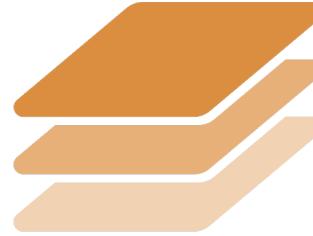


# Multimedia Didactics for Software Engineering

Ralf S. Engelschall

2023-07-31, Helmut-Balzert-Preis, Jury-Presentation



**Software  
Engineering  
Academy**

**TUM** TECHNISCHE  
UNIVERSITÄT  
MÜNCHEN

.msg



# About Author

- Dr. Ralf S. Engelschall (50)
- Science Context:
  - Computer Science Study at *TU München*
  - Computer Science Doctorate at *Uni Augsburg*
- Work Roles:
  - Director of *msg Research*
  - Director of *Software Engineering Academy*
  - Lecturer at *TU München*
- Education Activities:
  - *Software Engineering in der industriellen Praxis* (SEIP)
  - *Software Engineering Fundamentals* (SEF)
  - *Software Architecture Fundamentals* (SAF)
  - *IT-Architekten-Ausbildungsprogramm* (ITAAP)
  - *Trend Competence Program* (TCP)
  - *Container-Based Deployment* (CBD)



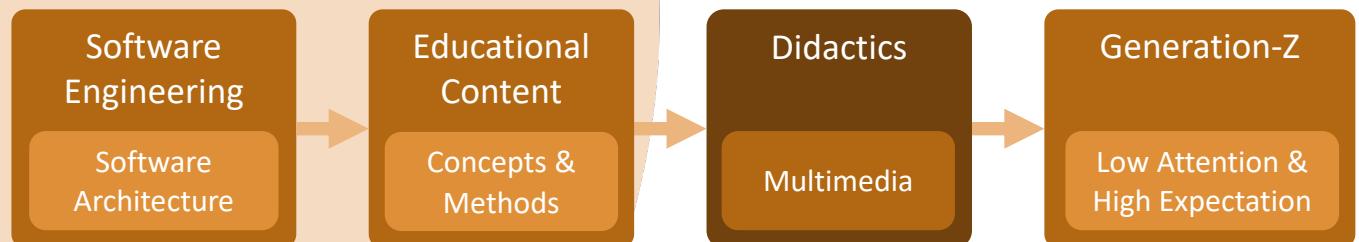
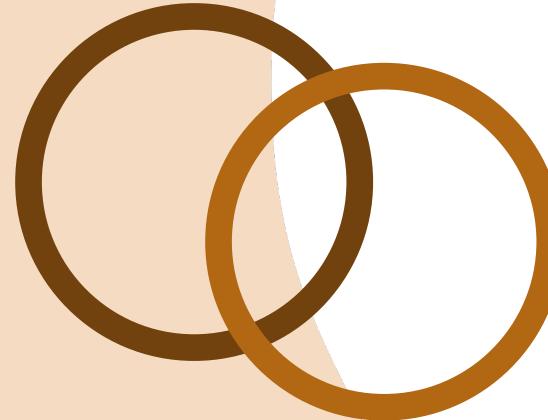
# My Education Challenges

- Different Education Contexts  
university lectures, industry trainings,  
different durations/brandings, etc
- Unsexy and Complex Topic  
non-agile upfront thinking,  
many Software Engineering disciplines, etc.
- Generation-Z Low Attention Threshold  
social acceleration, information overflow,  
strong catchyness expectation, etc.
- Post-Pandemic New Work  
online-first, home-office-driven,  
reduced traveling (sustainability), etc.



# My Education Context

- **Didactics:**  
the approaches, methods and activities of systematic teaching.
- **Multimedia:**  
the form of communication that combines different content forms (text, images, video, audio).

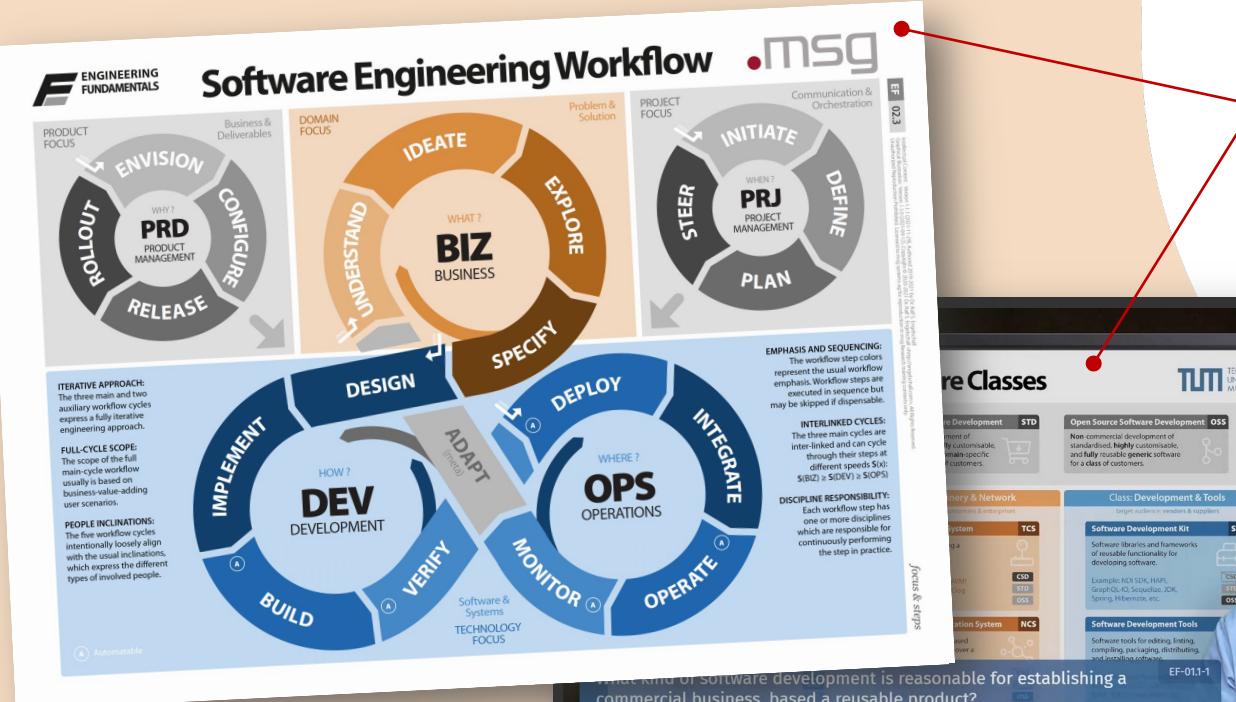


# My Education Solution

Multimedia Didactics for Software Engineering



Remember: “multimedia”, in this context, primarily refers to the educational content and its various formats (poster, handout, canvas, etc), variants (branding, annotation, etc), combinations of content (image, speech, etc) and channels (print, video, etc), and not just the use of a video-stream!



A screenshot of a video conference interface. At the top, it says "HUDS Pad" and "Status: Connected". Below that is a message box saying "Willkommen zu SEIP!". A large video window shows a man in a blue shirt sitting at a desk, smiling. In the bottom left corner, there is a poll titled "What kind of software development is reasonable for establishing a commercial business, based on a reusable product?". The options are:

- 1: Custom Software Development
- 2: Standard Software Development
- 3: Open Source Software

The results show:

- 1: Custom Software Development (14/18, 78%)
- 2: Standard Software Development (1)
- 3: Open Source Software (1)

At the bottom of the screen, there is a footer with the text "Dr. Ralf S. Engelschall TUM-SEIP 01: Software Engineering" and a participant count of "25".

A screenshot of a digital voting interface titled "HUDS Pad". It shows a poll with the following options and results:

1	2	3
4	5	6
7	8	9

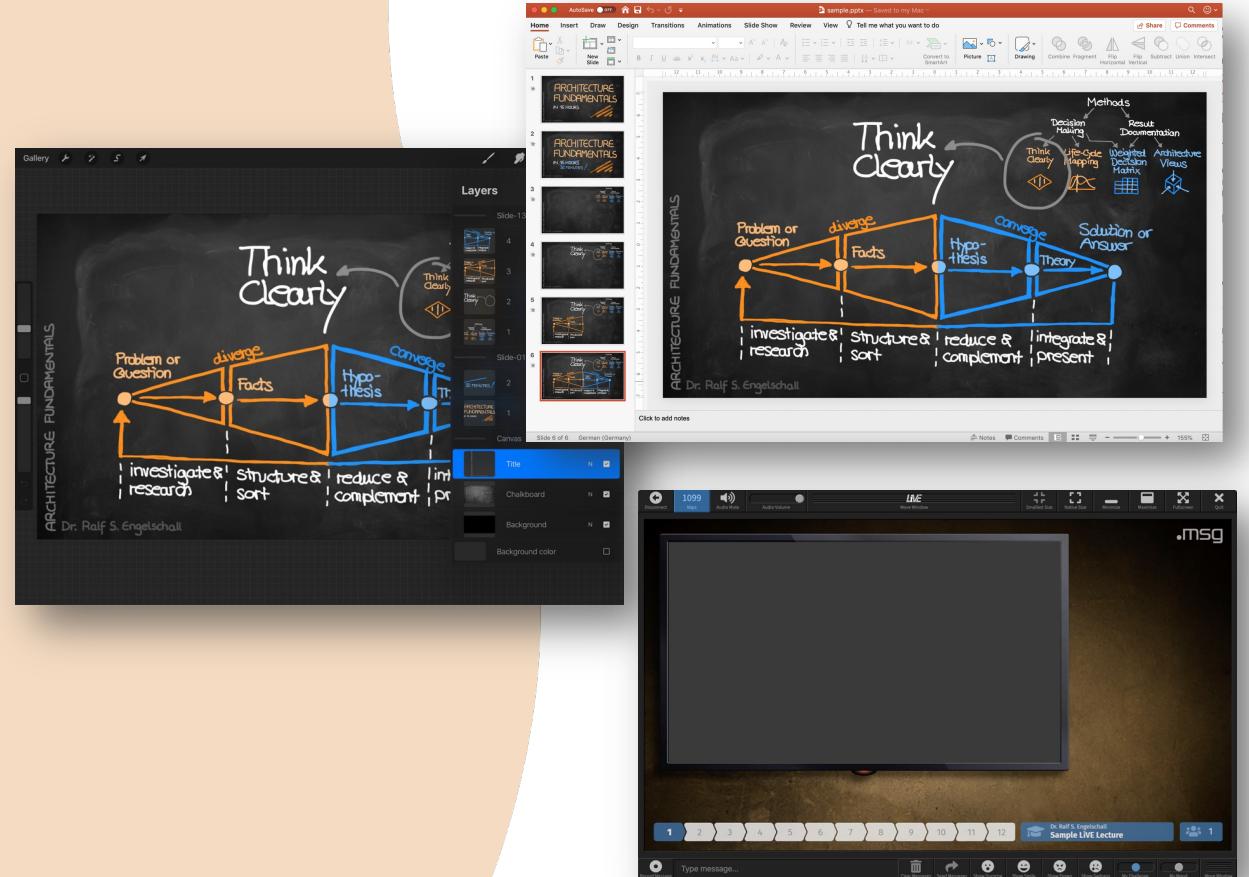
Below the numbers are buttons for "YES" (with a thumbs up icon), "NO" (with a thumbs down icon), and "Abstain" (with a circle icon). There are also buttons for "Clear" and "Send".

Underneath the poll is a "FEEDBACK" section with icons for "Consent" (handshake), "Refusal" (hand with a fist), "Surprise" (eyes wide open), "Smile" (smiling face), "Frown" (frowning face), and "Sadness" (sad face).

At the bottom, there are mood indicators: "sub" (neutral), "CHALLENGE" (challenge), "over" (neutral), "tired" (tired), "MOOD" (neutral), and "excited" (excited).

# My Didactics Journey

- ...many experiments...
- 2019: Hand-Drawn Slides  
(<https://github.com/rse/psd2pptx>)  
due to non-vector format, does not  
allow flexible content zooming and  
annotation.
- 2020: Desktop Player App  
(<https://github.com/rse/live-receiver>)  
download and executable signing  
causes too high entry barrier.
- ...and even more...



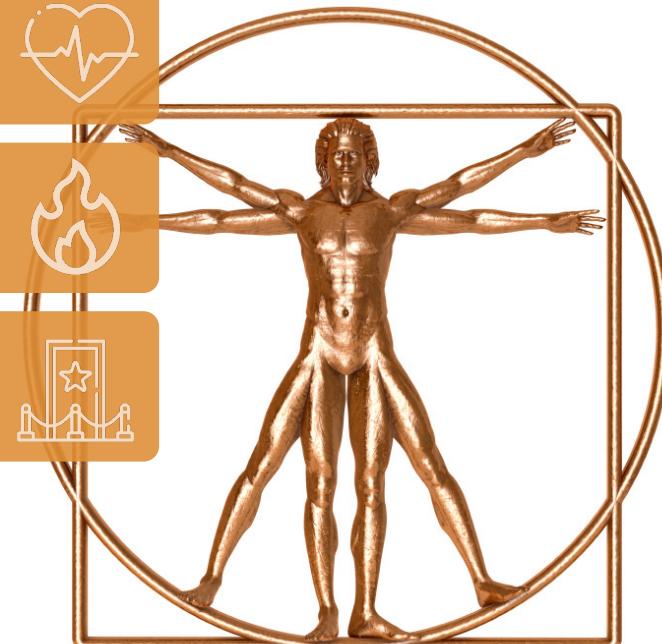
# My Education Building Blocks

12 essential building blocks for a  
really strong overall lecture experience



<b>What-Why-Where Paradigm</b> 	<b>Online-First Approach</b> 	<b>Gamification Quizzes</b> 
<b>Practice Back-Pressure</b> 	<b>Blended Studio Reality</b> 	<b>Live Attendee Feedback</b> 
<b>Diagram-Driven Education</b> 	<b>Content Zooming and Annotation</b> 	<b>Perception Amplifier</b> 
<b>Generative Lecture Content</b> 	<b>Live Questions and Answers</b> 	<b>Backstage Pass</b> 

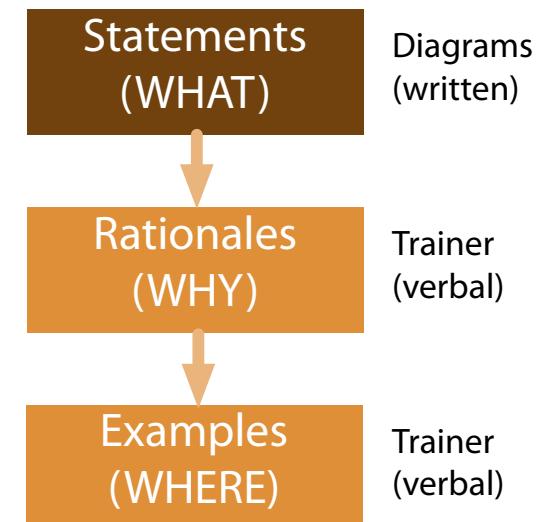
 Didactics Crux and Game Changer





- **WHAT:**  
show the *What* on written material,  
vocally explain the *Why*,  
vocally tell about the practical *Where*.
- **WHY (DIDACTICS):**  
the *What* has to be remembered,  
the *Why* is the key for acceptance,  
the *Where* is the example to understand it.
- **WHY (OTHER):**  
students still need both the content  
(written) and lecturer (vocally), so  
still attend the lecture.

Didactics Crux!

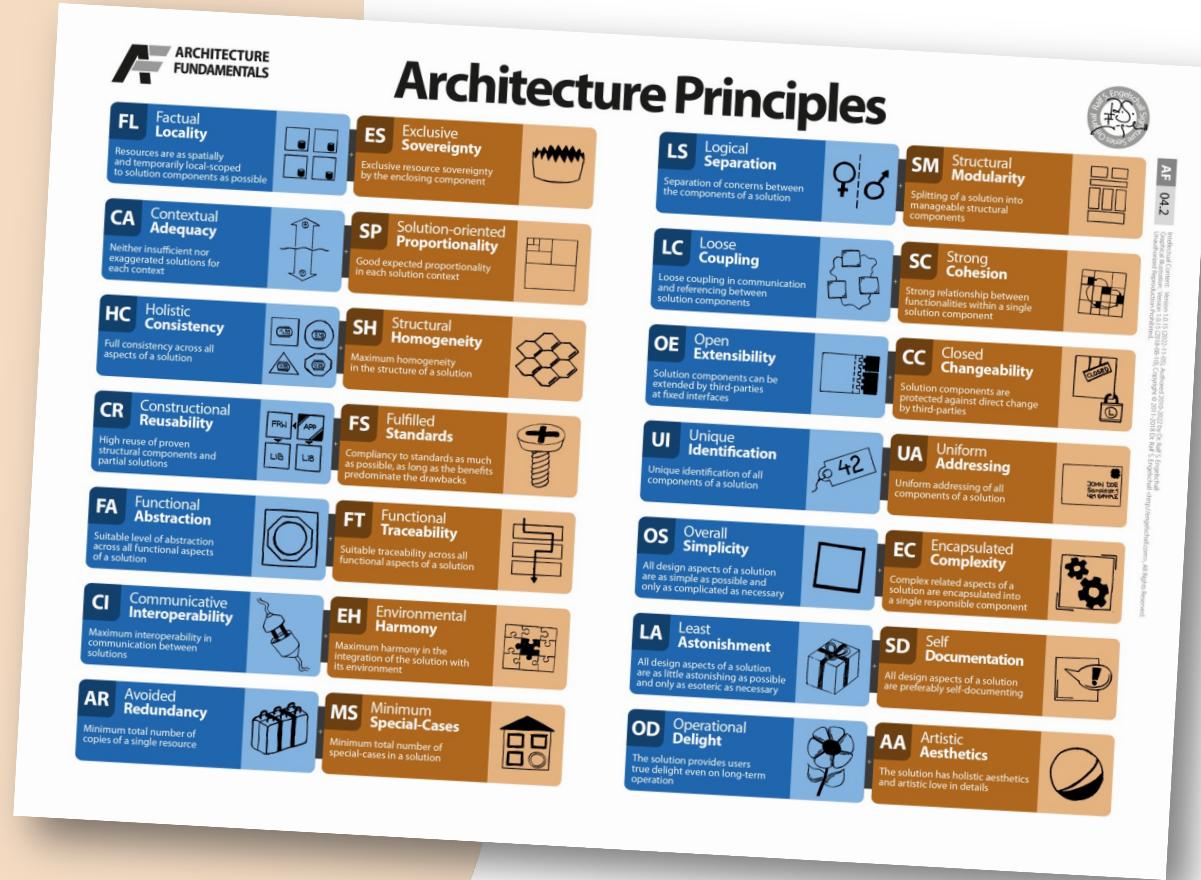


## Practice Back-Pressure



Building Block 2/12

- **WHAT:**  
provide *What* artifacts for practice,  
use them 1:1 also for education,  
minimize education-only artifacts.
- **WHY (DIDACTICS):**  
avoid mental gaps between  
education and subsequent  
practice, and practice relevance  
always convinces.
- **WHY (OTHER):**  
*(none)*



## Diagram-Driven Education

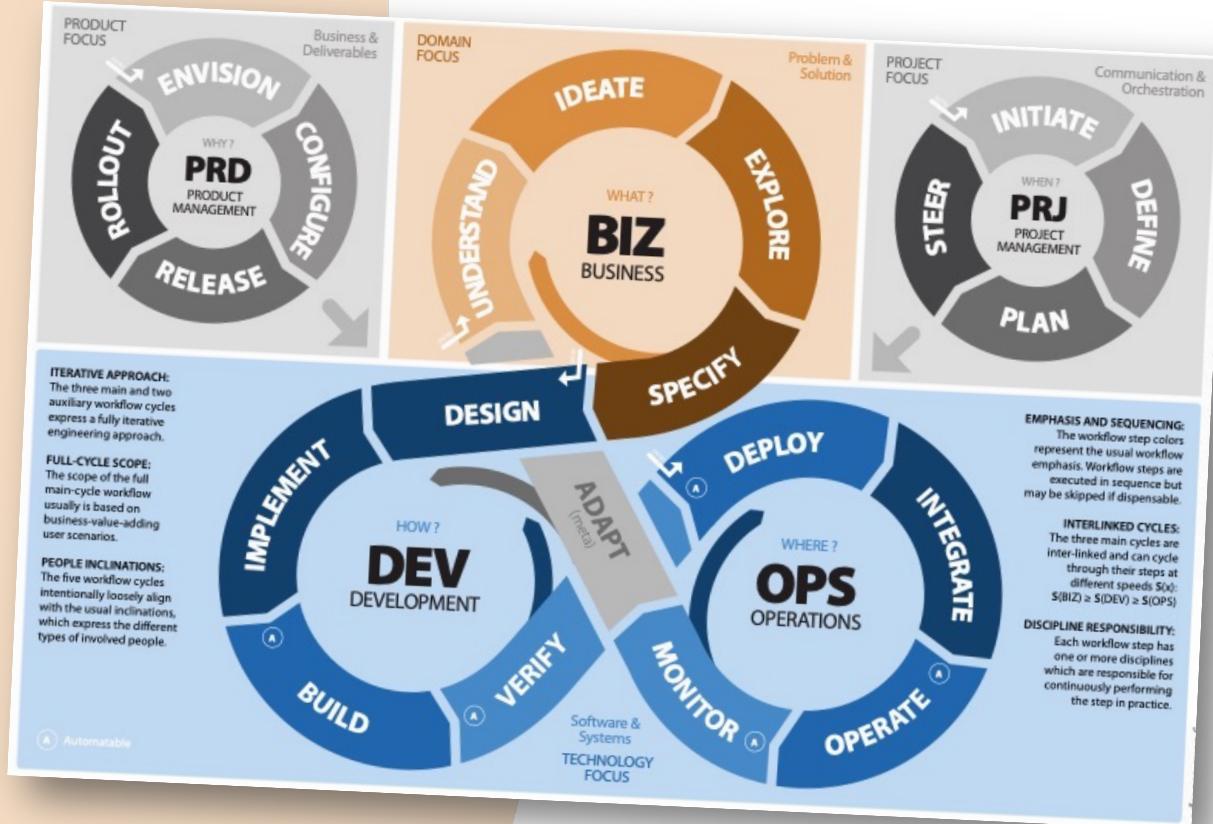


Building Block 3/12



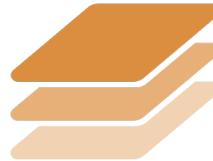
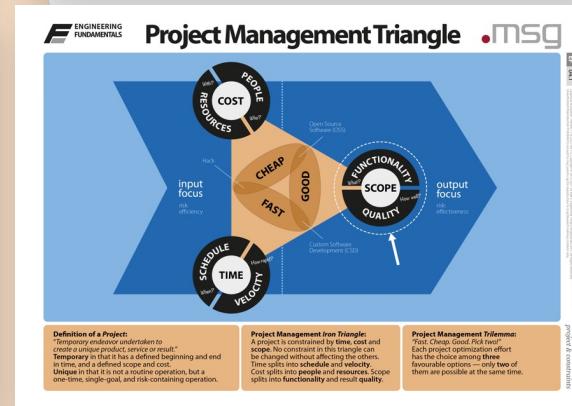
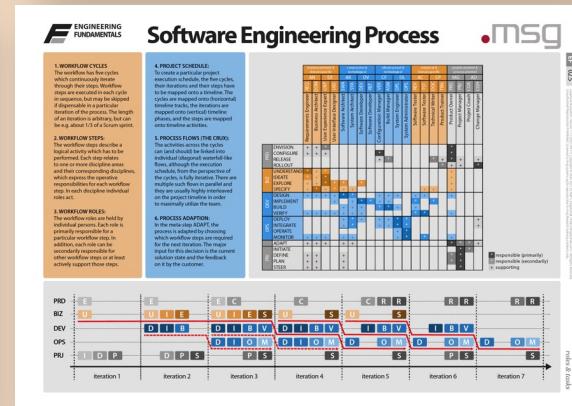
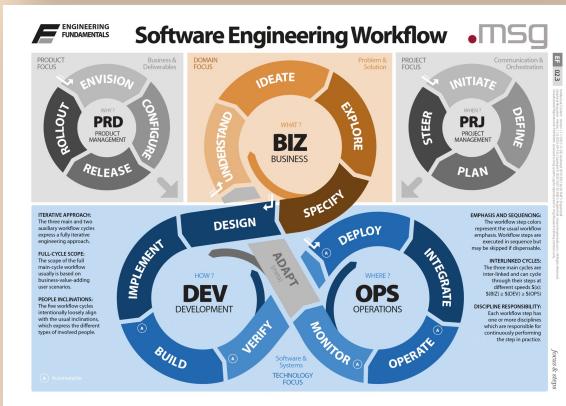
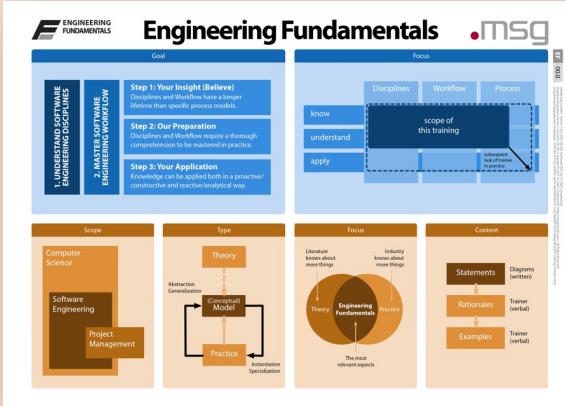
- **WHAT:** describe complex aspects, concepts or methods through visual models on dedicated diagrams.
- **WHY (DIDACTICS):** precision through abstraction and conciseness, and easier comprehension of reality.
- **WHY (OTHER):** visuality, recognition, catchyness.

Didactics Crux!



# Diagram-Driven Education

## Building Block 3/12



# Software Engineering Academy



- **WHAT:**  
select arbitrary combination of diagrams, overlay with logo and hints (duration, quiz markers), and generate multiple artifacts (agenda, content, handout, etc).
  - **WHY (DIDACTICS):**  
different content orders,  
different target groups.
  - **WHY (OTHER):**  
different artifacts,  
different lecture times,  
different lecture formats.

	A	B	K	M	N	O	P	AF	AO	AP	AQ	AR	AS	AT	AU	AV	AW
1			msg-gdita		msg-itaa-p-m1	msg-itaa-p-m2		msg-sef		tum-seip-01	tum-seip-02	tum-seip-03	tum-seip-04	tum-seip-05	tum-seip-06	tum-seip-07	tum-seip-08
2			msg		msg	msg		msg		tum							
3			16		16	8,00		8,00		SE	SE	AR	AR	AR	AR	SCM	PM
4	SOLL		960		960	480		480		180	180	180	180	180	180	180	180
5	IST		955		960	480		480		180	180	180	180	180	180	180	180
19	ENGINEERING FUNDAMENTALS																
20	EF-01.1 Software Classes									25	25						
21	EF-01.2 Software Development Approaches									30	25						
22	EF-01.3 Software Engineering									15	15						
23	EF-01.4 TRUE Manifesto									15	20						
24	EF-01.5 Sustainability									10							
25	EF-02.1 Software Engineering Meta-Model									25	25						
26	EF-02.2 Software Engineering Disciplines	1		5				30			40						
27	EF-02.3 Software Engineering Workflow	1		5				35			25						
28	EF-02.4 Software Engineering Steps									5		5					
29	EF-02.5 Software Engineering Process							30			30		30				
30	EF-02.6 Software Engineering Artifacts							30			30		30				
31	EF-03.1 Software Engineering Efforts									15		15					
32	EF-03.2 Software Engineering Uncertainty									10		15					
33	EF-03.3 Software Engineering Estimation							15									15
34	EF-04.1 Project Management Triangle							10									30
35	EF-04.2 Project Management Building Blocks							25									20
36	EF-04.3 Project Management Plan-Driven																20
37	EF-04.4 Project Management Agile																
38	CONTEXT & ENTITLEMENT																
39	AF-01.1 Architecture Stargate		15		20								30				
40	AF-01.2 Adequacy and Beauty		10		10								10				
41	AF-01.3 King Discipline Architecture		3		5								10				
42	AF-01.4 Architecture Manifesto		10		10								10				
43	AF-01.5 Complex vs. Complicated		5		5								5				
44	SPACE & ONTOLOGY																
45	AF-02.1 Architecture Space		20		20								20				
46	AF-02.2 Architecture Ontology		20		20								20				

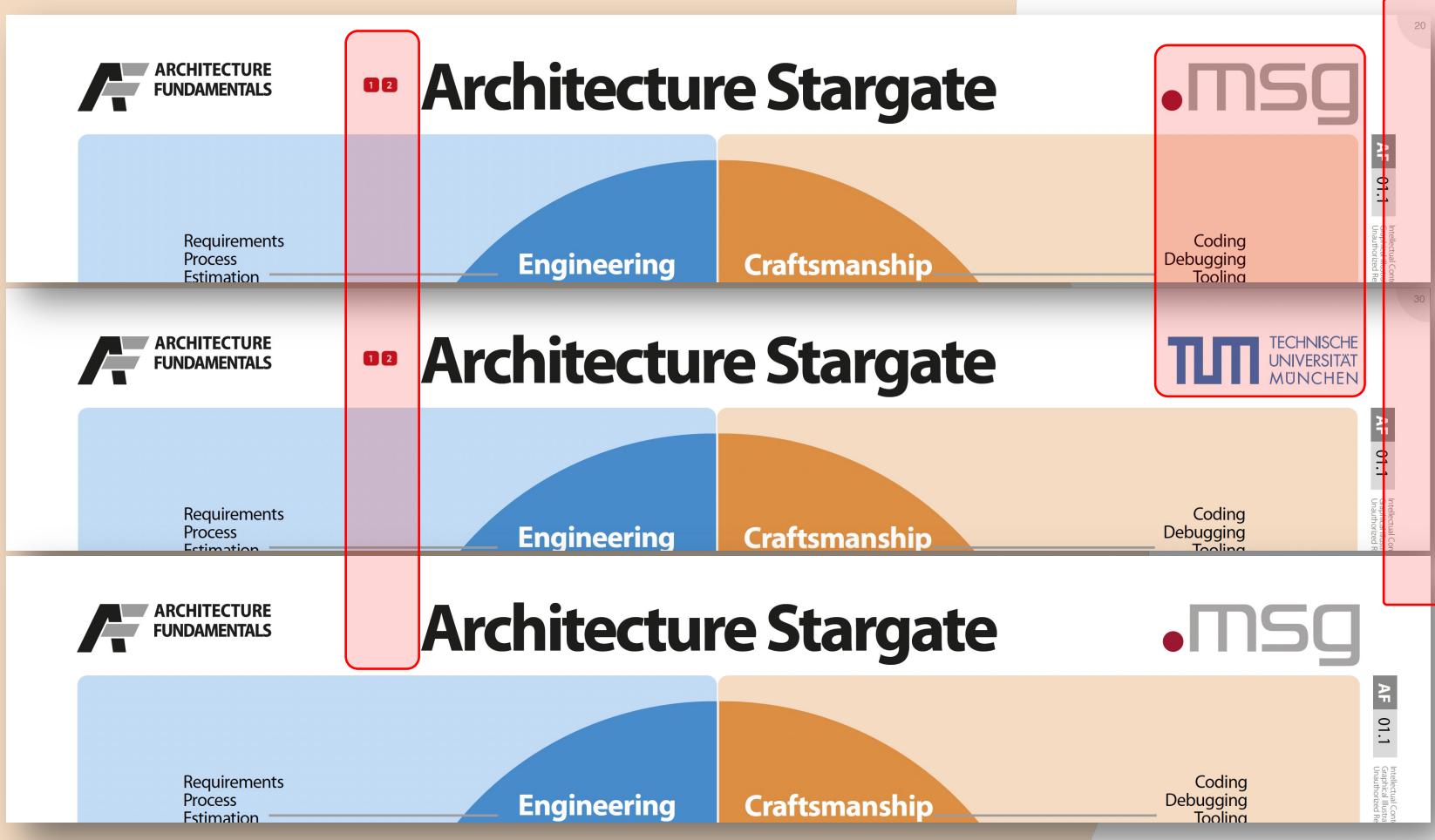


### TUM WS22/23, SEIP Modul 03 (2022-11-03)

Begin	End	Duration	Topic
14:00	14:30	00:30	AF-01.1 Architecture Stargate
14:30	14:40	00:10	AF-01.2 Adequacy and Beauty
14:40	14:50	00:10	AF-01.3 King Discipline Architecture
14:50	15:00	00:10	AF-01.4 Architecture Manifesto
15:00	15:05	00:05	AF-01.5 Complex vs. Complicated
15:05	15:25	00:20	AF-02.1 Architecture Space
15:25	15:40	00:15	Break
15:40	16:00	00:20	AF-02.2 Architecture Ontology
16:00	17:00	01:00	AF-04.1 Architecture Maxims

Begin	End	Duration	Topic
09:00	09:20	00:20	Introduction Round
09:20	09:30	00:10	AF-00.0 Architecture Fundamentals
09:30	09:35	00:05	EF-02.2 Software Engineering Disciplines
09:35	09:40	00:05	EF-02.3 Software Engineering Workflow
09:40	10:00	00:20	AF-01.1 Architecture Stargate
10:00	10:10	00:10	AF-01.2 Adequacy and Beauty
10:10	10:15	00:05	AF-01.3 King Discipline Architecture
10:15	10:25	00:10	AF-01.4 Architecture Manifesto
10:25	10:30	00:05	AF-01.5 Complex vs. Complicated
10:30	10:40	00:10	Break
10:40	11:00	00:20	AF-02.1 Architecture Space
11:00	11:20	00:20	AF-02.2 Architecture Ontology
11:20	11:25	00:05	AF-03.1 Requirements Basics
11:25	12:10	00:45	AF-04.1 Architecture Maxims
12:10	12:55	00:45	Lunch
12:55	13:55	01:00	AF-04.2 Architecture Principles
13:55	14:25	00:30	AF-05.1 Component Design
14:25	14:35	00:10	Break
14:35	15:25	00:50	AF-05.2 Interface Design
15:25	15:40	00:15	AF-05.3 Component Hierarchy
15:40	15:50	00:10	Break
15:50	16:10	00:20	AF-06.2 Layer Architecture
16:10	16:20	00:10	Break
16:20	16:40	00:20	AF-06.3 Slice Architectures
16:40	16:55	00:15	AF-07.1 Flow Architectures
16:55	17:10	00:15	AF-07.2 Process Architectures

### ITAAP Modul 1



# Generative Lecture Content



## Building Block 4/12

### # Zusammenfassung

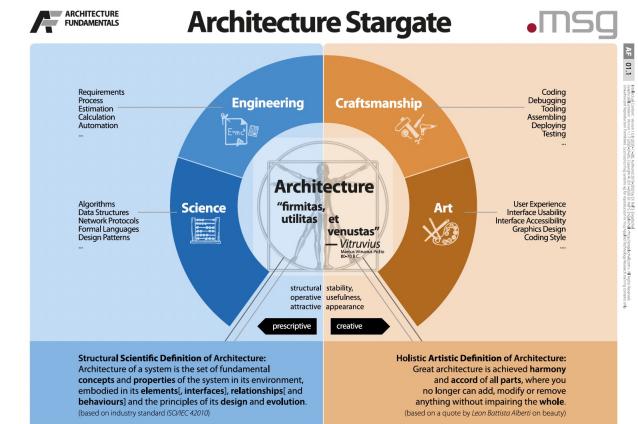
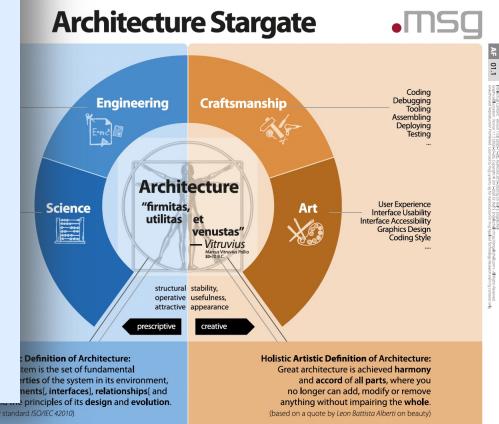
\*Architektur\* ist nicht einfach zu definieren. Man kann Architektur sowohl **strukturell wissenschaftlich** über messbare Elemente (elements), Schnittstellen (interfaces) und Beziehungen (relationships), als auch **ganzheitlich künstlerisch** über "die Harmonie und den Einklang aller Teile" definieren. Die "Wahrheit" liegt in der Praxis irgendwo dazwischen, denn die beiden Extrema spannen einen breiten Raum auf, in dem alle Lösungen in der Praxis liegen.

Auf der strukturell wissenschaftlichen Seite definiert sich Architektur über die Aspekte **Science** (insbesondere Computer Science) und **Engineering** (insbesondere Software Engineering). Auf der ganzheitlich künstlerischen Seite definiert sich Architektur über die Aspekte **Craftsmanship** (Handwerk, insbesondere Programmieren) und **Art** (Kunst, insbesondere User Experience).

### # Summary

\*Architecture\* is not easy to define. You can define architecture both **structurally scientific** through measurable elements, interfaces and relationships, or also **wholly artistic** through "the harmony and the accord of all parts." The "truth" lies somewhere in practice in between, because the two extremes span a broad space, in which all solutions are located in practice.

On the structurally scientific side, architecture defines itself through the aspects **Science** (in particular Computer Science) and **Engineering** (especially Software Engineering). On the holistic artistic side, architecture defines itself through the aspects of **Craftsmanship** (especially programming) and **Art** (especially User Experience).



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Architecture is not easy to define. You can define architecture both **structurally scientific** through measurable elements, interfaces and relationships, or also **wholly artistic** through "the harmony and the accord of all parts." The "truth" lies somewhere in practice in between, because the two extremes span a broad space, in which all solutions are located in practice.

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# Online-First Approach



## Building Block 5/12

- **WHAT:**  
design lecture setup primarily for online performance, use reduced setup for on-site performance.
  - **WHY (DIDACTICS):**  
*Generation-Z expectations (YouTube/TikTok-style consumption), post-pandemic New Work era, fresher attendees.*
  - **WHY (OTHER):**  
*(none)*



# Software Engineering Academy

**TUM Lehrveranstaltung**

**SOFTWARE ENGINEERING IN DER INDUSTRIELLEN PRAXIS (SEIP)**

(IN2235) im WS22/23, in Kooperation von

**TUM TECHNISCHE UNIVERSITÄT MÜNCHEN**

Prof. Dr. Florian Matthes  
sebis Lehrstuhl, TUM  
(Verantwortung, Organisation, Klausur)

Dr. Ralf S. Engelschall  
SEA Software Engineering Academy gGmbH  
(Lehrauftrag, Materialien, Infrastruktur)

Dr. Ralf S. Engelschall  
msg Research, msg systems ag  
(Lehrauftrag, Kontext, Erfahrungen)

**Software Classes**

Category	Class	Code	Description
Open Business & Data	Customer Software Development	CS0	Software for individual customers, new contracts or fully redeveloped software for reuse in different environments.
	Office Productivity Application	OP0	Software for productivity in office environment.
	Business Information Systems	BS0	Software for business information systems.
Classical Machinery & Network	Standard Software Development	SD0	Software for control of programmable logic controllers (PLCs).
	Technical Control System	TC0	Software for control of programmable logic controllers (PLCs).
	Network Communication System	NCS0	Software for protocol based communication between distributed systems.
Open Development & Tools	Open Source Software Development	OSS0	Software for open source development, highly compatible with other open source software for reuse in different environments.
	Software Development Kit	SDK0	Software for reuse and compatibility of existing software components.
	Software Development Tools	EDT0	Software for tooling for building, testing, and maintaining software products.

What kind of software development is reasonable for establishing a commercial business, based a reusable product?

1: Custom Software Development	1	1
2: Standard Software Development	14/18 (78%)	14
3: Open Source Software	1	1

Dr. Ralf S. Engelschall TUM-SEIP 01: Software Engineering 29

**IHRE LEHRVERANSTALTUNG**

In dieser Lehrveranstaltung lernen Sie alle in der industriellen Praxis relevanten Konzepte und Methoden des **Software Engineering** und dessen "Königsdisziplin" **Software Architecture** kennen – aus der spezifischen Perspektive der Software-Industrie. Die Lehrveranstaltung besteht aus einer Vorlesung mit 10 Modulen und jeweils 3 Stunden, komprimiert auf nur 5 Wochen in 2022/Q4 des WS22/23. Zusätzlich werden Sprechstunden angeboten.

**IHRE TEILNAHME**

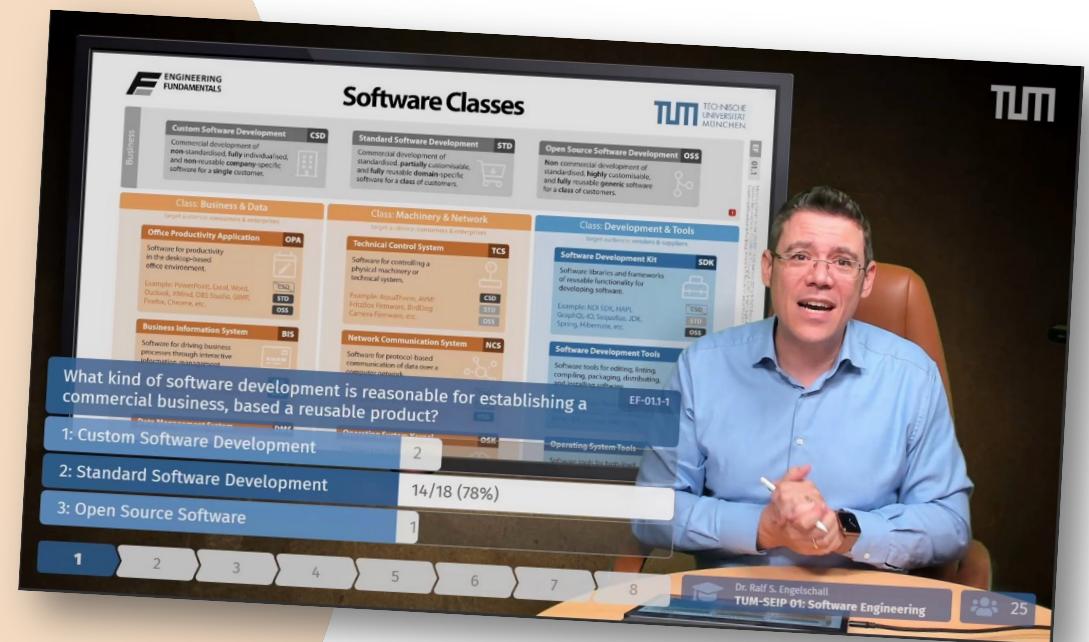
Die Lehrveranstaltung findet, bis auf die Abschlußklausur, ausschließlich online statt. Dabei kommen zwei unterschiedliche Arten der Kommunikation zum Einsatz, welche jede bewußt einen anderen Aspekt der Lehrveranstaltung optimiert.

Einerseits kommen für die **Vorlesung** hochauflösende 1080p30 Video-Streams für die Kombination von Dozent, Inhalten und einem Head-Up-



- **WHAT:**  
produce lecture in studio environment, with real-time video mixing. Blend content on tablet, lecturer at table, *Head-Up-Display (HUD)* and special effects. Use unified colouring theme.
- **WHY (DIDACTICS):**  
acceptance through consistency and seamless blending.
- **WHY (OTHER):**  
*Generation-Z* expectations (video-streaming style), overall user-experience.

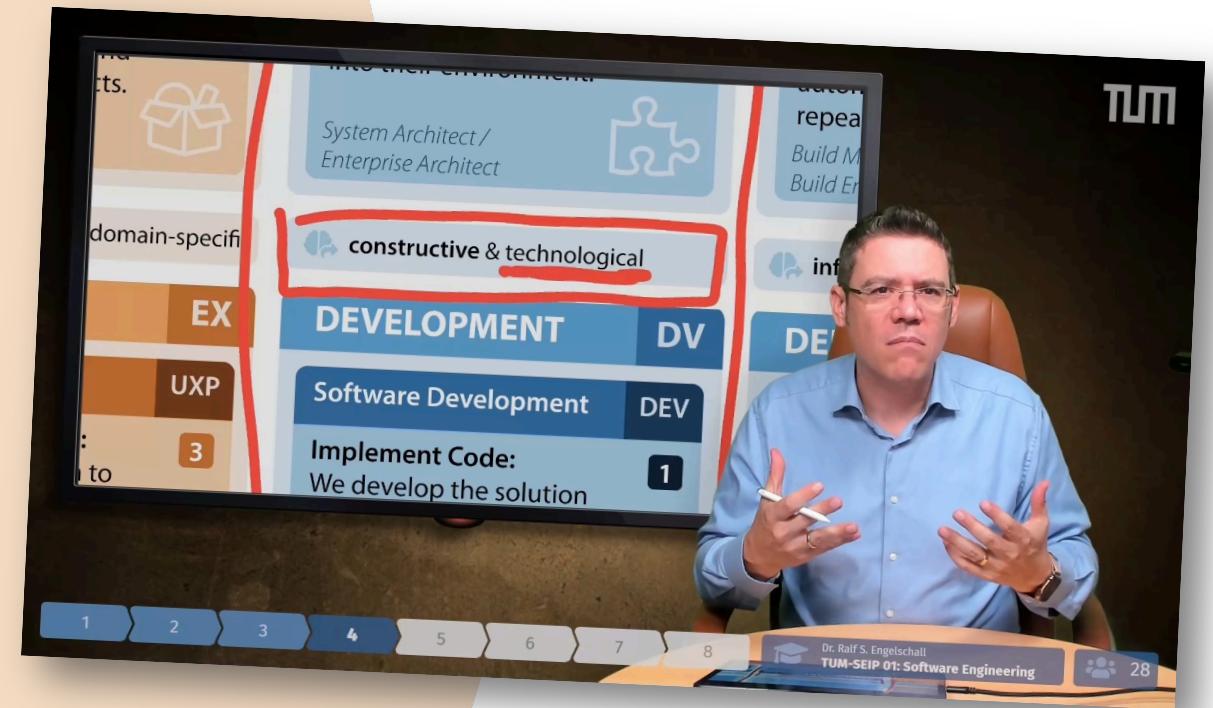
Didactics Crux!





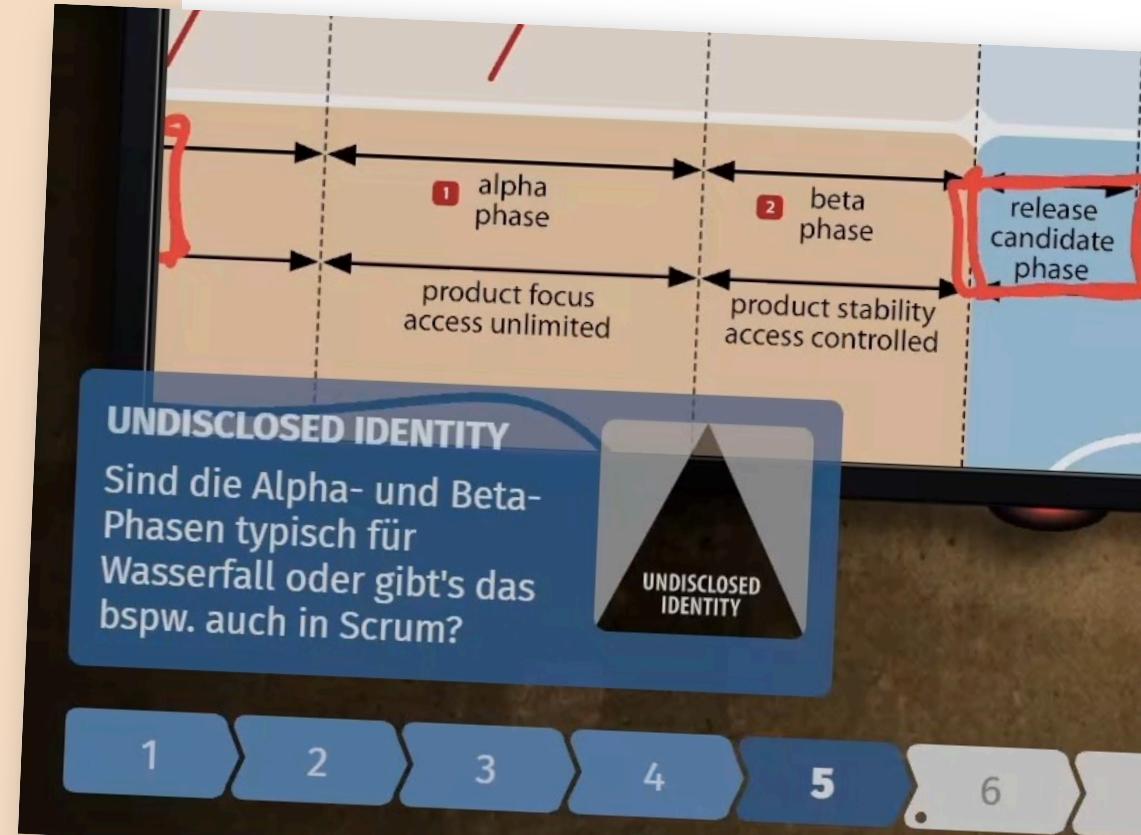
- **WHAT:**  
stay at and focus on single diagram for at least 15-20 minutes in total. Zoom around in diagram and on-the-fly annotate it.
- **WHY (DIDACTICS):**  
strong content focus during lecture, easily adjust “depth of lecturing”.
- **WHY (OTHER):**  
*Anti-Death-By-PowerPoint.*

Didactics Crux!





- **WHAT:**  
allow students to (optionally anonymously) raise questions and statements at any time, work them off sequentially.
- **WHY (DIDACTICS):**  
direct student involvement, no direct lecturer interruption, stronger questions & answers focus, less misunderstandings.
- **WHY (OTHER):**  
*YouTube/Twitch-style* chat communication of *Generation-Z*.





- **WHAT:**  
raise (potentially “beyond one’s own nose”) questions about every 10-15 minutes, let students vote anonymously and in real-time.
- **WHY (DIDACTICS):**  
continuous student involvement, loosening up lecture, competition fun.
- **WHY (OTHER):**  
*(none)*

Didactics Crux!

The screen displays a timeline of software development phases: alpha phase, beta phase, release candidate phase, and release phase. It also shows a feature development merging process. Below the timeline, a poll asks: "What primarily characterizes the ALPHA phase during product development?" The results are as follows:

Option	Count	Percentage
1: completing feature set	5	22 (22%)
2: gathering feature feedback	9	41% (highlighted in orange)
3: stabilizing functionality	5	22%
4: final release polishing	1	5%
5: bugfixing	3	14%

Dr. Ralf S. Engelschall  
TUM-SEIP 04: SCM & DevOps  
25

# Gamification Quizzes



Building Block 9/12

Software  
Engineering  
Academy

What primarily characterizes the ALPHA phase during product development?

- 1: completing feature set
- 2: gathering feature feedback
- 3: stabilizing functionality
- 4: final release polishing
- 5: bugfixing

(total)

Please choose with a numeric vote now by selecting one of the choices 1, 2, ...

1 2 3 4 5 6 7 8 9 10

Dr. Ralf S. Engelschall TUM-SEIP 04: SCM & DevOps 25

What primarily characterizes the ALPHA phase during product development?

- 1: completing feature set
- 2: gathering feature feedback
- 3: stabilizing functionality
- 4: final release polishing
- 5: bugfixing

(total) 16

Please choose with a numeric vote now by selecting one of the choices 1, 2, ...

1 2 3 4 5 6 7 8 9 10

Dr. Ralf S. Engelschall TUM-SEIP 04: SCM & DevOps 25

What primarily characterizes the ALPHA phase during product development?

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(total) 22 (41%)

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Dr. Ralf S. Engelschall TUM-SEIP 04: SCM & DevOps 25

What primarily characterizes the ALPHA phase during product development?

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- 5: bugfixing

(total) 22 (41%)

1 2 3 4 5 6 7 8 9 10

Dr. Ralf S. Engelschall TUM-SEIP 04: SCM & DevOps 25



- **WHAT:**  
allow students to continuously share their emotions (via *Emojis*), content-wise challenge and personal mood.
- **WHY (DIDACTICS):**  
real-time student feedback, lecturer speed/depth adjustment, inter-student sympathy.
- **WHY (OTHER):**  
annotation of lecture, perception of even “remote controlling” the lecture.

The image shows a lecturer, Dr. Ralf S. Engelschall, during a Software Engineering Fundamentals lecture. A digital overlay is displayed at the bottom of the screen, showing two bar charts: 'Your Challenges' and 'Your Moods'. Below the charts, there are two thumbs-up icons. The 'Your Challenges' chart has values [0, 1, 8, 0, 0] and the 'Your Moods' chart has values [0, 1, 3, 3, 2]. The lecturer is gesturing with his right hand. To the right of the lecturer is a digital interface titled 'HUDS Pad' which includes a message box saying 'Willkommen zu SEIP!', a voting grid, and a feedback section with emoji buttons for Consent, Refusal, Surprise, Smile, Frown, and Sadness. A red arrow points from the 'FEELING' section of the HUDS Pad interface towards the lecturer's hand.

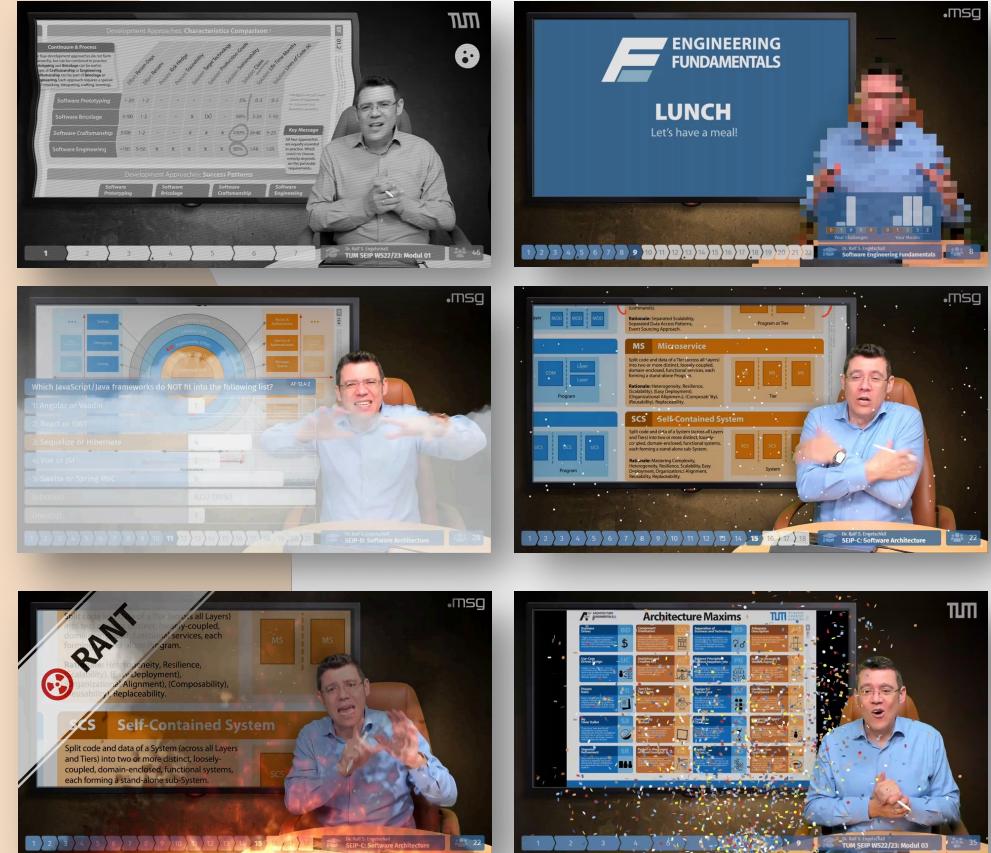
VOTE (temporarily disabled until new voting starts)		
1	2	3
4	5	6
7	8	9
YES	NO	Abstain

FEEDBACK		
Consent	Refusal	Surprise
Smile	Frown	Sadness

FEELING		
	CHALLENGE	over
tired		excited



- **WHAT:**  
use of curtains, banners, pause clock, and a set of overlayed special effects.
- **WHY (DIDACTICS):**  
draw extra attention,  
amplify content perception.
- **WHY (OTHER):**  
*(none)*

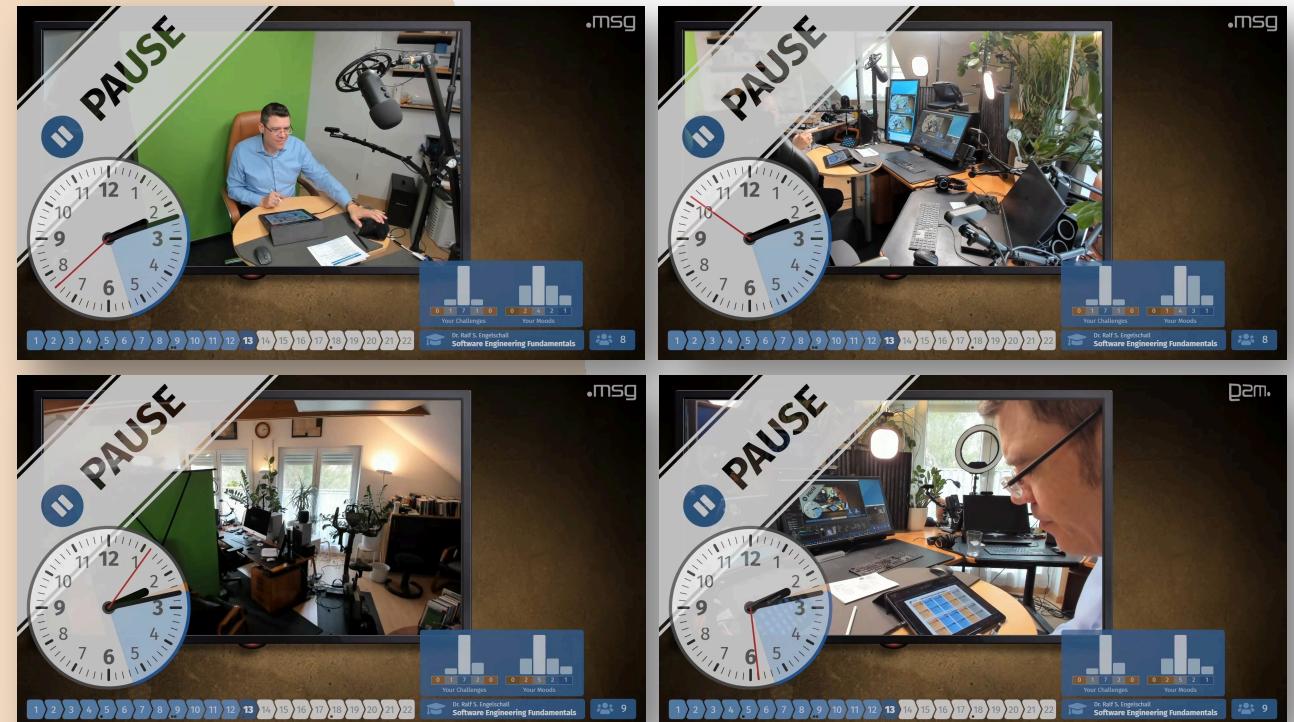


## Backstage Pass



Building Block 12/12

- **WHAT:**  
during breaks, lecturer gives students live backstage view and explanation of lecture production.
- **WHY (DIDACTICS):**  
inspiration and motivation for own presentations.
- **WHY (OTHER):**  
proof of media competence, also in *Generation-X*.



# My Education Status Quo

Some proving excerpts (in german)  
from official lecture evaluations:

[...]die Balance aus informativ und unterhaltsam, eigentlich die gesamte Vorlesung ist überragend.

– TUM, SEIP, WS 22/23

Die Professionalität [...] übersteigt alles was ich bisher in meiner Studentenlaufbahn erleben durfte.

– TUM, SEIP, WS 22/23

Definitiv die beste Vorlesung, die ich je besucht habe!

– TUM, SEIP, WS 22/23

Eine tolles Maß an “Gamification”

– TUM, SEIP, WS 20/21

[...] eine der didaktisch besten Lehrveranstaltungen, die ich JEMALS besucht habe.

– TUM, SEIP, WS 20/21

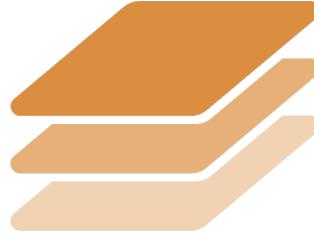
Die Vorlesung ist bei weitem die aufwändigste und beste, die ich je an der TUM [...] gesehen habe.

– TUM, SEIP, WS 22/23

Die Medien und das Setup sind unfassbar gut!

– TUM, SEIP, WS 21/22





**Software  
Engineering  
Academy**



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*Thanks for  
your attention!*