Software Project Management (3 – 20191009)

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A Brief History of (Software) Project Management

What is a project

The name of the game

Software Development Projects

- Some Examples of Software Development Projects and Operational Work

Projects and their Environment

The players (and you)

Organizing the Development of Software Projects

Software Project Management

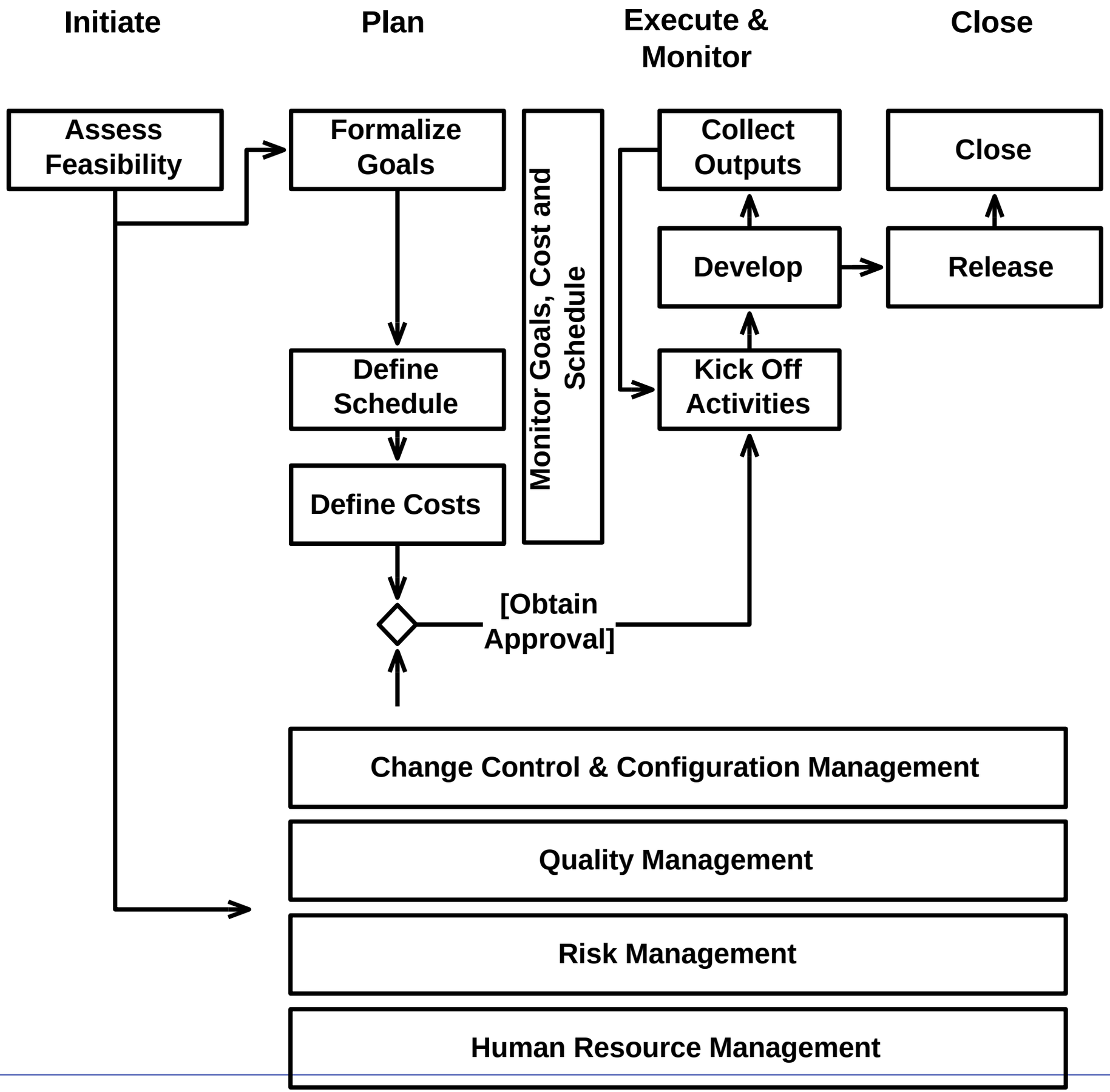
- **Software project management** is the integration of management techniques to software development.
- The need for such integration has its root in the sixties, in the days of the "**software crisis**", when practitioners recognized the increasing complexity of delivering software products meeting the specifications

Software Development Framework

- A general software project management framework is meant to:
  - Form a **shared vision** about the goals to be achieved, the characteristics of the project outputs, and the characteristics of the development process
  - Structure the work as a **progressive refinement**, from specification to goals
  - Reduce the impact of **uncertainties** and unknowns
  - Highlight any **deviation** from the plan (goals, costs, quality)
  - Ensure the coherency and **quality** of the project artifacts over time and in spite of unknowns and (request for) changes
  - **Motivate** your team

Some Concerns

- Feasibility Assessment
- Goals (Scope) Management
- Time Management
- Cost Management
- Change Control and Configuration Management
- Quality Management
- Risk Management
- Human Resource Management


Initiate
Plan
Execute & Monitor
Close
Assess Feasibility
Formalize Goals
Define Schedule
Define Costs
[Obtain Approval]
Monitor Goals, Cost and Schedule
Collect Outputs
Develop
Kick Off Activities
Close
Release
Change Control & Configuration Management
Quality Management
Risk Management
Human Resource Management

Software Development Processes

Initiate

Plan

Execute & Monitor

Close

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Formalize Goals

Define Schedule

Define Costs

[Obtain Approval]

Monitor Goals, Cost and Schedule

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Change Control & Configuration Management

Quality Management

Risk Management

Human Resource Management

Overview

- Software development is a progressive refinement which moves from concept to operations through the following phases:
  - Requirements and User Experience Design
  - Design
  - Implementation
  - Verification and Validation
  - Deployment
  - Operations and Maintenance
- As we move along these phases, we make and commit to specific choices; the **cost of changes** increases accordingly
- Different processes put different **emphasis** on each activity or define the **order** in which these activities can be performed

Requirements Management

Requirements

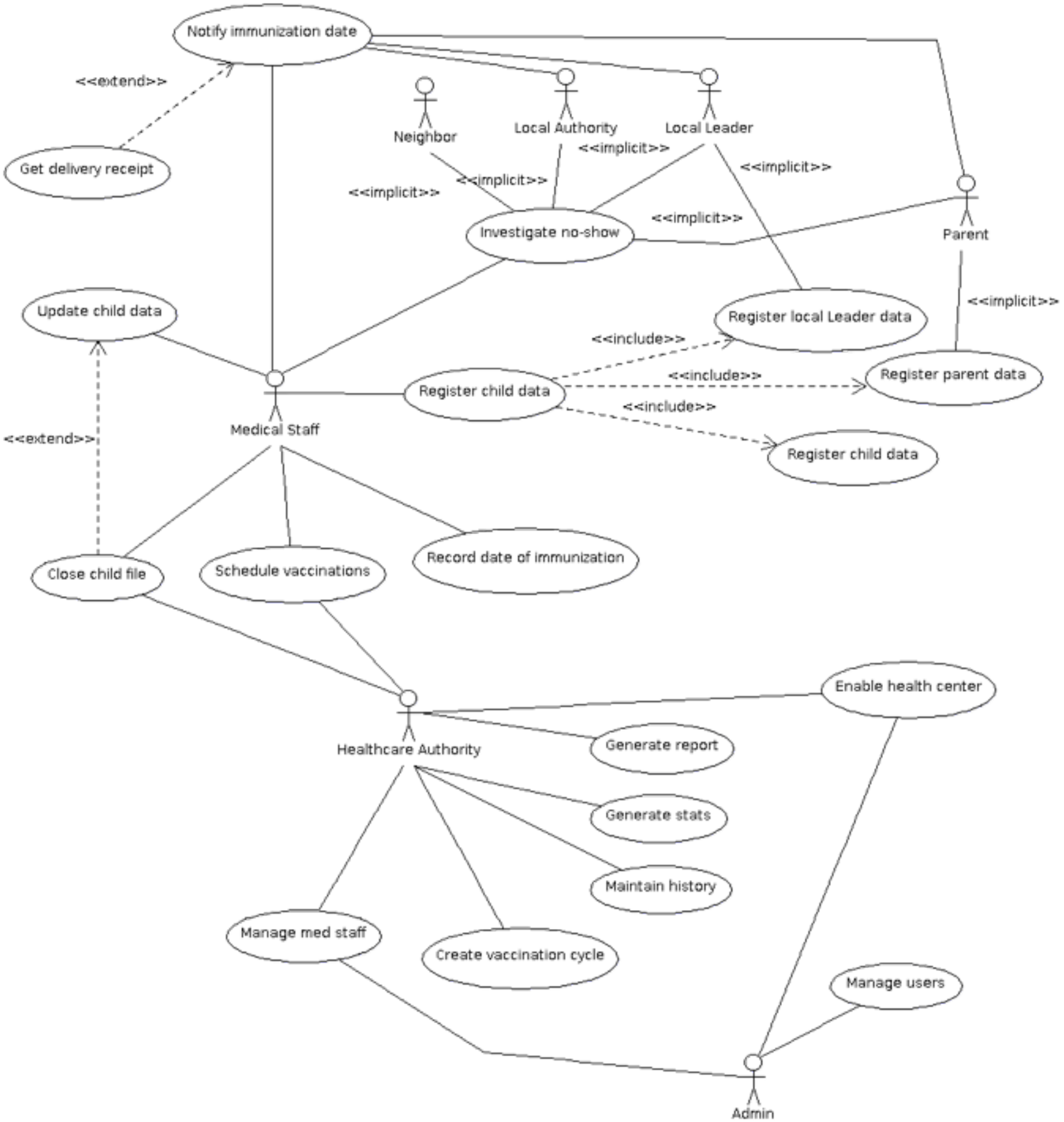
- Goal:
  - Forming a shared view about the characteristics of the system to build
- Output:
  - List of requirements, presented as:
    * a text document
    * a list of user stories
    * a set of diagrams (e.g., use case diagrams) and corresponding textual descriptions

List of Requirements

- Format:
  - Free or structured text describing the functions and other properties of a system
- Advantages
  - Simple to draft and distribute
  - The format can be used to keep track of changes (versioning)
- Disadvantages
  - No focus on user interaction: it can be difficult to understand for a customer
  - Ambiguities and incoherencies; interactions among requirements

Use Case Diagrams

- Format:
  - Diagrams describing the interaction between users and the system
  - Textual description of the interaction as a sequence of steps


Notify immunization date
<<extend>>
Get delivery receipt
Neighbor
Local Authority
Local Leader
<<implicit>>
<<implicit>>
<<implicit>>
<<implicit>>
<<implicit>>
Investigate no-show
Parent
Update child data
Register local Leader data
<<implicit>>
<<include>>
Register parent data
<<include>>
Register child data
<<include>>
Register child data
Medical Staff
<<extend>>
Close child file
Schedule vaccinations
Record date of immunization
Enable health center
Healthcare Authority
Generate report
Generate stats
Maintain history
Manage med staff
Create vaccination cycle
Manage users
Admin

Use Case Diagrams

- Format:
  - Diagrams describing the interaction between users and the system
  - Textual description of the interaction as a sequence of steps
- Advantages
  - Intuitive, simpler to understand for a customer
  - It focuses on what the system does (user functions)
- Disadvantages
  - Difficult to represent and keep track of non-functional requirements
  - Managing diagrams requires a bit more work than working with text only

User Stories

- Format:
  - Structured textual descriptions of user functions: As a [user] I want to do [this] because [of that]
- Advantages
  - Intuitive, compact, and simple to understand for a customer
  - It focuses on what the system does (user functions)
- Disadvantages
  - Difficult to represent and keep track of non-functional requirements
  - It is a partial specification (many details need to be worked out during the implementation) - used by Agile methodologies

Requirements Engineering

- Goal:
  - Define and maintain requirements over time
- Activities:
  - Requirements elicitation
    (workshops, brainstormings, focus groups, …)
  - Requirements structuring
  - User experience design
  - Requirements validation

Requirements Structuring

- Goal:
  - Improving maintenance of requirements over time
- Tools:
  - Isolated and made identifiable (reason and manipulate each requirement more easily)
  - Organized and classified
    - Functional and non-functional
      - Usability, reliability, performance, supportability
  - Annotated (priority, importance, traceability, …)
    - Importance for the customer
    - Difficulty to develop

User Experience Design

- Goal:
  - Providing a coherent and satisfying experience on the different artifacts that constitute a software system, including its design, interface, interaction, and manuals
- Tools:
  - User-centered analysis: **understanding** how users will interact with the system (focus groups, experiments)
  - User-centered design: **specifying** how users will actually interact with the system (storyboards, mock-ups, prototypes)

Requirements Validation

- Find (and address):
  - Inconsistencies
    * **scenario 1:** the system should always abort in case of error
    * **scenario 2:** the system should recover from a sensor-reading error
  - Incompleteness
    * the behavior is not specified for certain cases and situations
  - Duplicates
    * the same requirements is described twice (possibly in different ways)

Business Process Modeling and Re-engineering

Organizations and Software

- Software has to be designed to fit an organization's operational structure
- However: software can also change the way in which an organization work

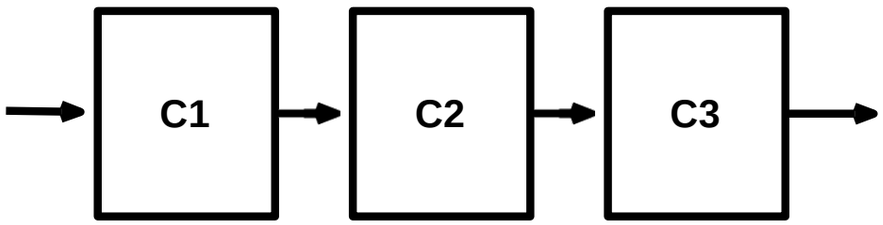
- Business process modeling models the way in which an organization works
- Business process re-engineering plans the way in which an organization works, to make its operations more efficient ("as is" and "to be")

System Design

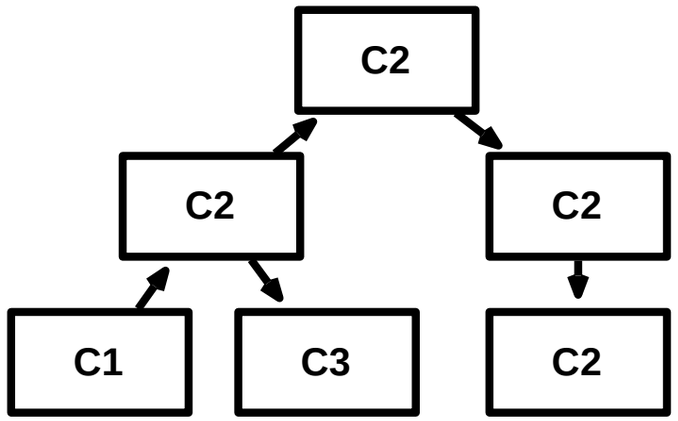
System Design

- Goal:
  - Defining the structure of the software to build (= system architecture)
- Outputs:
  - components which constitute the system
  - functions each component implements
  - how the components are interconnected
- The activity is relevant also for managerial reasons: the system architecture provides a “natural” decomposition of work

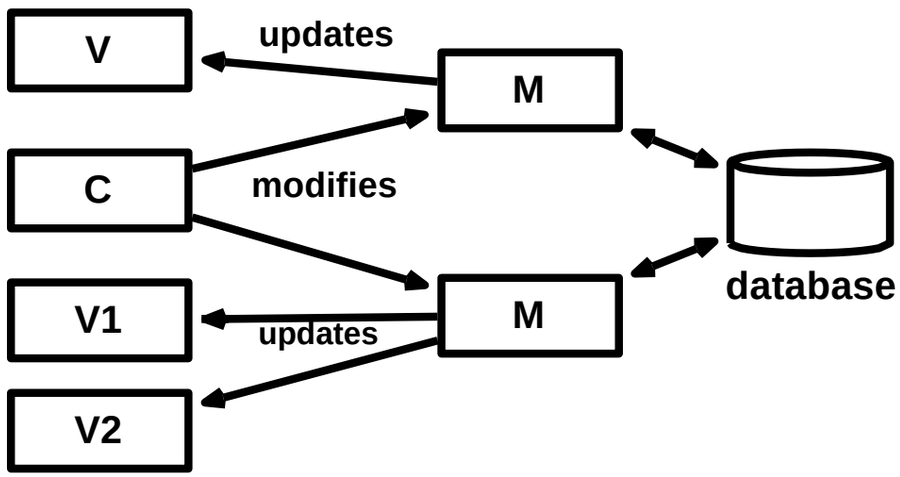
Architectural Patterns



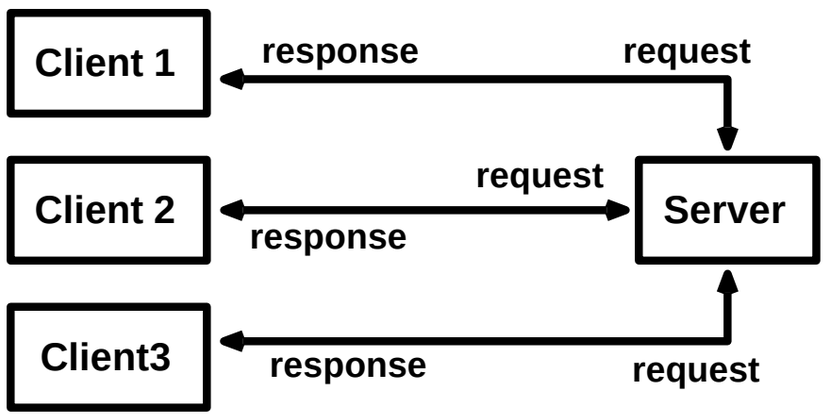
A Pipeline Architecture



A Layered Architecture



A Data-Centric applicaton with two MVCs



A client-server Architecture

Architectural Patterns

- Pipe and filter
  - Composition of data processing units
  - Focus: I/O specification
- Layered/Hierarchical
  - Hierarchy of components
  - Focus: control and information flow; block responsibilities
- Data-Centric
  - MVC: data, presentation, and logic
  - Focus: data model, operations
  - Many web applications and many desktop applications use the data-centric architectural style
- Client-server
  - Server (main functions) and clients (requesting services)
  - Focus: communication protocolo/service specifications

Implementation

Implementation

- Goal:
  - Writing the code!
- Some of the PM-relevant activities during implementation:
  - Collection of productivity and size metrics
  - Collection of quality metrics
  - Use of coding and documentation standards
  - Code management practices (versioning; code releasing standards)

Verification and Validation

Verification and Validation

- Verification = did we build the system right?
- Validation = are we building the right system?

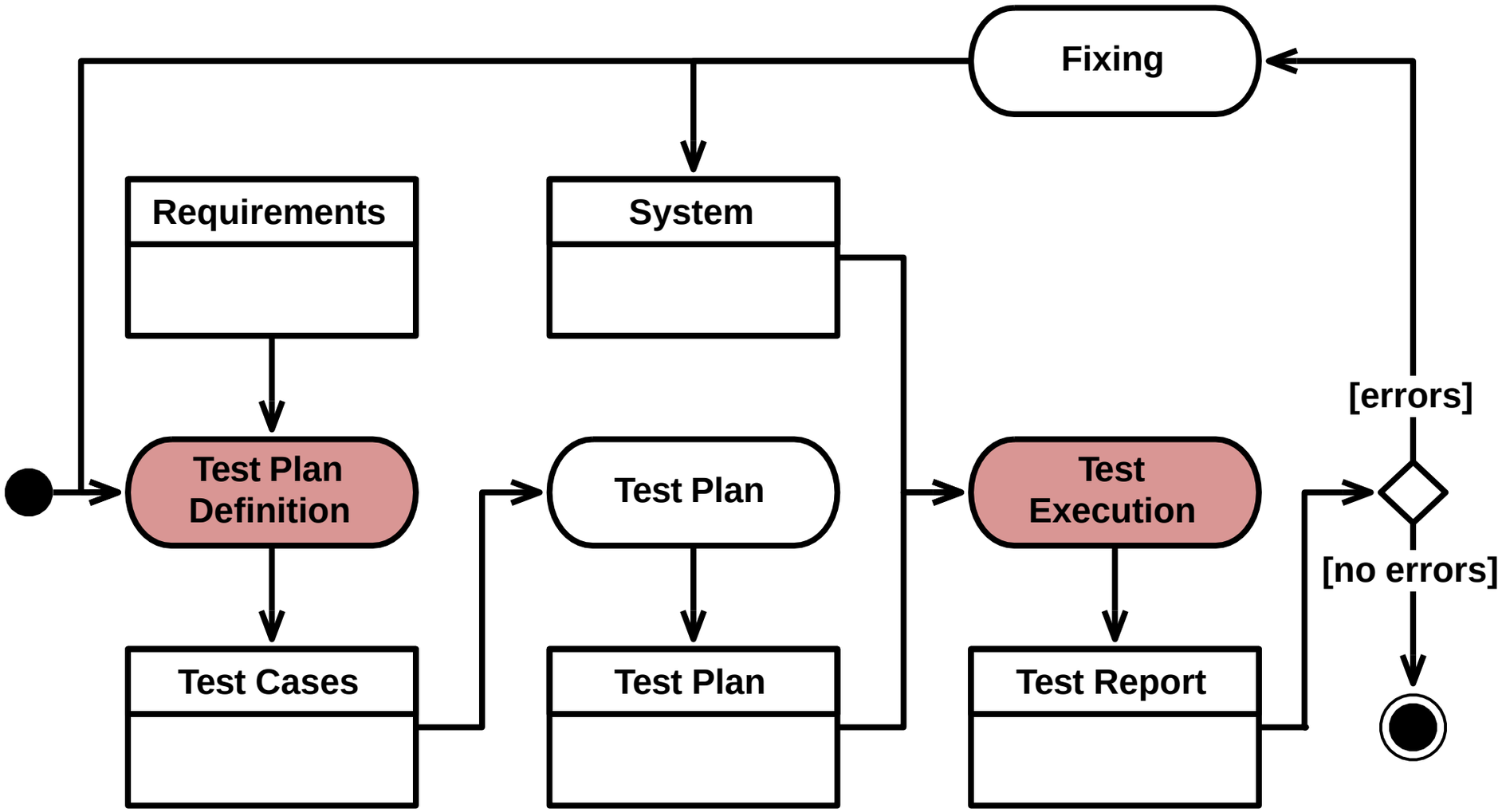
- Collectively known with the acronym **V&V**

- Part of quality management
- The main (but not the only) way of performing V&V for software systems is testing

Types of Testing

- Unit testing
  - Scope: a piece of code, such as a class
- Integration testing
  - Scope: the interaction between two components
  - Mars Climate Orbiter bug: two components used different units (metric and imperial); ~400M USD loss.
- System testing
  - Scope: the system behaves as expected and implements correctly all the requirements
  - Test cases
- Usability testing
  - Scope: verifying whether the user experience and interaction is intuitive, effective, and satisfying
  - Used to reduce the probability of human errors (safety-critical systems).

The System Testing Process



Deployment

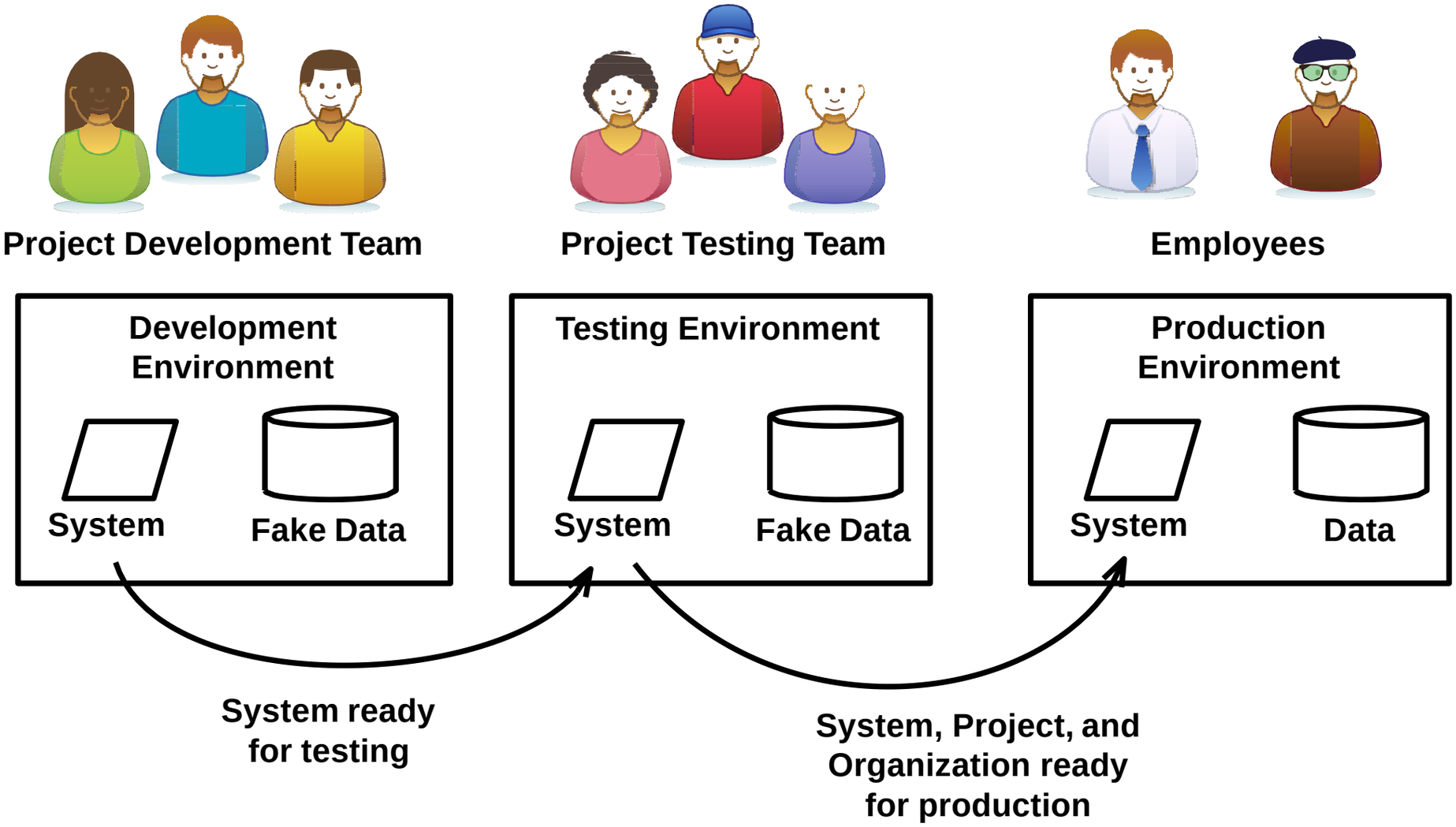
Deployment

- Goal
  - Installing the new system and making it operational
- Some concerns:
  - Ensuring continuity of business operations
  - Migrating data
  - Transitioning to operations and maintenance
- Factors to consider:
  - The human factor: is the people ready to use the system?
  - The data factor: is all the data which is needed for the system to run available to the new software?
  - The hardware factor: are all interfaces ready and functional?

Approaches

- Cut-over: the new system replaces the old one
- Parallel Approach: the old and the new system operate simultaneously for a period
- Piloting: the new system is installed for a limited number of users or for a specific business unit
- Phased Approach: functions are rolled out incrementally

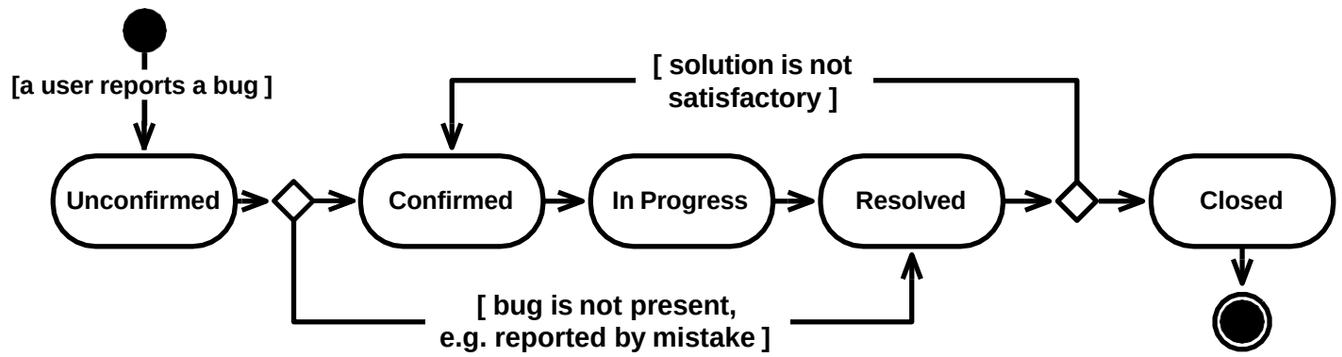
Managing Software Evolution



Operations and Maintenance

Operations and Maintenance

- Goal
  - Ensuring the system runs smoothly
- Activities:
  - Providing Technical Support
  - Monitoring system performance
  - Collecting and managing tickets (clarifications, bugs, requests for improvement)
  - Trigger maintenance activities



Types of Maintenance

- Corrective, if relative to fixing an issue discovered after the release of the system
- Preventive, if relative to fixing an issue discovered, but not occurred (or, at least, signaled by users)
- Adaptive, if relative to adapt a system to changed external conditions
- Perfective, if relative to improve some characteristics of a system, like, for instance, performances

Questions