Virtuelle Inbetriebnahme von cyber-physischen Produktionssystemen

am Lehrstuhl für Konstruktionstechnik (Prof. Dr.-Ing. M. Vielhaber)

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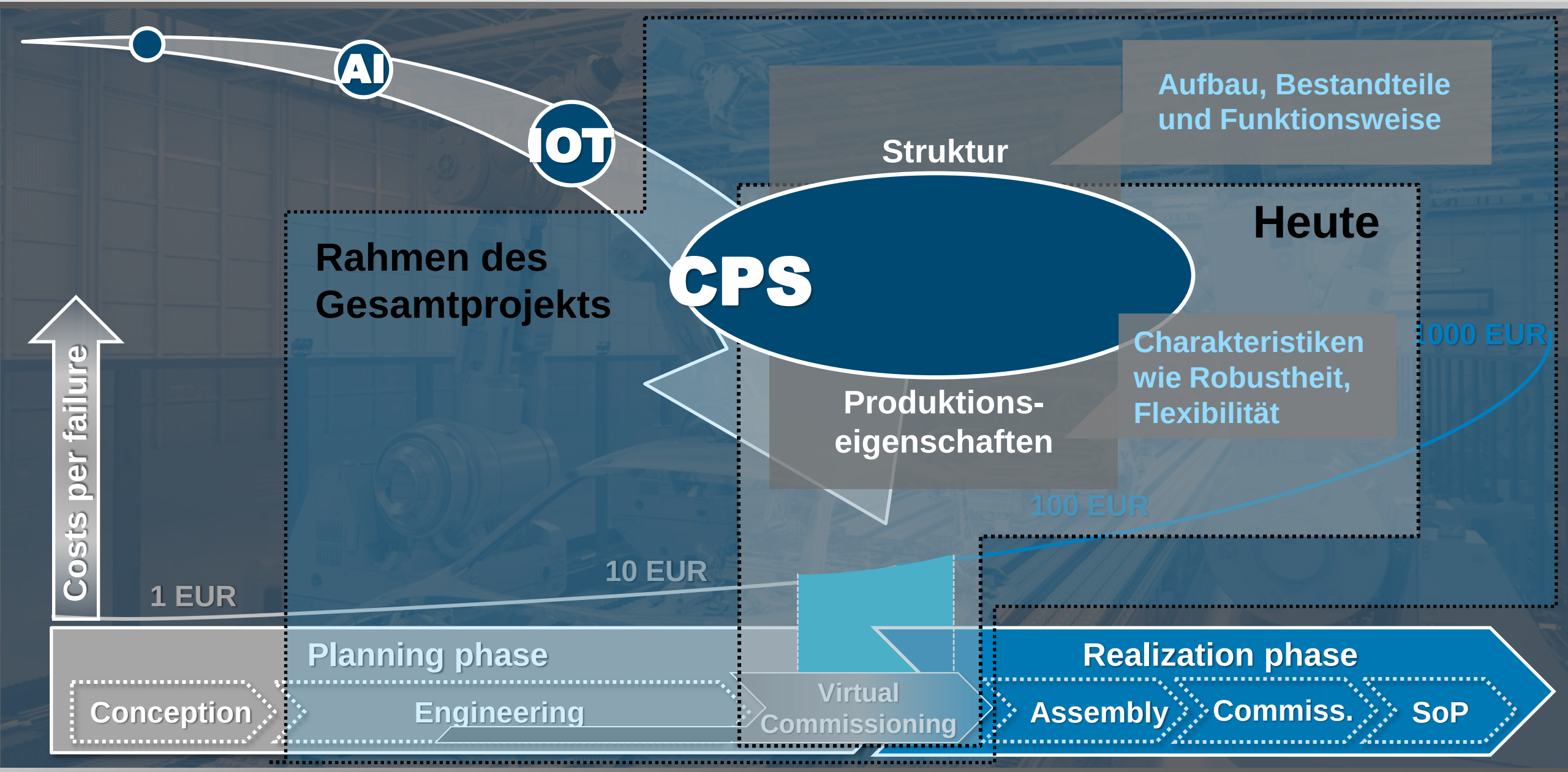
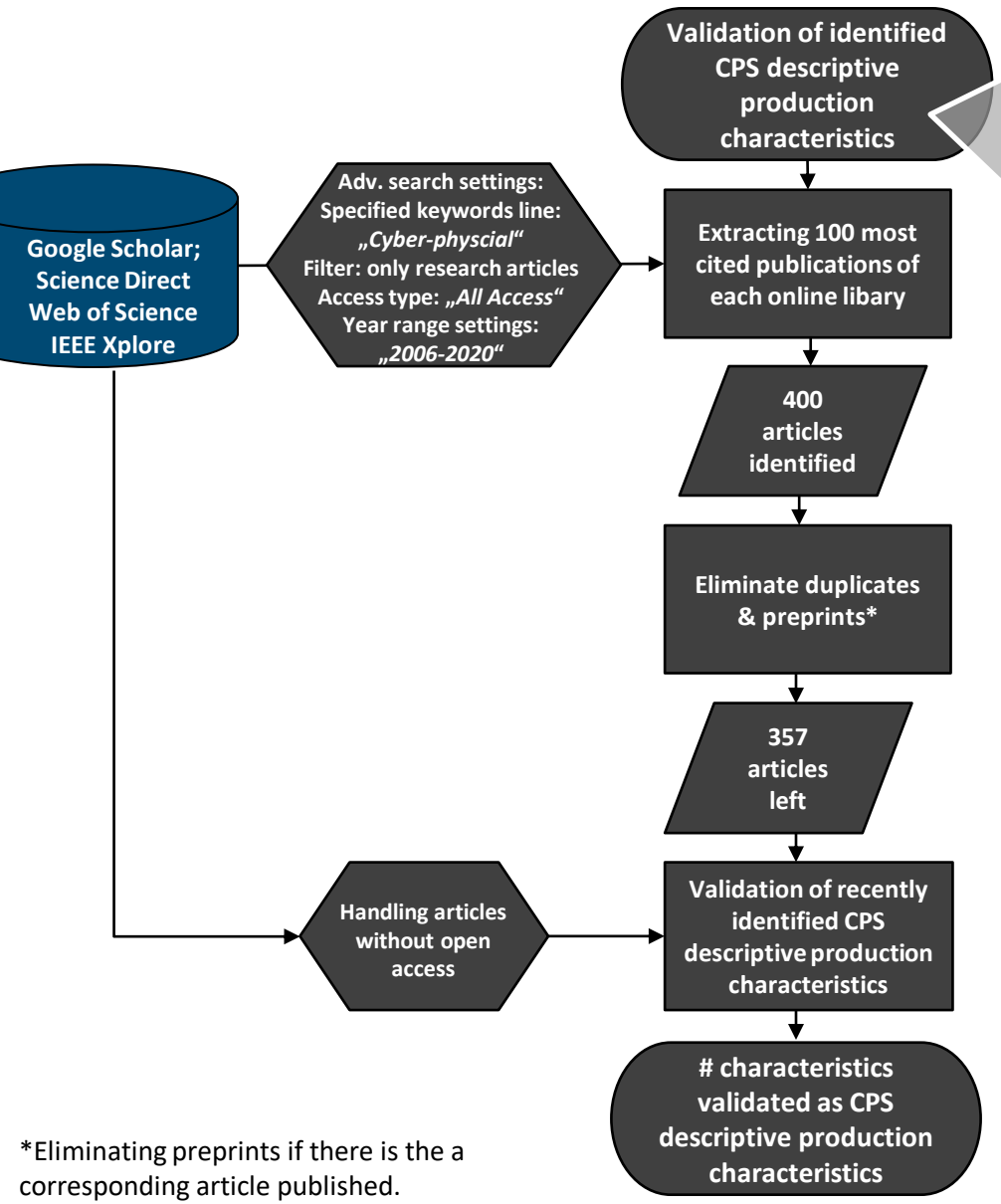
Agenda


01
EINFÜHRUNG
02
FORSCHUNGS-
FRAGEN
03
VORGEHEN &
ANSÄTZE
04
AUSBLICK


AI
IOT
CPS
Struktur
Aufbau, Bestandteile und Funktionsweise
Heute
Rahmen des Gesamtprojekts
Produktions-eigenschaften
Charakteristiken wie Robustheit, Flexibilität
Costs per failure
1 EUR
10 EUR
100 EUR
1000 EUR
Planning phase
Conception
Engineering
Virtual Commissioning
Realization phase
Assembly
Commiss.
SoP

3 Ansatz zur Lösung der Forschungsfrage RQ2 – Ein Rückblick



*Eliminating preprints if there is the a corresponding article published.

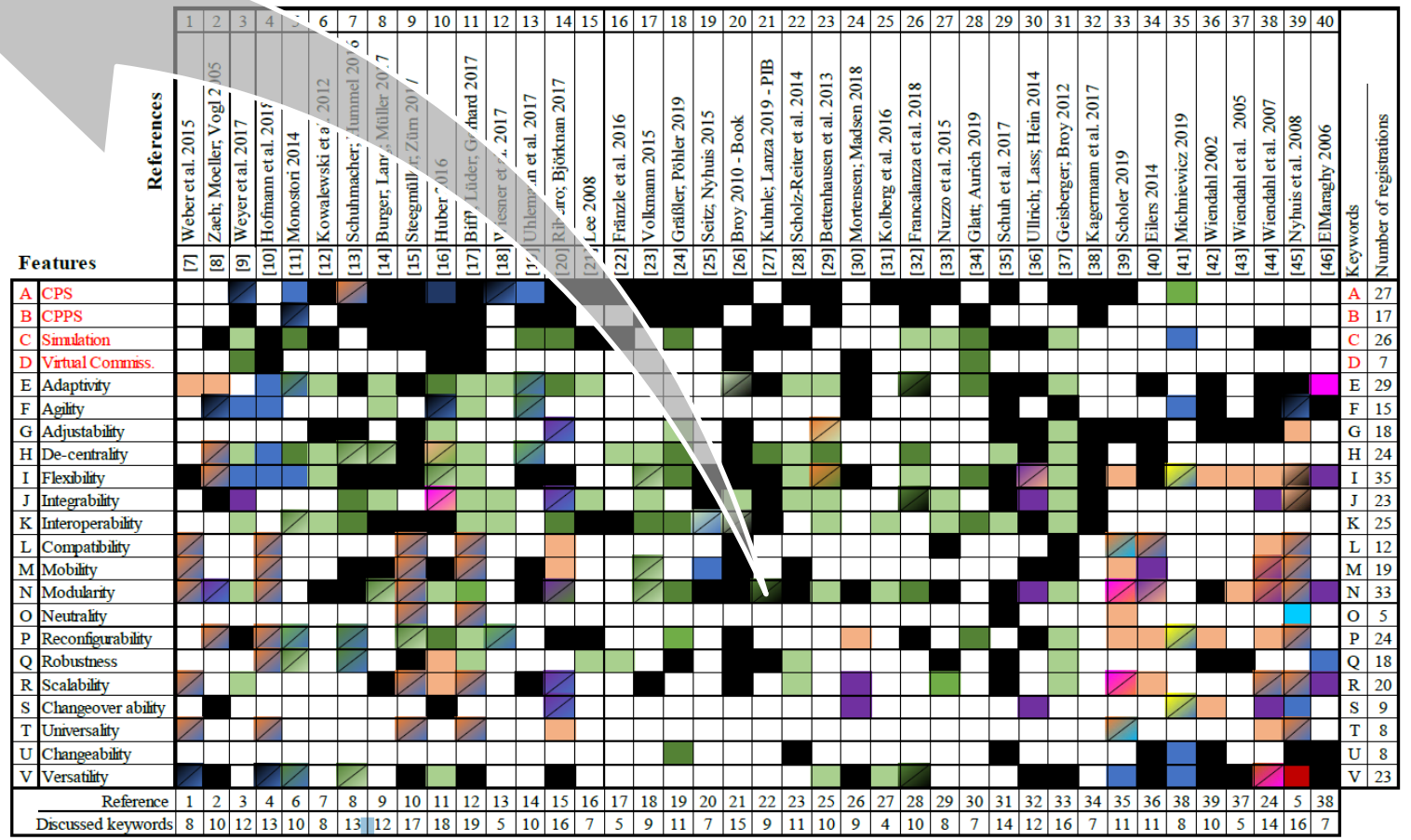


Fig. 1. Multicriteria matrix-based literature review result.

3 Ansatz zur Lösung der Forschungsfrage RQ3

Table 1. Classification levels according to literature.

Lvl.	[5]	[6]	[7]	[8]	[9]	This paper
0	-	-	Connected world	-	Production network	-
1	Global plant network	Company level	Enterprise	-	Factory level	Company level
2	Local plant network	Operating level	Work units	Location level	Production line	Factory level
3	System level	Process control level	Station	General structure level	Production line segment	Production line level
4	Aggregate level	Control level	Control device	Area/ field level	Work Unit	Cell level
5	Device level	Field level	Field device	Group/ cluster	Work station	Machine level
6	-	-	-	Single work place	Function group	-
7	Assembly level	-	-	-	Component	-
8	Item level	Sensor level	Product	-	Construction element	Element level
9	Material level	-	-	-	-	-

[5] Ropohl G. Allgemeine Technologie : eine Systemtheorie der Technik. 3rd revised edition. 2009. p. 122.

[6] IEC 62264-1. Enterprise-control system integration - Part 1: Models and terminology (IEC 62264-1:2013). https://dx.doi.org/10.31030/2156368.

[7] Adolphs P; Bedenbender H; Dirzus D; Ehlich M; Epple U; Schewe F; Hankel M; Walter A; Heidel R; Waser B; Hoffmeister M; Wollschlaeger M; Huhle H. Reference Architecture Model Industrie 4.0 (RAMI4.0), Status Report, VDI/VDE, ZVEI, 2015. p. 7.

[8] Wiendahl HP; ElMaraghy HA; Nyhuis P; Zäh MF. Changeable Manufacturing – Classification, Design and Operation. In: Cirp Paper Annals. 2007. p. 783-809.

[9] Lüder A; Schmidt N; Hell K; Röpke H; Zawisza J. Fundamentals of Artifact Reuse in CPPS. In: Biffl S; Lüder A; Gerhard D. Multi-Disciplinary Engineering for Cyber-Physical Production Systems. Springer international Publishing. 2017. p. 135. DOI 10.1007/978-3-319-56345-9.

3 Ansatz zur Lösung der Forschungsfrage RQ3

Supporter (1)
Als Supporter gekennzeichnete Produktionseigenschaften bilden eine unterstützende oder begünstigende Basischarakteristik aber keine absolut notwendige Voraussetzung zur Erfüllung der unterstützten Eigenschaft.

Enabler (2)
Als Enabler gekennzeichnete Produktionseigenschaften bilden eine Voraussetzung in Form einer befähigenden Eigenschaft zur Erfüllung der übergeordneten Charakteristik.

Influencing production characteristics \ *Influenced production characteristics*	Adaptivity	Agility	Decentrality	Flexibility	Integrability	Interoperability	Compatibility	Mobility	Modularity	Neutrality	Reconfigurability	Robustness	Scalability	Changeover ability	Universality	Changeability	Versality	Σ
Adaptivity		○	○	2	○	○	○	○	○	○	○	1	○	○	○	2	1	6
Agility	1		○	○	○	○	○	○	○	○	○	1	○	○	○	2	○	4
Decentrality	○	○		○	○	○	○	○	○	○	○	1	1	○	○	○	1	3
Flexibility	1	○	○		○	○	○	○	○	○	2	1	○	○	○	2	2	8
Integratability	1	1	○	○		○	○	○	1	○	2	○	1	○	○	1	2	9
Interoperability	1	○	2	1	1		○	○	○	○	1	1	○	○	○	○	1	8
Compatibility	1	○	○	○	2	2		○	2	○	2	○	1	1	○	1	2	14
Mobility	1	○	○	○	1	○	○		○	○	2	○	○	○	○	○	2	6
Modularity	1	○	○	○	1	○	○	1		○	2	1	1	○	○	1	2	10
Neutrality	1	1	1	○	1	1	2	2	2		2	○	2	1	2	1	1	20
Reconfigurability	2	○	○	○	○	○	○	○	○	○		1	○	○	○	2	2	7
Robustheit	○	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	0
Scalability	1	1	○	○	○	○	○	○	○	○	2	1		○	○	1	2	8
Changeover ability	2	○	○	○	1	○	○	○	○	○	2	2	○		○	2	2	11
Universality	1	1	1	○	1	1	2	○	1	○	2	○	1	1		1	2	15
Changeability	○	○	○	○	○	○	○	○	○	○	○	1	○	○	○		○	1
Versality	2	○	○	○	○	○	○	○	○	○	○	1	○	○	○	2		5
Σ	**16**	**4**	**4**	**3**	**8**	**4**	**4**	**3**	**6**	**0**	**19**	**12**	**7**	**3**	**2**	**18**	**22**	

The higher the sum, the higher in the hierarchy.

The higher the sum, the lower in the hierarchy.

3 Ansatz zur Lösung der Forschungsfrage RQ3

Hierarchical classification levels	Definition of the classification level	CPS descriptive production characteristic
6 - Company level	*„Describes a network of factory locations“*	Changeability
5 - Factory level	*„Describes a plant at a given location“*	Adaptability, Agility
4 - Production line level	*„Describes combinations of production cells”*	**Flexibility, Versality**
3 - Cell level	*„Describes a single work segment“*	**Integrability,** Interoperability**, Scalability Reconfigurability, Modularity**
2 - Machine level	*„Describes a single working device “*	**Decentrality, Robustness, Mobility, Changeover ability**
1 - Element level	*„Describes individual component groups “*	Neutrality**, Universality,** Compatibility
		<u>Characteristic suitable for validation using VC</u>

CPS descriptive production characteristics

Identified CPS descriptive characteristics

[4] Illmer B; Vielhaber M. Cyber-physical systems and production characteristics – classification and visualization of relationships. In: Proceedings of the 53rd CIRP Conference on Manufacturing Systems. 2020.

[10] Illmer B; Karkowski M; Vielhaber; M. Petri net controlled virtual commissioning – A virtual Design loop approach. In: Proceedings of the 30th Cirp Design Conference. 2020.

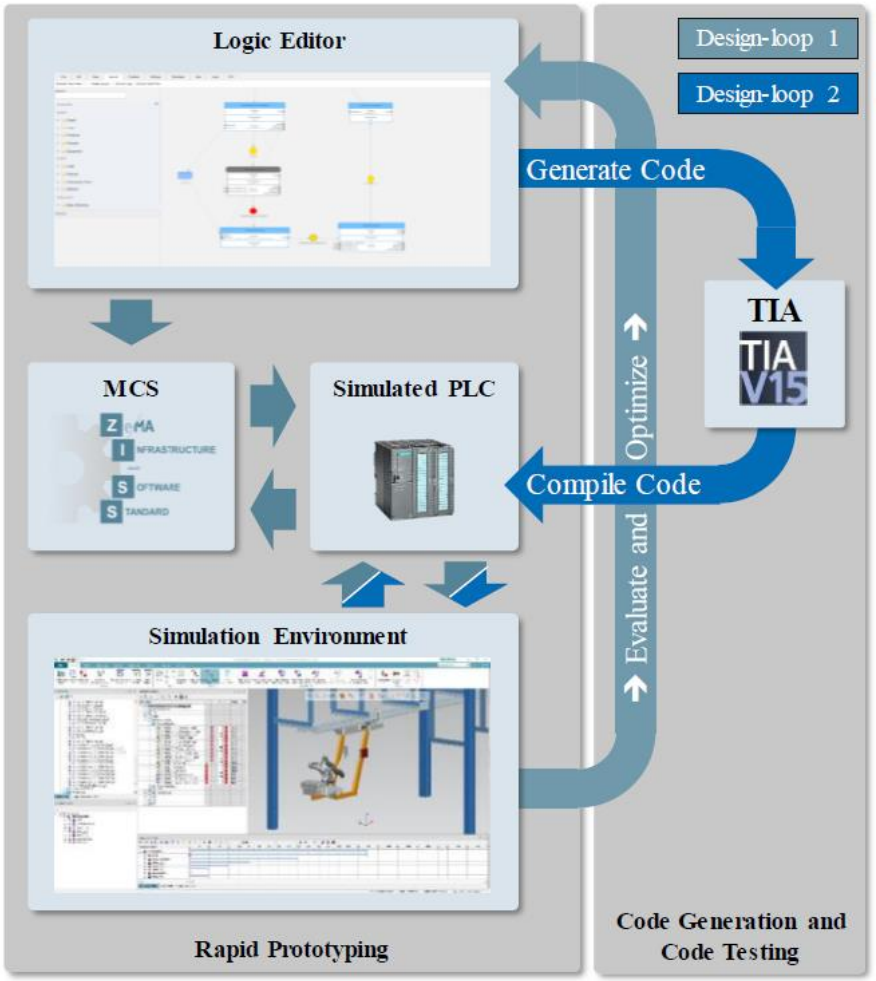
[11] Makris S; Michalos G; Chryssolouris G. Virtual Commissioning of an Assembly Cell with Cooperating Robots. Research Article. In: Advances in Decision Sciences. Volume 2012. 2012.

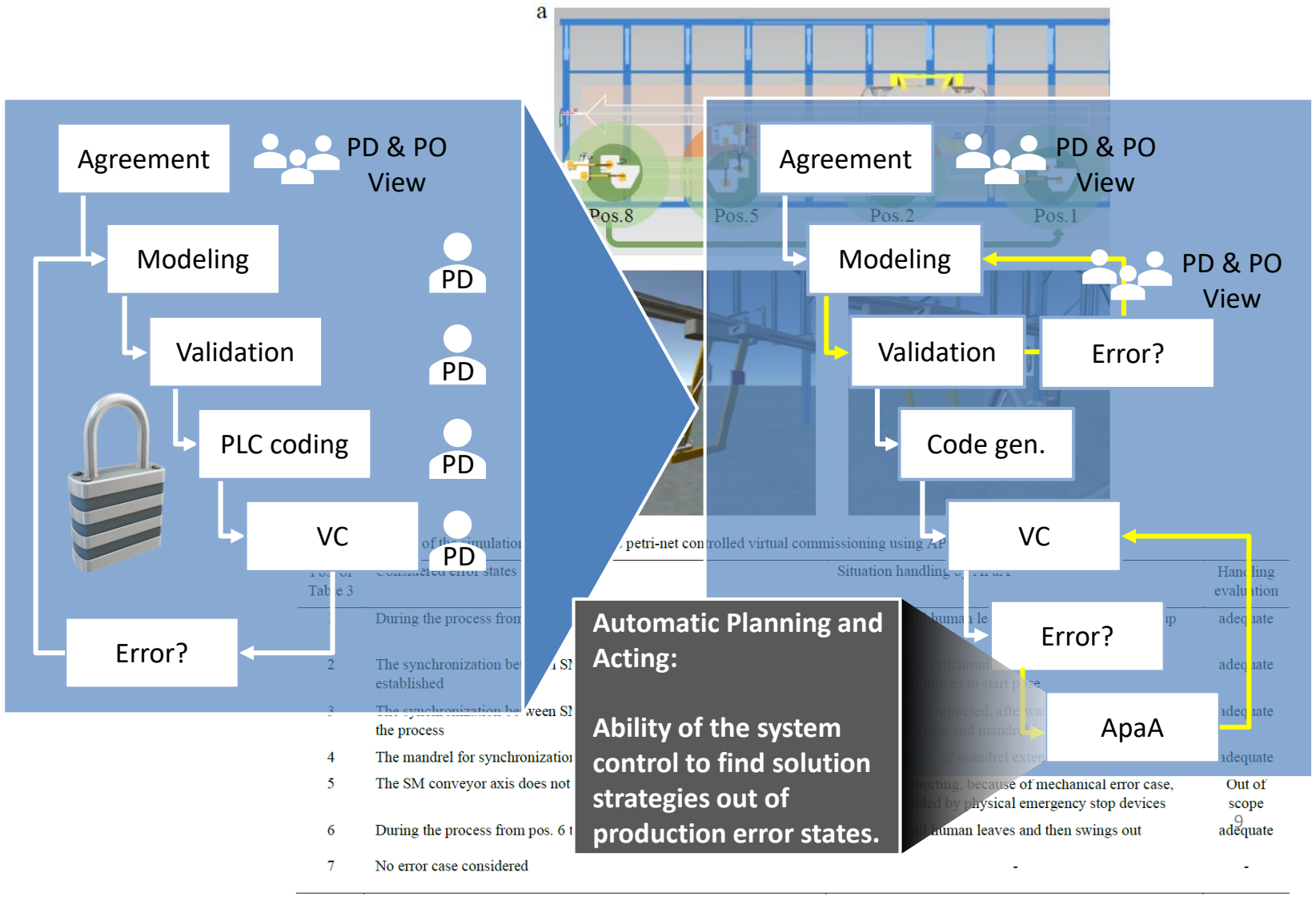
[12] Tram Mortensen S, Madsen O. Operational Classification and Method for Reconfiguration & Recommissioning of Changeable Manufacturing Systems in System level. In: Proceedings of the 28th Internationa CARV Conference, 2019. pp. 90-95.

[13] Kampker A; Wessel S; Lutz N; Reibetanz M; Hehl M. Virtual Commissioning for Scalable Production Systems in the Automotive Industry: Model for evaluating benefit and effort of virtual commissioning. In: 9th ICITM Conference. 2020, pp. 107-111, doi: 10.1109/ICITM48982.2020.9080348

Validierung!

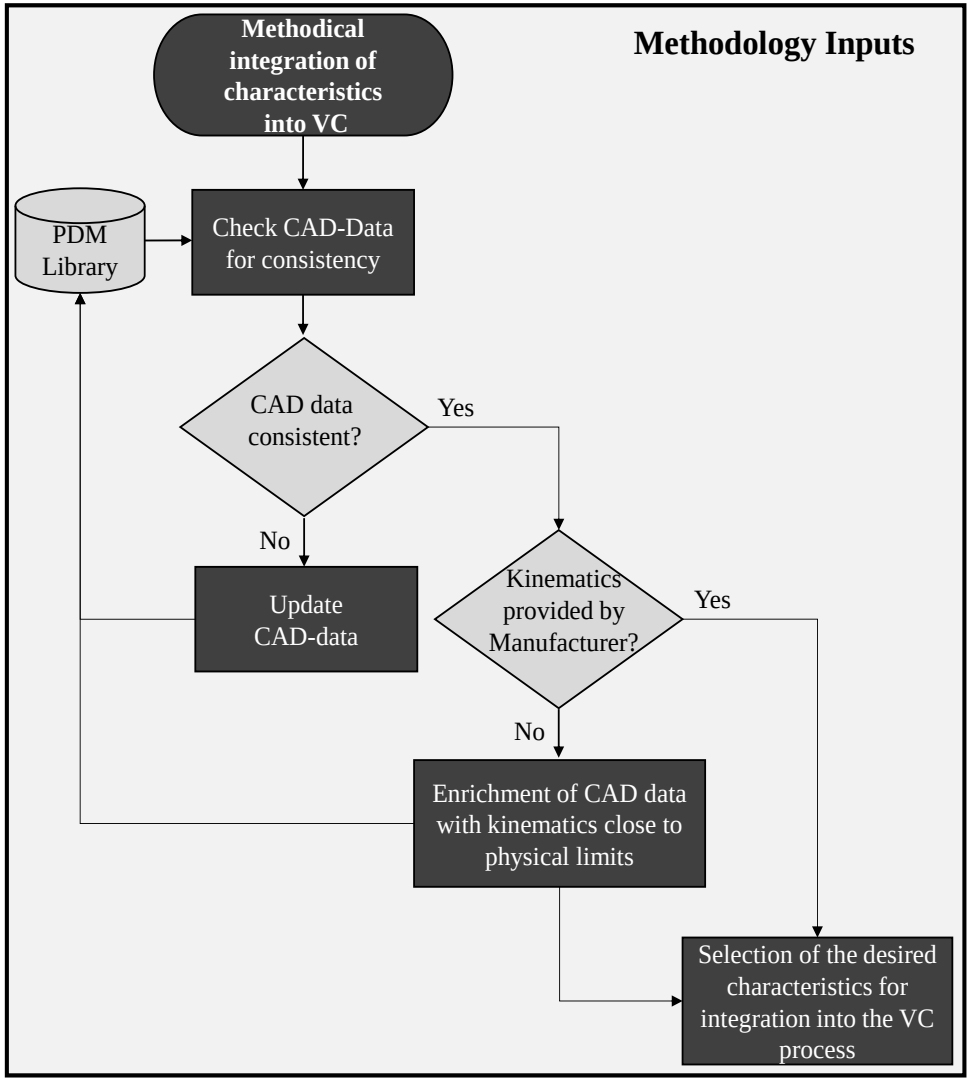
3 Ansatz zur Lösung der Forschungsfrage RQ4

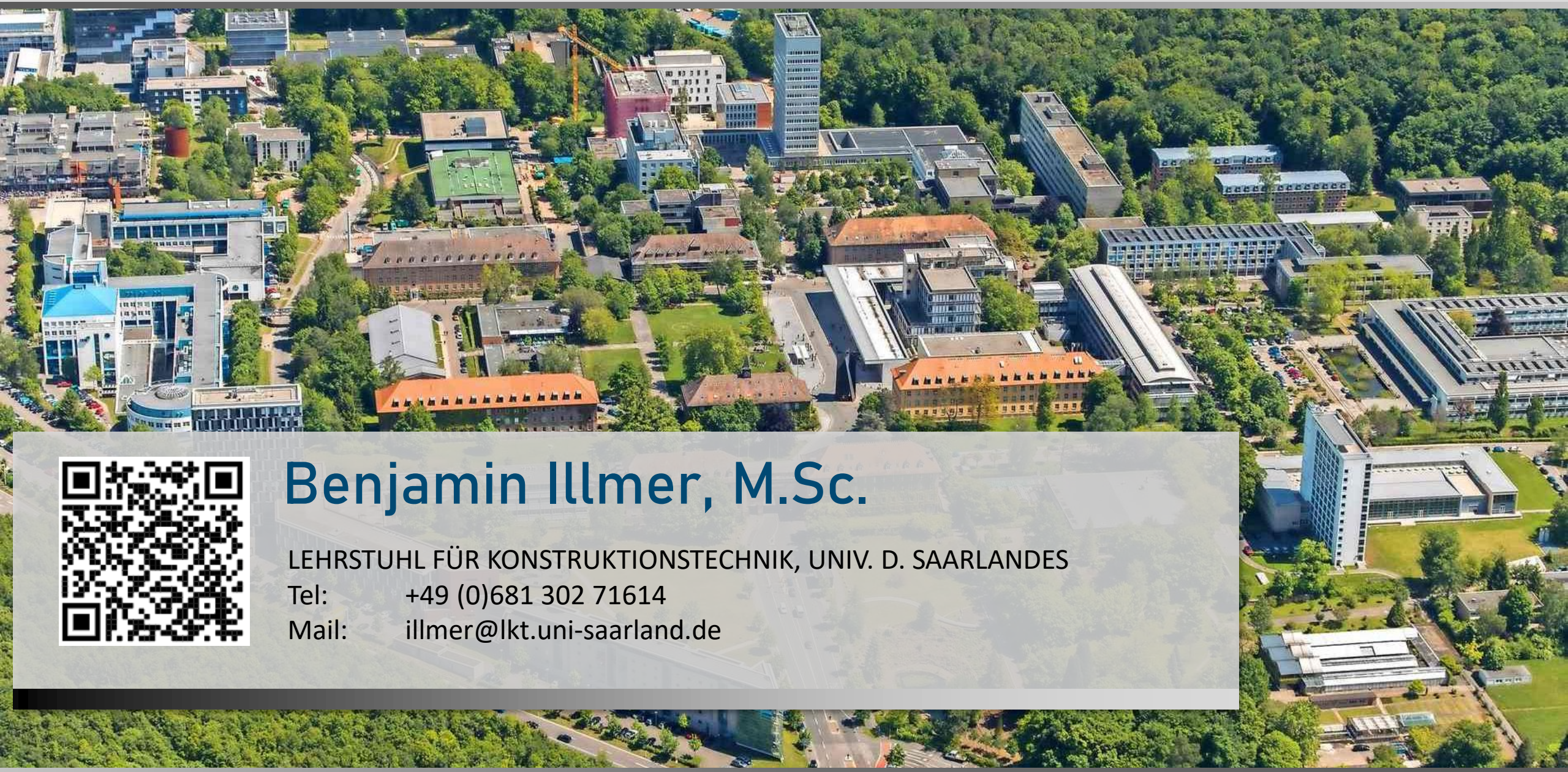




3 Ansatz zur Lösung der Forschungsfrage RQ5

- **Grundlegende Fragestellungen vor vielen VIBN Projekten gleich.**
- **Vorbereitung/ Beschaffung der Daten vor vielen VIBN Projekten gleich.**
- **Schritte innerhalb von verschiedenen Methoden können vergleichbar sein.**
- **Teilergebnisse aus *Methode A* können Parameter für *Methode B* darstellen.**





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