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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 IGCV. 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 statement
... a stronger customer focus will become necessary.	☐	☒	☐	☐	☐	☐
... services around the product are becoming increasingly important.	☐	☐	☐	☐	☐	☒

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

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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?	☐	☐	☐	☐	☑	☐
Do you have experiences in production systems?	☐	☐	☑	☐	☐	☐
Do you work with simulation models?	☐	☐	☑	☐	☐	☐
Do you work with data from production systems?	☐	☐	☑	☐	☐	☐
Do you know how to program a PLC?	☐	☑	☐	☐	☐	☐
Have you used a Knowledge Management System before?	☑	☐	☐	☐	☐	☐

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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?	☐	☐	☐	☑	☐	☐
If you think there is a deviation: Do you think you can specify it (e.g., location, origin, size, …)	☐	☑	☐	☐	☐	☐
Imagine working with larger or more systems: Do you think you can find out multiple deviations in various systems you are part of?	☐	☐	☐	☑	☐	☐

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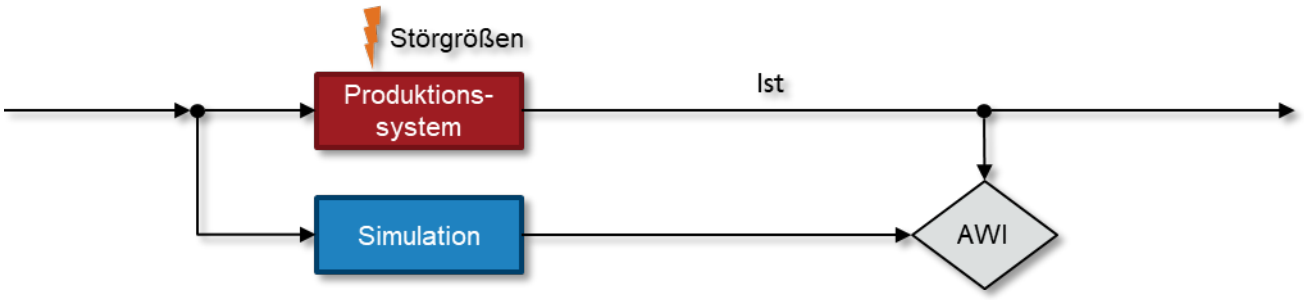
3. Presentation of all deviations between the real production system and its simulation model.

System architecture:



- AWI: Deviation detection (Abweichungsidentifikation), based on live date 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	Definitely Yes	No statement
Imagine you are working at the production system: Do you think you can find the relevant deviation where you have knowledge?	☐	☑	☐	☐	☐	☐

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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 statement
The deviations recommended to me are relatable to me	☐	☐	☐	☐	☐	☑
The Recommender System helped me discover new deviations.	☐	☐	☐	☐	☑	☐
The recommender system recommended me diverse deviations.	☐	☐	☐	☑	☐	☐
I understand why the recommended items are suggested to me.	☐	☐	☐	☐	☐	☑
The deviation labels (titles) of the recommender system are adequate	☐	☐	☐	☑	☐	☐
The recommender system explains why the recommendation items are recommended to me.	☐	☐	☐	☐	☑	☐
The recommendation system can be trusted.	☐	☐	☑	☐	☐	☐
Do you think randomness in the recommendation list is justified?	☐	☐	☐	☐	☐	☑
Given a list of multiple deviations, will you look into deviations that are not part of your project?	☐	☑	☐	☐	☐	☐
Given a list of multiple deviations, will you look into deviations that are not the type of processes you are familiar with?	☐	☑	☐	☐	☐	☐

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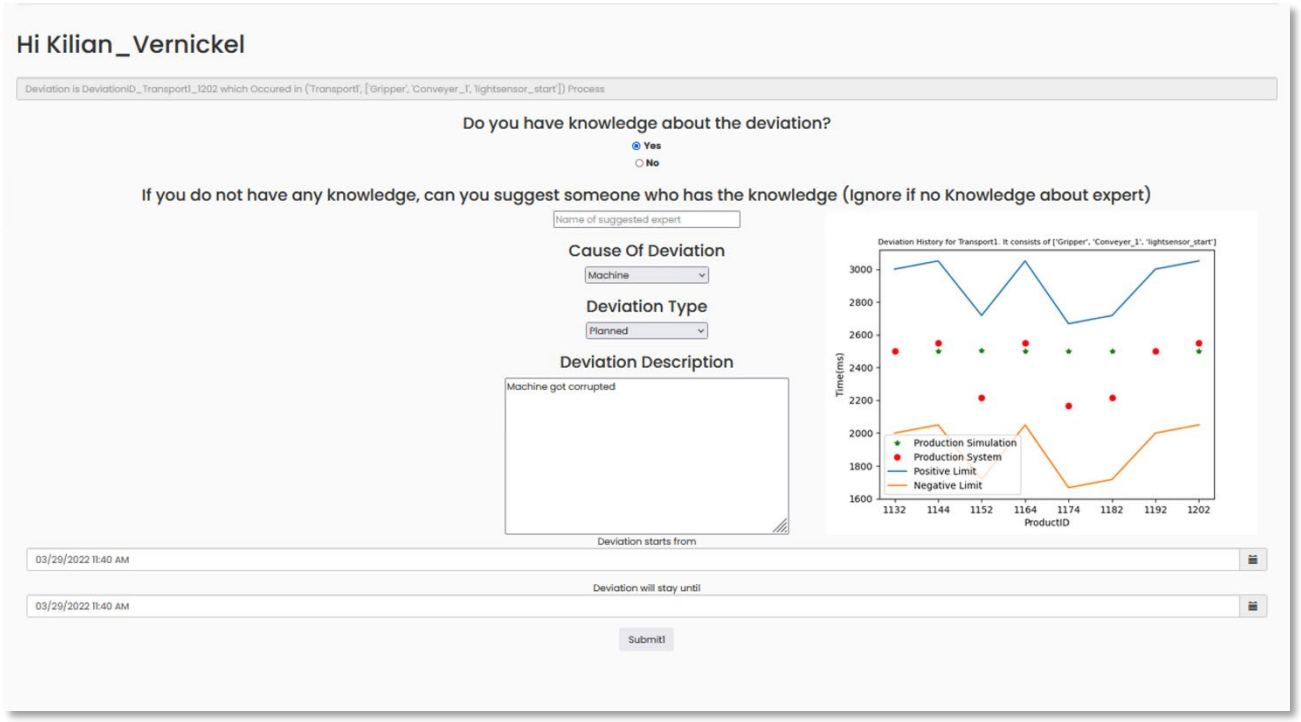
5. Presentation of details of the deviations (Historical Chart, dates, …)

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



	Not at all	No	Some-what	Yes	Definitely Yes	No statement
The information provided to me is sufficient for me to share my knowledge about the deviation.	☐	☐	☐	☑	☐	☐
I found it easy to tell between what I know and what I don't know about a deviation.	☐	☐	☐	☑	☐	☐
The deviation-field should provide more information	☐	☑	☐	☐	☐	☐
If **yes**: The following information is missing/ could be added: (please describe)						

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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?	☐	☑	☐	☐	☐	☐
Do you think you can update the simulation model based on the received knowledge for a deviation that occurred?	☐	☐	☐	☑	☐	☐

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7. General evaluation of the whole system

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

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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.	☐	☐	☑	☐	☐	☑
Do you think there is more potential in the stored knowledge for other use cases in the production/ companies environment?	☐	☐	☐	☑	☐	☐
Do you have any further comments/ ideas?						

Thank you very much for your participation!