Fachhochschule Frankfurt am Main
Fachbereich 2: Informatik
SS 2008

IT Project Management

Lecture 9:

Software Life Cycle Models and Modelling

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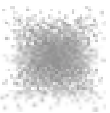
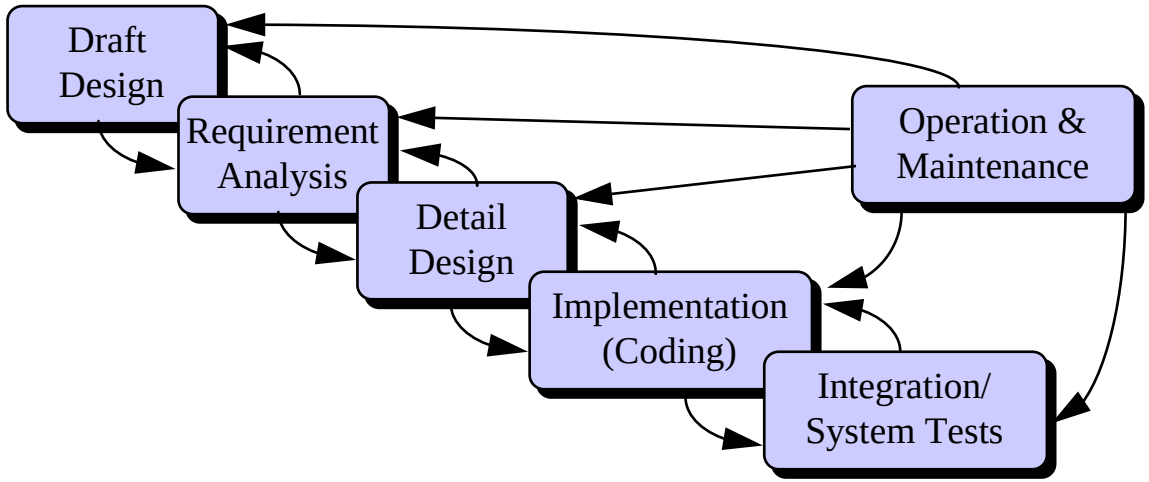


Software Life Cycle Models

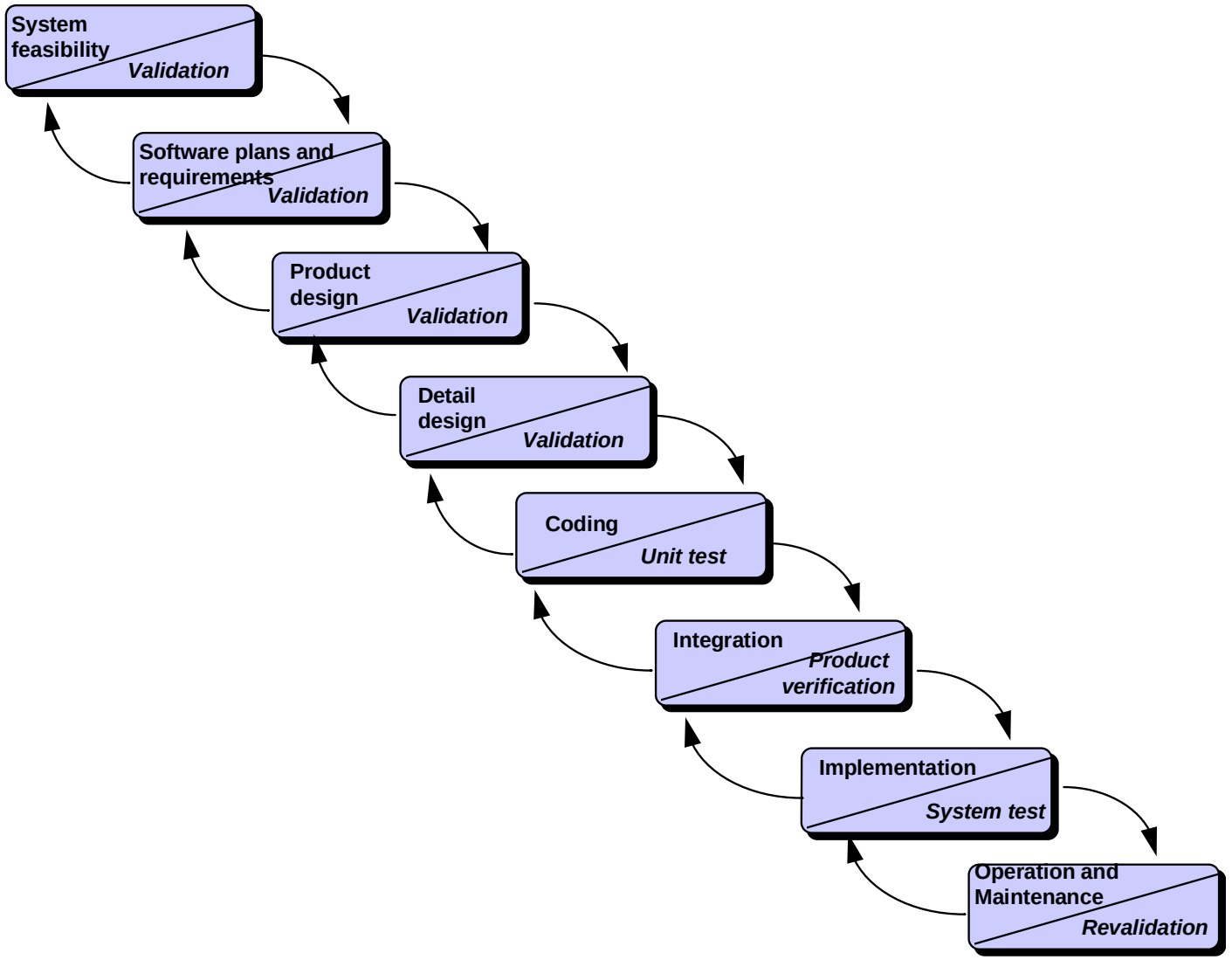
- Today it is recognised that any Computer software has it's own life cycle.
  - This life cycle probably starts with the initial idea and is certainly not finished when the software becomes into operation.
- Since the first software projects have been realised, different life cycle models have been proposed and effectively used here.



Waterfall Model

- The Waterfall Model is probably the earliest approach to improve software development, as it has bee defined in 1956 already a part of the Semi-Automated Ground Environment (SAGE) as so-called stage-wise model.
  - The final description of the Waterfall Model was carried out in 1970.
- The main features of the Waterfall Model are:
  - Recognition of feedback loops between the different stages and thus the impact of errors on one stage is restricted to the next stage and not passed to the final product.
  - The inclusion of prototyping in the software lifecycle as a so-called "build-twice" step.
- As a result, the Waterfall Model demands an existing verification/validation process before entering the next stage.
  - Since "open issues" are not accepted, in particular the development of interactive systems, requiring human intervention can not be handled efficiently, since the concept of "Use Cases" was not present yet.

Waterfall Model (2)



V-Model

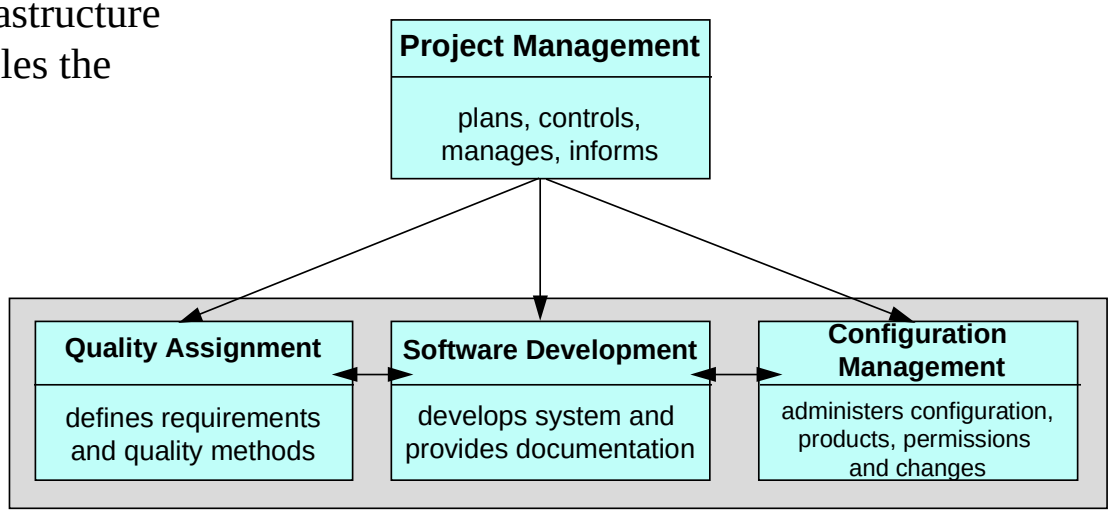
- The V-Model is a process-oriented approach for software development as part of IT project management and has been inspired by Barry Boehm and further developed in Germany, in particular for Government and here in addition for military projects.
  - The 1986 published V-Model is now superseded with it's successor the V-Model XT.
- Applying the V-Model for software developments can be seen as a cornerstone to comply with the ISO 9000 standards.
  - It actually requires a particular infrastructure for software development and couples the responsibilities of

    Project Management,

    Quality Management,

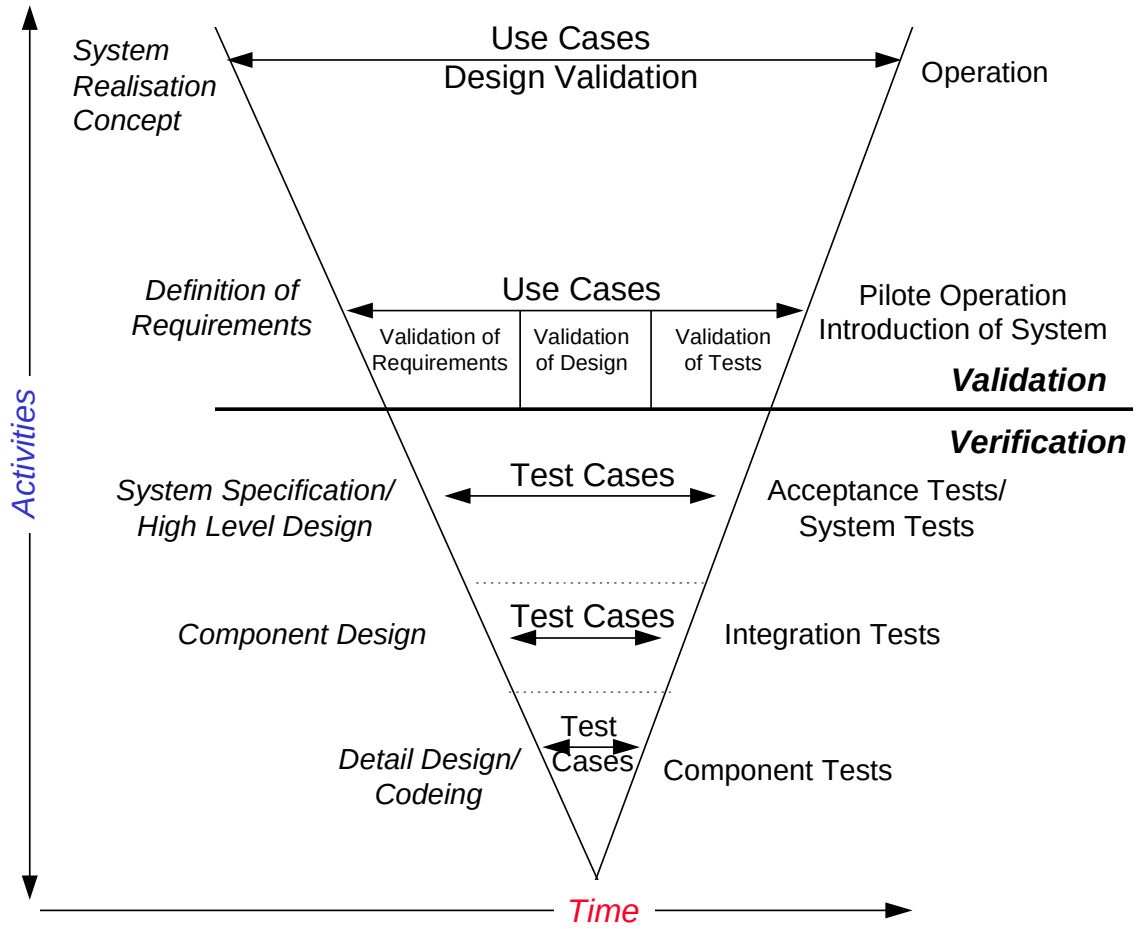
    Configuration Management,

    and Software Development.



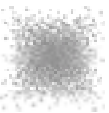
V-Model (2)

- Unlike classical project management approaches which defines phases and transitions on a time line, the V-Model is *procedure-driven*:
  - The V-Model defines a set of inter-related Events and Activities for planning and design, software development, testing, and the final roll-out process.
- Thee V-Model is *document driven*:
  - During project execution, the activities are broken down per management level and the resulting state has to be documented to provide the required transparency for the project evolution.



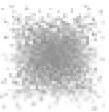
V-Model (3)

- The drawbacks of the V-Model approach are the following:
  - It formalises the whole project management and software development (and demands the respective documents) while burdening it with a lot of administrative tasks.
  - Software development is strictly pre-determined, which is unrealistic; and any change has to be approved.
  - It provides too little interaction among the team members and thus does not exploit the team creative capacity.



V-Model XT

- Both the V-Model 1997 and the new V-Model XT is maintained by the German BMI-KBSt (Koordinierungs- und Beratungsstelle der Bundesregierung) and made public available (in a set of documents and downloadables).
- Within the V-Model XT several new approaches are incorporated which align with the achieved progress in the IT world.
- On the lowest level it introduces the *Project Subject*:
  - This might be a hardware solution,
  - a software system,
  - a complex system consisting of both,
  - an embedded system,
  - or perhaps system integration;
  - however it does not cover system services (which are out of scope).



V-Model XT (2)

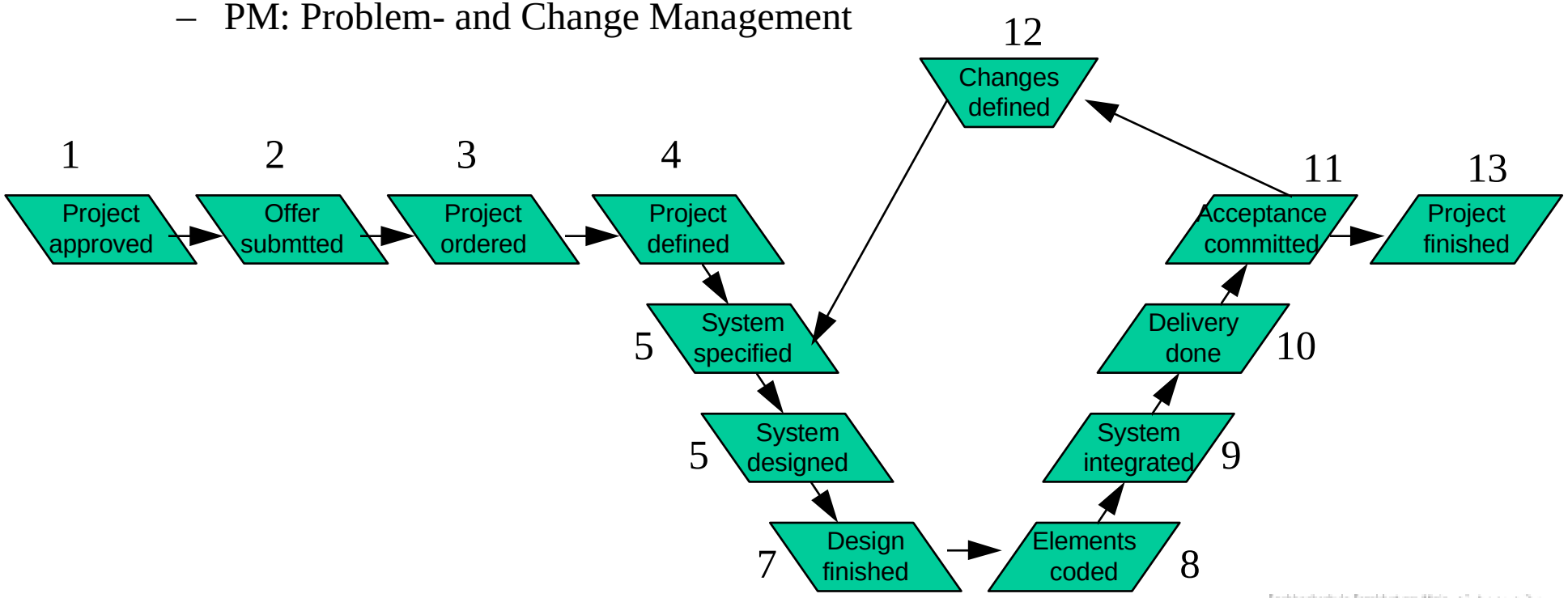
- The definition of the Project Rôle tells who is using V-Model XT for co-ordination:
  - the customer (Auftraggeber) managing one or several the vendors (Auftragnehmer),
  - the vendor (Auftragnehmer) employing it itself or other sub-vendors,
  - both customer and vendor using the V-Model XT.
- Thus, the V-Model XT adjusts explicitly to the typical situation for Government-related development, where the Government acts as 'client' and the 'vendor' is an external company; chosen after the bidding process.

  ⇨ *The V-Model XT can be characterised as an incremental, adaptable, and model-driven procedure model.*

  ⇨ *Unlike the original V-Model it does not employ formal documents, but rather CASE tools are now considered for description and follow up.*

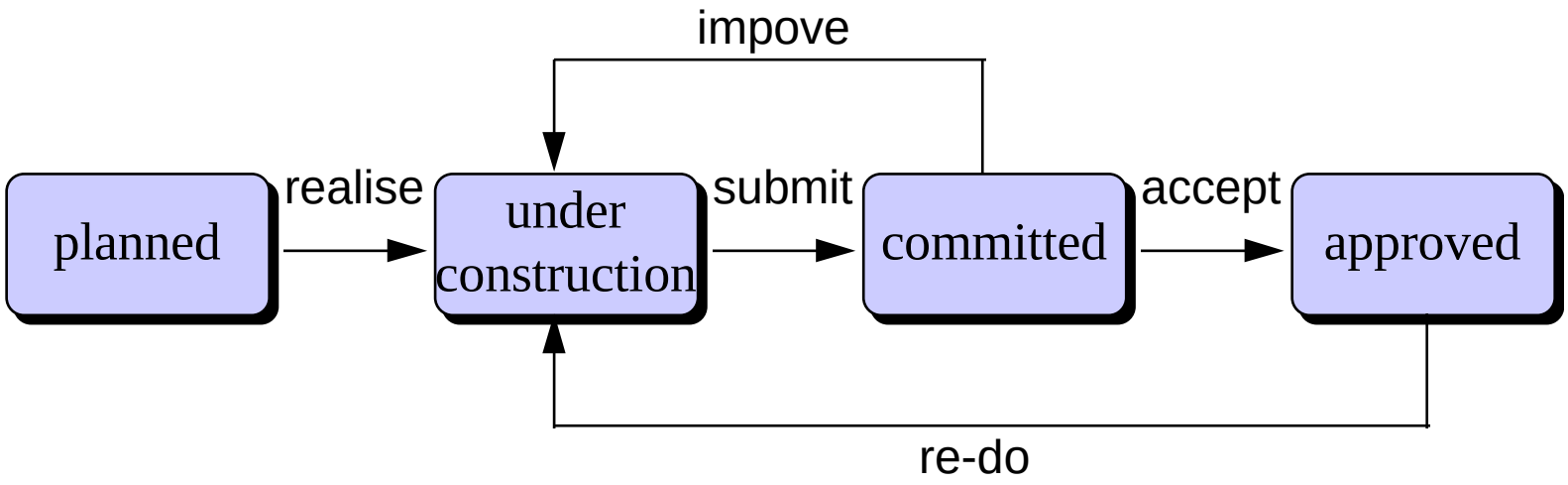
V-Model XT (3)

- The V-Model XT covers the main modules:
  - PM: Project Management
  - QA: Quality Assignment
  - CM: Configuration Management
  - PM: Problem- and Change Management



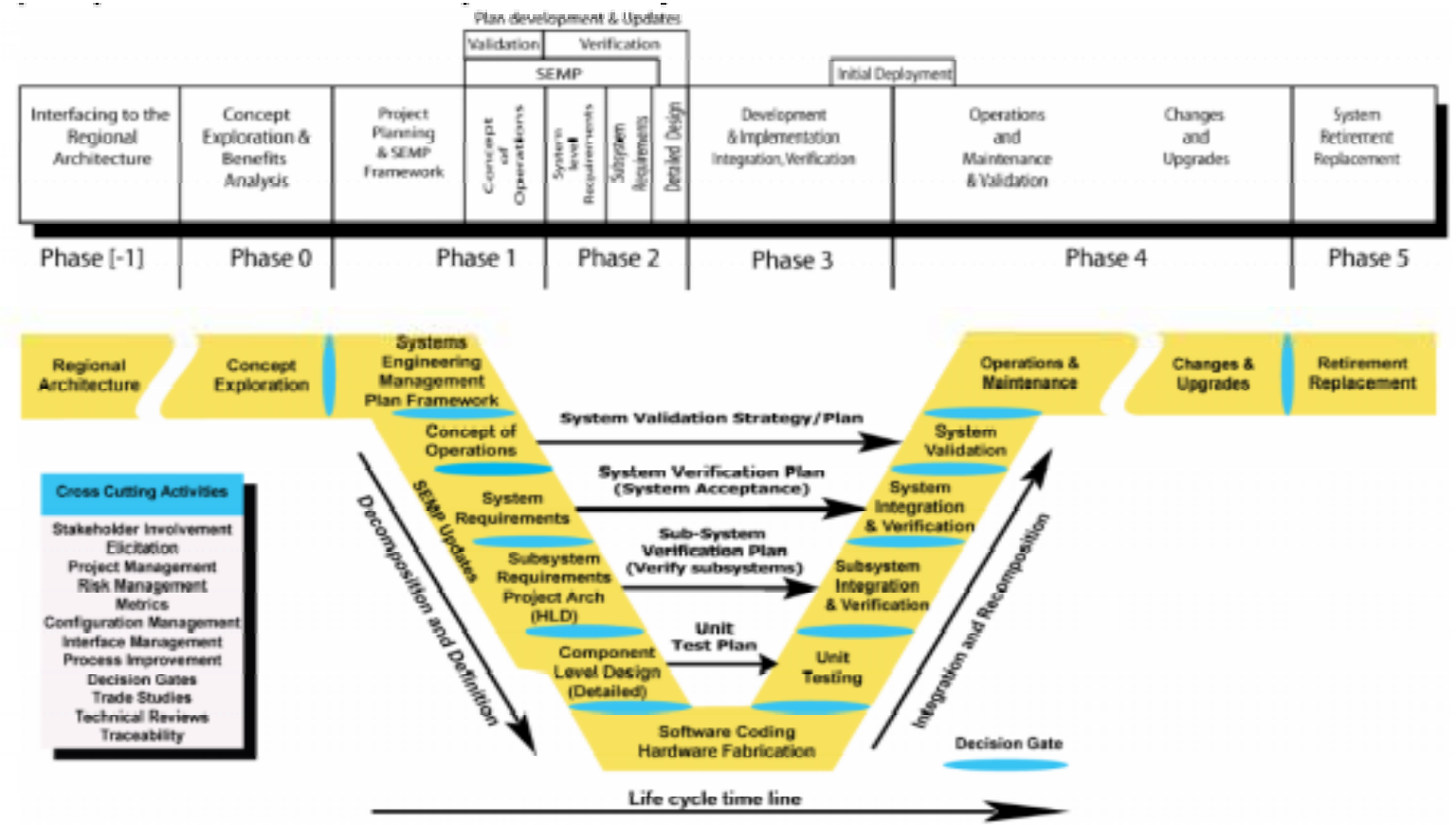
V-Model XT (4)

- Any change of the *Product* (or a sub-product) is called an *Activity* and has to obey the following phase changes:



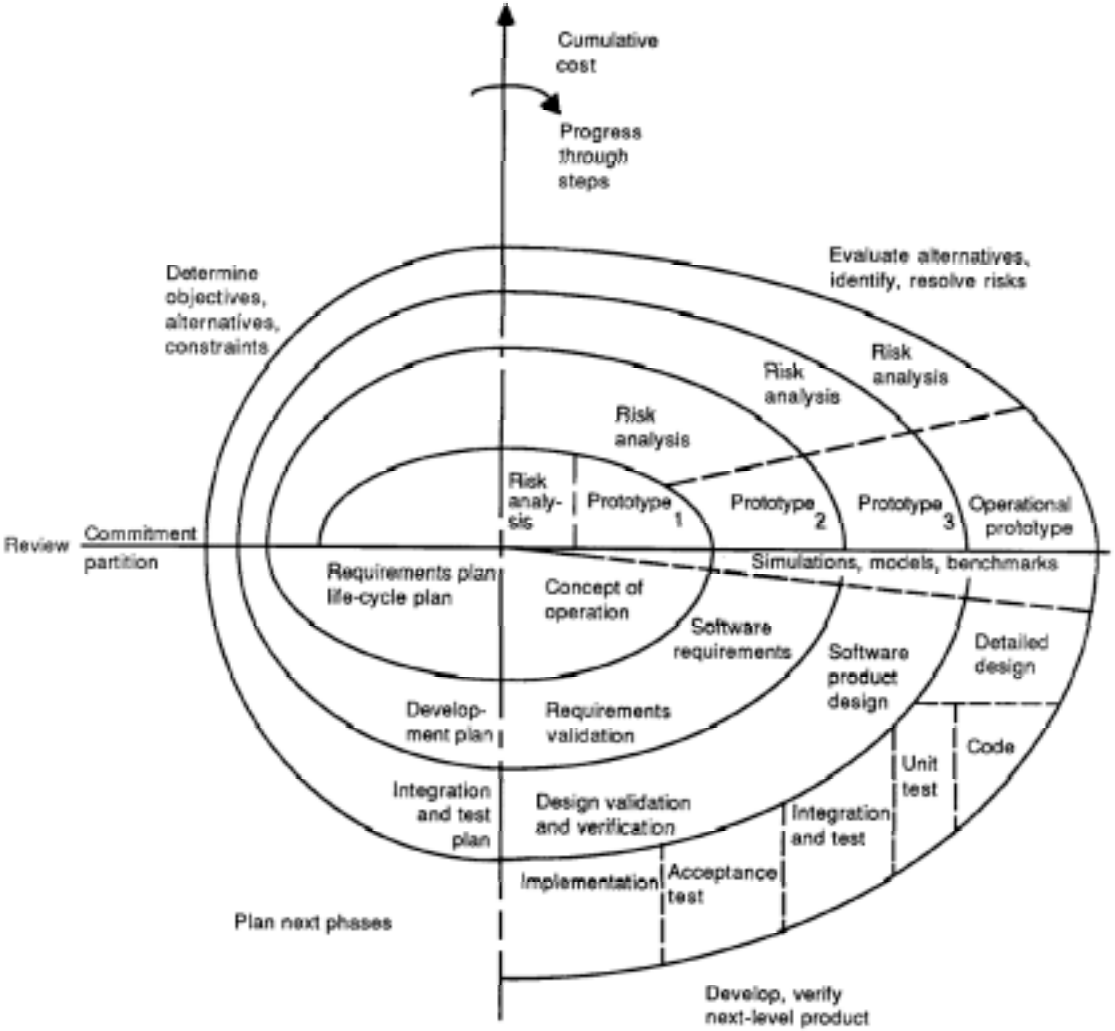
V-Model XT (5)

- While the V-Model XT is mostly deployed in Germany it is recognised and used internationally, for instance for the US American ITS (Intelligent Transport System) and documented in the "System Engineering Guidebook For ITS":



Spiral Model

- The original Spiral Model was invented in 1988 by Barry W. Boehm and it projects the life-cycle of a (software) product on a (repetitious) spiral while defining four quadrants Q1 - Q4:
  - Q1: Determines objectives, considers alternatives and constraints
  - Q2: Evaluation of alternatives, identify and resolve risks
  - Q3: Develop and verify, even consider next-level product
  - Q4: Plan next phases



Unlike the other models, the Spiral Model is risk-driven; after each "round" the risk to start with the next round is assessed.

Spiral Model (2)

- The risk assessment is based on certain key questions needed to be answered and documented:
  - *What are the objectives?*
  - *What are the constraints?*
  - *What are the alternatives?*
  - *Which risks are involved?*
  - *How to resolve the risks?*
  - *What would be the result of the risk resolution?*
  - *What are the plans for the next phase?*
  - *What are the commitments?*
- In this context, each cycle ("a round") can be considered as *stage*:
  - Round 0: *Feasibility study*
  - Round 1: *Concept of operation*
  - Round 2: *Specification of the top-level requirements*

GQM: Goal/Question/Metric

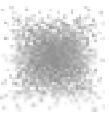
- GQM is the acronym for

  Goal/Question/Metric

  and has been introduced by Victory Basili at the University of Maryland in 1983 and improved by Dieter Rombach 1988.
- It can be seen as enhancements of the following :
  - ***QFD*** Quality Function Deployment (developed by Yoji Akao 1966 at the Tamagawa University in Tokyo)
  - ***SQM*** Software Quality Metrics (developed in 1980 by Marine for Metrics Incorporated)

  approaches and is suitable for
  - Quality Management and
  - Project Management as well.

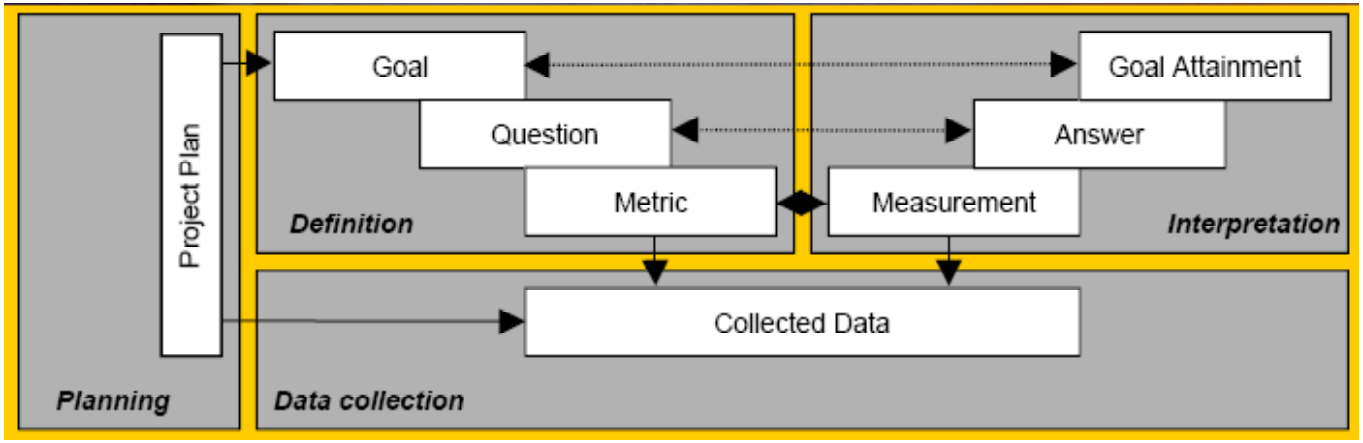
  ⇨ *GQM is a paradigma-driven approach; the result of any measurement is only valid in the context, as provided by the GQM plan*



GQM: Goal/Question/Metric (2)

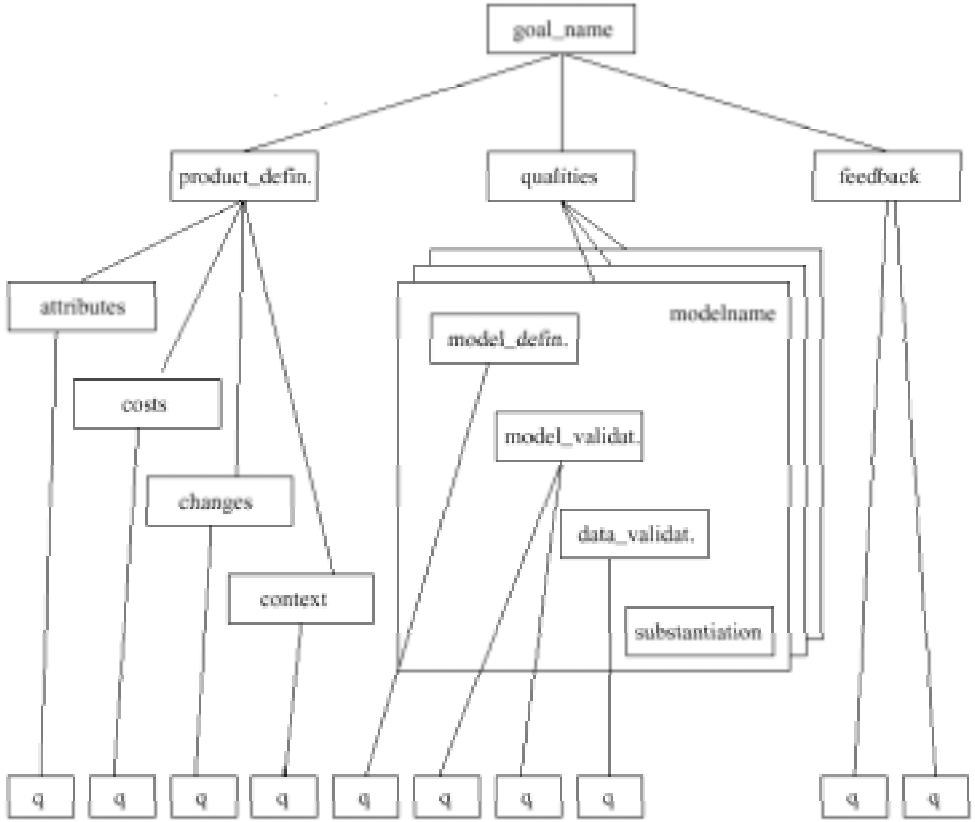
- Within the GQM approach, the following phases are considered:
  - The GQM plan
  - The definition of the questions and the metric for measurements
  - The collection of the measurement data
  - The interpretation of the measurements in the given context

    Unlike other models, it respects the origin of the measurement data; sensible data are sheltered against random access.



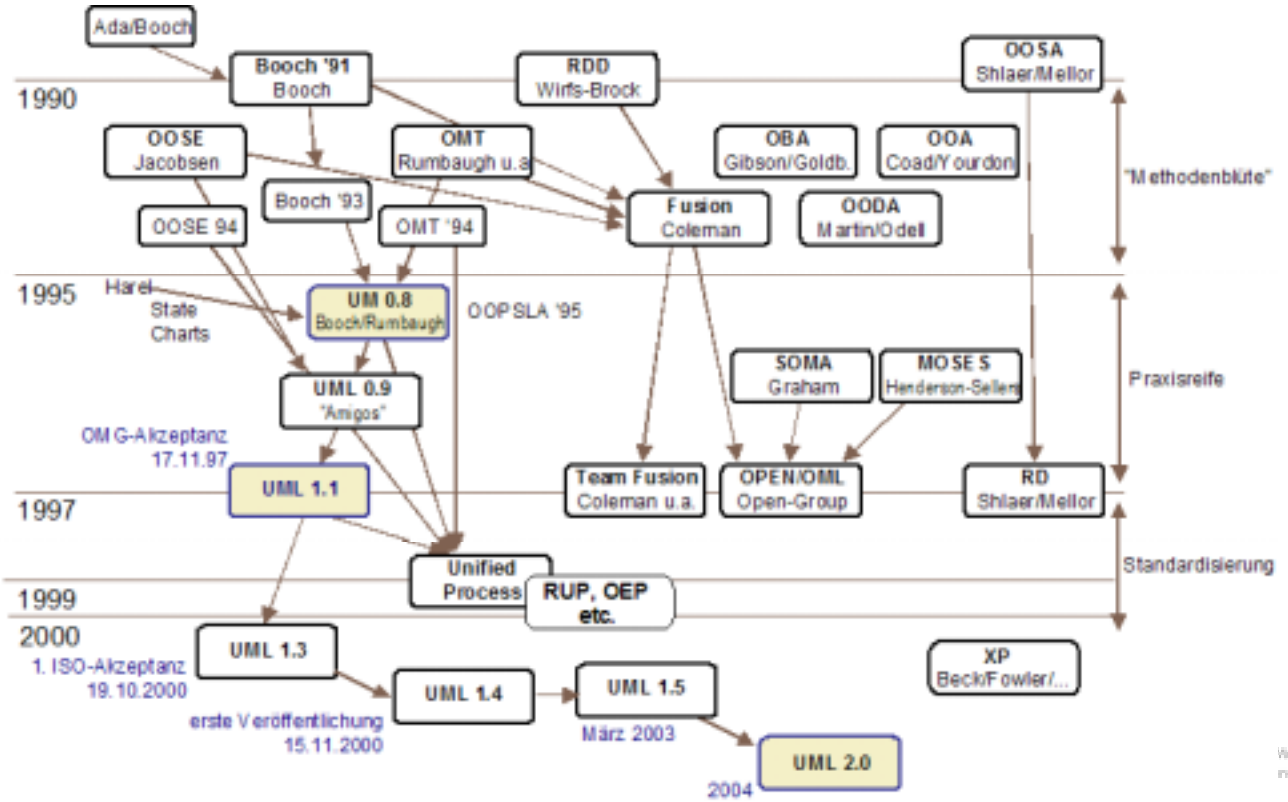
GQM: Goal/Question/Metric (3)

- Most import for software development is, that GQM provides a *procedural language* allowing a modelling of it's dependencies.
  - For Eclipse, a plug-in FOCUS is available which allows the modelling.



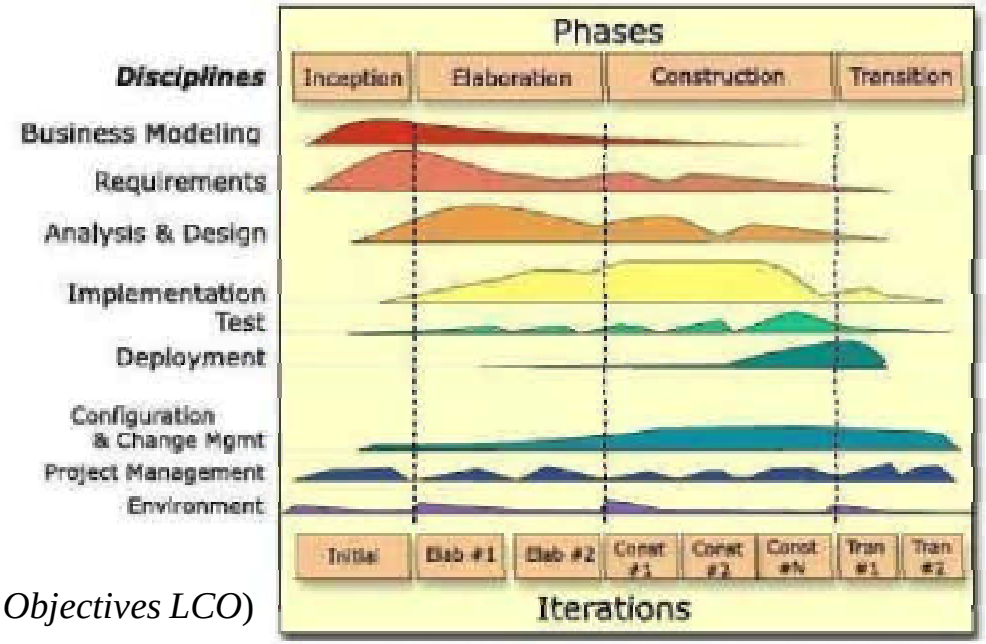
RUP Model

- The *Rational Unified Processs **RUP*** Model has been created by the company *Rational* (like Rose, Clear Case and other Rational software products) in 1996, which has been taken over by IBM.
  - RUP is as procedure model for software development and currently available in version 9.



RUP (2)

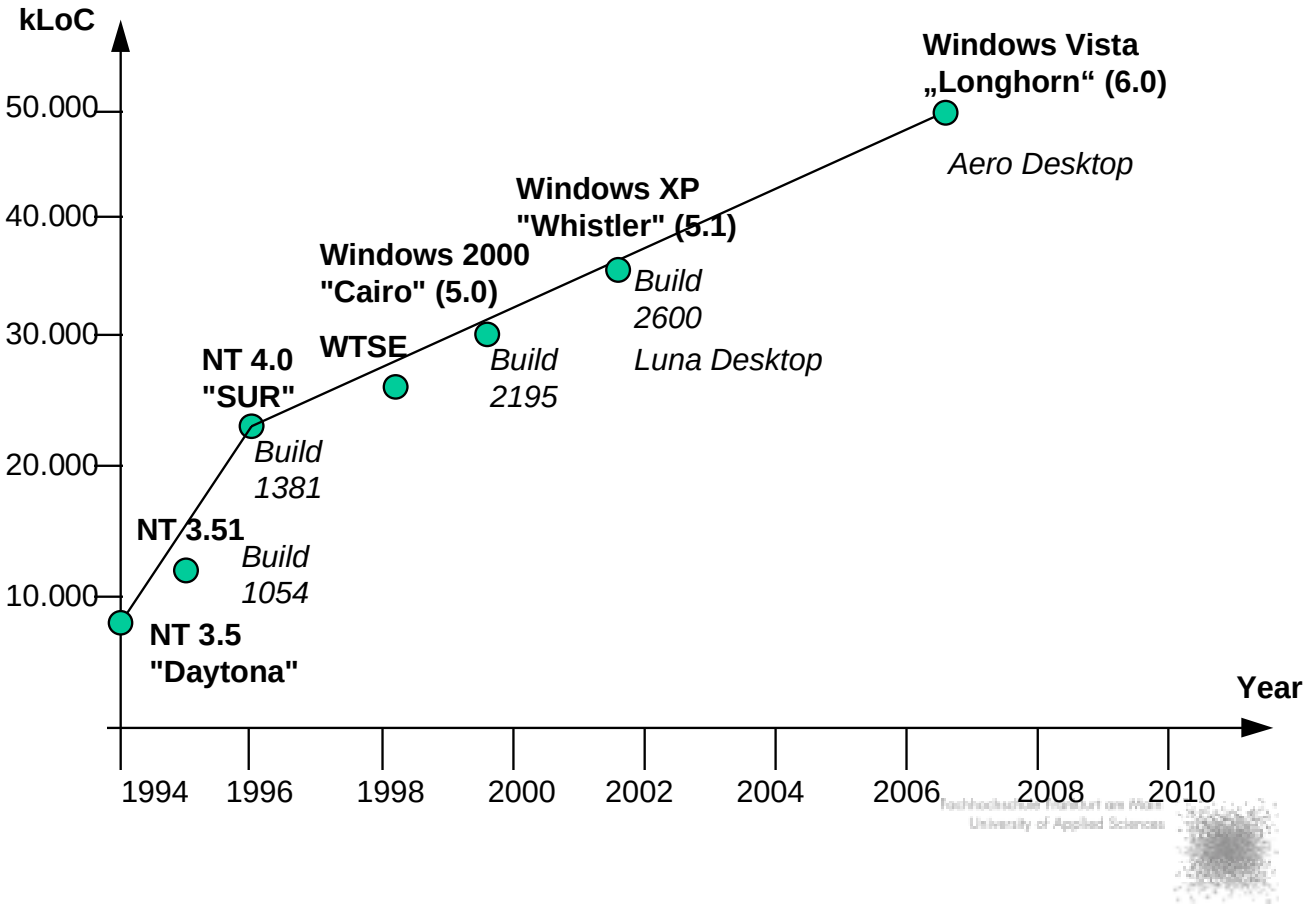
- Like Rose, RUP uses an Object Oriented approach for software development and basically devides software development into two independent (orthogonal) streams:
  - Disciplines:
    - *Business Modelling*
    - *Requirements*
    - *Analysis & Design*
    - *Implementation*
    - *Test*
    - *Deployment -- and additionally*
    - *Configuration & Change Management*
    - *Project Management*
    - *Environment*



  - Phases:
    - *Inception* (initial design providing the *Lifecycle Objectives LCO*)
    - *Elaboration* (design, yielding the *Lifecycle Architecture LCA*)
    - *Construction* (coding, introducing the *Initial Operational Capabilities IOC*)
    - *Transition* (phase-change, responsible for *Product Release RP*)

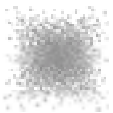
Software Metrics

- Software Metrics is the approach, to define a measure for the given code (sizing). The measure is typically an one-dimensional value based on a certain method. The following methods are known:
  - Number of Lines of Code (LoC), expressed as kLoC or MLoC.
  - Number or words, characters, files
  - Number of functions or subroutines.
  - Number of classes (for OO languages).



Software Metrics - Laws

- Which measure we use. depends on the programming language.
  - The measure itself has to be unified, thus the same formula to determine the size has to be used.
  - The rational behind that measure is to correlate it's value with the behavioristic behaviour of software development:
- *Law of continuous change*: Once a Use Case is subject for a change, all relevant software modules have to be changed.
- *Law of growing entropy*: During it's evolution, the code becomes less and less maintainable.
- *Law of a statistical smooth growth*: A typical software project will produce a continuos and smooth growth of the code base.
- *Pareto's law* claims, that 20% of the code impacts 80% of the result.
- *The law of the re-usability requires*:
  - "Don't solve any problem that has already been solved.
    Check your software repository for already existing solutions unlike develop them again."
- The *Parkinson's law* includes:
  - "Work expands to fill the available time."
  - "There's always time to do the right projects, but there's never time to do them over."
  - "Adding manpower to a late software project makes it later."



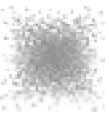
Software Metrics - Developments

- More lines of code does not mean better:

Mail Transfer Agent	Lines	Words	Characters	Files
qmail-1.03	16617	44780	395243	279
sendmail-8.9.1	55059	179376	1229121	54
zmailer-2.2e10	57595	205524	1423624	227
smail-3.2	62331	246140	1701112	151
exim-2.02	70102	283295	2172786	128

Software Modelling and CASE Tools

- In software design several distinct design documents are relevant:
  - *High Level Design document* (***HLD***), describing the products functionality in a bird's view, and the
  - ***Low Level Design documents*** (*LLD*), detailing the individual software components (and thus are also called *Detailed Design documents*).
- In particular in Germany, the HLD is fed from the following input documents:
  - *Pflichtenheft* - the agreed specifications between the customer and the software vendor/developer.
  - *Lastenheft* - the requirement specification as provided by the customer.
- The descriptions herein follow a formal modelling language and are provided in terms of charts.
  - In order to produce the respective charts and to make them consistent for a given software layout. CASE tools (Computer Aided Software Engineering) are used in the design process.



Software Modelling and CASE Tools (2)

- Today, three different modelling languages are common:
  - UML - *Unified Modelling Language*
  - ERM - *Entity Relationship Model*
  - SA/SD - *Structured Analysis/Structured Design*
- The CASE tools allow during the modelling process the determination of the dependencies of the software components.
- Thus, while deriving the WBS structure, CASE tools and be efficiently used to support this evaluation.