Keynote at the SIMUL Conference 2020:

What is more Important for Simulation:
Methods or Tools?

Who? Prof. Dr. Carlo Simon

Where?

Hochschule Worms (University of Applied Sciences), Germany

When? SIMUL 2020

# Our Path through this Keynote

- Personal Introduction

- Nature of Simulation

- Tools & Simulation

- Invitation



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## Scientific Steps

- since Oct. 2015: Professor for Business Computing at Hochschule Worms

- Feb. 2013 - Sep. 2015: Vice President for Research and Teaching at the Provadis School of International Management &Technology

- Sep. 2007 - Sep. 2015: Professor for Business Computing and Software Engineering at the Provadis School of International Management &Technology, Dean of the Business Informatics Faculty

- 2007 Habilitation: „Negotiation Processes: The Semantic Process Language and Applications"

- 2000 Dissertation: „A Logic of Actions and Its Application to the Development of Programmable Controllers"
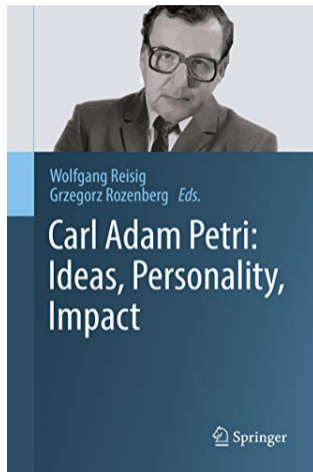
# Professional Activities

- Aug. 2018 - Feb. 2020: Managing Director and Shareholder Loginifinity ProcessBase

- June 2013 - Nov. 2018: Member of the Board of Management SIRIUS Consulting & Training AG

- Since 2002: Consulting Projects in Strategic and Process Management for Chemical Industry, Trade and Logistics



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- Since 2002: Advanced Training on Process, Innovation & Change Management, mainly for Provadis Group, Frankfurt

- Since 2002: Teaching at further universities (Stuttgart Institute of Management and Technology (SIMT), Hochschule Trier)

- Apr. 2001 - Aug. 2001: Project Manager Software Engineering SER Technology Deutschland GmbH

# A Curious Hobby

- I know Petri nets since 1990 and

- and develop Petri net tools since 1993. First, only to answer scientific questions, but ...

- for 10 years I am developing a tool for research, teaching, and consulting.

- You find a current version of the tool under

  https://process-simulation.center

- An English version of the tool will be published soon.

- Follow me on **XING** and **Linked in** for being

  informed concerning updates.

Wolfgang Reisig
Grzegorz Rozenberg *Eds.*

Carl Adam Petri:
Ideas, Personality,
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## What is the Nature of Simulation?

After I developed models for the simulation of processes, machines, organizations, and natural processes for more than 30 years, I'm now thinking about the nature of simulation itself.

In order to structure my thoughts, I want to give answers to the following questions in twisted order:

- **Who** simulates and who develops models for simulations?

- **Where** do we simulate and where do we develop models?

- **When** do we simulate?

- **What** is the outcome of a simulation?

- **How** do we simulate and **which** methods do we use?

- **Why** do we simulate et all?

And as a computer scientist, I am also interested in the role of tools for simulation.

There are different reasons for simulation:

- We want do understand the world!

- We want to learn the rules by which we behave in the world!

- We want to validate technical plans!

- We want to anticipate alternatives to the world as it is!

# We Want do Understand the World!

- Simulation plays a major role in the currently most important political debates

- Computer models and simulations are used to understand the human impact on the climate change

- But computer simulation also help to understand how the Covid-19 virus spreads all over the world

- Without a computer, we couldn't even capture or visualize all the data relevant for this

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# We Want to Learn the Rules by Which we Behave in the World!

- If children play, and especially when they construct toys, they conduct a simulation

- And when they play together, they learn social behavior

- Toys and computer games encourage this learning process



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# We Want to Validate Technical Plans!

- Simulations are used in the construction of cars to prevent injuries in subsequent car accidents

- Since they are based on physical laws, they are a special case for „Understanding the World"

- However, this form of simulation has a clear future orientation.



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# We Want to Anticipate Alternatives to the World as it is!

- Strategic decisions need to be reviewed

- Using the scenario theory, possible effects of decisions on the future can be anticipated.

- It is, however, a difficult decision to decide which facts are based on such a simulation.



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# **Who** Simulates and **Who** Develops Models for Simulations?

- While simulation models are being developed by mathematicians, ...

- ... the simulation tools are developed by computer scientists.

- Typical users are domain experts, ...

- but especially in the case of explaining the world, the simulation results must be understood by everyone.



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**This is important and we have to come back to it!**

# **When** do we Simulate?

- We simulate when we are unsure concerning the world as it is or the consequences of our behavior on the future or to convince others.

- We need to understand the methods and algorithms in order to trust them

- And we need a clear and unambiguous presentation of the results in order to be able to apply them



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**This is also important and we have to come back to it!**

# **Where** do we simulate and where do we develop models?

- Model creation and its simulation are often spatially separated from one another

- This is problematic if the model and the purpose of the simulation differ from one another and this cannot be recognized

- The simulation and the simulated reality can also often be spatially separated

- Exceptions can be found in medicine and increasingly in the control of technical systems, especially when "Industry 4.0" methods are used



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## **How** do we Simulate and **Which** Methods do we use?

- There is a brought range of simulation methods from statistical methods over discrete and continuous process simulation to symbolic simulation or evolutionary computing

- However, we need to distinguish between those who develop the simulation method and environment and those who use it.

- Alternative simulation approaches are mostly unknown to users

- **The danger here is that what is known and not what is appropriate is used.**



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ALL GENDER IDENTITIES
ALL SEXUAL ORIENTATIONS
ALL ABILITIES AND DISABILITIES
ALL SPOKEN LANGUAGES
ALL AGES
EVERYONE.

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# **What** is the outcome of a simulation?

- Numbers or diagrams are not the results of a simulation, they are decisions!

- As a community, we must therefore ensure that our research does not focus on mathematical processes, but on their use

- **A simulation is good if it includes a purpose, a method derived from purpose and data material, a comprehensible algorithm and an adequate presentation of the results**



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# **Why** are Tools Important for Simulation?

- **Computer tools are the enablers of simulations.** They collect data and they implement the simulation algorithmically

- **But only the appropriate presentation of the simulation result ensures that the simulation goal is achieved!**

- For this, the method and tool must be designed as simply as possible so that they can be understood as a whole by the domain experts

- This is the prerequisite for a correct interpretation of the simulation result!



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# Conclusion

- So: What is more important for Simulation: Methods or Tools?

- **To be honest, they can't do without each other.**

- However, the tools must be able to do more than algorithmically implement mathematical methods

- Taking into account a contemporary user experience, you must also pay attention to the purpose of the simulation and support the end user in interpreting the results



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# Invitation

- I have already drawn the first conclusions from the preparation for this presentation

- From next year I will develop dashboard visualizations for the simulation results for my subject area „Process simulations based on higher Petri nets"

- I have even been able to win a first third-party funding and first partners for this

- I would be very happy about further cooperation! If you are interested, send me an email to

  simon@hs-worms.de



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