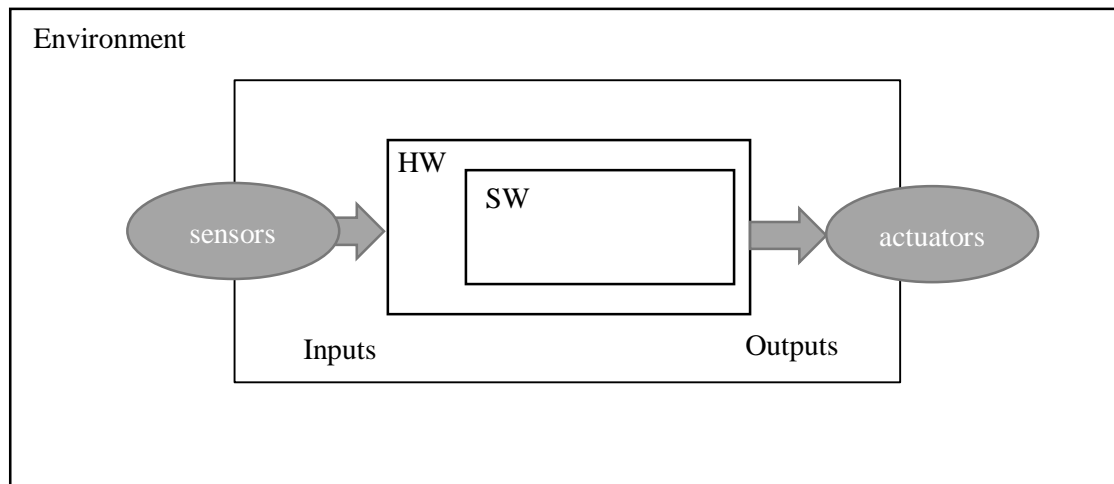


Quality Management of Software and Systems (WS19/20)

Problem Set 1

Problem 1: Systems in general

- a) Please define the general term “system” according to Birolini and explicitly name the parts a system can encompass. Explain your answer in the view of a real domain.
- - Technical and organizational means for the autonomous fulfillment of a task (based on Birolini, ETH)
 - Generally, a system can consist of hardware, software, people (service and maintenance personnel) and logistic assistance
- b) What is the difference to a “technical system”?
- - Technical system where influences by people and logistics are ignored
- c) For the analysis of a technical (embedded) system it is crucial to extract it from its environment. How can this be achieved? Please sketch your ideas.



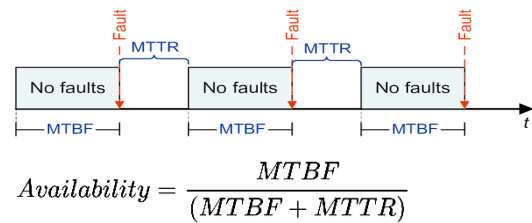
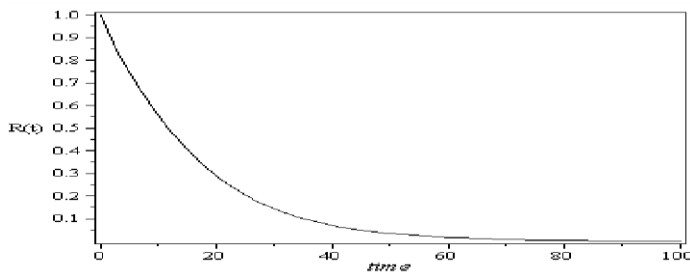
- d) Please list important non-functional requirements for embedded systems.
- Availability – Readiness for correct service.
 - Reliability – Continuity of correct service.
 - Safety – Absence of catastrophic consequences on users and environment.
 - Confidentiality – Absence of unauthorized disclosure of information.
 - Integrity – Absence of improper system state alterations.
 - Maintainability – Ability to undergo repairs and modifications.

Problem 2: Reliability vs. Availability

Show the differences and the dependencies between “reliability” and “availability”

Availability: The probability that the system will be up and running and able to deliver useful services to users.

Reliability: The probability that the system will correctly deliver services as expected by users.



Problem 3: Safety

Please explain the term “safety” in a general and a technical view.

Birolinis definitions:

- Safety is a measure for the ability of an item to endanger neither persons, property nor the environment.
- Technical safety is a measure for the ability of a failure afflicted item to endanger neither persons, property nor the environment.

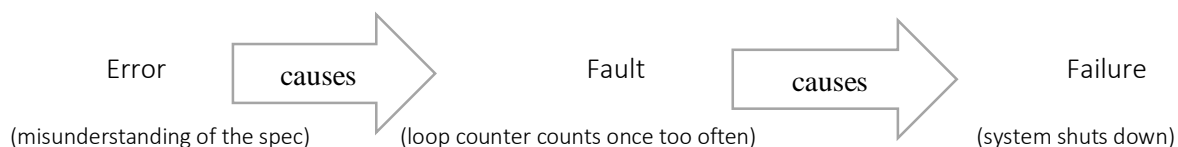
Better definition for safety(DIN):

- State where the danger of a personal or property damage is reduced to an acceptable value.

Problem 4: Error, Fault, Failure

What is meant by the terms “failure”, “fault”, and “error”? Please explain their dependencies on a real example

- Error: Basic cause for the fault (e.g., misunderstanding of a particular statement of the programming language)
- Fault, defect: Statically existent cause of a failure, (i.e., a bug). Usually the consequence of an error made by the programmer.
- Failure: Inconsistent behavior w.r.t specified behavior while running a system (happens dynamically during the execution) -> Each failure has a time stamp.



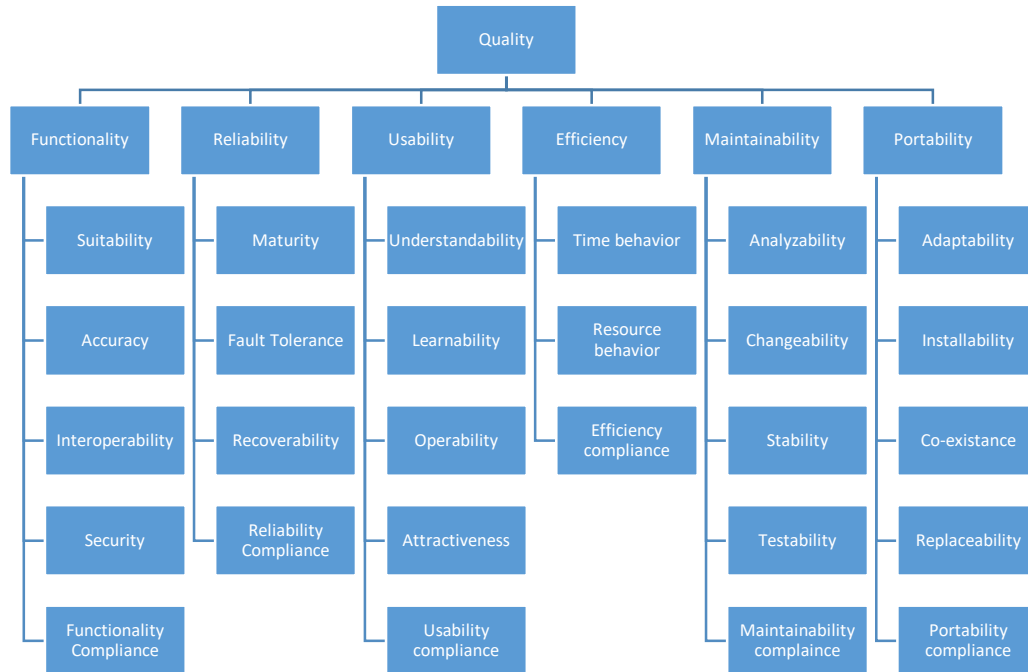
Problem 5: Correctness, Completeness, Robustness

Please give your opinion on the following statements:

	True - False
Correctness has a binary character	True
An artifact is not consistent to its specification, if it is not correct	True
If there is no specification the system works always correct	False
A system is complete, if all functions required in the specification are implemented.	
Robustness has a binary character	False
A correct system can have low robustness	
Robustness is a property only of the implementation	False

Problem 6: Quality

a) Please give some quality characteristics and explain how different characteristics might influence each other.



b) Think about the following dependencies and figure out, whether the influences are positive or negative.

- I. Safety – Availability: negative influence – can't be defined
- II. Safety – Reliability: Not defined / May be positive
- III. Availability – Reliability: Tends to positive, but can be negative also.

(find others by yourself)

Problem 7: QIP

Please answer the following questions about the Quality Improvement Paradigm:

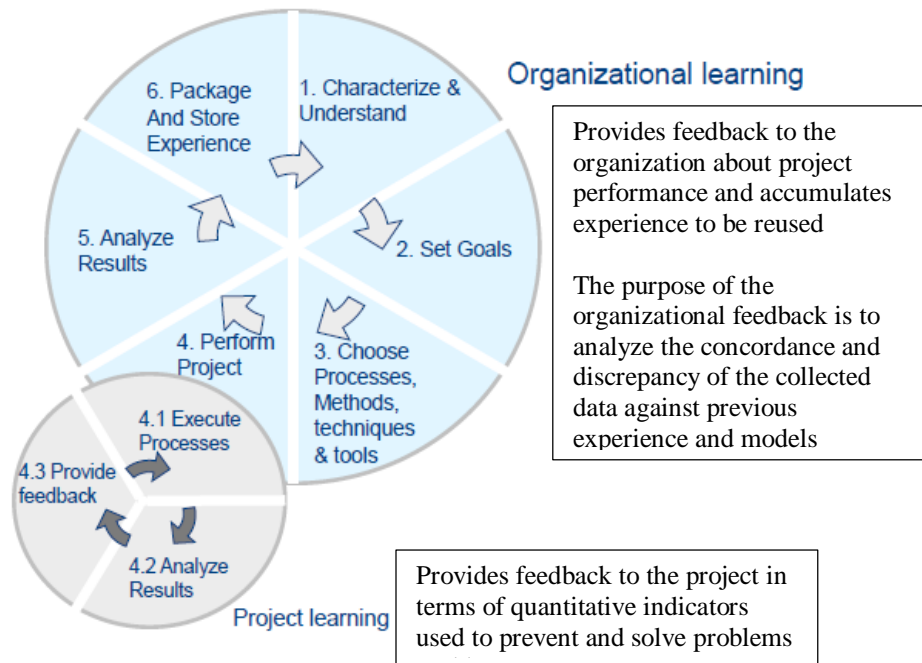
a) What is the objective of QIP?

-

Objectives of QIP:

- For reuse of products, processes and experience, because this is seen today as a feasible solution to develop high quality software at low cost.
- For quality improvement. The improvement process is often achieved by reusing and modifying over and over the same elements and procedures.
- Supplying experience of earlier projects to various projects on demand.

b) What are the two feedback cycles?



c) What are the phases of each cycle?

1. Characterize & understand:
 - Understand the environment in which an organization's project will be performed by using available data and building models of processes, people and products.
 - Characterize the project based upon these models.
 - Set baselines for conducting the project based on the existing organization's assets, e.g. processes, people, and products.
2. Set goals:
 - Set quantifiable goals for successful project organization and improvement. The goals should be realistic, i.e. they should be defined according to the defined models and stated baselines.
3. Choose processes, methods, techniques and tools:
 - Choose a suitable support for the project, based on the characterization of the environment and the established goals
4. Perform project:
 - Run the project life cycle by performing the corresponding processes and providing feedback.
 - Feedback is provided by means of information that serves to determine whether the established goals will be achieved or not.
5. Analyze data:
 - Analyze information that has been collected during the project to assess the used methods, techniques and tools.
 - Determine if the established goals were achieved.
 - Propose corrective measures that will lead to project improvement.
6. Package experience for future projects:
 - Collect experience acquired by performing the project and store it in an experience base.
 - Experience is represented in the form of structured knowledge: models (quality, product, process, resources) and lessons learned.

- d) Why does an organization achieve improvement when applying this paradigm?
- e) In which of the QIP steps are GQM (Goal question metric) and EF (Experience Factory) applied?

-

The Quality Improvement Paradigm (QIP) is based upon the notion that improving the software process and product requires the continual accumulation of evaluated experiences (learning) in a form that can be effectively understood and modified (experience models) into a repository of integrated experience models (experience base) that can be accessed and modified to meet the needs of the current project (reuse)

- The Experience Factory is a logical and/or physical organization that supports project developments by analyzing and synthesizing all kinds of experience, acting as a repository for such experience, and supplying that experience to various project on demand.
- It packages experience by building informal, formal or schematized, and productized models and measures of various software processes, products and other forms of knowledge via people, documents, and automated support.

Problem 8: Experience Factory

To answer some questions of this problem, please refer to the article “Basili, V., Caldiera, G., Lombach D.: The Experience Factory”.

- a) What is the Experience Factory (EF) used for?

-

The Experience Factory offers an organizational structure that separates the product development focus from the learning and reuse focus. It supports learning and reuse and generates a tangible corporate asset in form of packaged experiences. It aids in the formalization of management and development processes. It links focused research with development.

- b) Which kind of information is packaged in there (EF)?
- c) Could you give some examples of “experience packages” and how are they defined?

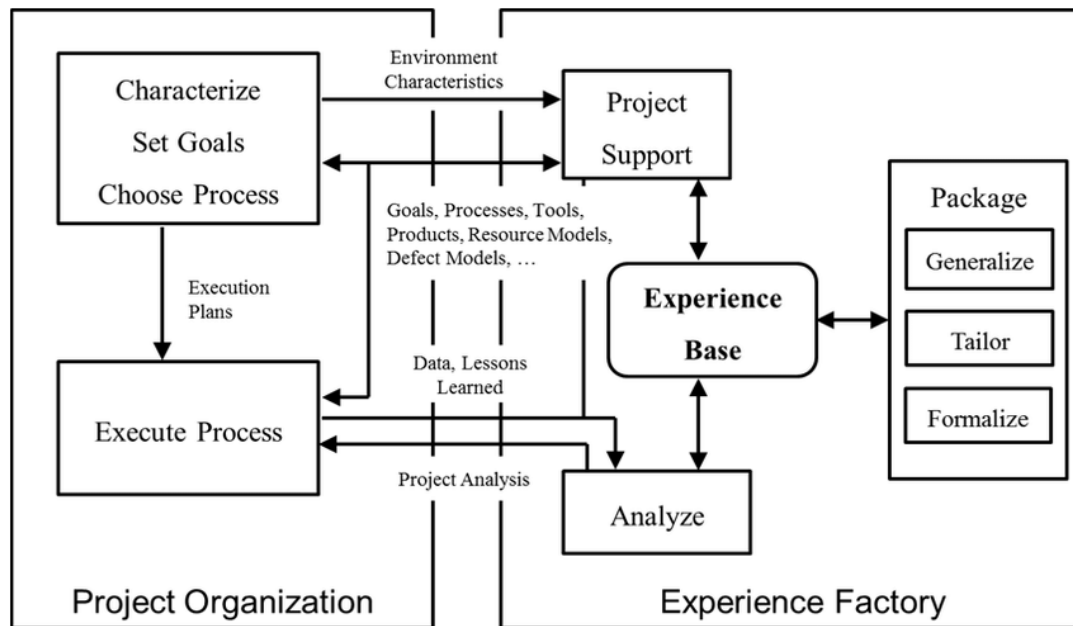
-
- Product packages
 - Programs
 - Architectures
 - Design models
 - Process packages
 - Process models
 - Methods
 - Relationship packages
 - Cost and defect models
 - Resource models
 - Management packages
 - Management handbooks
 - Decision Support Models
 - Data packages
 - Project database
 - Quality database

- d) In which way does the EF support improvement?

-

QIP is based on notion that improving software process requires accumulation of evaluated experiences. In EF these experiences are effectively understood and modified (Experience models) into a repository of integrated experience models (Experience base) which helps in (reuse)

e) How does the EF support QIP?



Problem 9: GQM

a) What is the purpose of GQM?

-

The Goal Question Metric (GQM) approach is based upon the assumption that for an organization to measure in a purposeful way it must first specify the goals for itself and its projects, then it must trace those goals to the data that are intended to define those goals operationally and finally provide a framework for interpreting the data with respect to the stated goals.

b) How are goals refined into metrics? Please give a brief description.

c) Why is it necessary to have goals associated with metrics?

❖ Within GQM a goal is defined by using the following template:

Object	Purpose	Focus	Viewpoint	Context

- **Object** refers to any process, model, product, which will be the measurable object of the goal.
- **Purpose** is the way, in which the collected measurement data will be used, e.g. characterize, evaluate, compare, predict, control, and improve.
- **Focus** refers to the quality characteristic to be taken into account when measuring, e.g. effectiveness
- **Viewpoint** refers to the perspective of the stakeholder which needs the information, e.g. researcher
- **Context** refers to the environment, in which the measurement goals are defined, e.g. company ABC

d) Using the aforementioned template, please define the following goals of members of the software company "IET" in terms of measurement goals:

1. The quality assurer would like to know: how effective are the currently used inspection techniques (PBR, CBI) with respect to fault detection?

Object	Purpose	Focus	Viewpoint	Context
Currently used inspection techniques	Evaluate effectiveness	Fault detection	Quality Assurer	IET company

2. IET has got a new project: development of a web based system for handling customer registration. The project manager has to select a suitable IDE for this web based development. He has two options either .NET (C#) or eclipse (Java).

Object	Purpose	Focus	Viewpoint	Context
Development environments	Compare IDE's and select one	Suitability for web development	Project Manager	IET company (developing a new web system)

3. The business manager would like to classify available Quality Management approaches, to select the most appropriate one to be implemented in the organization.

Object	Purpose	Focus	Viewpoint	Context
Quality management approaches	Compare QMA's and select one	Suitability	Business manager	IET company

e) Please derive corresponding questions and metrics for the first goal. There are three groups of questions that can be derived:

- Questions that characterize the object with respect to the goal
- Questions that characterize attributes of the object with respect to the goal
- Questions that evaluate (quality) characteristics of the object with respect to the goal

For more information about defining questions and deriving metrics, please use as reference the given article: "Basili, V., Caldiera, G., Rombach D., The Goal Question Metric Approach"

Questions and metrics can be documented by using the following template:

Goal:	
Question Q1: Which resources consumed by the technique?	M1.1: People which are involved M1.2: Meetings that are required M1.3:
Question Q2: How effective is the technique?	M2.1: Mean inspection time for 1000 lines of code M2.2: M2.3:
Question Q3: How many faults could be found by using these techniques?	M3.1: Mean rate of identified faults per 1000 lines of code M3.2: M3.3: