Project Management
Software Engineering Theory

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Requirements

System Design
(Architecture, High-level Design)

Module Design
(Program Design, Detailed Design)

Implementation
of Units (classes, procedures, functions)

Unit testing

Module Testing
(Integration testing of units)

System Testing
(Integration testing of modules)

Acceptance Test
(Release testing)

Validate Requirements, Verify Specification

Verify System Design

Verify Module Design

Verify Implementation

Project Management, Software Quality Assurance (SQA), Supporting Tools, Education

Maintenance
What is a project?

- Climb Mount Everest
- Build a house
- Take a course
- Create a software
A project is a temporary endeavor undertaken to create a unique product or service

Project Management Institute
Clear purpose/goal, but no predefined process to follow to get there.

Unclear purpose/goal, but a strict process that you have to follow.
SMART Goals

**Specific**
Must be straightforward and answer the questions: **What** will you do? **Why** is it important?

**Measurable**
If you cannot measure it, how do you then know if the goal is reached or not?

**Agreed Upon**
Agreed upon with all stakeholders (e.g. customer, user etc.)

**Realistic**
Possible with the current resources, knowledge and time. You must be both willing and able to do it.

**Timely**
A clear time frame for the goal.

Note that there exist other similar versions the definition of SMART goals.
Software is invisible, but...

18 years late
11 times more costly
Who are involved in a software project?

**Stakeholders**

- **User** - Uses the system
- **Customer** - Pays for the system
- **Development Organization** - Provides the system
- **Supplier**

A person or organization with a major interest in the project outcome.
Dependent project parameters

- Calendar Time
- Resources
- Features
- Quality
A project

Lots of things to do...
A project

Work breakdown
A task or an activity

Examples:
- Implement encryption module
- Interview users
- Design user-interface prototype

Task (or activity)

Duration, e.g. 10 days
Dependencies between tasks

Task1 and Task2 are precursors (predecessors) to Task3
Tool Support

Microsoft Project

OpenProj

IDA's Dreamspark Premium
(see "Resources" on course page)

http://openproj.org
Tasks, Duration, and Dependencies

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessors</th>
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<tr>
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<td>72 days</td>
<td>Mon 07-08-27</td>
<td>Tue 07-12-04</td>
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<td>Training in J2EE</td>
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<td>Mon 07-08-27</td>
<td>Fri 07-09-21</td>
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<tr>
<td>Inception</td>
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<td>Mon 07-08-27</td>
<td>Tue 07-09-04</td>
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<tr>
<td>Requirement spec. v1</td>
<td>5 days</td>
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<td>Tue 07-09-04</td>
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<tr>
<td>User interface prototype</td>
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<td>Mon 07-09-03</td>
<td>4</td>
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<td>Elaboration</td>
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<td>Wed 07-09-06</td>
<td>Tue 07-09-18</td>
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<td>finalize project plan</td>
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<td>Thu 07-09-13</td>
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<tr>
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<td>Tue 07-09-15</td>
<td>10, 11</td>
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<td>Fri 07-11-23</td>
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<td>Detailed design</td>
<td>15 days</td>
<td>Wed 07-09-19</td>
<td>Tue 07-13-09</td>
<td></td>
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<tr>
<td>Implement Database module</td>
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<td>Wed 07-09-19</td>
<td>Tue 07-13-15</td>
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<tr>
<td>Implement Business logic</td>
<td>25 days</td>
<td>Mon 07-09-24</td>
<td>Fri 07-13-26</td>
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<tr>
<td>Implement User interface</td>
<td>15 days</td>
<td>Wed 07-09-19</td>
<td>Thu 07-13-09</td>
<td></td>
</tr>
<tr>
<td>Integration testing</td>
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<td>Mon 07-10-26</td>
<td>Fri 07-11-09</td>
<td>15, 17, 16</td>
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<tr>
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<td>Mon 07-11-12</td>
<td>Fri 07-11-16</td>
<td>13</td>
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<tr>
<td>Buffer</td>
<td>5 days</td>
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<td>Fri 07-11-23</td>
<td>19</td>
</tr>
<tr>
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<td>13</td>
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<td>Mon 07-11-26</td>
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<td>Tue 07-12-04</td>
<td>23</td>
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<td>User training</td>
<td>5 days</td>
<td>Tue 07-11-27</td>
<td>Mon 07-12-03</td>
<td>22</td>
</tr>
</tbody>
</table>

Gantt-chart

- Phases
- Tasks/Activity
- Duration
- Task
- Dependency
- Phase
Milestone and Tollgate

**Milestone**

- Verify internal sub-goal fulfillment
- Properties of a SMART goal

**Tollgate**

- External decision point
- E.g. after a pre-study phase, the customer decides if the project should continue or not.
Critical Path, Slack and Real time

Available time = Slacktime + Real time
Resource Planning

Who is going to "do" the task and with what?

Resource planning

START

Task1

STOP

Time

START

Task1

STOP
Effort Estimation… a good approach?

How long time does it take for you to implement the encryption layer?

No idea. I have never done this before... I wonder if it is even possible.

8 months +- 2 months
Effort Estimation

Expert Judgment - the **Delphi** technique

- Experts make individual predictions secretly
- Estimates are shown to each other (anonymously)
- Experts discuss the estimates

[Convergence]

[No Convergence]

Algorithmic Methods - COCOMO and COCOMO II

**COCOMO (Boehm, 1981)**
- An formula where parameters are estimated using real projects.
- Input: No of code lines
- Output: Effort (time)

**COCOMO II**
- Takes into account changes in SE, such as component reuse, prototyping
- Other inputs than number of code lines. E.g. functionality from requirements, number of screens etc.
Planning Poker

- Variant of Delphi method
- Unit: Hours or Points (the effort of a well understood, small item)
- Fibonacci-series of numbers

Source: brothersoft
A key to a success project

Buffer Time

Time

Internal Deadline

External Deadline

Buffer

To who should you communicate the deadlines?
Another key to a success project

Team efficiency

A good team can produce better results than individuals working alone.
“Coming together is a beginning, keeping together is progress, working together is success”

Henry Ford
A Team is more than just a Group
A team

A group of people with different skills and different tasks, who work together on a common purpose/goal.
Team Size

Optimal size between 5-12 members

Large projects can divide into several teams according to need.
There are problems you encounter as size increases.
Brooks’ law

Assigning more programmers to a project running behind schedule will make it even later, due to the time required for the new programmers to learn about the project, as well as the increased communication overhead.

Fred Brooks
Team Intercommunication

Team intercommunication formula:
Number of channels of communication = n(n − 1) / 2
n = people
Efficiency & Success

- Vision
- Motivation
- Competence
- Resources
- Activity plan
- Rewards for good behavior

Irritation
- Bad start, confusion, messy

Confusion
- Low efficiency, stagnation

Frustration
- Fear

Ref. Rune Olsson – IEI - LiU
What is a risk?

Risk is something that can eliminate full success of the project

Examples:
- **Staff turnover** - Experienced team members will leave the project
- **Requirement change** - Significant requirements will change late in the process.
- **Size underestimated** - The size of the project was larger then expected
Kinds of risks

General

"A team member gets sick"

"There is a risk that the project gets delayed"

Project Specific

"The delivery of the development hardware environment is delayed."

"Anders needs to visit his family, since his father is sick."

Direct

The project has great control
"The Windows platform will not scale"

Indirect

Risk where the project has little control
"The servers will stop running due to an earthquake"
What is risk management?

Risk management is the process of measuring or assessing risk and then developing strategies to manage the risk.

"What can go wrong"  "How bad is it"  "What shall we do with it"  "Has the probability changed?"
1. Risk Identification

Brainstorming with the whole team for 10 minutes.
What can go bad?!?

Types of risks

- **Technology risks** - Hardware/software technology used for development, e.g. using Java
- **People risks** - people in the development team
- **Organizational risks**
- **Tools risks** - Risks with the current tool used
- **Requirements risks** - Changes in customer requirements
- **Estimation risks** - Wrong project estimations
2. Risk Analysis

Probability

- low
- moderate
- high
- very high

Impact

- catastrophic
- serious
- tolerable
- insignificant

Probability x Impact = Risk Magnitude Indicator

Sort list after risk magnitude!
3. Risk Planning

1. Risk Avoidance
   Reorganize so that the risk disappears.

2. Risk Transfer
   Reorganize so that someone else takes the risk, insurance, customer, bank.

3. Risk Acceptance
   Live with it

Mitigate the risk
   Lower the probability.

- "Communication problem between develop sites in Stockholm and India
  -> localize all development in India?"

- "the web-server fails often low accessibility
  -> outsource the operation?"

- "Changes of requirements late in project
  -> a prototype?"

Define Contingency plan
   Lower the impact
   A plan B...

- "The key architect starts to work for another company
  -> 2 architects?"
### Example

#### Identify

<table>
<thead>
<tr>
<th>No Risk Description</th>
<th>Probability</th>
<th>Impact</th>
<th>Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>During implementation it is discovered that the new web-platform cannot talk to the legacy database system</td>
<td>Moderate (2)</td>
<td>Serious (3)</td>
<td>6</td>
</tr>
</tbody>
</table>

#### Analyze

<table>
<thead>
<tr>
<th>Probability</th>
<th>Impact</th>
<th>Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate (2)</td>
<td>Serious (3)</td>
<td>6</td>
</tr>
</tbody>
</table>

#### Plan

- **Avoid risk:** Do not introduce a new web-platform. Use the existing platform.
- **Transfer risk:** Sign a contract with a contractor, who guarantees access to the system.

**Accept risk**

- **Mitigate:** - Create a prototype early in the process.  
  - Solve issues before implementation phase

- **Contingency plan:** Transfer the whole old legacy database system to a modern DBMS.
Make the risks useful

- Few (3-10)
- Project Specific
- Regular meetings
The Project Plan

Why a project plan?

- Tool for the project manager
- Communication medium between project members and other stakeholders
- **What** should be done, **when** and by **who**

When is the plan finished?

Time: v1 v2 v3 v4

More information...
The Project Plan - Content

**Project Description**
- Background to the project
- Relevant constraints (budget etc.)
- Project Goal
- Start and expected end date.

**Time and Resource Plan**
- Milestones
- Tollgates
- Deliverables
- Activities
- Resources

**Project Organization**
- Roles
- Knowledge / skill
- Training
- Communication and reports

**Risk Management**
- Risks, Probability, and Impact
- Mitigation and Contingency plan
Project Status Reports

Content of a status report?

- Summary - current status
- What has happened since last report
- What happens next (both in long and short term)
- Problems and risks