

Validation of the knowledge management system for the parameterization of discrete-event simulation models in operational use

Introduction

As part of Mayank Singh's master's thesis and Kilian Vernickel's doctoral project, a knowledge management system for parameterizing discrete-event simulation models in operational use was researched and developed at Fraunhofer IGC. The system is to ensure that a simulation model always represents the real production system and can be used for predictive experiments. In this context, a corresponding system should record the changes between simulation and reality as well as support the process of adapting the simulation model through targeted knowledge acquisition.

Aim of the questionnaire

The questionnaire aims to validate the knowledge management system for parameterization of discrete-event simulation models in operational use.

Notes on editing: There are no wrong answers to the questions asked.

The questionnaire contains three different types of questions:

1. **Multiple Choice:** For these questions, several answer options can be ticked and the free text field can be filled in.

Beispiel: Als plangetriebene Vorgehensmodelle verwenden wir ...

- ☐ ...the V-Model.
- ☐ ...the V-Model XT.
- ☒ ...the Waterfall-Model.
- ☒ ...Six Sigma.
- ☐ ... a proprietary approach: **Adapted V-model**
- ☐ ...another procedure: _____

2. **Tabular questions:** Please answer these questions with the degree of agreement
Example: In the future ...

	Not at all	No	Some-what	Yes	Definitely Yes	No state ment
... a stronger customer focus will become necessary.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
... services around the product are becoming increasingly important.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

3. **Open questions:** Please answer this question in your own words.

1. Your background

1.1. In which industry is your company mainly active?

- ☐ Automotive/ motor vehicle manufacturers
- ☐ Mechanical and plant engineering
- ☐ Supply industry
- ☐ Consulting
- ☒ Research
- ☐ Other:

1.2. What is your experience with the tools/activities mentioned below?

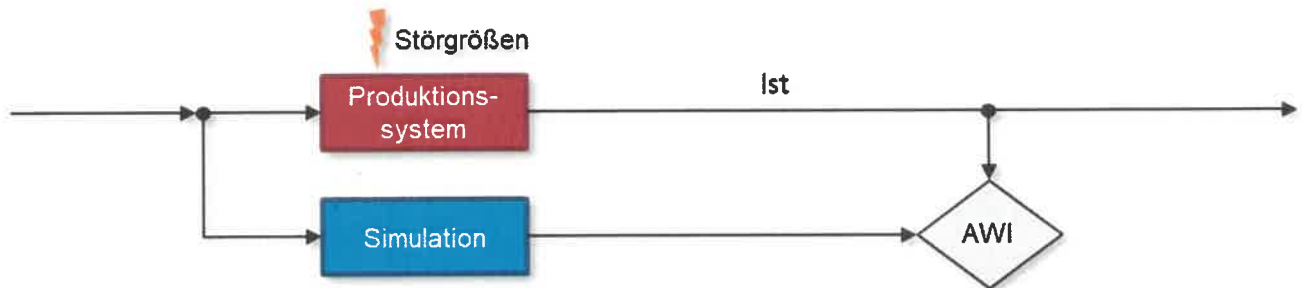
	Not at all	No	Some what	Yes	Definitely yes	No statement
Are you involved in engineering tasks?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Do you have experiences in production systems?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Do you work with simulation models?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you work with data from production systems?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you know how to program a PLC?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Have you used a Knowledge Management System before?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2. Explaining the different parts in the demonstrator (production line, simulation model, etc.)

	Not at all	No	Some-what	Yes	Definitely Yes	No statement
How confident are you that there is a deviation between the real production system and the simulation model?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If you think there is a deviation: Do you think you can specify it (e.g., location, origin, size, ...)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imagine working with larger or more systems: Do you think you can find out multiple deviations in various systems you are part of?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Presentation of all deviations between the real production system and its simulation model.

System architecture:



- AWI: Deviation detection (Abweichungsidentifikation), based on live data from the production system and the simulation model
- Mapping of sensor data from the production line with parameters from the simulation model

	Not at all	No	Some -what	Yes	Defini- tely Yes	No state ment
Imagine you are working at the production system: Do you think you can find the relevant deviation where you have knowledge?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. Presentation of deviations between the real production system and its simulation model

Imagine you are a worker within the project DAMOKLEZ and work on the station "Transport_1".

	Not at all	No	Some-what	Yes	Definitely Yes	No state ment
The deviations recommended to me are relatable to me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
The Recommender System helped me discover new deviations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
The recommender system recommended me diverse deviations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
I understand why the recommended items are suggested to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
The deviation labels (titles) of the recommender system are adequate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The recommender system explains why the recommendation items are recommended to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
The recommendation system can be trusted.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you think randomness in the recommendation list is justified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Given a list of multiple deviations, will you look into deviations that are not part of your project?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Given a list of multiple deviations, will you look into deviations that are not the type of processes you are familiar with?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Presentation of details of the deviations (Historical Chart, dates, ...)

Example of a deviation in station *Transport_1* for the worker *Kilian_Vernickel*.

Hi Kilian_Vernickel

Do you have knowledge about the deviation?

☒ Yes
☐ No

If you do not have any knowledge, can you suggest someone who has the knowledge (Ignore if no Knowledge about expert)

Cause Of Deviation
Machine

Deviation Type
Planned

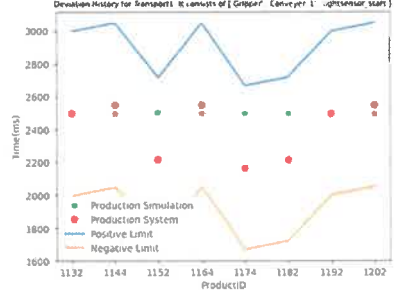
Deviation Description
Machine got corrupted

Deviation starts from

Deviation will stay until

Submit

Deviation History for Transport_1 (consists of [Gripper, Conveyor, LightSensor, Start])



	Not at all	No	Some-what	Yes	Definitely Yes	No state ment
The information provided to me is sufficient for me to share my knowledge about the deviation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I found it easy to tell between what I know and what I don't know about a deviation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
The deviation-field should provide more information	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If yes : The following information is missing/ could be added: (please describe)						
<i>Historische Daten einfließen lassen</i>						

6. Parameterization of the simulation model after the knowledge extraction process for a deviation

Consider that you are the simulation expert, you have control of the parameters in the simulation, and you are responsible for providing an accurate simulation model.

	Not at all	No	Some-what	Yes	Definitely Yes	No statement
Do you think you are able to parameterize the simulation model correctly if you don't have the information from the shop floor workers?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you think you can update the simulation model based on the received knowledge for a deviation that occurred?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

7. General evaluation of the whole system

	Not at all	No	Some -what	Yes	Definitely Yes	No state ment
I quickly became familiar with the Knowledge Management System (KMS).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
The KMS can be trusted.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The Recommender System helped me to discover new deviations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does the system reduce the effort to identify deviations between the real production system and the simulation model?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Does the system reduce the effort to solve deviations between the real production system and the simulation model?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Does the system support the process of extracting knowledge from shop floor experts?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In your opinion, does the KMS increase the quality of the simulation model?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
As a shop floor worker: Would you use the system to share knowledge and help improve the quality of the simulation model?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
As a simulation expert: Does the system support you to keep the simulation models up-to-date?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
As a simulation expert: Does the combination of the data-based approach of a deviation with the knowledge from the shop floor lead to more precise adjustments in the simulation model?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does the system help focus on the correct data needed according to a deviation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Please answer the statement: With the KMS, future behavior of the real production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

system, which can't be seen in the historical data, can be taken into account in the simulation model.						
Please answer the statement: The system fastens the process to interpret failures of the real production system.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you think there is more potential in the stored knowledge for other use cases in the production/ companies environment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you have any further comments/ ideas? <i>Wahrscheinlichkeit einbringen</i>						

Thank you very much for your participation!

