Aspects of the Central and Decentral Production Parameter Space its Meta-Order and Industrial Application Simulation Example

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Content

Introduction

Introduction

Motivation and Introduction:

- Decision Problem in Systems, Production and Simulation for General Strategies, Central-Decentral
- Dilemma Central-Decentral

Method and Goal:

- Axiomatisation
- Production Example Motor Housing: Modeling in Witness
- Understanding aspects of why and how the central-decentral works in more generality, and when to decide for which option

Central and Decentral Production Systems

Axioms I

Modeling Theorem:

Axiom 1

The production can be divided into an **information** *and a* **material production line** *which both are (a)* **decoupled** *with respect to time/room and (b)* **structurally coupled** *to each other and the environment.*

Attractor Theorem:

Axiom 2

Information and material processes have an **attractor according to their order** *and can hence dominate or limit the process.*

Axioms II

Bottleneck Theorem:

Axiom 3

Production can be regarded as a **growth process** *under limitations.* **Optimal production** *is at the overall dominating limit.*

Diversity Axiom:

Axiom 4

The central-decentral parameter space in production integrates production parameters into overall **production efficiency**.

$\rightarrow$ Lockstepping order increase, by osmotic diversity

Example: Electrical Motor Housing I

- Classical Production vs. Additive Manufacturing (AM) → Parare GmbH [Qui18; Qui19]
- Production Steps

Central-Decentral I

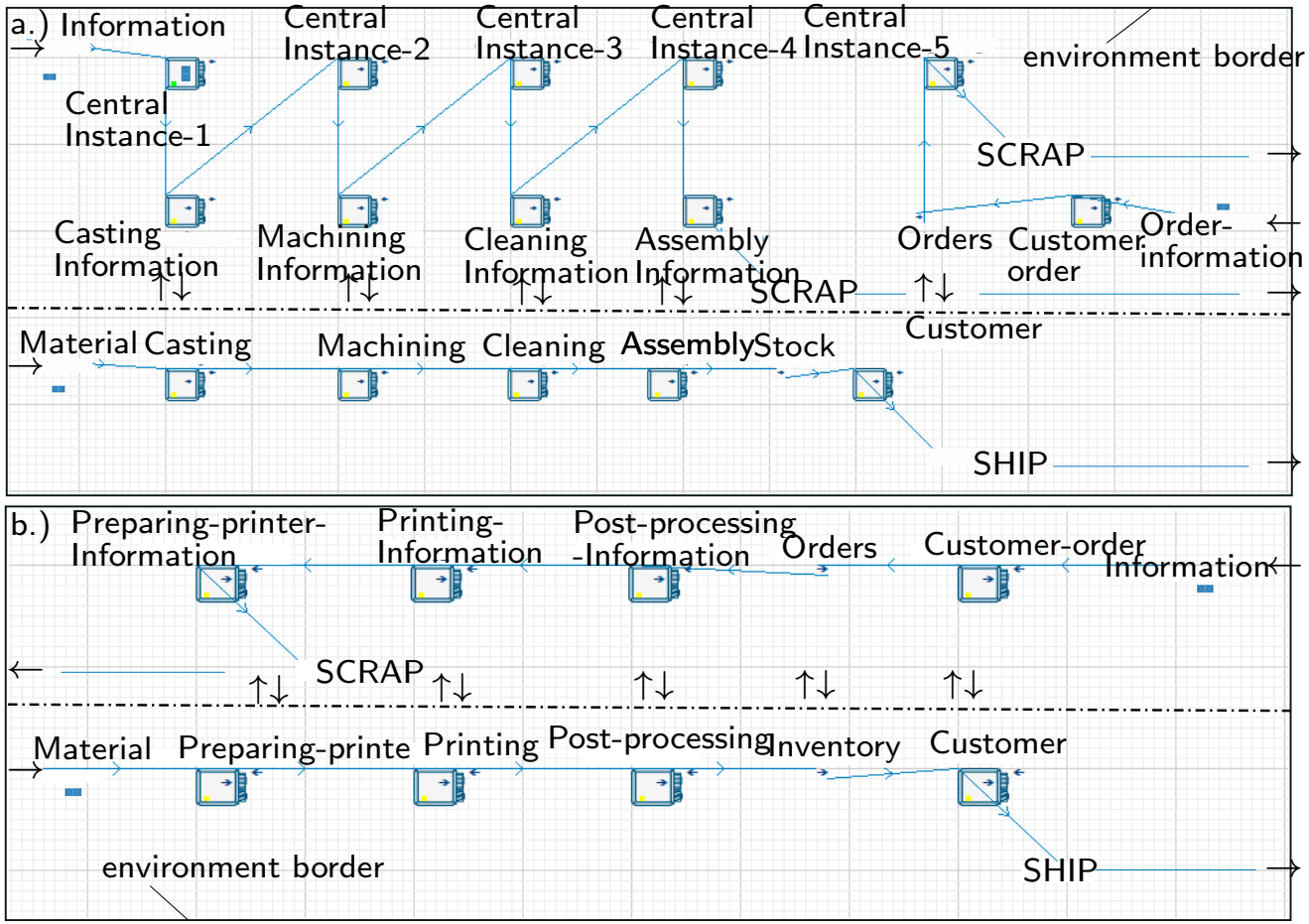

Figure 1: Central a.) and decentral b.) production control system as Witness model [Kri22]

Central-Decentral II

- $\uparrow\downarrow$ indicate the meta-information exchange between material and informational processes.
- $\leftarrow \rightarrow$ indicate the material and informational flows from and towards the environment
- Model is implementation example of Axiom 1.

Scenarios I

Table 1. Summary of the scenarios of this work.

Scenarios	Parts produced	Variants	Total production time
Scenario 1 central	10	1	830 [min] ≈ 14 [h]
Scenario 1 decentral	10	1	3955 [min] ≈ 3 [d]
Scenario 2 central	2	2	5932 [min] ≈ 4 [d]
Scenario 2 decentral	2	2	1345 [min] ≈ 1 [d]

Limits, Conclusion, and Outlook

Limits, Conclusions, and Outlook

Limits:

- Central-Decentral Aspects/Small set of/One Example

Conclusion:

- Four Axioms - (1) Production Model, (2) Attractor, (3) Bottleneck, and (4) Diversity Theorem
- Results indicate, that only simulation gives insight of correct, near optimal production in the decision case - central-decentral, and no general proposition is valid in advance
- Hence for each 'Structure' there can be a specific 'evolutionary' advantage $\rightarrow$ flexible specific structure seems to be best solution

Outlook:

- Portfolio Production Theory $\rightarrow$ heuristic and mathematical framework $\rightarrow$ Portfolio Fairness Theory!

Thank you cordially for your attention!




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PS.: The presentation can later also be found at:

http://www.dr-heiden.com/Vortraege.htm

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