

Lambda Computatrix -: :

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Content

Introduction

Lambda Computatri:

Applications Al-Legal Model Management Mode Production and Logistic Model

Summary, Conclusions and Outlook Lambda Computatrix (LC) - Towards a Computational Enhanced Understanding of Production and Management

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02/25/2021 Online 5:15pm-5:30pm, H, Virtual Room D (London UK) - Conference Date: 02/25-26/2021



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## Goal I

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## Introduction

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Summary, Conclusions and Outlook

- What is TP especially in the context of production and management?
- 2 How can the management actively use TP in production processes?
- Why is **TP increasingly important** for future production and management?

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Summary, Conclusions and Outlook

- Lambda (λ) calculus goes back to Freges Begriffsschrift [1879]
- Forms of Logic
  - Propositional Logic (Boole/Leibniz)
  - First order logic (partly automated)
  - Higher Order Logic (HOL) (interactively automated) → quantifiers all x, one x → systems theory!, explainable Artificial Intelligence (XAI)
  - Phase transition towards **all** by means of AI-systems like TP-which are based on the lambda calcalus-the numeric analogon of HOL
- Implementations
  - Isabelle
  - lambda-Prolog

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## Application: Production and Management I

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Applications

Al-Legal Model Management Mode Production and Logistic Model

Summary, Conclusions and Outlook

- Modelling & simulation  $\rightarrow$  correlations  $\rightarrow$  prediction
- Production and Management
  - Technical Innovation Systems (TIS)
  - Technology Life Cycles (TLC)  $\rightarrow$  growth-, cybernetic models
- Simulation & modelling
  - Industrial process simulation with: Witness, Anylogic, Aspen Plus, Aspen Batch Plus, Pro II, etc.
  - → Need for integration or merging with AI like TP: e.g. linking to TP → e.g. Witness  $\leftrightarrow$  Prolog ; this problem is analogous to human  $\leftrightarrow$  machine  $\rightarrow$  multicriteria optimisation

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## Application: Al-Legal Model I

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Al-Legal Model

Intelligence according to Benzmüller:

- solve hard problems
- 2 sucessfully act in known and unknown environment
- 3 reason abstractly and rationally
- 4 FUTURE: reflect upon itself and adjust its reasoning with respect to goals and norms
- **5** FUTURE: interact socially with other entities and align own values and norms with that of larger society and a greater good
- $\rightarrow$  future vision in concordance with Socrates, Leibniz etc.
- $\rightarrow$  increasing human-machine-interaction (e.g. by "self control training" with TP)

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## Application: Logistic and Supply Chain Management I

Questions:

- (1) Tasks & challenges in logistics?
- (2) Optimisation and connection to TP?
- (3) Practical TP-Methods in logistics?

Solutions:

- 1 Make-to-Order or Make-to-Stock<sup>1</sup>
- 2 Push or Pull inventory deployment logic<sup>1</sup>
- **3** Inventory centralization or decentralization<sup>1</sup>
- Make or Buy as another strategic LM-decision from the organisational point of view.

TP can e.g. be used to check the  $\ensuremath{\textbf{reliability}}$  of the supply  $\ensuremath{\textbf{chain}}^1$ 

<sup>1</sup>https://doi.org/10.29007/6177

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Conclusions and Outlook I

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Summary, Conclusions and Outlook

## Summary and Conclusions:

- future production and society is increasingly connected → complex → exponential consequences (e.g. lock down phenomenon: i.e. one single negative consquence shuts down a whole production chain)
- The production has to be **rational** above chance  $\rightarrow$  TP Outlook:
  - Human support by Theorem Proving (TP) using Lambda Computatrix (LC): interactivity for Higher Order Logical (HOL) reasoning
  - Learning tool to decide increasingly rational and to justify decisions quickly and correctly
  - Distinction of wide and narrow interpretation
  - Seamless integration for managers & all humans

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Summary, Conclusions and Outlook

# 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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