

Course "Softwareprozesse"
V-Modell XT
(in German/English Kauderwelsch 'Engleutsch')
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- Overview
- Meta model
- *Projektdurchführungsstrategien*
 - Example:
Incremental development
- *Entscheidungspunkte*
- System decomposition
- *Vorgehensbausteine*
- Project characteristics and tailoring
- Roles, product types, activities
- Historical notes
- What's classical or modern?

Learning objectives

- Understand the nature of the V-Modell as a classical-view, highly detailed, tailorable, multi-domain *Vorgehensmodell*
 - not only for SW development
- Understand the basic concepts that are specific to V-Modell
 - *Vorgehensbausteine, Entscheidungspunkte, Projektdurchführungsstrategien*
- Understand the idea of tailoring
 - Eliminating process parts; generating project-specific templates
- Roughly understand the size and coverage of V-Modell XT

What is the V-Modell?

- The V-Modell ("*Vorgehensmodell*") is a German government recommendation for the software process to be used for government projects
 - Its use is sometimes mandatory in the public sector, in particular for projects of the Bundesverwaltung (Ministries etc.)
- Development of the V-Modell:
 - 1986: started as a project of *Bundesministerium für Verteidigung*
 - 1993: Version 2 accepted by *Bundesministerium des Inneren*
 - 1997: adapted to iterative and object-oriented development
 - 2005: replaced by V-Modell XT ("extreme tailoring")
 - complete redesign: customer participation, process modularization, process tailoring to project settings and sizes, what rather than how
 - 2006ff: new releases of V-Modell XT appear from time to time
 - [WEIT e.V.](#); correcting defects, realizing improvements suggested by users
- <http://www.v-modell-xt.de>



- on www.cio.bund.de
 - Version 2.3 as of 2019-01
 - versions 1.x also had an English edition

Elements:

- Documentation (439 pages)
 - A Einstieg in das V-Modell XT
 - B Konzepte und Inhalte
 - C Referenz Produkte
 - D Referenz Rollen
 - E Referenz Abläufe
 - Aktivitätssteuerung
 - F Referenz Tailoring
 - G Referenz Arbeitshilfen
 - Aktivitäten, Produktvorlagen, Projektassistent etc.

- H Referenz Andere Standards
 - e.g. relationship to CMMI and ISO 9001
- I Anhang
 - glossary, abbrev's, literature

- Product templates
 - a template for each product type (document type)
 - for different project types
 - system development (customer organization view)
 - system development (developer organization view)

(continued on next slide)

Elements:

- V-Modell XT sources
 - XML source code from which all V-Modell documents are generated
 - Meta-model documentation
- Tools
 - *Project assistant*: tailoring
 - *Editor*: extension, modification
- Release information
 - versions, dates, change log
 - V2.0 has in particular changed a lot of terminology and has given the documentation a new structure
 - V2.2 has made lots more content changes

V-Modell XT is released under Apache License v2.0

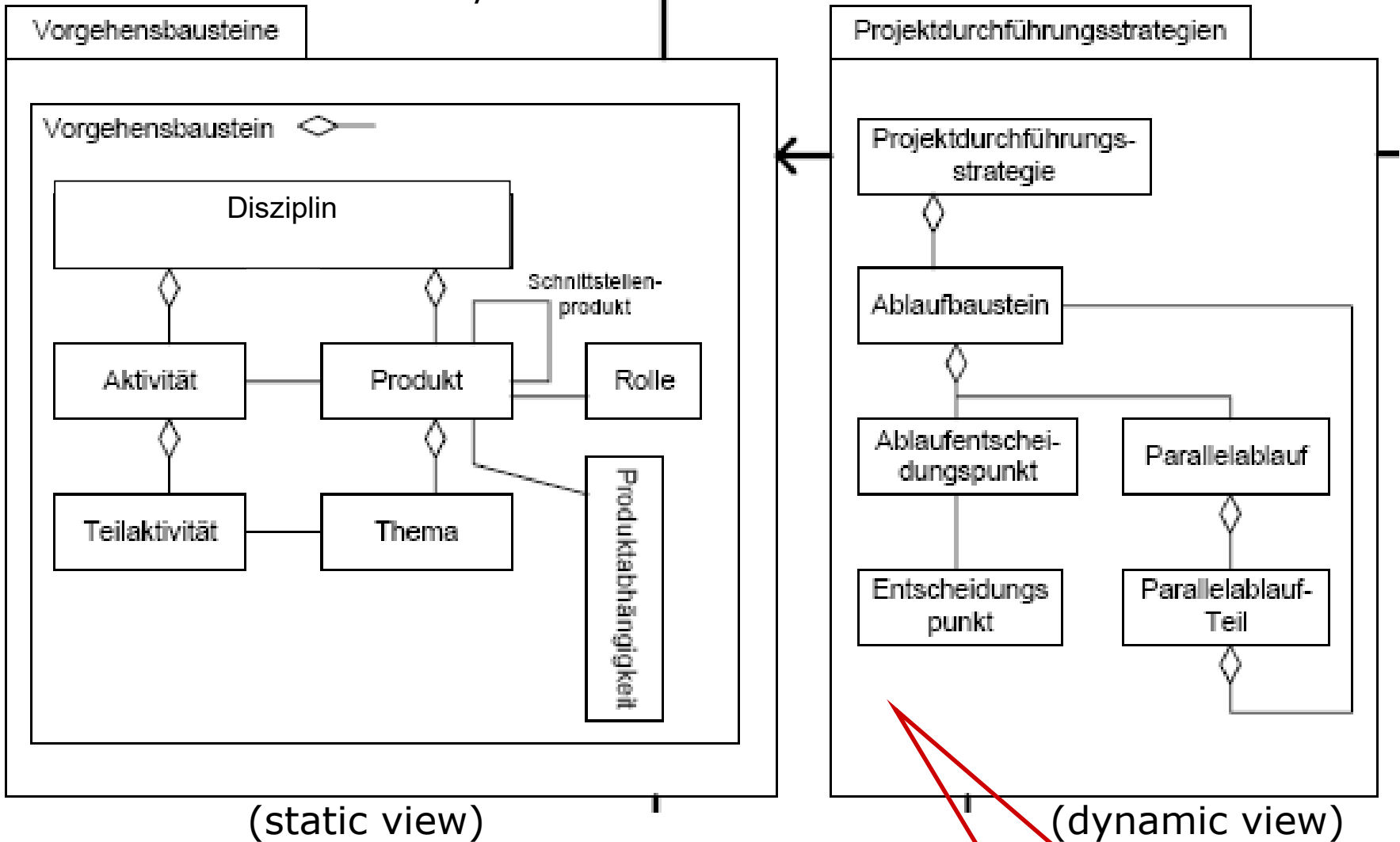
B.1: V-Modell describes who has to do what when in a project

- It discriminates several fundamental project types
 - by role (*Auftraggeber* **AG**, *Auftragnehmer* **AN**, both; 1/several) and project topic (HW, SW, complex, embedded, integration)
- Each type has **Projektdurchführungsstrategien** (dynamic)
 - each one roughly itself a process model, consisting of *Ablaufbausteine* and **Entscheidungspunkte**
 - V-Modell XT could be considered a process model family
- Task areas are described by **Vorgehensbausteine** (static)
 - which define products, activities, roles, and their relationships.
 - Some of them are mandatory, forming the **V-Modell-Kern**, others are subject to tailoring.
- **Tailoring** selects the applicable *Vorgehensbausteine* (and a *Projektdurchführungsstrategie*) to create a project-specific process.

Lots of ideas!

V-Modell UML meta-model (excerpt)

V1.2/V1.4



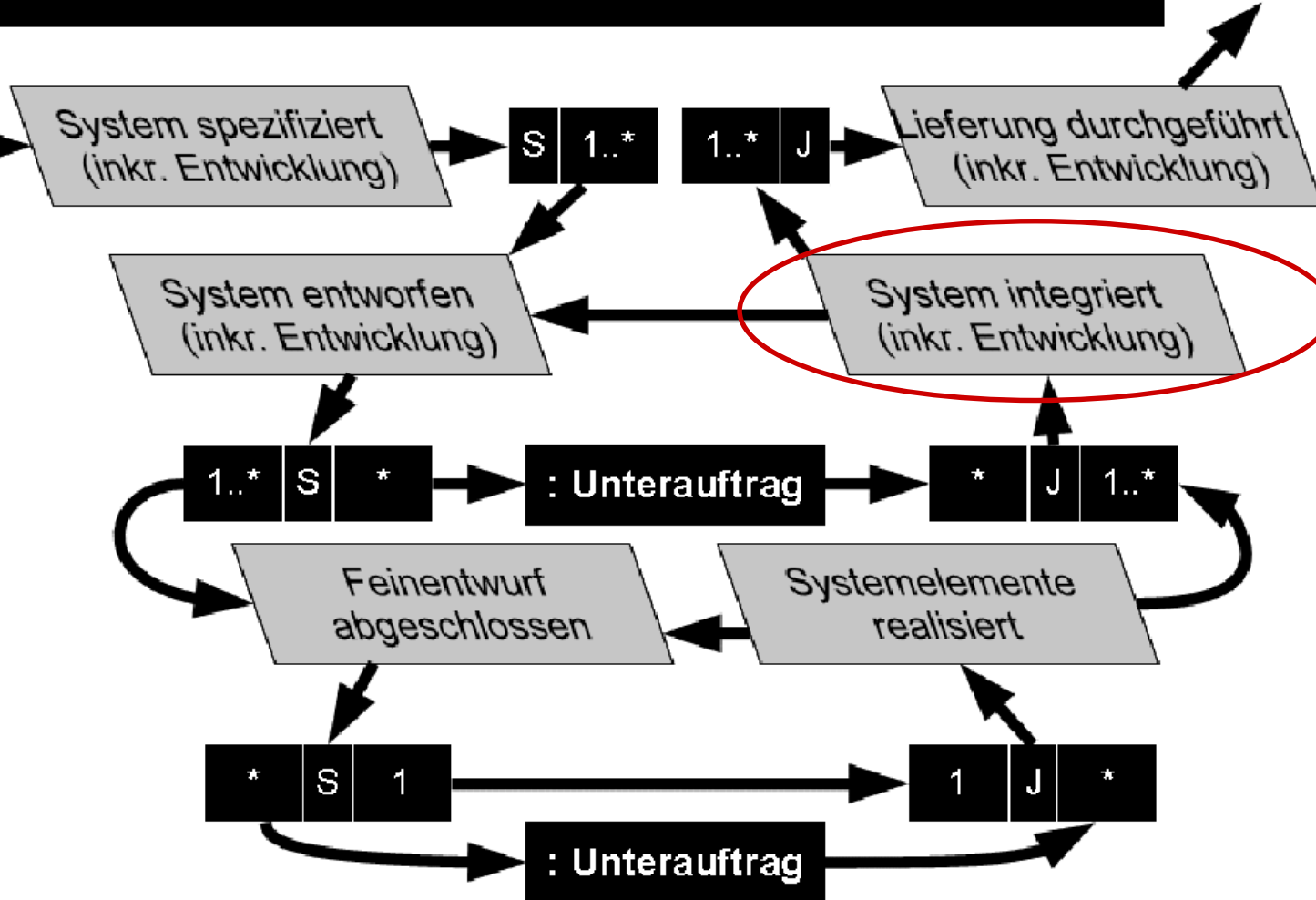
(static view)

(dynamic view)

Our first topic

Example *Projektdurchführungsstrategie* part "Incremental Development"

Inkrementelle Systementwicklung : Entwicklungsstrategie



- Section E.2.3

- S: Split
- J: Join

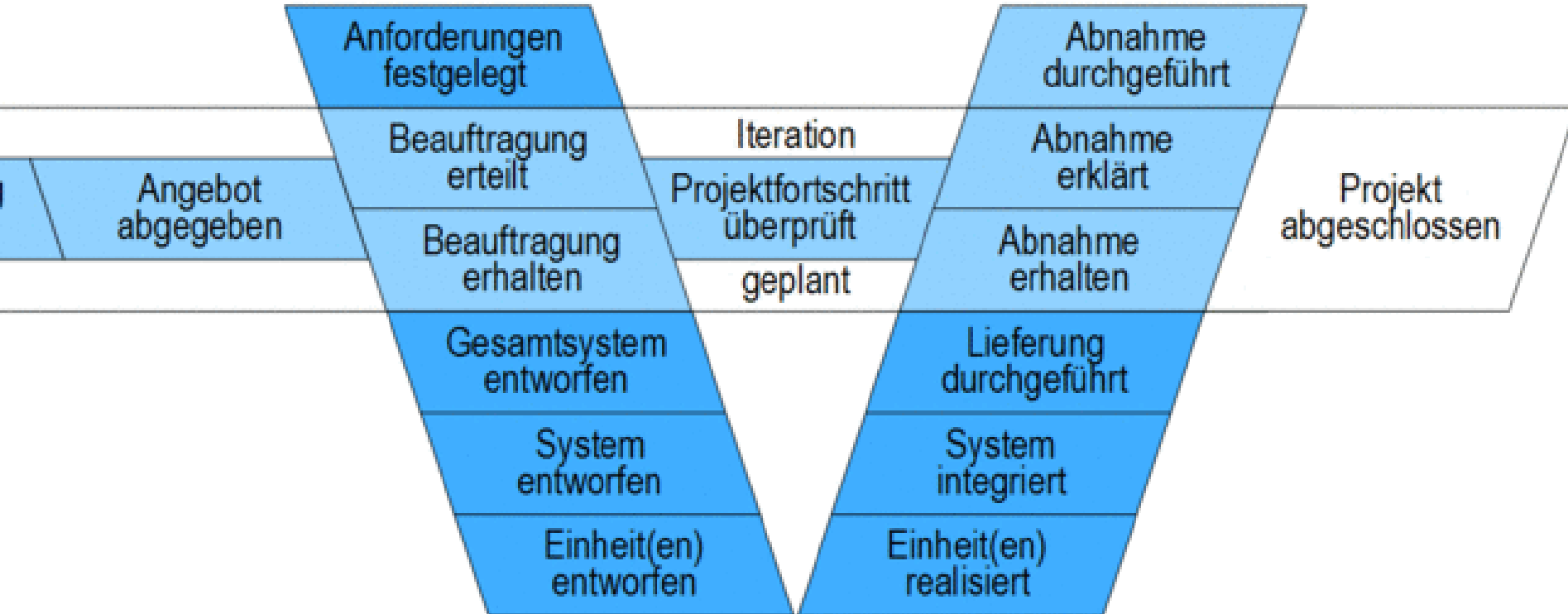
Siehe nächste Folie

Abschnitt E.1.13: *System integriert*

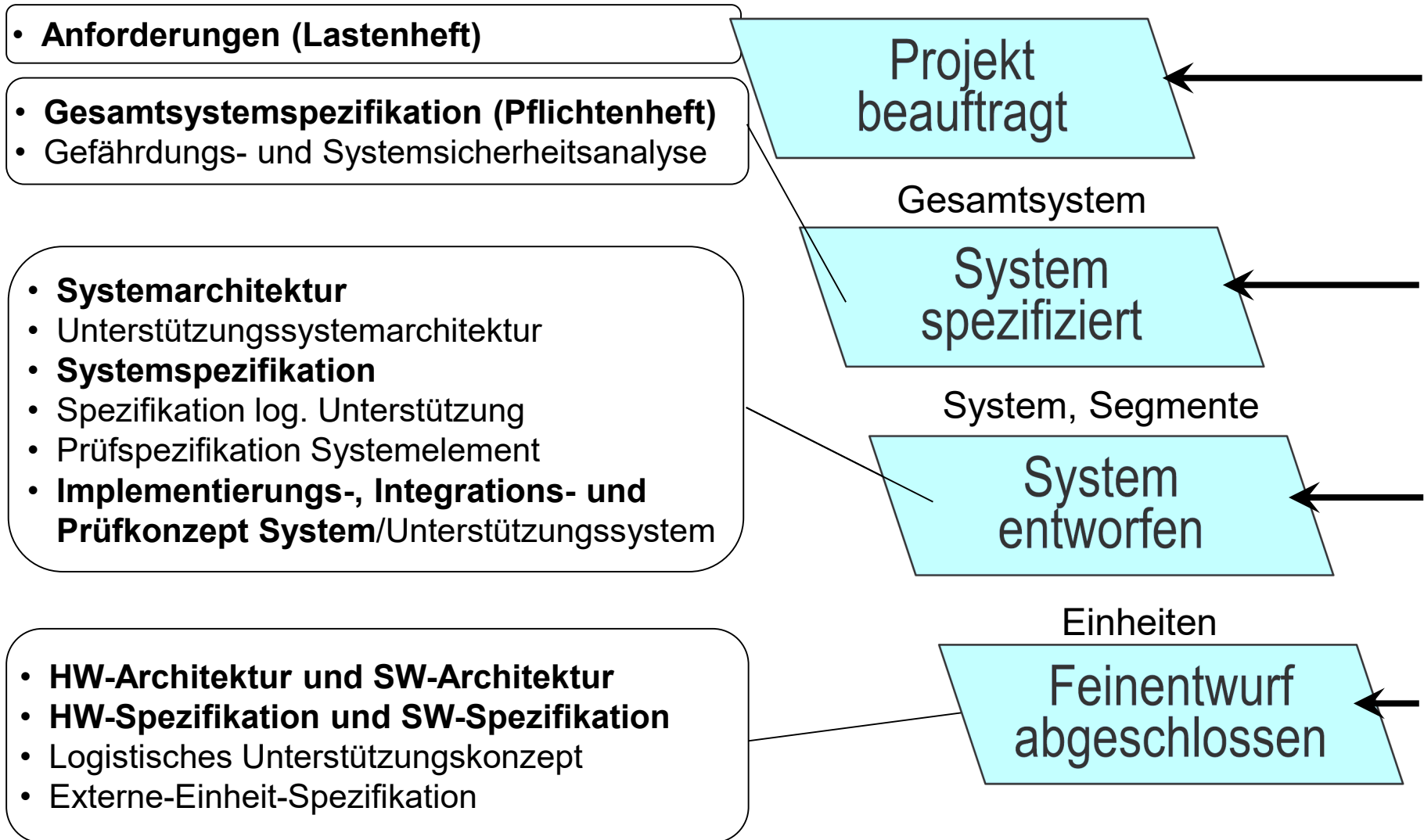
- Beschreibung:
 - In dem Entscheidungspunkt "*System integriert*" wird vom Auftragnehmer anhand des Produktes "*Prüfprotokoll Systemelement*" bewertet, ob das System den Anforderungen des Auftraggebers entspricht.
 - Im Falle einer positiven Bewertung liegen das integrierte System mit allen beinhalteten *Segmenten, HW-Einheiten, SW-Einheiten* und Produkten vom Typ *Externe Einheit* sowie die *Logistische Unterstützungsdokumentation* in einer lieferbaren Form vor.
 - [...]
- Zugeordnete Produkte:
 - *Externe Einheit, Logistische Unterstützungsdokumentation, Projektfortschrittsentscheidung, Projektplan, Projektstatusbericht, Prüfprotokoll Systemelement, QS-Bericht, Segment, System*

The *Entscheidungspunkte* within *Projektdurchführungsstrategien*

- Section B.1: Much like milestones in a waterfall project, but each may appear more than once.
 - (3 Entscheidungspunkte are missing on the left)



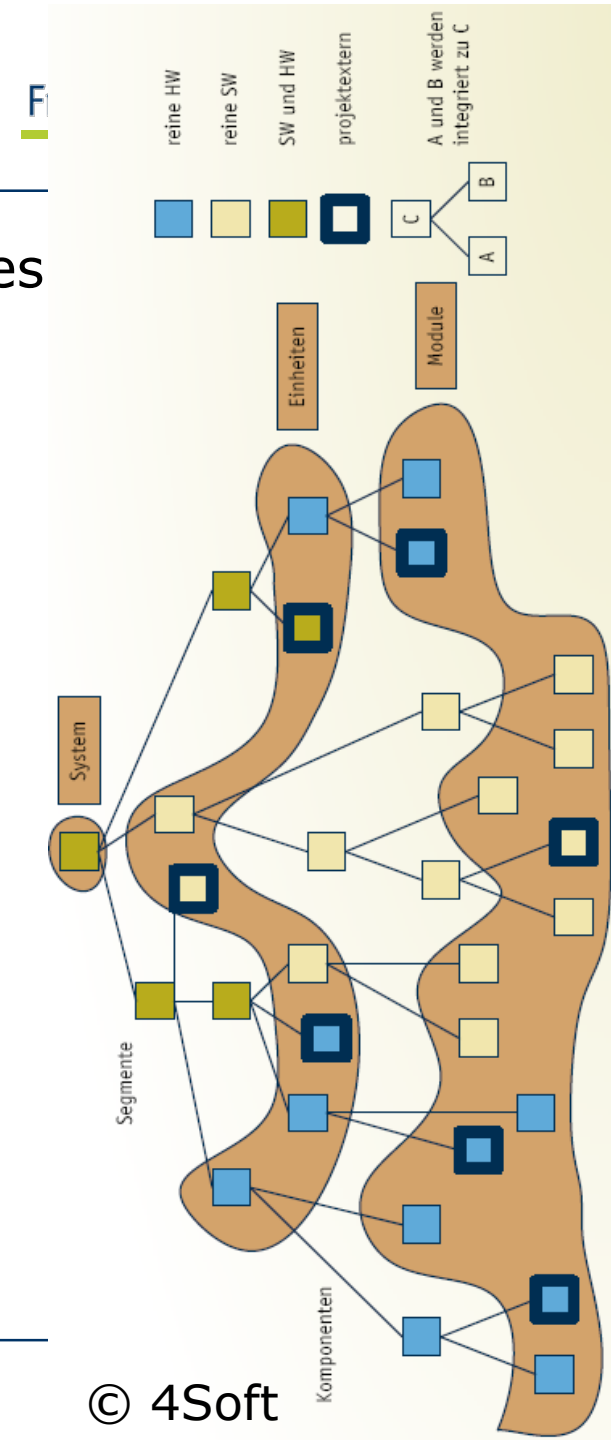
Different products are needed at each *Entscheidungspunkt* (examples, v1.4)



System decomposition in V-Modell lingo

In V-Modell terminology, a system decomposes into parts and subparts as follows (Section C.1.9; simplified):

- System
 - Segment
 - Externe Einheit [supplied by 3rd party]
 - HW-Einheit
 - HW-Komponente
 - HW-Modul
 - Externes HW-Modul
 - SW-Einheit
 - SW-Komponente
 - SW-Modul
 - Externes SW-Modul

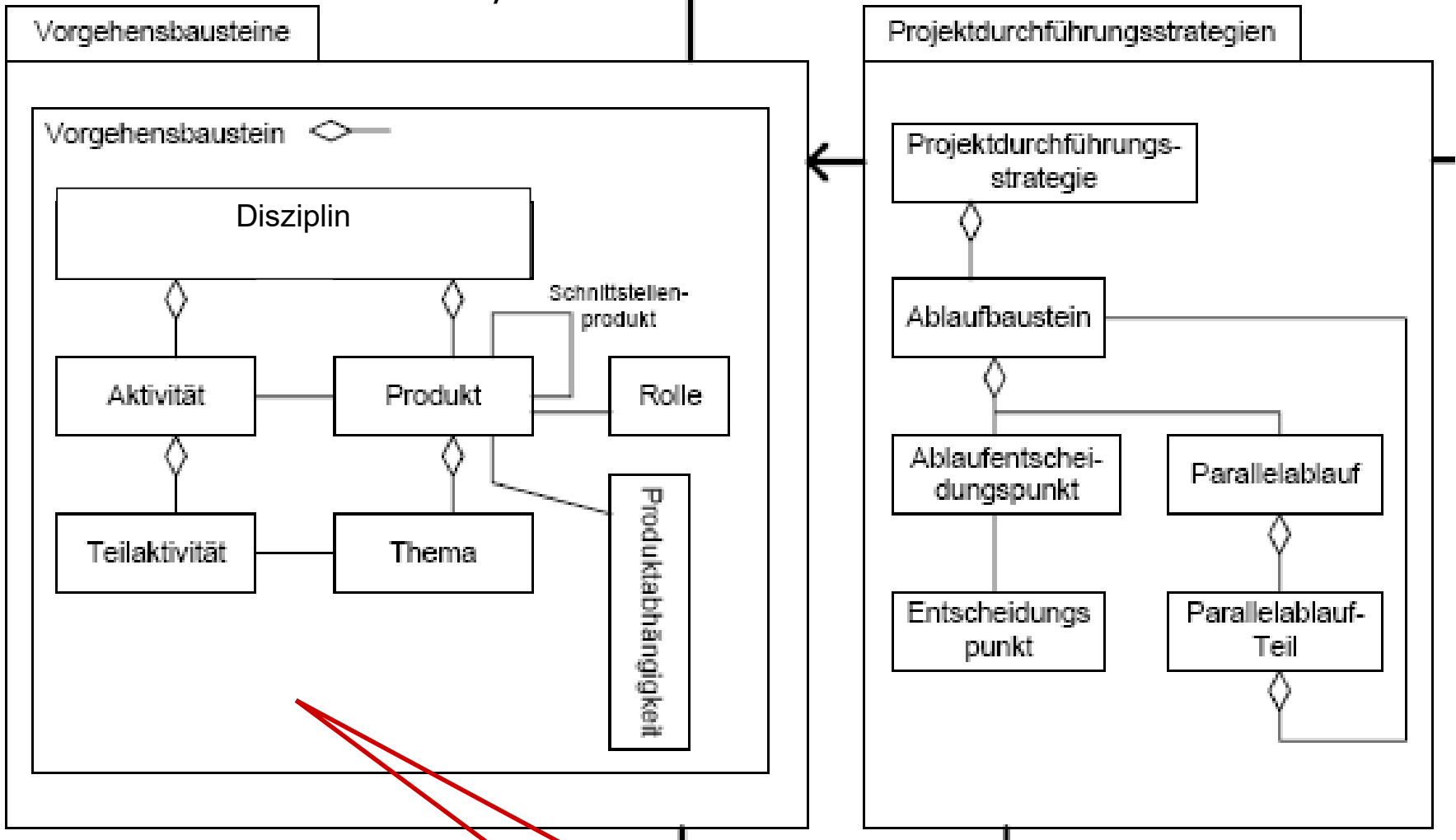


Hallmark of V-Modell: Cross referencing

- A salient characteristic of V-Modell is the heavy cross referencing among its elements
 - See the *Entscheidungspunkt* example above
- Cross referencing is most pronounced in the areas of products, e.g.
 - structural decomposition of products (seen above)
 - requirements tracing between products
 - "erzeugende Abhängigkeiten"
 - role assignments of products or product sections
 - *Vorgehensbaustein* use depends on project type (static tailoring)
 - *Vorgehensbaustein* use depends on system design (dynamic t.)
- See below

V-Modell UML meta-model (excerpt)

V1.2/V1.4



The 21 *Vorgehensbausteine* (F.3)

Mandatory (*V-Modell-Kern*):

- Project management
- Quality assurance
- Configuration management
- Problem and change mgmt.

Generic, optional:

- *Kaufmännisches Projektmgmt.*
- Measurement and analysis

AG-AN relationship:

- Contract conclusion (AG)
- Contract conclusion (AN)
- Delivery & acceptance (AG)
- Delivery & acceptance (AN)

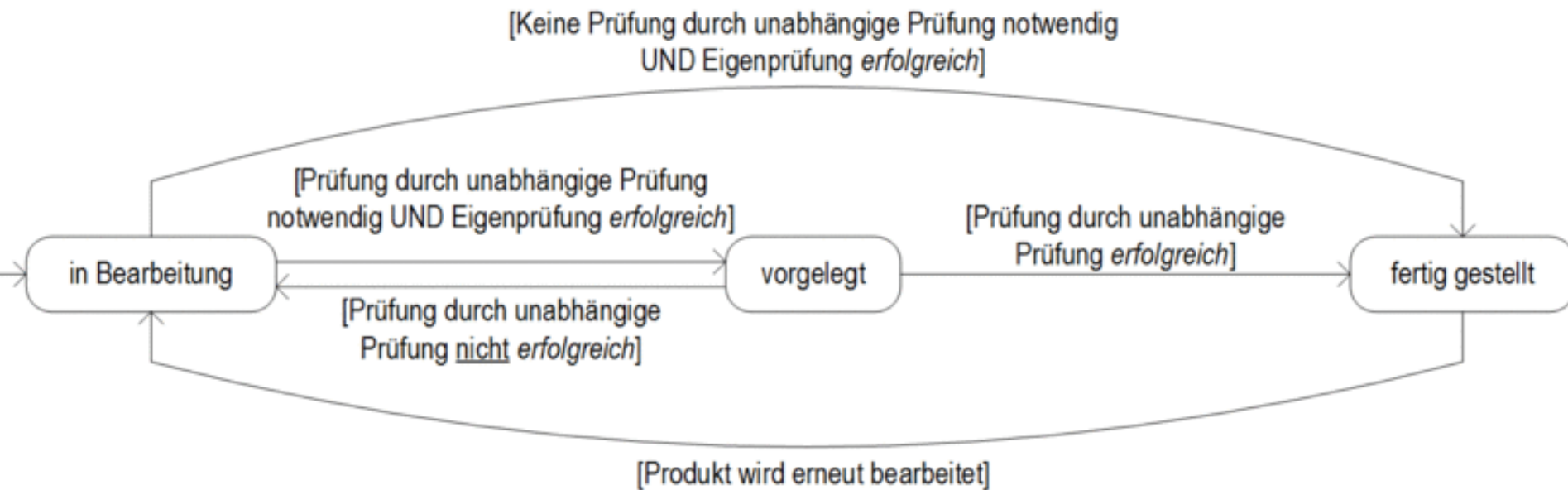
System development:

- *Anforderungsfestlegung*
- *Evaluierung von Fertigprod.*
- *Sicherheit*
- *Sicherheit (AN)*
- *Systemerstellung*
- *HW-Entwicklung*
- *SW-Entwicklung*
- *Logistikkonzeption*
- *Benutzbarkeit und Ergonomie*
- *Weiterentwicklung und Migration von Altsystemen*
- *Multi-Projektmanagement*

Product-centered view

V-Modell has a product-centered view:

- The centers of attention are the products and their quality.
 - There are 3 product states (plus 'non-existing'):
 1. *in Bearbeitung* (initially, during changes, and after unsuccessful quality checks)
 2. *vorgelegt* (for quality checking)
 3. *fertig gestellt* (after successful quality checking, a very waterfall-ish concept)



Product-centered view (2)

- The purpose of the *Vorgehensbausteine* is
 - grouping the products and
 - relating them to the roles
- The purpose of *Projektdurchführungsstrategien* is
 - orchestrating the use of the *Vorgehensbausteine*

- Tailoring means selecting the Vorgehensbausteine (VB) to be used in the project
- Static tailoring occurs at project definition time
 - Project type and project characteristics (see below) together suggest a set of VB
 - Some choices are open (optional VBs or 1-of-n VB selections)
 - Project-specific adaptations may involve e.g. using different strategies for prototypes vs. final development etc.
 - A waterfall-ish idea
- Dynamic tailoring may occur during project execution
 - e.g. when architectural design decides to realize some functionality in HW, the VB 'HW development' will be included dynamically

Tailoring: project characteristics

These are the initial criteria used during static tailoring:

- *Projekttypen und Projekttypvarianten (F.1)*
 - *AG mit einem AN,*
AG mit mehreren AN,
AN,
AN mit Unter-AN,
AG/AN,
AG/AN mit Unter-AN
- *Projektmerkmale (F.2):*
 - *Systemsicherheit*
 - *kaufmännisches Projektmgmt*
 - *Messung und Analyse*
 - *Projektgegenstand*
 - *Fertigprodukte*
 - *Benutzerschnittstelle*
 - *Unterauftrag*
 - *Altsystem*
 - *Prototypentwicklung*

Auftraggeber **AG**, *Auftragnehmer* **AN**

- Änderungssteuerungsgruppe
 - Änderungsverantwortlicher
 - Anforderungsanalytiker
 - AG; AN
 - Anwender
 - Ausschreibungsverantwortlicher
 - Betriebsverantwortlicher
 - Datenschutzverantwortlicher
 - Ergonomieverantwortlicher
 - Fachverantwortlicher
 - Funktionssicherheitsverantw.r
 - HW-Architekt
 - HW-Entwickler
 - Informationssicherh.verantw.
 - KM-Administrator
 - KM-Verantwortlicher
 - Lenkungsausschuss
 - Logistikentwickler
 - Logistikverantwortlicher
 - Projektkaufmann
 - Projektleiter
 - Projektmanager
 - Prüfer
 - QS-Verantwortlicher
 - SW-Architekt
 - SW-Entwickler
 - Systemarchitekt
 - Systemintegrator
 - Technischer Autor
 - Verfahrensverantwortlicher
 - fachlich; Betrieb; Weiterentwicklg.
- plus 6 "organization roles":
- Akquisiteur
 - Betriebsbeauftragter
 - Datenschutzbeauftragter
 - Einkäufer
 - IT-Sicherheitsbeauftragter
 - Qualitätsmanager

V-Modell product types

- Section C.1 defines 110 different types of products

- 151 pages of description

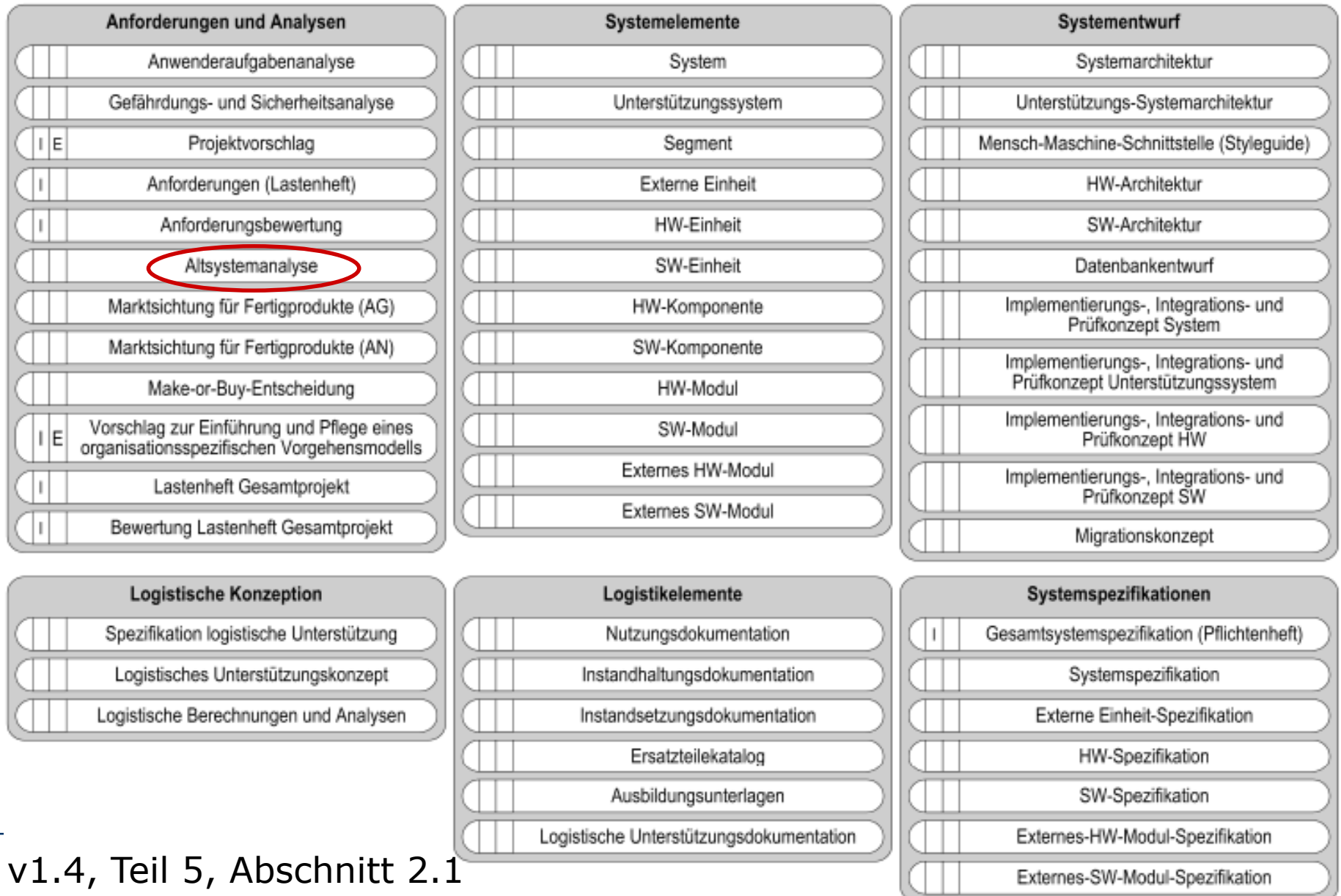
- They are arranged into 17 product groups

- v1.4 had 13 groups

- 6 of which were concerned with development
- and are shown on the next slide
 - (v2.x lacks this graphic)

- 🔖 C.1 Produkte
 - + 🔖 C.1.1 Anbahnung und Organisation
 - + 🔖 C.1.2 Planung und Steuerung
 - + 🔖 C.1.3 Risikomanagement
 - + 🔖 C.1.4 Problem- und Änderungsmanagement
 - + 🔖 C.1.5 Konfigurationsmanagement
 - + 🔖 C.1.6 Qualitätssicherung
 - + 🔖 C.1.7 Messung und Analyse
 - + 🔖 C.1.8 Berichtswesen
 - + 🔖 C.1.9 Systemelemente
 - + 🔖 C.1.10 Systemanalyse
 - + 🔖 C.1.11 Systementwurf
 - + 🔖 C.1.12 Systemspezifikation
 - + 🔖 C.1.13 Logistikelemente
 - + 🔖 C.1.14 IT-Organisation und Betrieb
 - + 🔖 C.1.15 Ausschreibungs- und Vertragswesen
 - + 🔖 C.1.16 Angebots- und Vertragswesen
 - + 🔖 C.1.17 Lieferung und Abnahme

Product groups and types in category 'development'



Section C.1.10.10: Altsystemanalyse [excerpts]

- Beschreibung des Ist-Zustandes eines Systems. [...] Als Grundlage der Migration ist das aktuelle Datenmodell des Altsystems zu ermitteln sowie eine Einschätzung d. Datenqualität zu erstellen. [...]

Verantwortlich	<u>Systemarchitekt</u>
Aktivität	Altsystem analysieren
Vorlagen	<u>Altsystemanalyse(.odt .doc)</u>
Erzeugt durch	<u>Systementwurf:</u> <u>Pflichtenheft (Gesamtsystementwurf)</u> (Dekomposition des Gesamtsystems)
Inhaltlich abhängig	<u>Einfluss der Altsystemanalyse auf die Systemerstellung:</u> <u>Pflichtenheft (Gesamtsystementwurf)</u>

(to be continued...)

Enthaltene Abschnitte:

- **C.1.10.10.1 Systemüberblick**
 - Grobarchitektur, Einbettung in Umgebung, Aufgaben d. Systems, Komponenten, Technologien
- **C.1.10.10.2 Funktionsüberblick**
 - Funktionalität, unterstützte Geschäftsprozesse
- **C.1.10.10.3 Schnittstellen- und Abhängigkeitsanalyse**
 - abhängige oder benötigte Nachbarsysteme, jeweilige Kommunikationsmechanismen, genaue Interaktionsprotokolle (Schnittstellenverträge), Abhängigkeiten zwischen Schnittstellen, Vorbedingungen und Benutzungsreihenfolgen
- **C.1.10.10.4 Datenmodell**
 - benutzte Datenbanktechnologien, Datenschemata, genaue Bedeutung der Daten, derzeitige Datenqualität und deren Auswirkungen

V-Modell activities

- **Version 2.1:** Section G.1 defines 89 different types of activity
 - 41 pages of description
 - They are mere supportive items ("Arbeitshilfen"), because of the product-centric structure
 - They are arranged into 16 activities groups (just like the products)
- **Version 2.2** release notes:
 - *"Die Aktivitätsbeschreibungen (Kapitel G.1) wurden entfernt."*
 - Can you guess why?
 - So today, V-Modell XT is completely product-centric

Abstract bird's eye view: Execution of a V-Modell project

1. Determine project type and project characteristics
 2. Choose a corresponding *Projektdurchführungsstrategie*
 3. Tailor the V-Modell to your project
 4. Repeat
 - Identify all *Entscheidungspunkte* (EP) to be reached in the next step
 - For each of these EPs,
 1. identify all products to be generated for that EP (directly mentioned or via a dependency)
 2. generate the products
 - Evaluate the EPs
- until the project is finished

- Along with the V-Modell XT comes a set of product templates
 - one ODT file for almost each of the product types
 - exceptions are e.g. the technical products such as *SW-Modul* etc.
- Tailoring is operationalized by the *V-Modell Projektassistent*
 - a software application running on Microsoft Windows
 - that generates project-specific versions of the V-Modell documentation and of the product templates
 - which leave out all information regarding *Vorgehensbausteine* that will not be used in the project
 - and that generates a project plan sketch that can be exported to Microsoft Project

V-Modell Projektassistent

V-Modell XT Projektassistent 1.5.5 - Beispielprojekt

Datei Hilfe

Projekttyp Anwendungsprofil Vorgehensbausteine

Bestimmen Sie den Projekttyp und die Projekttypvariante.

i Das Projekt kann jetzt exportiert werden.

Projekttyp

- Systementwicklungsprojekt (AG)
- Systementwicklungsprojekt (AN)
- Systementwicklungsprojekt (AG/AN)

Projekttypvariante

- AN-Projekt mit Entwicklung, Weiterentwicklung oder Migration
- AN-Projekt mit Wartung und Pflege

Übersicht

Durch Projekttyp bedingte Vorgehensbausteine

- Projektmanagement
- Qualitätssicherung
- Problem- und Änderungsmanagement
- Konfigurationsmanagement
- Lieferung und Abnahme (AN)
- Vertragsschluss (AN)
- Systemerstellung

Durch Projekttypvariante bedingte Vorgehensbausteine

–

Durch Projekttyp bedingte zu entscheidende Projektmerkmale

- Systemsicherheit (AN)
- Kaufmännisches Projektmanagement
- Messung und Analyse
- Projektgegenstand
- Fertigprodukte
- Benutzerschnittstelle

Durch Projekttypvariante bedingte zu entscheidende Projektmerkmale

- Unterauftrag
- Altsystem
- Prototypentwicklung

Exportverzeichnis:

C:\

Siehe Abschnitt G.3

- All V-Modell documentation is generated automatically out of a database (a huge XML file)
 - This file is public, i.e., V-Modell XT is open source
 - This means the meta model is real: all its classes actually exist
 - The network of cross references etc. is available in machine-readable form
 - Tool builders can integrate the V-Modell into their software
- This XML structure was generated by another application, called the *Fouever (4ever) XML Framework Editor*
 - written by 4Soft GmbH as open source:
<http://sourceforge.net/projects/fouever>
- The availability of the Editor means that everybody can extend and customize the V-Modell
 - to create a domain-specific or company-specific version

What's classical or modern?



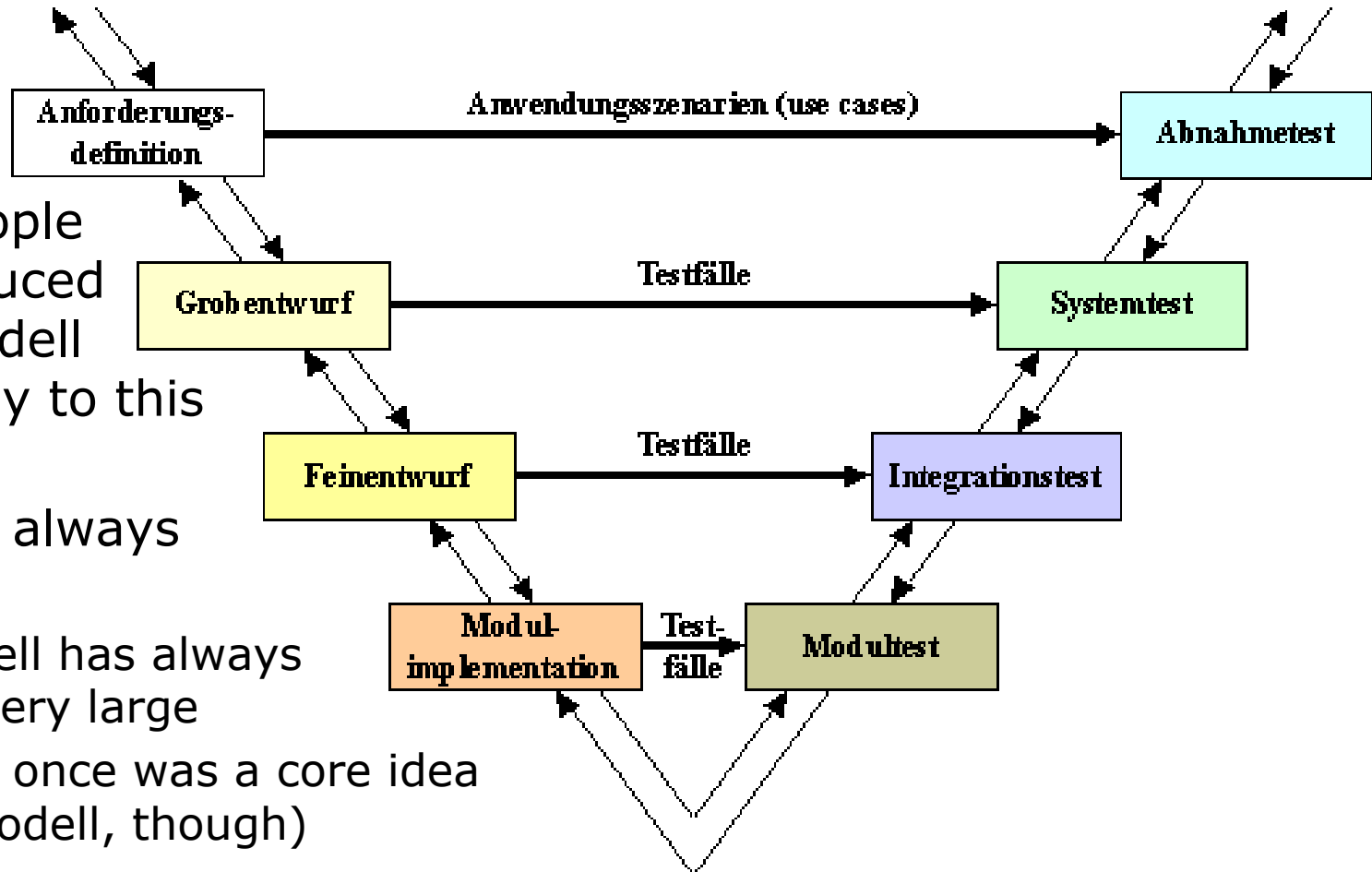
- From what you have seen so far?
- From introductory text:
 - *"[Durch die genauen Begriffe] werden Reibungsverluste zwischen Auftraggeber und Auftragnehmer durch eine gemeinsame Sprache und ein abgestimmtes Vorgehen reduziert."*
 - mostly engineering values, but recognizes people as hard-to-predict
 - *"Planungsabweichungen und Risiken werden [durch die präzisen Vorgaben] frühzeitig erkannt."*
 - positivistic optimism
 - *"Qualitätsbewusstsein von Anfang an zahlt sich mit Blick auf das gesamte Projekt bzw. den gesamten Systemlebenszyklus aus – auch monetär."*
 - Somewhat modern-ish? Holistic? Fully compatible with classic view
- Conclusion: V-Modell XT is >95% classical – but not totally blind for modern thinking

- Kuhrmann, Lange, Schnackenburg: "[A Survey on the Application of the V-Modell XT in German Government Agencies](#)", EuroSPI 2011
 - 70% report V-Modell XT use as mandatory; 25% have a process owner, 35% monitor correct use, the others tend to struggle.
 - 70% report V-Modell XT to be adequate.
 - Overall slightly better communication and slightly more effort compared to other process models.
 - As the other styles were often ad-hoc, the reliability of these estimates is unclear.
- Kuhrmann, Mendez, Steenweg: "[Systematic Software Process Development: Where Do We Stand Today?](#)", ICSSP 2013
 - Finds V-Modell XT metamodel as one of only four metamodels (along with ISO 24744, OPEN, and SPEM) and the one with the strongest support.

- Kalus, Kuhrmann: "[Criteria for Software Process Tailoring: A Systematic Review](#)", ICSSP 2013
 - Finds 49 criteria used in the literature (not just in a V-Modell XT context, also CMMI L3 etc.). 4 groups:
 - Team: e.g. size, distribution, domain/tech/process knowledge
 - Internal environment: e.g. project budget, duration, type, role
 - External env.: e.g. stakeholder properties, reqs stability
 - Objectives: e.g. complexity, domain, HW dev.?, UI issues?, neighboring systems
- Martinez-Ruiz, Münch, Garcia, Piattini: "[Requirements and constructors for tailoring software processes: a systematic literature review](#)", Software Quality Journal 2012
 - In process tailoring *research*, V-Modell XT is the most-used tailorable process model (second is RUP).

Historical note: The "V"

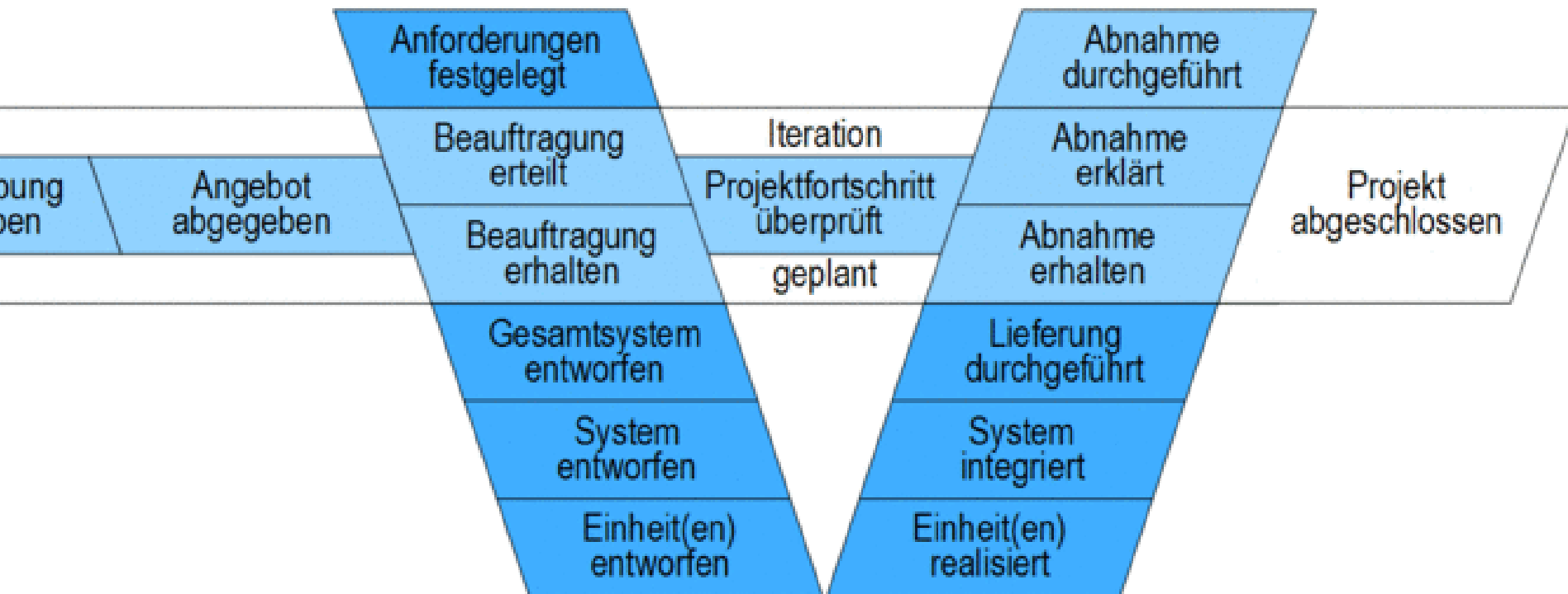
- The original V-Modell had a correspondence of development levels to test levels that was initially the reason for the name:



- Many people even reduced the V-Modell essentially to this idea
- That was always simplistic
 - V-Modell has always been very large
 - (The V once was a core idea of V-Modell, though)

Historical note: The "V" (2)

- V-Modell XT has now embedded testing in a different way
 - The original "V" of V-Modell97 is no longer part of V-Modell XT
- Only a strange remainder of the "V" is left in v2.3:
 - Entscheidungspunkte, not activities!



- V-Modell XT is a very detailed process model for system development
 - SW, HW, or both
 - covers views of developer organization and customer separately
- It has very many roles (>30) and products (>100).
- These are grouped and structured into *Vorgehensbausteine*
- Project characteristics can be used to tailor the V-Modell to a project by removing unneeded *Vorgehensbausteine*
 - Tailored versions of the V-Modell documentation and all product templates can be generated automatically
- V-Modell can be used with different *Projektdurchführungsstrategien*
 - incremental development, component-based, prototype-based development ("agile")

Expectations for the exam

- Be able to answer How/Why-questions (rationale)
 - e.g. why does V-Modell XT have so many roles? How is the V helpful?
 - and argue what is useful when
- Be able to explain how V-Modell XT is classical.
- To do that, you need to know key terms (e.g. slide 6, parts of slides 7 & 12) and ideas (e.g. slides 7, 10)
- Of the many details (e.g. lists of activities or roles) you only need to know enough examples to explain/illustrate terms, ideas, rationales, and usefulness arguments with them
- Likewise for all other topics:
 - I am interested in your understanding of ideas, purposes, pros/cons, tradeoffs, and relationships (e.g. cause-effect)
 - I am interested in only enough facts knowledge to support the above understanding, not more.

Thank you!
(Danke!)