Softwaretechnik / Software-Engineering

Lecture 05:Examples of & Metrics for Process Models

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Contents & Goals

Last Lecture:

- procedure models (iterative, incremental, spiral, etc.), difference to process models,
- software metrics

This Lecture:

- **Educational Objectives:** Capabilities for following tasks/questions.
  - what are the constituting elements of "V-Modell XT"?
  - what does project types and tailoring mean in "V-Modell XT"?
  - how does "V-Modell XT" 'work'?
  - please explain this "V-Modell XT" building block
  - what are examples of agile process models? what are their principles?
  - describe XP, Scrum: roles, artefacts, activities?
  - is "V-Modell XT" and "agile" a contradiction?
  - what is the purpose of a process metric? What is CMMI, SPICE?
  - how are the levels of CMMI and SPICE defined?
- **Content:**
  - V-Modell XT
  - agile process models, XP, Scrum
  - process metrics CMMI/SPICE

Process Models

From Procedure to Process Model

A **process model** may describe:

- organisation, responsibilities, roles;
- structure and properties of documents;
- methods to be used, e.g. to gather requirements or to check intermediate results
- steps to be conducted during development, their sequential arrangement, their dependencies (the **procedure model**);
- project phases, milestones, testing criteria;
- notations and languages;
- tools to be used (in particular for project management).

Process models typically come with their **own terminology** (to maximise confusion?), e.g. what we call **artefact** is called **product** in V-Model terminology.

Process models are legion; we will take a closer look onto:

- **Phases**, **V-Model XT**, **(Rational) Unified Process**, **Agile** (**XP**, **Scrum**)

Light vs. Heavyweight Process Models

- You may hear about **"light"** and **"heavyweight"** process models.
- Sometimes, "heaviness" seems to be measured in number of rules...
- Sometimes, "heaviness" seems to be related to flexibility, adaptability during a process...
- "Light" sounds better than "heavy", so advocates of a certain process model tend to tag theirs "light" and all others "heavy".
- In the end,
  - a process model is **too "light"** if it doesn't support you in doing things which are useful and necessary for your project;
  - a process model is **too "heavy"** if it forces you to do things which are neither necessary nor useful for your project.
- Thus following (Ludewig and Lichter, 2013), we will not try to assign the following process models to a "weight class".

Phase Models

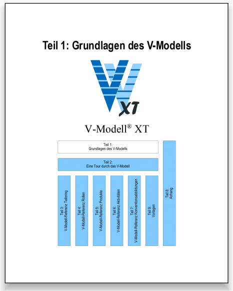
The Phase Model

- The project is planned by **phases**, delimited by well-defined **milestones**.
- Each phase is assigned a time/cost budget.
- Phases and milestones may be part of the development contract;
  partial payment when reaching milestones.
- Roles, responsibilities, artefacts defined **as needed**.

- By definition, there is **no iteration of phases**.
- But **activities may span multiple phases**.

- Not uncommon for small projects (few software people, small product size), small companies.

V-Modell XT



Teil 1: Grundlagen des V-Modells

V-Modell® XT

Teil 1:
Grundlagen des V-Modells

Teil 2:
Eine Tour durch das V-Modell

Teil 3:
V-Modell-Referenz Tailoring

Teil 4:
V-Modell-Referenz Rollen

Teil 5:
V-Modell-Referenz Produkte

Teil 6:
V-Modell-Referenz Aktivitäten

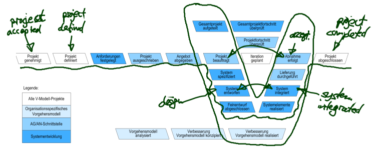
Teil 7:
V-Modell-Referenz Konventionsabbildungen

Teil 9:
Vorlagen

Teil 8:
Anhang

V-Modell XT

- There are different **V-shaped** (in a minute) **process models**,
  we discuss the (German) "V-Modell".
- **"V-Modell"**: developed by company IABG in cooperation with the Federal Office for Defence Technology and Procurement ('Bundesministerium für Verteidigung'), released 1998
- (German) government as customer often **requires** usage of the V-Modell
- 2012: "**V-Modell XT**" Version 1.4 (Extreme Tailoring) (V-Modell XT, 2006)



V-Modell XT: Project Types

<table>
<tr><td>project role</td><td>customer
'Auftraggeber'</td><td>developer
'Auftragnehmer'</td><td>customer/developer
'Auftragg.'/'Auftragn.'</td><td>customer/developer
'Auftragg.'/'Auftragn.'</td></tr>
<tr><td><b>project type</b></td><td>system development project (AG)</td><td>system development project (AN)</td><td>system development project (AG/AN)</td><td>introduction and maintenance of specific process model</td></tr>
<tr><td>project subject</td><td colspan="3">HW system
SW system
HW-SW system/embedded
System integration</td><td>introduction and maintenance of specific process model</td></tr>
</table>

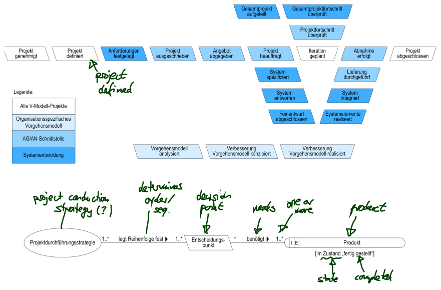
V-Modell XT offers support for four different **project types**:

- **AG**: project from the perspective of the customer
  (create call for bids, choose developer, accept product)
- **AN**: project from the perspective of the developer
  (create offer, develop system, hand over system to customer)
- **AG/AN**: customer and developer from same organisation
- **PM**: introduction or improvement of a process model
- **project type variants**:
  one/more customer; development/improvement/migration; maintenance

V-Modell XT: Terminology

our course	**V-Modell XT**	**explanation**
role	role ('Rolle')	✓
activity	activity ('Aktivität')	✓
-	step ('Arbeitsschritt')	parts of activities
artefact	product ('Produkt')	!
-	topic ('Thema')	parts of products
-	discipline ('Disziplin')	a set of related products and activities
phase	project segment (?) ('Projektabschnitt')	

V-Modell XT: Decision Points



V-Modell XT: The V-World (naja. . .)

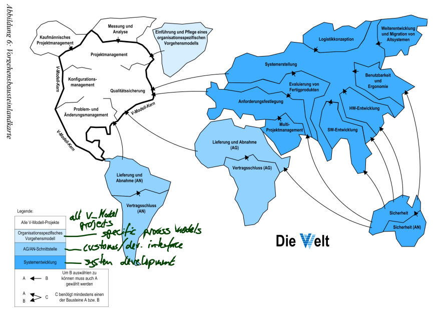
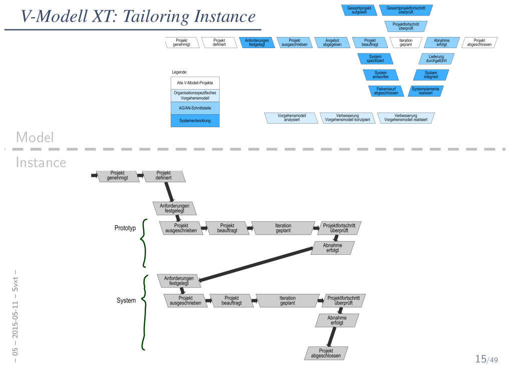
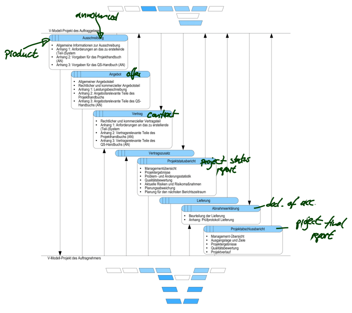


Abbildung 6: Vorgehensbausteinlandkarte
Kaufmännisches Projektmanagement
Messung und Analyse
Einführung und Pflege eines organisationsspezifischen Vorgehensmodells
Projektmanagement
V-Modell-Kern
Konfigurations-management
Qualitätssicherung
Problem- und Änderungsmanagement
Lieferung und Abnahme (AN)
Vertragsschluss (AN)
Logistikkonzeption
Weiterentwicklung und Migration von Altsystemen
Systemerstellung
Evaluierung von Fertigprodukten
Benutzbarkeit und Ergonomie
Anforderungsfestlegung
HW-Entwicklung
Multi-Projektmanagement
SW-Entwicklung
Lieferung und Abnahme (AG)
Vertragsschluss (AG)
Sicherheit
Sicherheit (AN)
Die Welt
Legende:
Alle V-Modell-Projekte
Organisationsspezifisches Vorgehensmodell
AG/AN-Schnittstelle
Systementwicklung
all V_Model projects
specific process models
customer/dev. interface
system development
A B Um B auswählen zu können muss auch A gewählt werden
A B C C benötigt mindestens einen der Bausteine A bzw. B

V-Modell XT: Tailoring Instance



V-Modell XT: Customer/Developer Interface


announced
product
V-Modell-Projekt des Auftraggebers
Ausschreibung
Allgemeine Informationen zur Ausschreibung
Anhang 1: Anforderungen an das zu erstellende (Teil-)System
Anhang 2: Vorgaben für das Projekthandbuch (AN)
Anhang 3: Vorgaben für das QS-Handbuch (AN)
Angebot
offer
Allgemeiner Angebotsteil
Rechtlicher und kommerzieller Angebotsteil
Anhang 1: Leistungsbeschreibung
Anhang 2: Angebotsrelevante Teile des Projekthandbuchs
Anhang 3: Angebotsrelevante Teile des QS-Handbuchs (AN)
Vertrag
contract
Rechtlicher und kommerzieller Vertragsteil
Anhang 1: Anforderungen an das zu erstellende (Teil-)System
Anhang 2: Vertragsrelevante Teile des Projekthandbuchs (AN)
Anhang 3: Vertragsrelevante Teile des QS-Handbuchs (AN)
Vertragszusatz
Projektstatusbericht
project status report
Managementübersicht
Projektergebnisse
Problem- und Änderungsstatistik
Qualitätsbewertung
Aktuelle Risiken und Risikomaßnahmen
Planungsabweichung
Planung für den nächsten Berichtszeitraum
Lieferung
Abnahmeerklärung
decl. of acc.
Beurteilung der Lieferung
Anhang: Prüfprotokoll Lieferung
Projektabschlussbericht
project final report
Management-Übersicht
Ausgangslage und Ziele
Projektergebnisse
Qualitätsbewertung
Projektverlauf
V-Modell-Projekt des Auftragnehmers

V-Modell XT: Roles (a lot!)

Project Roles:

Anwender

Projektleiter **SW-Entwickler** **Prüfer**

Organisation Roles:

V-Modell XT: Roles (a lot!)

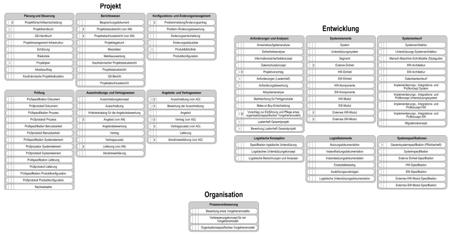
Project Roles:

Änderungssteuerungsgruppe (Change Control Board), Änderungsverantwortlicher, Anforderungsanalytiker (AG), Anforderungsanalytiker (AN), Anwender, Assessor, Ausschreibungsverantwortlicher, Datenschutzverantwortlicher, Ergonomieverantwortlicher, Funktionssicherheitsverantwortlicher, HW-Architekt, HW-Entwickler, Informationssicherheitsverantwortlicher, KM-Administrator, KM-Verantwortlicher, Lenkungsausschuss, Logistikentwickler, Logistikverantwortlicher, Projektkaufmann, Projektleiter, Projektmanager, Prozessingenieur, Prüfer, QS-Verantwortlicher, SW-Architekt, SW-Entwickler, Systemarchitekt, Systemintegrator, Technischer Autor, Trainer

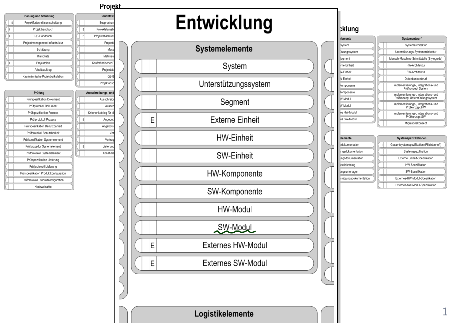
Organisation Roles:

Akquisiteur, Datenschutzbeauftragter (Organisation), Einkäufer, IT-Sicherheitsbeauftragter (Organisation), Qualitätsmanager

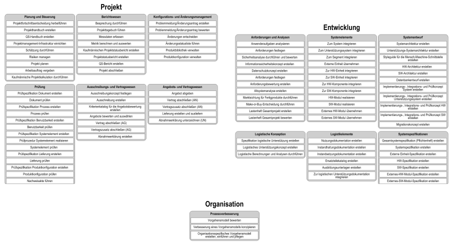
V-Modell XT: Disciplines and Products (even more!)



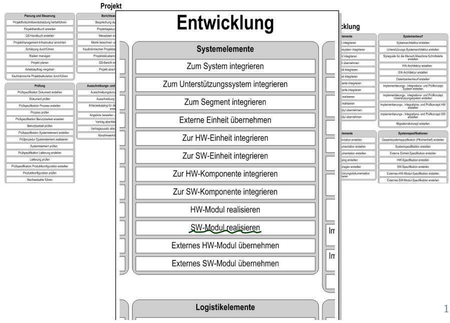
V-Modell XT: Disciplines and Products (even more!)



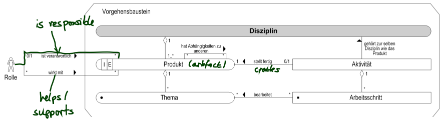
V-Modell XT: Activities (as many?!)



V-Modell XT: Activities (as many?!)

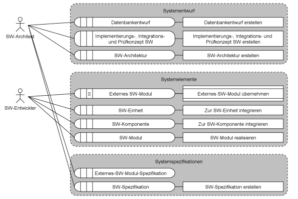

Projekt
Entwicklung
Systemelemente
Zum System integrieren
Zum Unterstützungssystem integrieren
Zum Segment integrieren
Externe Einheit übernehmen
Zur HW-Einheit integrieren
Zur SW-Einheit integrieren
Zur HW-Komponente integrieren
Zur SW-Komponente integrieren
HW-Modul realisieren
SW-Modul realisieren
Externes HW-Modul übernehmen
Externes SW-Modul übernehmen
Logistikelemente

V-Modell XT: Procedure Building Blocks

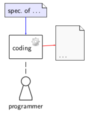


- a **discipline** comprises one or more **product**
- a **product** may be **external** ('E') or **initial** ('I'), i.e. created **always** and **exactly once** (e.g. project plan)
- a **product** may consist of **topics**
- a **product** may depend on other **products**
- an **activity** creates a **product** and belongs to a **discipline**
- an **activity** may consist of **steps**
- a **step** works on a **topic**
- a **role** may be **responsible** for a product or **contribute**
- each **product** has at most one **responsible** role

V-Modell XT: Example Building Block

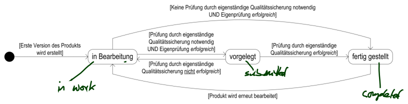

SW-Architekt
SW-Entwickler
Systementwurf
Datenbankentwurf
Datenbankentwurf erstellen
Implementierungs-, Integrations- und Prüfkonzept SW
Implementierungs-, Integrations- und Prüfkonzept SW erstellen
SW-Architektur
SW-Architektur erstellen
Systemelemente
E
Externes SW-Modul
Externes SW-Modul übernehmen
SW-Einheit
Zur SW-Einheit integrieren
SW-Komponente
Zur SW-Komponente integrieren
SW-Modul
SW-Modul realisieren
Systemspezifikationen
Externes-SW-Modul-Spezifikation
SW-Spezifikation
SW-Spezifikation erstellen

vs.



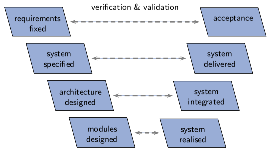
SW-Development ('SW-Entwicklung')

Product States


[Erste Version des Produkts wird erstellt]
in Bearbeitung
in work
[Keine Prüfung durch eigenständige Qualitätssicherung notwendig UND Eigenprüfung erfolgreich]
[Prüfung durch eigenständige Qualitätssicherung notwendig UND Eigenprüfung erfolgreich]
[Prüfung durch eigenständige Qualitätssicherung nicht erfolgreich]
vorgelegt
submitted
[Prüfung durch eigenständige Qualitätssicherung erfolgreich]
fertig gestellt
completed
[Produkt wird erneut bearbeitet]

V-Modell XT: Development Strategies

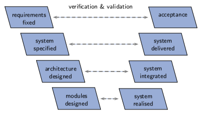
Recall the idea of the **"V shape"**:

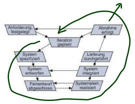


V-Modell XT mainly supports three **strategies** to develop a system, i.e. principal **sequences between decision points**:

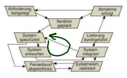
- incremental,
- component based,
- prototypical.

V-Modell XT: Development Strategies

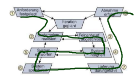




incremental



component based



prototypical

V-Modell XT: Discussion

Advantages:

- certain **management related building block** are part of each project, thus they may receive **increased attention** of management and developers
- publicly **available**, can be used **free of license costs**
- very **generic**, support for **tailoring**
- **comprehensive**, **low risk of forgetting** things

Disadvantages:

- **comprehensive**, tries to cover everything; tailoring is supported, but may need high effort
- tailoring is **necessary**, otherwise a huge amount of useless documents is created
- description/presentation leaves **room for improvement**

Needs to prove in practice, in particular in small/medium sized enterprises (SME).

Rational Unified Process

Rational Unified Process (RUP)

Exists.

- in contrast to "V-Modell XT", a commercial product

Agile Process Models

The Agile Manifesto

> *"Agile denoting 'the quality of being agile; readiness for motion; nimbleness, activity, dexterity in motion' software development methods are attempting to offer an answer to the eager business community asking for lighter weight along with faster and nimbler software development processes. This is especially the case with the rapidly growing and volatile Internet software industry as well as for the emerging mobile application environment."* (Abrahamsson et al., 2002)

The Agile Manifesto (2001):

We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

Individuals and interactions	≥ over	**processes and tools**
Working software	over	**comprehensive documentation**
Customer collaboration	over	**contract negotiation**
Responding to change	over	**following a plan**

that is, while **there is value in the items on the right**, we value the items on the left more.

Agile Principles

- *Our highest priority is to* **satisfy the customer** *through early and* **continuous delivery** *of valuable software.*
- **Welcome changing requirements**, *even late in development. Agile processes harness change for the customers competitive advantage.*
- **Deliver working software frequently**, *from a couple of weeks to a couple of months, with a preference to the shorter timescale.*
- **Business people and developers must work together** *daily throughout the project.*
- **Build projects around motivated individuals**. *Give them the environment and support they need, and trust them to get the job done.*
- *The most efficient and effective method of conveying information to and within a development team is* **face-to-face conversation**.
- **Working software is the primary measure** *of progress.*
- *Agile processes promote* **sustainable development**. *The sponsors, developers, and users should be able to maintain a constant pace indefinitely.*
- *Continuous* **attention to technical excellence** *and good design enhances agility.*
- **Simplicity** *the art of* **maximizing the amount of work not done** *is essential.*
- *The best architectures, requirements, and designs emerge from* **self-organizing teams**.
- *At regular intervals,* **the team reflects** *on how to become more effective, then tunes and* **adjusts its behavior accordingly**.

Similarities of Agiles Process Models

- iterative; cycles of a few weeks, at most three months,
- require work in small groups (6–8 people),
- dislike the idea of large, comprehensive documentation (radical or with restrictions),
- consider the customer important;
  recommend or request customer's presence in the project,
- dislike dogmatic rules.

(Ludewig and Lichter, 2013)

Extreme Programming (XP)

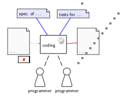
Extreme Programming (XP) (Beck, 1999)

XP values:

- **simplicity**, **feedback**, **communication**, **courage**, **respect**.

XP practices:

- **management**
  - integral team (including customer)
  - planning game (→ Delphi method)
  - short release cycles
  - stand-up meetings
  - assess in hindsight
- **team**:
  - joint responsibility for the code
  - coding conventions
  - acceptable workload
  - central metaphor
  - continuous integration
- **programming**
  - **test driven development**
  - refactoring
  - simple design
  - **pair programming**



Scrum

Scrum

- first published 1995 (Schwaber, 1995), based on ideas of Takeuchi and Nonaka
- inspired by Rugby: get the ball in a **scrum**, then **sprint** to score
- role-based; iterative and incremental;
  in contrast to XP no techniques proposed/required

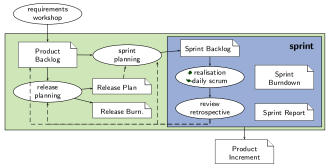
Three roles:

- **product owner**:
  - representative of customer,
  - maintains requirements in the **product backlog**,
  - plans and decides which requirement(s) to realise in next sprint,
  - (passive) participant of **daily scrum**,
  - assesses results of sprints
- **scrum team**:
  - members capable of developing autonomously,
  - decides how and how many requirements to realise in next sprint,
  - distribution of tasks self-organised, team decides who does what when,
  - environment needs to support communication and cooperation, e.g. by spatial locality
- **scrum master**:
  - helps to conduct scrum the right way,
  - looks for adherence to process and rules,
  - ensures that the team is not disturbed from outside,
  - moderates **daily scrum**, responsible for keeping **product backlog** up-to-date,
  - should be able to assess techniques and approaches

Scrum Documents

- **product backlog**
  - comprises all requirements to be realised,
  - priority and effort estimation for requirements,
  - collects tasks to be conducted,
  - maintained by **product owner**
- **release plan**
  - based on initial version of product backlog,
  - how many sprints, which major requirements in which sprint,
- **release-burndown report**
  - see **sprint-burndown report**
- **sprint backlog**
  - requirements to be realised in next spring, taken from product backlog,
  - more precise estimations,
  - daily update (tasks done, new tasks, new estimations)
- **sprint-burndown report**
  - completed/open tasks from sprint backlog,
  - should decrease linearly, otherwise remove tasks from sprint backlog,
- **sprint report**
  - which requirements have (not) been realised in last sprint,
  - description of obstacles/problems during sprint

Scrum Process



- **daily scrum**:
  - daily meeting, 15 min.
  - discuss progress, synchronise day plan, discuss and document new obstacles
  - team members, scrum master, product owner (if possible)
- **sprint**: at most 30 days, usually shorter (initially longer)
- **sprint review**: assess amount and quality of realisations; product owner accepts results
- **sprint retrospective**: assess how well the scrum process was implemented; identify actions for improvement (if necessary)

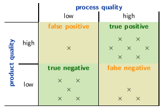
Scrum: Discussion

- has been used in many projects, experience in majority positive
- team size bigger 7–10 may need **scrum of scrums**
- competent **product owner** necessary for success
- success depends on motivation, competence, and communication skills of team members
- team members responsible for planning, and for adhering to process and rules, thus **intensive learning and experience** necessary
- can (as other process models) be combined with techniques from XP

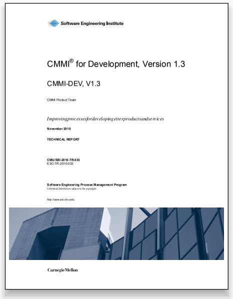
Process Metrics

Assessment and Improvement of the Process

- For **material** goods:
  quality of the production process influences **product quality**.
- **Idea**: specify abstract criteria (metrics)
  to determine **good production processes** (e.g., to choose manufacturer).
- **Again**: a **good process** does not stop us from creating **bad products**, but (the hope is, that) it is less likely, i.e. there is a correlation:



- Industry in general (**production!**):
  ISO 9001, ISO/TS 16949 (automotive), . . .
- Software industry (**development!**): **CMM(I)**, **SPICE**



Software Engineering Institute

CMMI® for Development, Version 1.3

CMMI-DEV, V1.3

CMMI Product Team

Improvingprocessesfordevelopingetterproductsandservices

November 2010

TECHNICAL REPORT

CMU/SEI-2010-TR-033
ESC-TR-2010-033

Software Engineering Process Management Program
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CarnegieMellon

CMMI

- 1991: Capability Maturity Model (CMM), DoD/SEI/CMU; superseded by
- 1997: **Capability Maturity Model Integration** (CMMI) (Team, 2010);
  constellations: **CMMI-DEV** (development), CMMI-ACQ (acquisition), CMMI-SRV (service)
- **Goals**:
  - **applicable** to all organisations which develop software,
  - make strengths and weaknesses of the real process visible, to point out ways for **improvement**,
  - **neutral** wrt. technology employed in project,
  - **levels**: higher levels have lower levels as premise,
  - be consistent with ISO 15504 (SPICE)
- **Assumptions**:
  - better **defined, described, and planned** processes have **higher** maturity,
  - higher maturity levels require **statistical control** to support continuous improvement,
  - higher maturity level yields:
    - **better** time/cost/quality **prediction**;
    - **lower risk** to miss project goals;
    - **higher quality** of products.

CMMI Levels

level	level name	process areas
1	**initial**	-
2	**managed**	REQM, PP, PMC, MA, PPQA, CM, SAM
3	**defined**	+ RD, TS, PI, VER, VAL, OPF, OPD, OT, IPM, RSKM, DAR
4	**quantitatively managed**	+ OPP, QPM
5	**optimising**	+ OID, CAR

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- **initial** – the process is not consciously designed, just evolved (need not be bad!)

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- **managed** (formerly: **repeatable**) – important areas of software development organised and prescribed to responsible people; each project may have own process
- **Areas**: requirements management (REQM), project planning (PP), project monitoring and control (PMC), measurement and analysis (MA), Process and Product Quality Assurance (PPQA), configuration management (CM), supplier agreement management (SAM)

CMMI Levels

level	level name	process areas
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- **defined** – all projects of an organisation follow a unified scheme; standard process is defined, documented, and used; tailoring for projects.
- **Areas**: requirements development (RD), technical solution (TS), product integration (PI), verification (VER), validation (VAL), organisational process focus (OPF), organisational process definition (OPD), organisational training (OT), integrated project management (IPM), risk management (RSKM), decision analysis and resolution (DAR)

CMMI Levels

level	level name	process areas
1	**initial**	-
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- **quantitatively managed** – unified metrics enable people to detect problems early and take countermeasures.
- **Areas**: organisational process performance (OPP), quantitative project management (QPM)

CMMI Levels

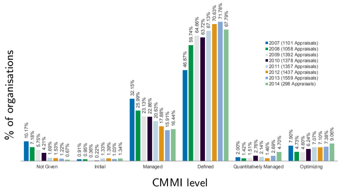
level	level name	process areas
1	**initial**	-
2	**managed**	REQM, PP, PMC, MA, PPQA, CM, SAM
3	**defined**	+ RD, TS, PI, VER, VAL, OPF, OPD, OT, IPM, RSKM, DAR
4	**quantitatively managed**	+ OPP, QPM
5	**optimising**	+ OID, CAR

- **optimising** – errors and problems are analysed systematically, to avoid them in the future; process organisation/techniques change accordingly
- **Areas**: organisational innovation and deployment (OID), causal analysis and resolution (CAR)

CMMI General/Specific Goals and Practices

- CMMI certificates can be obtained via a so-called **appraisal**
- there are three levels of review methods A, B, C; A most thorough (and expensive)
- a certificate authority checks, to what amount **generic goals** GG.1, . . . , GG.3 with their **generic practices** are reached.
  Example: GG.2 (for level 2) includes
  - GG 2.1: create strategy for planning and installation of process
  - GG 2.2: plan the process
  - GG 2.3: allocate reources
  - . . .
- each area, like RD, has **specific goals** and **specific practices**, sometimes per level
  Example: RD (requirements development) includes
  - SG 1: develop customer requirements
  - SG 2: develop product requirements
  - SG 3: analyse and validate requirements
- **that is**, to reach CMMI level 2, an organisation has to reach GG.1, GG.2, and in particular for area RD SG 1 and SG 2.

CMMI Statistics



Statistics on achieved CMMI maturity levels
(Source: SEI, Jan. 1, 2007 – Mar. 31, 2014)

- **Note**: appearance in the statistics is **voluntary**.

CMMI: Discussion

- in CMMI, e.g. area RD requires **that** requirements are analysed, but does not state **how** — there are examples, but no particular techniques or approaches
- CMMI as such **is not** a process model in the sense of the course
- CMMI certificate is **required** by certain (U.S) government customers; may guide selection of sub-contractors (a certificate at least proves that they think about their process)
- CMMI can serve as an **inspiration** for important aspects of process models wrt. product quality
- **Criticism**:
  - CMM(I) assumptions are based on experience in specific projects; may not be present for all kinds of software,
  - CMMI certification applies to one particular state of process management; changed processes may require new (expensive) appraisal, in this sense CMMI may hinder innovation,
  - CMMI levels are chosen somewhat arbitrarily; "why is an area in level N and not already in level $N - 1$?"

SPICE / ISO 15504

- **S**oftware **P**rocess **I**mprovement and **C**apability **D**etermination
- ideas similar to CMM(I): maturity levels, assessment, certificates
- european development, standardised in ISO/IEC 15504 (2003)
- maturity levels: 0 (incomplete), . . . , 5 (optimizing); SPICE 0 corresponds to CMMI 1
- provides "process reference models" (in particular specific ones for automotive, aerospace, etc.)
- Literature: (Hörmann et al., 2006)

References

References

Abrahamsson, P., Salo, O., Ronkainen, J., and Warsta, J. (2002). Agile software development methods. review and analysis. Technical Report 478.

Beck, K. (1999). *Extreme Programming Explained – Embrace Change*. Addison-Wesley.

Hörmann, K., Dittmann, L., Hindel, B., and Müller, M. (2006). *SPICE in der Praxis: Interpretationshilfe für Anwender und Assessoren*. dpunkt.verlag.

Ludewig, J. and Lichter, H. (2013). *Software Engineering*. dpunkt.verlag, 3. edition.

Schwaber, K. (1995). SCRUM development process. In Sutherland, J. et al., editors, *Business Object Design and Implementation, OOPSLA'95 Workshop Proceedings*. Springer-Verlag.

Team, C. P. (2010). Cmmi for development, version 1.3. Technical Report ESC-TR-2010-033, CMU/SEI.

V-Modell XT (2006). *V-Modell XT*. Version 1.4.