requirements

- **Software Requirement**: condition or capability needed by a user to solve a problem or achieve an objective that must be met or possessed by a system or system component. Represented in a contract, standard, specification, or other formally imposed document
  - Informally: a description of what the customers want
  - May be buried beneath layers of assumptions, misconceptions, and politics

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10

Requirements Engineering (1)

- Systematic way of developing requirements through an iterative process
- Results in a specification of the system that stakeholders understands
  - natural language (e.g., use cases)
  - easy to understand pictures (UML Use Case Diagrams)

- A stakeholder is a key representative of the groups who have a vested interest in your system and direct or indirect influence on its requirements.

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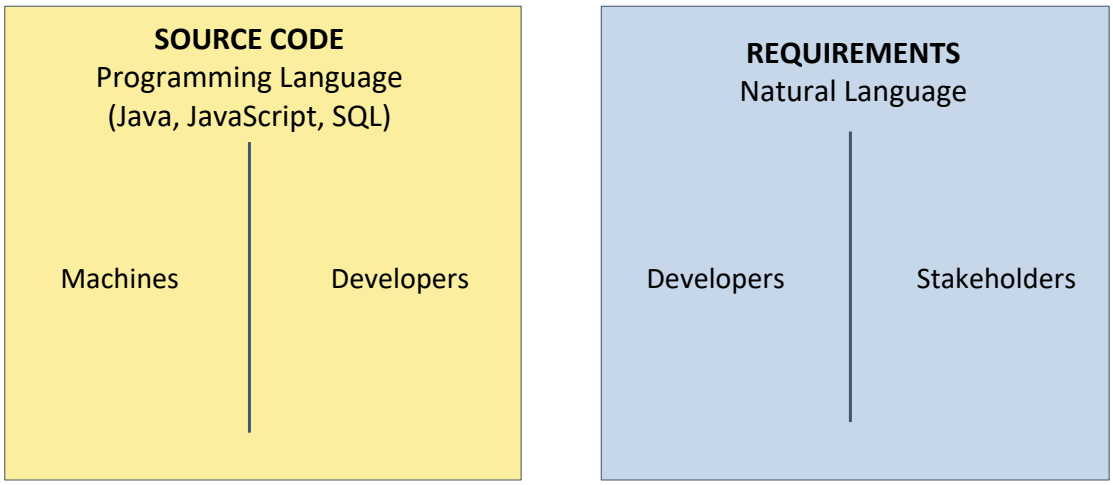
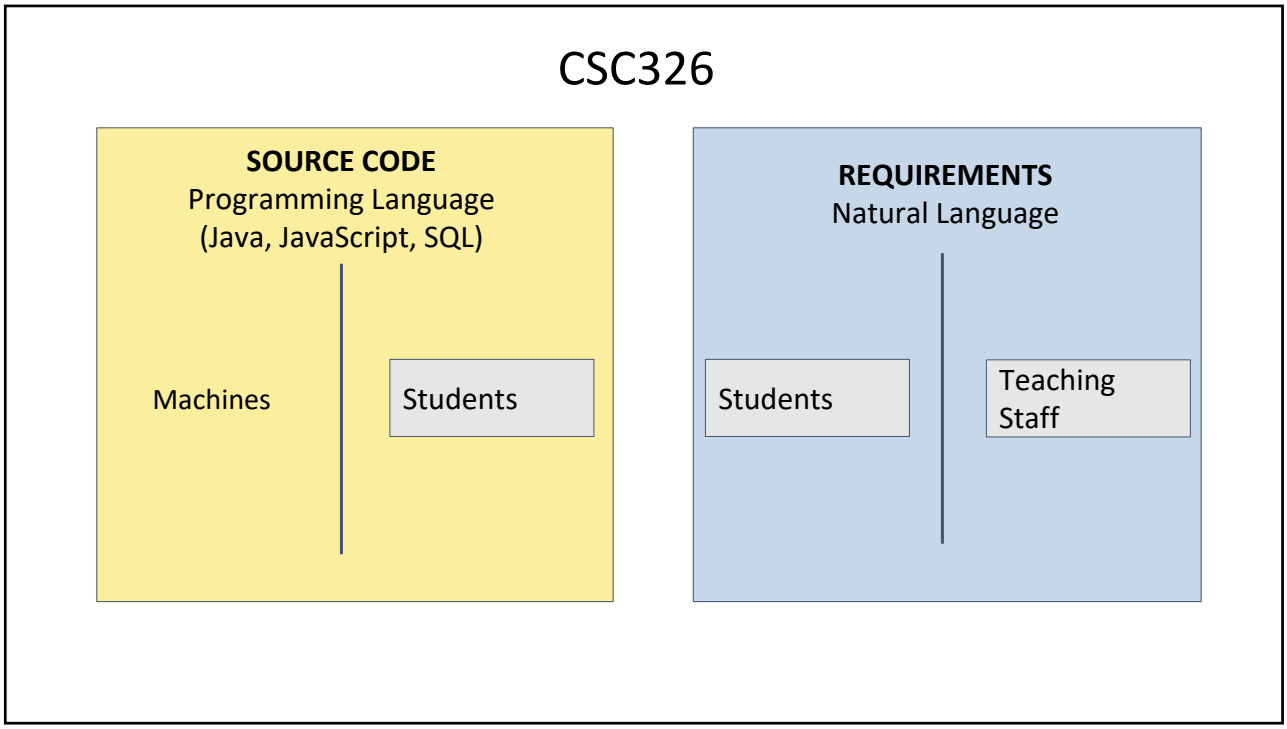
11

REQUIREMENTS: Two Audiences



12



13

Requirements Engineering (2)

- **Analysis**: studying user needs to generate system definition that users understand (often done in conjunction with Product Managers)
  - Fact-finding
  - Communication
  - Fact-validation
- **Modeling**: translating requirements the user understands to a form that software engineers understand
  - Representation
  - Organization

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14

Types of Requirements Statements

- Traditional
  - "The system shall…"
- ***Use case based***
  - ***This is what CoffeeMaker uses***
- User story – married with acceptance test to supply the detail
  - Agile requirements

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15

Types of Requirements

- Functional requirements: *requirements that specify a function that a system or system component must be able to perform*
  - **Example:** The watch shall display the time.
- Non-functional requirements ("quality attribute"): not specifically concerned with the functionality of a system but place restrictions on the product being developed
  - User visible aspects of the system not directly related to functional behavior
  - Usability; accessibility; reliability; privacy; security; availability; performance; scalability
  - Best to translate non-functional to measurable.
    - ***Example:*** The response time must be less than 1 second
- Constraints ("Process requirements"): not user-visible; imposed by the client that restricts the implementation of the system or the *development process*
  - ***Example:*** The implementation language must be Java.
  - ***Example:*** Unit tests must be written in JUnit.

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16

Exercise 03.01

Work on this with those around you (or by yourself)

You have 3 minutes.

17

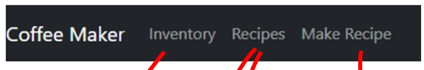
CoffeeMaker (Milestone 0 Requirements)

Use Case 1: Display Menu

Display a menu of options for working with the CoffeeMaker systems for a user.

Main Flow

1. A user goes to the CoffeeMaker website.
2. A user selects one of the following menu options:
   - Add Recipe [UC2]
   - Delete Recipe [UC3]
   - Edit Recipe [UC4] ?
   - Update Inventory [UC5]
   - Order Beverage [UC6]



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18

CoffeeMaker (Milestone 0 Requirements)

Use Case 2: Add Recipe

Preconditions

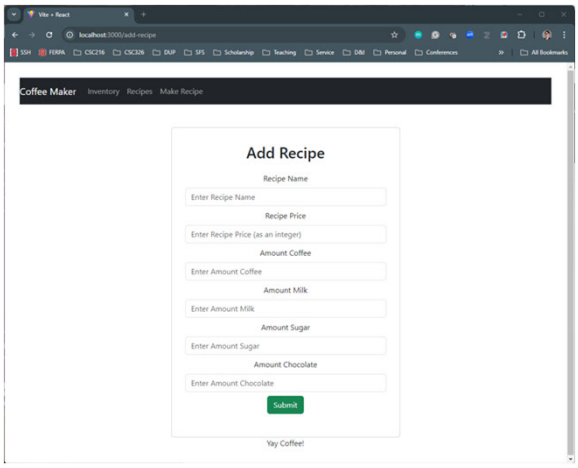
User selected the Add Recipe option from the menu [UC1]

Main Flow

1. A user selects the option to add a recipe.
2. The user enters the name, price, units coffee, units tea, units sugar, units milk, and units chocolate that make up the recipe. The user clicks Submit. The recipe is saved. [Too Many] [Invalid Price] [Invalid Unit] [Duplicate].
3. The user returns to the main menu [UC1].

Alternative Flows

- [Too Many] If there are already three recipes in the system, then a new recipe may not be added. An error message is printed, and the recipe is not added.
- [Invalid Price] The price must be a positive integer. If the price is not a positive integer then, an error message is printed, and the user is returned to the form to edit. The recipe is not added.
- [Invalid Unit] The units of coffee, sugar, milk, and chocolate must be positive integers. If the unit value on any of the ingredients is not a positive integer, an error message is printed, and the user is returned to the form to edit. The recipe is not added.
- [Duplicate] If the name of the new recipe already exists in a recipe in the system, an error message is printed, and the user is returned to the form to edit. The recipe is not added.



19

19

How do we check that requirements are satisfied?

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20

20

https://arxiv.org/abs/2311.00984

Extra Food - Read for fun!

Inclusiveness Matters: A Large-Scale Analysis of User Feedback

Nowshin Nawar Arony§, Ze Shi Li§, Bowen Xu, Daniela Damian

Abstract—In an era of rapidly expanding software usage, catering to the diverse needs of users from various backgrounds has become a critical challenge. Inclusiveness, representing a core human value, is frequently overlooked during software development, leading to user dissatisfaction. Users often engage in discourse on online platforms where they indicate their concerns. In this study, we leverage user feedback from three popular online sources, Reddit, Google Play Store, and Twitter, for 50 of the most popular apps in the world to reveal the inclusiveness-related concerns from end users. Using a Socio-Technical Grounded Theory approach, we analyzed 23,107 posts across the three sources and identified 1,211 inclusiveness related posts. We organize our empirical results in a taxonomy for inclusiveness comprising 6 major categories: Fairness, Technology, Privacy, Demography, Usability, and Other Human Values. To explore automated support to identifying inclusiveness-related posts, we experimented with five state-of-the-art pre-trained large language models (LLMs) and found that these models' effectiveness is high and yet varied depending on the data source. GPT-2 performed best on Reddit, BERT on the Google Play Store, and BART on Twitter. Our study provides an in-depth view of inclusiveness-related user feedback from most popular apps and online sources. We provide implications and recommendations that can be used to bridge the gap between user expectations and software so that software developers can resonate with the varied and evolving needs of the wide spectrum of users.

Index Terms—inclusion, diversity, user feedback, human aspects, deep learning