Intro to Software Processes
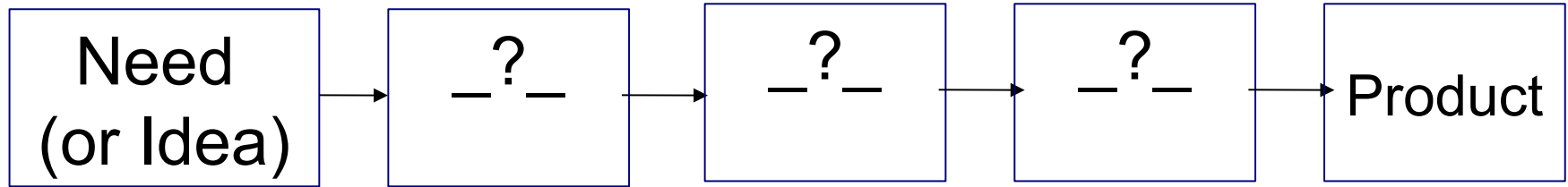
and the Software Development Life Cycle

Goal of Software Development

Need
(or Idea) → Product

Produce a software product that fulfills a need or realizes an idea.

What are the Steps?

| Need (or Idea) | → | _?_ | → | _?_ | → | _?_ | → | Product |

What are the major steps or **activities** you would need to do?

List major **activities** that would apply to almost any software project.

Activities in Software Development

Not necessarily in the order they are performed.

1. _____

2. _____

3. _____

4. _____

Activities

Creating software involves

- elicit requirements
- analysis & specification
- design
- construction & testing
- validation
- documentation
- maintenance
- enhancement

Managing the project involves

- planning
- obtaining resources
- tracking progress
- resolving problems
- analyzing results
- closing the project

Process

Process -

a [systematic] series of actions to achieve a particular result

Software process - a method for producing software

Software Process according to experts

A software process is a sequence of activities that leads to production of a software product.

-- Ian Summerville, *Software Engineering*, 9 Ed.

...a collection of activities, actions, and tasks that are performed to create [software].

-- Roger Pressman,
Software Engineering: A Practitioner's Approach, 7 Ed.

Do You Have a Software Process?

What is <u>your</u> software process?

(discussion)

What did you do to create:

- Programming 2 project?

- Exceed Camp project?

Do You Have a Software Process?

Yes!

Everyone who develops software uses a process.

Do You Have a Software Process?

"I never thought about it" …

process is *implicit* or *informal*

"It's different for each project" …

ad hoc process

Why Define a Software Process?

Why not *just do it*? *(like Nike)*

Realities of Software

Software is plagued by defects, over-budget, schedule overrun, and complete failure of projects.

1. Change can occur almost anytime in a project.

2. Useful software is complex.

3. Software must *evolve* (more change)

4. Communication problems plague software

    - between developers and customer

    - within development team

    - implicit assumptions are often not true

Common Project Outcomes (failures)

1. Project is late and over-budget.

2. Software does not do what customer wants.

3. Excessive defects.

4. Project is canceled.

Software Project Failure over Time
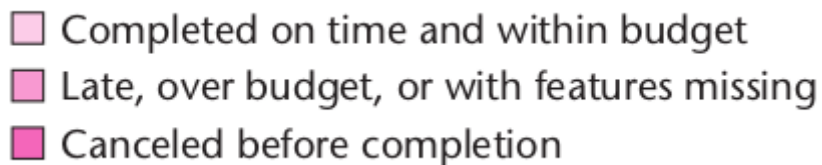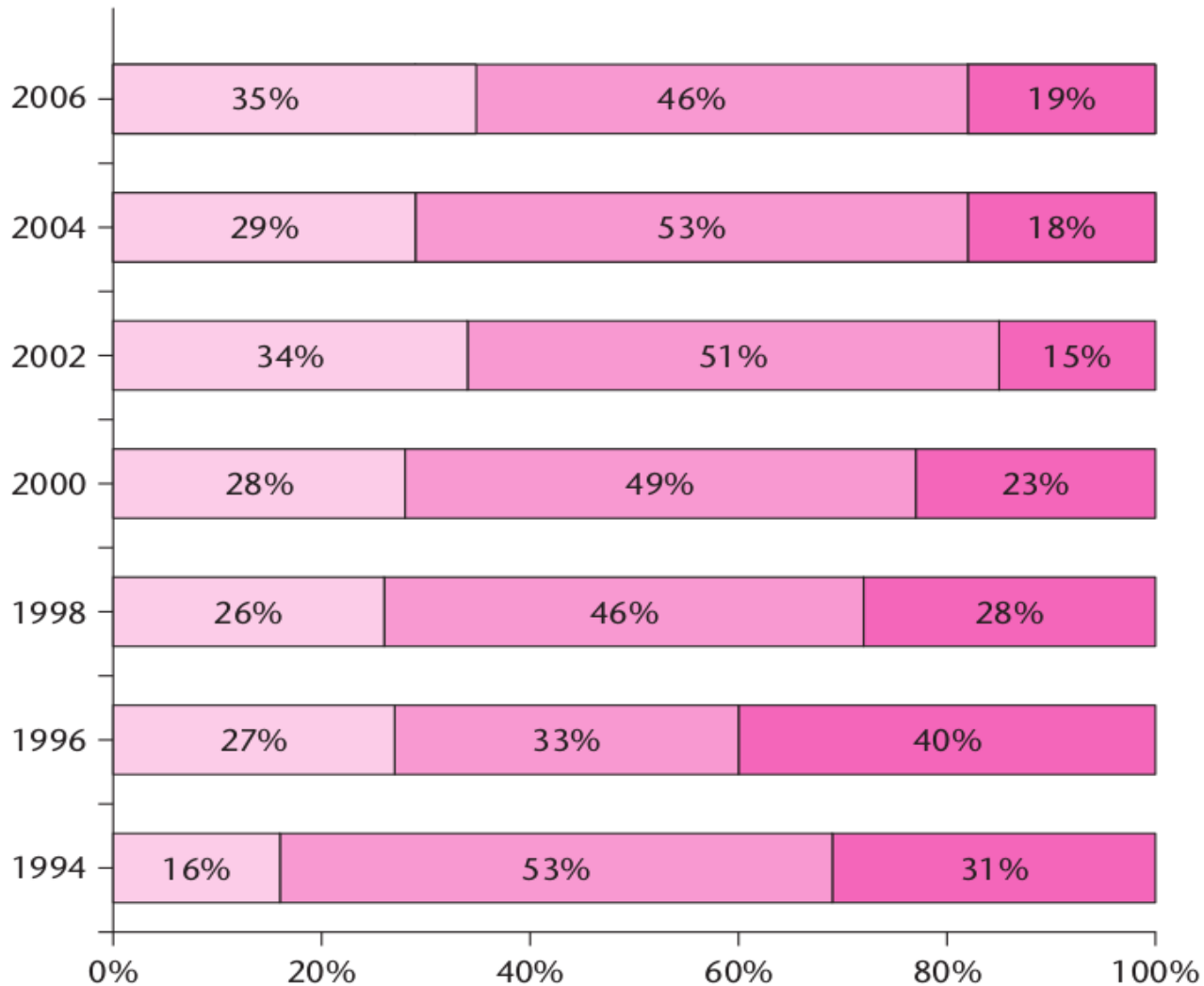
Stanish Group annual CHAOS report

Britain Abandons NHS IT Project

After 10 years and 11 Billion pounds (450,000,000,000 Baht), the British government abandoned a huge IT project for the National Health System (NHS) in 2011.

Some components continue to be developed, but they are all late and over-budget.

Why? What Happened?

https://www.henricodolfing.com/2019/01/case-study-10-billion-it-disaster.html

https://www.computerweekly.com/opinion/Six-reasons-why-the-NHS-National-Programme-for-IT-failed

Microsoft Windows Critical Flaws

Each month in 2020, Microsoft set a new record for the number of critical vulnerabilities disclosed & patched.

Microsoft programmers have been working on Windows code for almost 20 years. (*)

Yet Windows still contains hundreds or thousands of critical vulnerabilities.

Why?

* Assuming Windows 7 as the start for current code base

Causes of Project Failure

1. Poor communication.

2. Unrealistic schedule or budget.

3. Forced deadlines.

4. Unclear requirements.

5. Excessive change in requirements.

6. Unwillingness to accept change.

7. Not monitoring *actual* progress regularly.

8. Insufficient developer skills.

Benefits of a Defined Process

- **Saves Time** - don't rediscover how to perform each project

- **Enables Planning** and **Tracking**

- **Basis for Estimation** - you collect data for each activity and task from previous projects and learn

- **Repeatable** results

- **Improve the Process** - it must be defined before you can examine and improve it

4 Factors in Development Speed

1. **People**

   ability, knowledge, skills, motivation

2. **Process**

   promotes effective work or hinders it

   helps team stay on track? quality focus?

3. **Product**

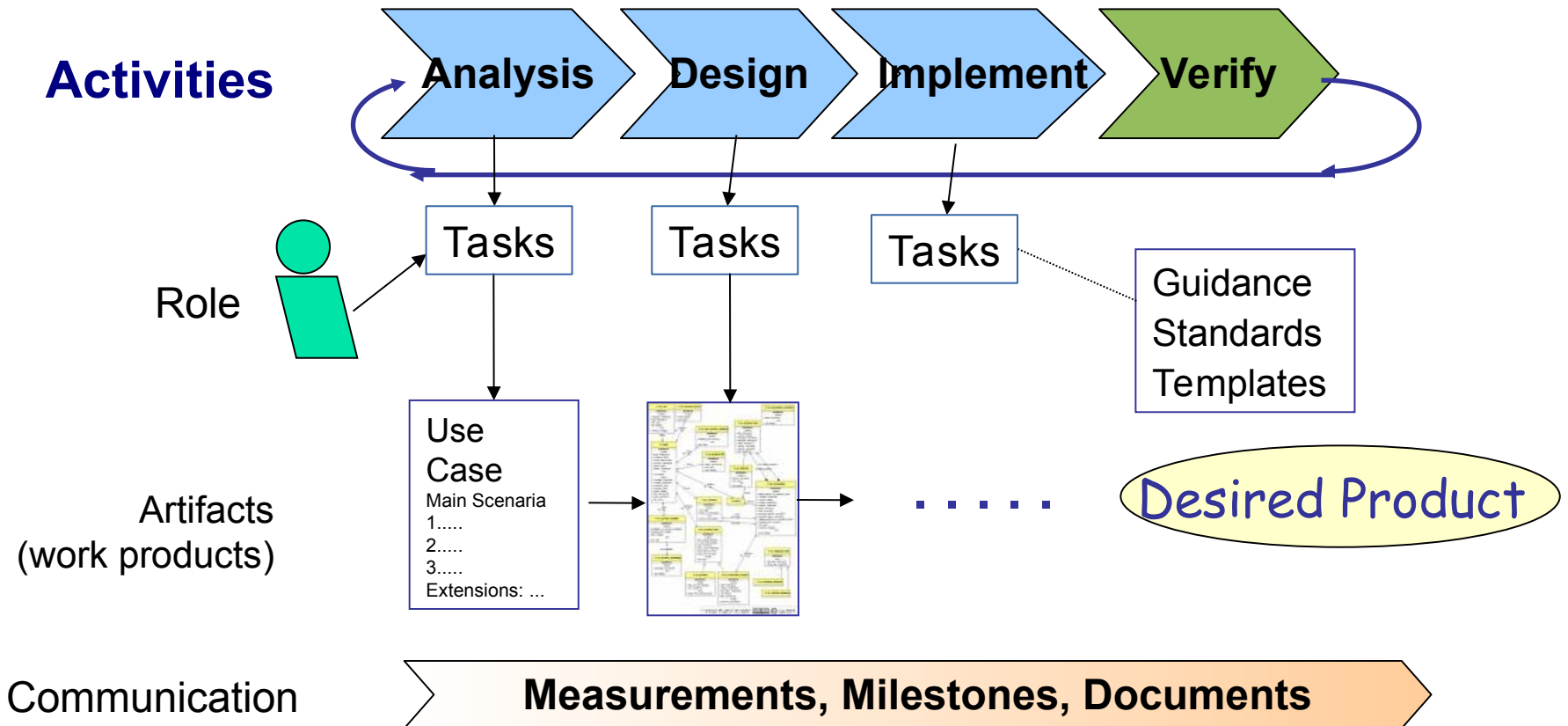   Size and characteristics, nature of requirements

4. **Technology**

   Language and software frameworks

   Tools

Software Process **Model**

Process consists of activities

Activities

Analysis → Design → Implement → Verify

Role

Tasks   Tasks   Tasks

Guidance
Standards
Templates

Artifacts
(work products)

Use
Case
Main Scenaria
1.....
2.....
3.....
Extensions: ...

. . . . .

Desired Product

Communication

Measurements, Milestones, Documents

Activities

Activities are large(r) scopes of work that are important to a software project.

Major activities:

- requirements specification

- modeling & design

- construction

- validation

- deployment

[Major activities listed by Summerville & Pressman.]

Tasks

Activities are large and general.

Activity is broken down into concrete tasks.

Some tasks during Construction:

- iteration planning

- backlog selection & estimation

- detail design

- coding

- unit testing

- integration testing

Activity May Subdivide into 2 Levels

In Pressman, an activity consists of **actions** divided into **tasks**.

Activity**: Construction**

Action: *iteration (or sprint) planning meeting*

Tasks:

- review & prioritize items in product backlog

- select items for this iteration (sprint)

- estimate items

- assign a "done" criterion (acceptance test) to each

- design software to implement the items

How to do it? What to produce?

"Activities", "actions", and "tasks" should make *progress toward finishing* the project.

What to do?

    Write a task description & guidance

What is the result?

    Every task should have an <u>output</u> -- a work product

Is the work correct?

    Define how to <u>evaluate</u> the work product

Example Task

Title: `Add Item to Card`   **Priority**: `High` **Est**: `8 hr`

When a visitor navigates to item detail page, there is an "*Add to Cart*" button on the page. When visitor clicks "Add to Cart", a unit of the item is added to his shopping cart.

Acceptance Criteria

Given user is viewing an in-stock item

When he clicks "Add to Cart"

Then the item is added to his shopping cart. When navigate to "My Cart" page, the item, with quantity and price, are shown.

Common Process Models

Code and Fix

- The most common software development process

- Little or no planning and design.

1. think about the problem, write ideas on paper
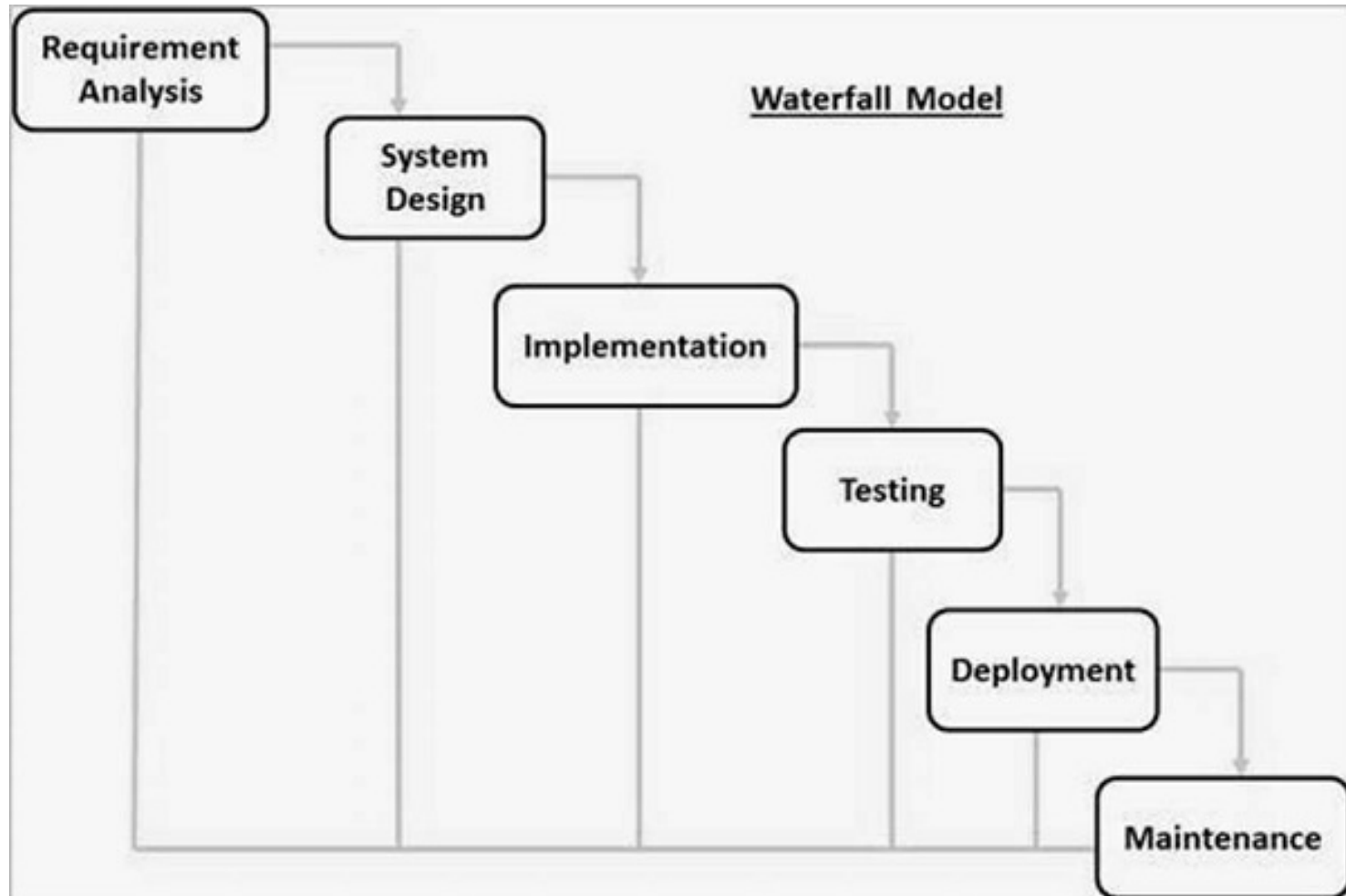
2. start coding

3. run it. fix the code.

4. add another feature. As code grows I need to rewrite some parts to support each new feature.

- modify the code for new feature
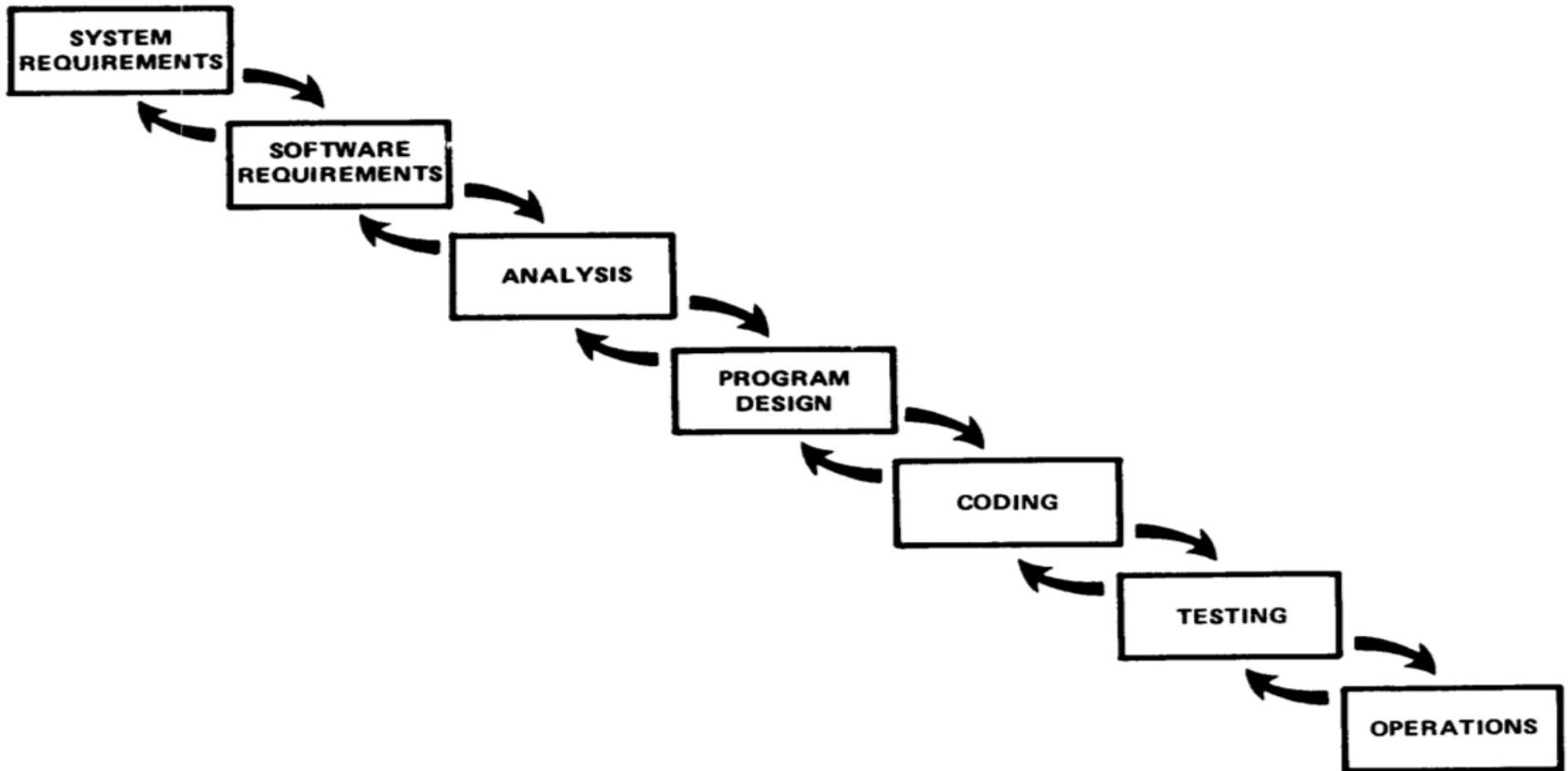
- goto step 2.

My software process since high school

Do the activities in order

Similar to a civil engineering project.

(This is a common diagram of the waterfall model.)

The Original Waterfall Model

Winston Royce, *Managing the Development of Large Software Systems* (1970)

Waterfall is still widely used.

What Could Go Wrong?

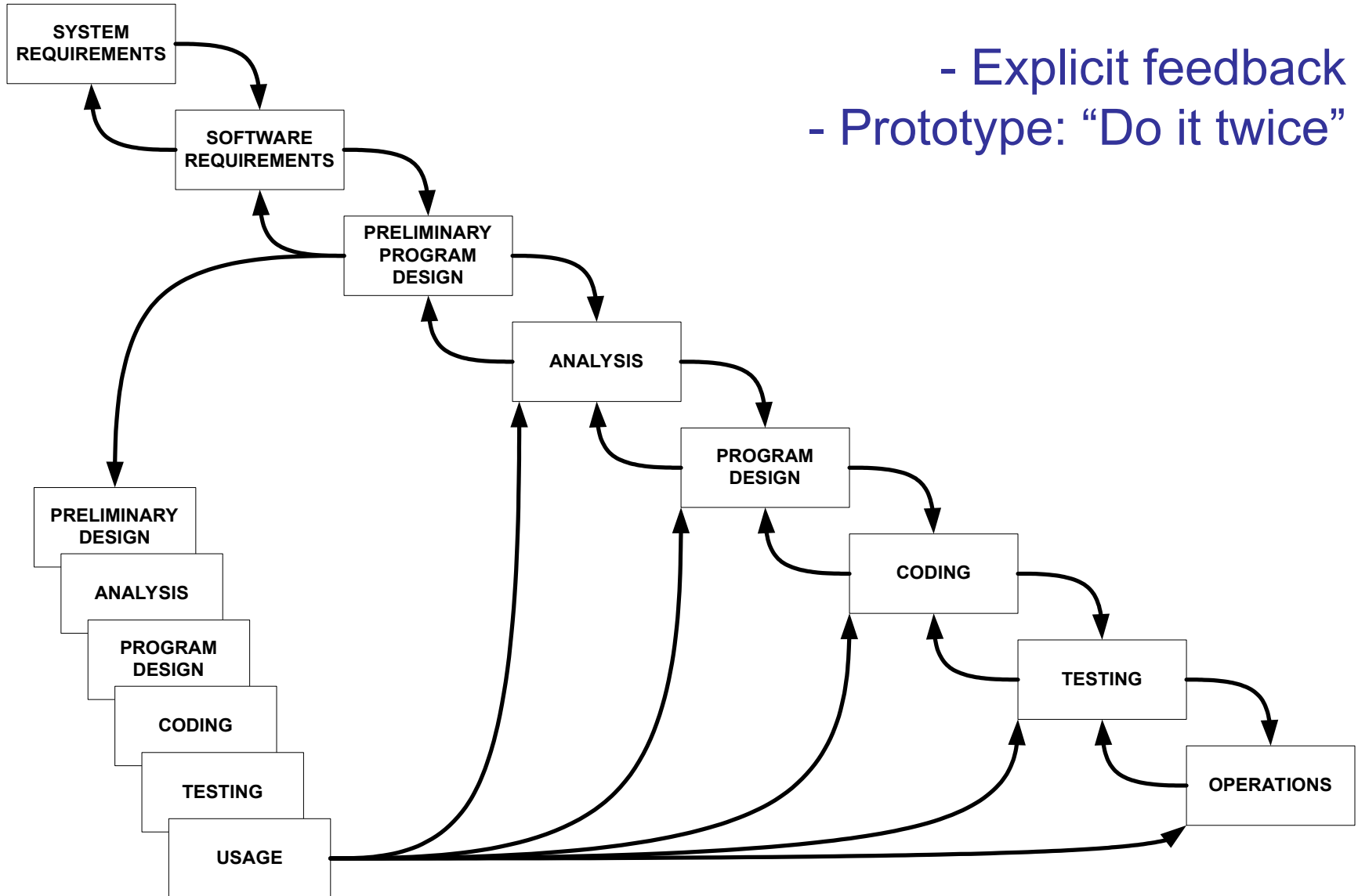# Problems with Waterfall

What would be effect on project if ...

1. You <u>miss</u> some requirement(s).

2. You <u>misunderstand</u> a requirement, so the design is not what the customer wants.

3. The solution you chose <u>can't meet</u> the requirements.

4. Coding takes a lot longer than expected.

5. Testing discovers a lot of <u>defects</u> in the code.

How to Avoid These Problems?

- *Early* Feedback

- *Early* Testing

- *Continuously* review actual versus planned progress

- *Involve customer* at key points during project

- *Incremental delivery* of functionality.

- *Analyze* results and take corrective action

Royce Waterfall Model with Prototype

- Explicit feedback
- Prototype: "Do it twice"

SYSTEM REQUIREMENTS

SOFTWARE REQUIREMENTS

PRELIMINARY PROGRAM DESIGN

ANALYSIS

PROGRAM DESIGN

CODING

TESTING

OPERATIONS

PRELIMINARY DESIGN

ANALYSIS

PROGRAM DESIGN

CODING

TESTING

USAGE

Project Phase = Process Activity

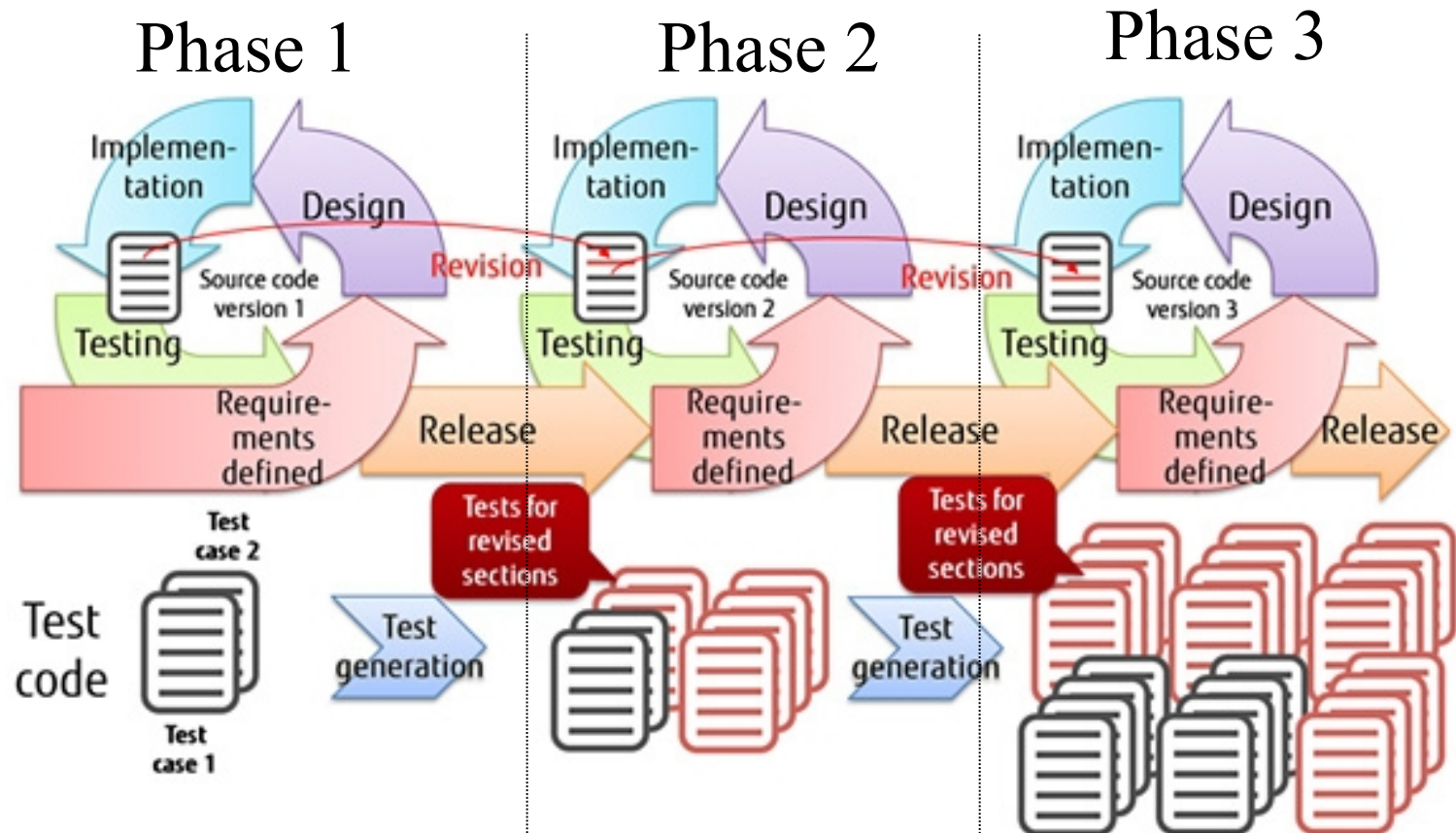In Waterfall, major activities are *phases* of project...

- Requirements phase

- Analysis phase

- Design phase

- Construction phase

...

Iterative and Incremental

Let's not try to build the whole product at once.
Build a useful part (subset), evaluate it, then repeat.

Activities ≠ Phases

Phase 1   Phase 2   Phase 3

Iterative and Incremental

Incremental - product divided into increments.
Each increment adds **new features** and produces a
usable product.

Iterative - iterate over the (almost) same activities for
each product increment.

Benefits

1. Rapid delivery of value to customer - he can try the features you have implemented.

   What are other benefits of iterative & incremental?

Consider:

   feedback

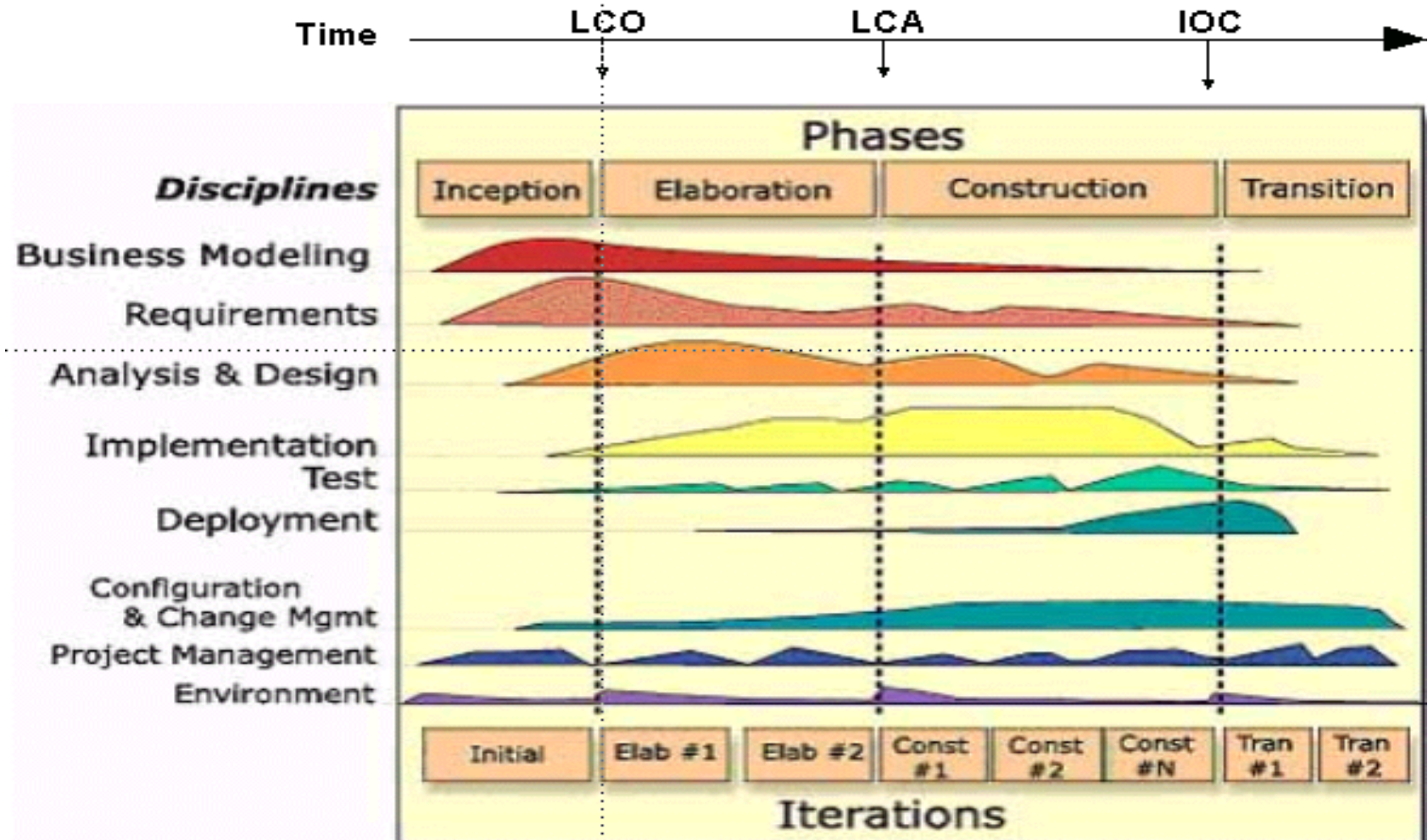   *detecting problems in design or implementation*

   monitoring progress & deviation from schedule

   effect of change

Unified Software Dev't Process (U.P.)

Workflows (disciplines) for different kinds of activities.

Phases: major divisions of project. Each has iterations.

UP is an Iterative Process **Model**

The diagram *conveys a lot* about UP…

- workflows (disciplines) are done in parallel

- "phases" for major evolutions of the project

- iterations within each phase, as needed

Characteristics of UP

□ **Time-boxed** iterations

□ **Plan based**, but adapts to change

□ "Architecture centric"

□ Identify **risks** early & address them

□ Order requirements based on business value, architecture, & risk

  ▪ handle risky requirements early

  ▪ implement requirements that have big impact on the architecture

□ UP is a "framework" for a process -- tailor to your project

UP is covered in *Software Spec and Design* course.

Agile

Agile is <u>not</u> a software process

Agile is a mindset, collection of values, and practices that reflect those values.

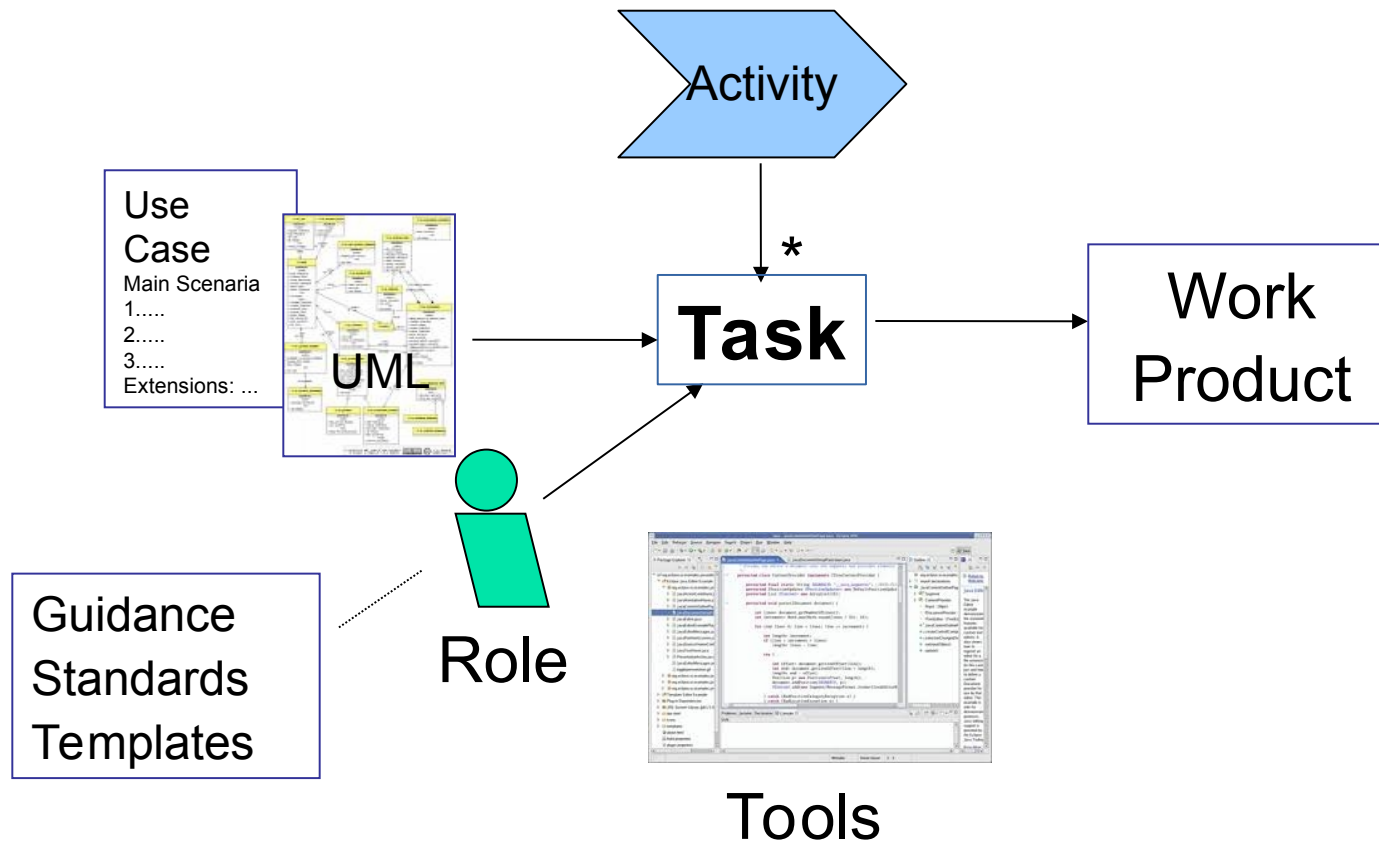Agile & Scrum are covered later

What About <u>Individual</u> Process?

This is a course about <u>individual</u> process.

What is that?

The Individual

People apply a process, use tools, technology, & guidance, to create the work products.

Problem of Teaching Software Process

1. We learn on *small, one-semester* projects.

2. Projects often succeed based on heroic effort or super-programmers.

3. Programs aren't deployed or supported.

4. We are still learning, so process seems awkward.

5. We have many courses -- different environment from full-time developers

6. Outcome is a grade, not a paycheck or bonus

Reading

These are highly regarded books about *Software Engineering*. Each has a chapter or two on software process.
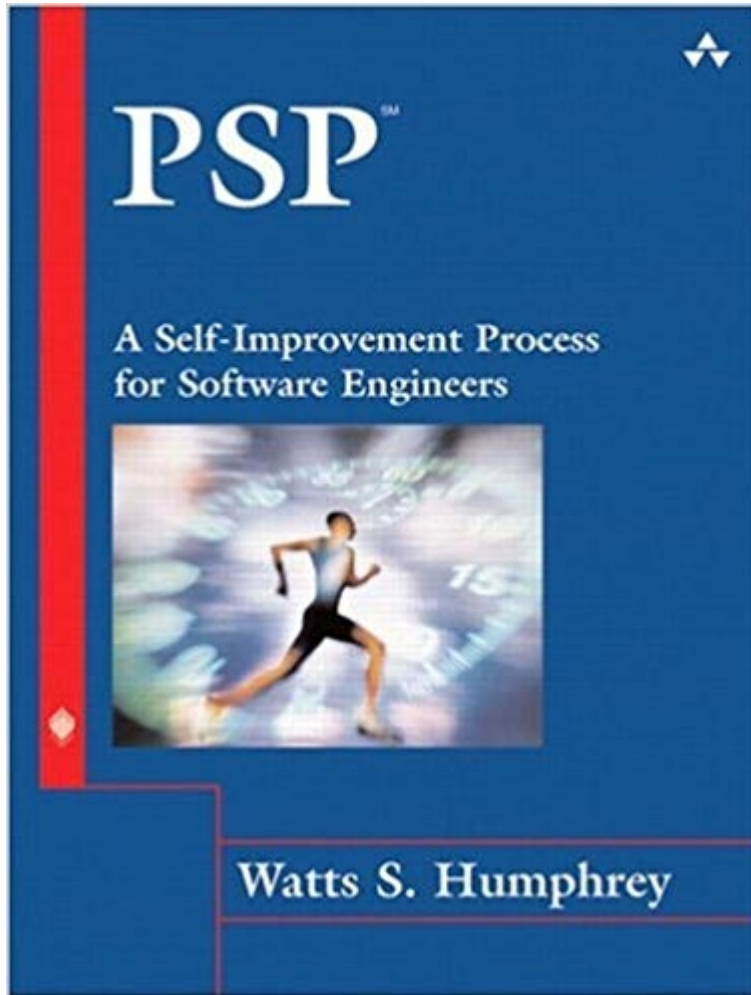
- Ian Summerville, *Software Engineering,* 10th Ed.

- Stephen Schach, *Object-oriented & Classical Software Engineering,* 8th Ed.

- Roger Pressman, *Software Engineering: A Practitioner's Approach*.
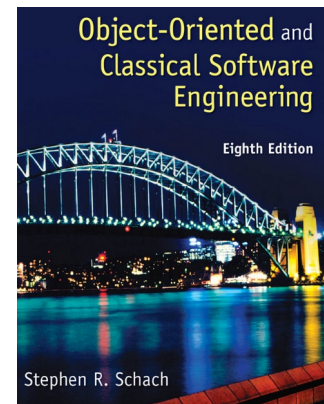
Historical Material

...for the curious

Original Syllabus: Personal Software Process

Step-by-step course to build a personal process for:

planning

defect tracking

estimation

measuring quality & efficiency

evaluation

process improvement

Goals of PSP

Objective: provide a disciplined process for SEs to manage their own work

- improve estimation and planning skills

- reduce defects in their products

- manage their own schedule & work quality

- improve their own software process

PSP progress through levels

PSP0: [baseline] measure time you spend on planning, design, coding, test, and *post mortem* (retrospective)

PSP0.1: measure output LOC. Add a coding standard and process improvement proposal (PIP).

PSP 1.0: Estimate program size using level 0 data. Make a test plan.

PSP 1.1: Add planning. Estimate time from program size.

PSP 2.0: Add design & code review. Emphasis on defect removal and prevention.

PSP 2.1: Add design specification.

PSP 3: Apply an iterative process to PSP2.1.

PSP Tools and Support

PSP emphasizes use of scripts, forms, and checklists to guide the user. These are included in course.

A useful tool is Process Dashboard (Sourceforge).

- performs time tracking. Automates some reporting.

- includes the PSP scripts and forms, and generates reports

- *can be used for other processes*!