ŠKODA AUTO University

Computer Simulation of Logistics Processes

Methodology of the simulation project

Jan Fábry

06/03/2023

Methodology of the simulation project

ŠKODA AUTO University

Aim of the lecture

- To define methodically discrete computer simulation.

Methodology of the simulation project

ŠKODA AUTO University

Structure of the lecture

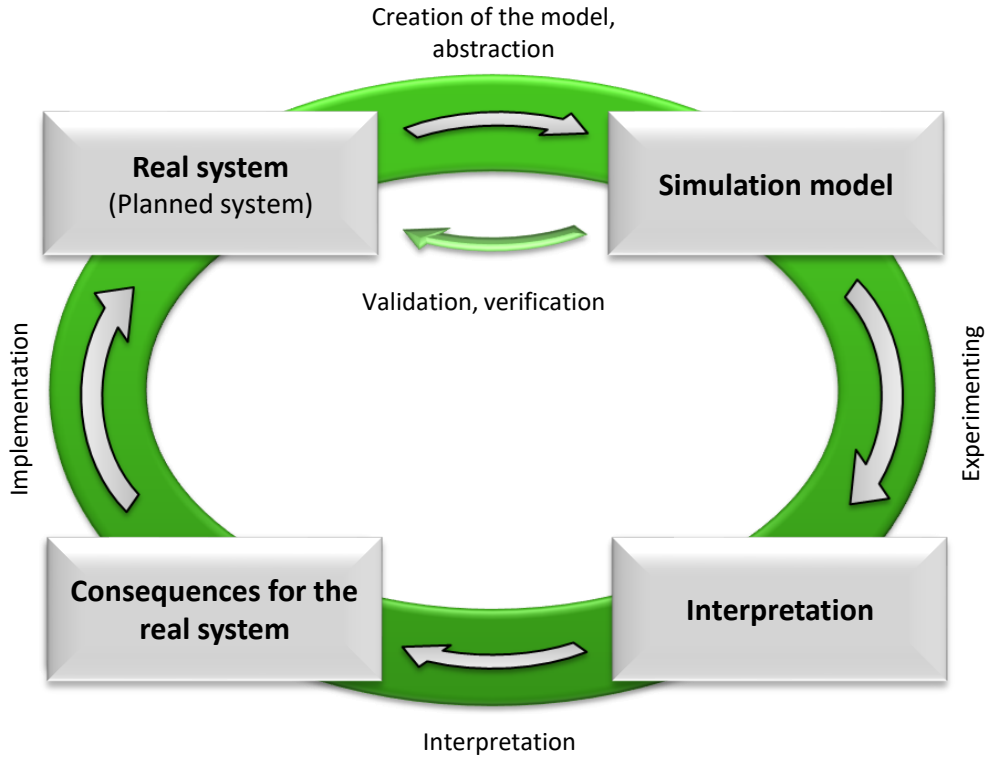
- What is a discrete simulation?
- Reasons for using the simulation.
- Simulation vs. optimization.
- Phase model of simulation project.
- Advantages and disadvantages of discrete simulation.
- Difficulties of simulation.
  - Time.
  - Costs.
- Share of individual activities on the project.

Methodology of the simulation project

ŠKODA AUTO University

Simulation

- The simulation is a representation of a planned or real system with its dynamic processes via model. We try to collect experiences by experimenting with simulation model. Gained information can be used in the production.
- The simulation combines the preparation, realization and evaluation of specific experiments using simulation model.

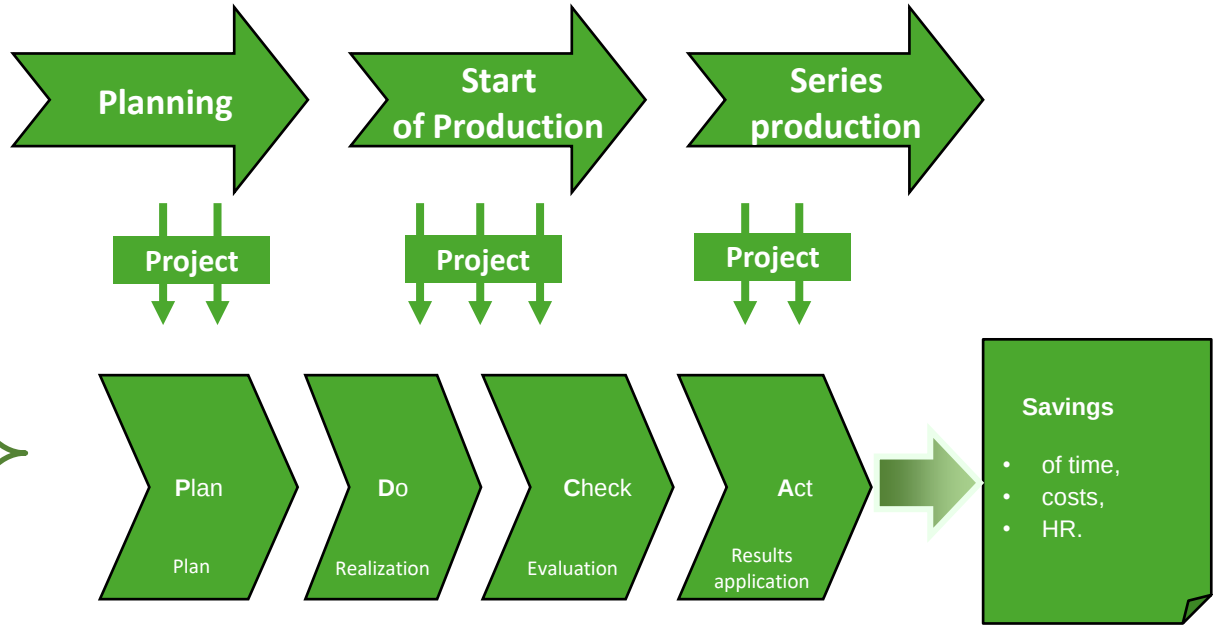


Methodology of the simulation project

ŠKODA AUTO University

Reasons for using simulations

- Identification of bottleneck spots in the production.
- Shortening of average production time.
- Production batches optimization.
- Capacity planning.
- Implementation of the Just-in-Time method.
- Designing of production units, reengineering.
- Requirements optimization of the labour.
- Logistics analysis, production costs analysis.
- Support during development and test of control software.
- Personnel education.
- Capital investment planning, etc.



SIMULATION

- Testing of the solution in a risk-free environment.
- Visualization of the consequences of planned changes.
- Early response to criticism, easier acceptance of changes.
- Visions of the future in the virtual world.

Methodology of the simulation project

ŠKODA AUTO University

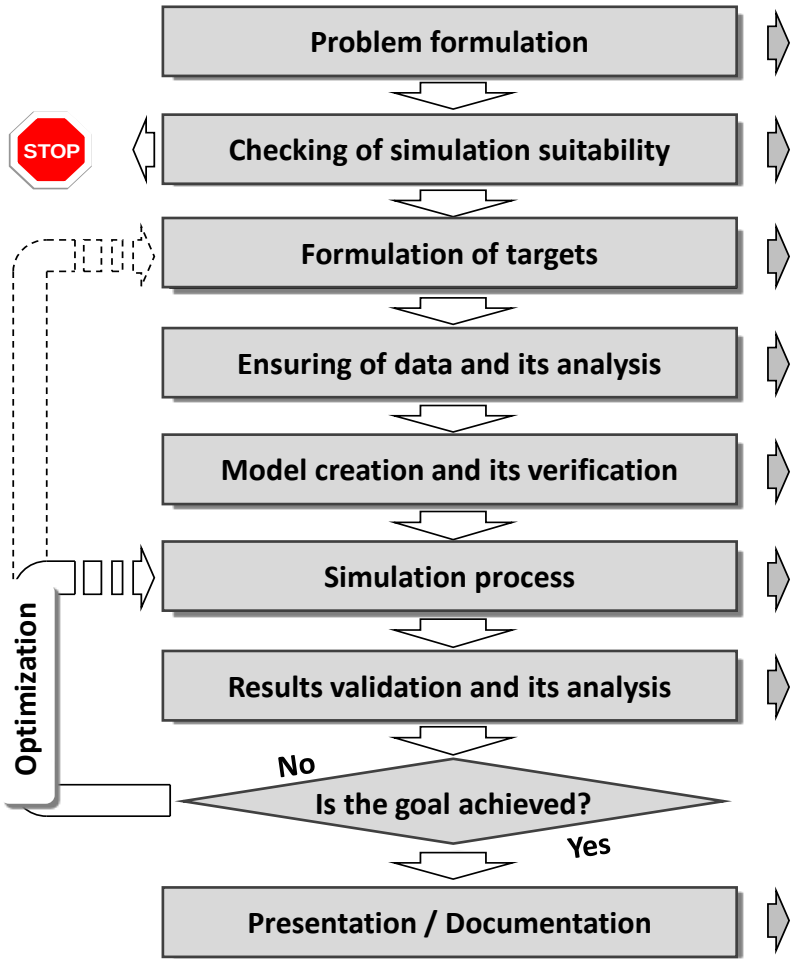
Simulation vs. optimization

- Simulation ≠ Optimization.
- Simulation is considered as a tool for specific process modelling.
  - Simulation as the tool itself does not guarantee the optimal solution.
  - Key feature is ability to work with random influences.
- Optimization is considered as a mean of improvement of parameters of current processes (according to the select criteria).
- Optimization is based on experimenting.
- It is called a conditional optimum.

Methodology of the simulation project

ŠKODA AUTO University

Phase model of simulation project



- Meeting of persons interested in the topic.
- Creating of the team and determination of responsibilities.
- Definition of the main problems.

- Analysis of given problems.
- Determination of suitability, area, possibilities and limits of the simulation.
- Resolvability with help of the simulation.

- Goal determination and its hierarchy.
- Definition of the interface of system surroundings.
- Determination of measures and project indicators.
- Determination of output form.

- Data obtaining with help of interested departments.
- Detailed data analysis.
- Verification of received data.

- Creation of conceptual model.
- Creation of conceptual model for defined tool.
- Model creation → model verification → model validation.

- Creating of the test plan.
- Experiment realization.
- Recording of experiments and conditions.

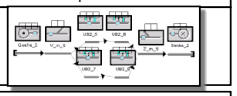
- Validation of the results acceptability.
- Adjustment of the simulation results.
- Results interpretation and analysis of costs and contributions.

- Results presentation.
- Discussion of achieved results, contributions and measures.
- Project documentation.

Requests and desires
- Production plan
- Production time
- Usage level
- …

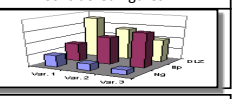
System and production data
- Capacity
- Working plan
- Layout
- …

Computer model



Statistical data
- Production plan
- Flow time
- Usage level
- …

Considered figures



Achieving of the goal and bottleneck places

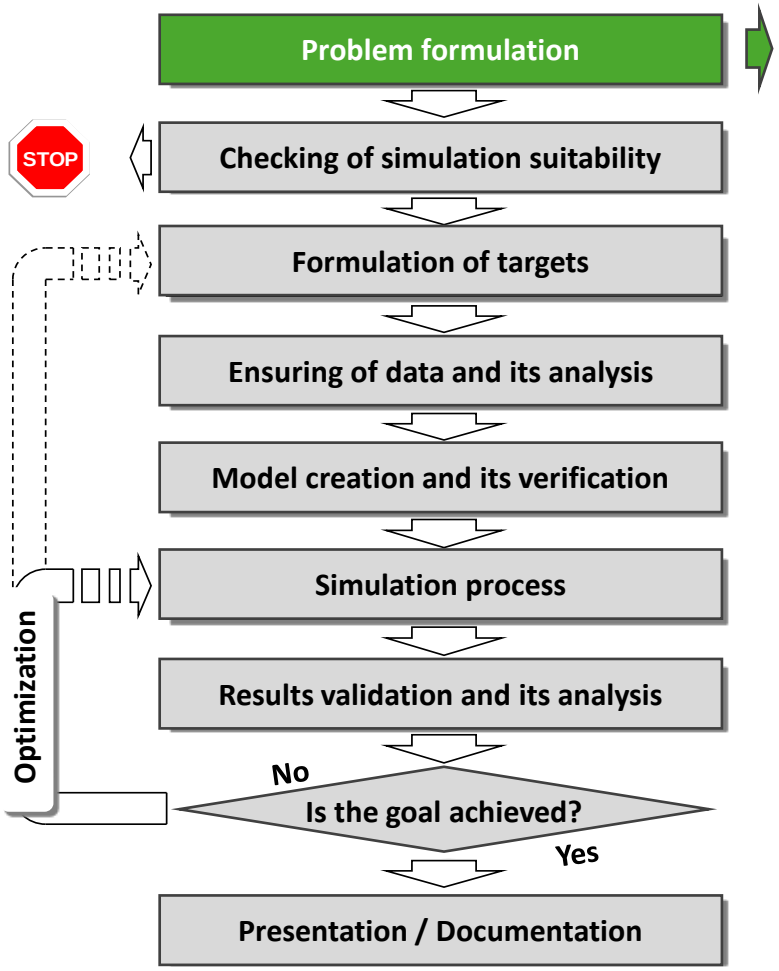
	Var.1	Var.2	Var.3
Bp	●	◒	○
Ng	●	◒	○
DLZ	○	◒	●

Optimal concept
- Capacities
- Layout
- Management strategy
- …

Methodology of the simulation project

ŠKODA AUTO University

Phase model of simulation project

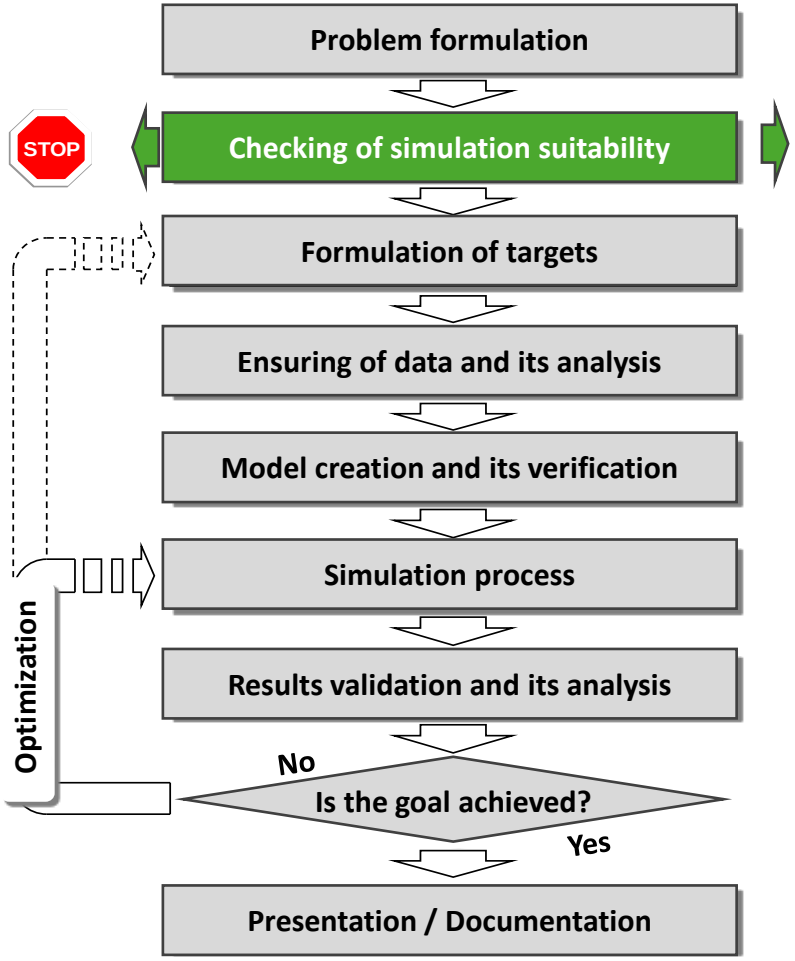


1) Creating of the team, getting know with production, process and system structure understanding.
2) Determination of all interested persons' responsibilities .
3) Problem definition.
4) Define problems, which need to be solved.
5) Verification, whether the defined steps lead towards defining of the problem
6) Write down defined problem, consider and approve it with the team.

Methodology of the simulation project

ŠKODA AUTO University

Phase model of simulation project

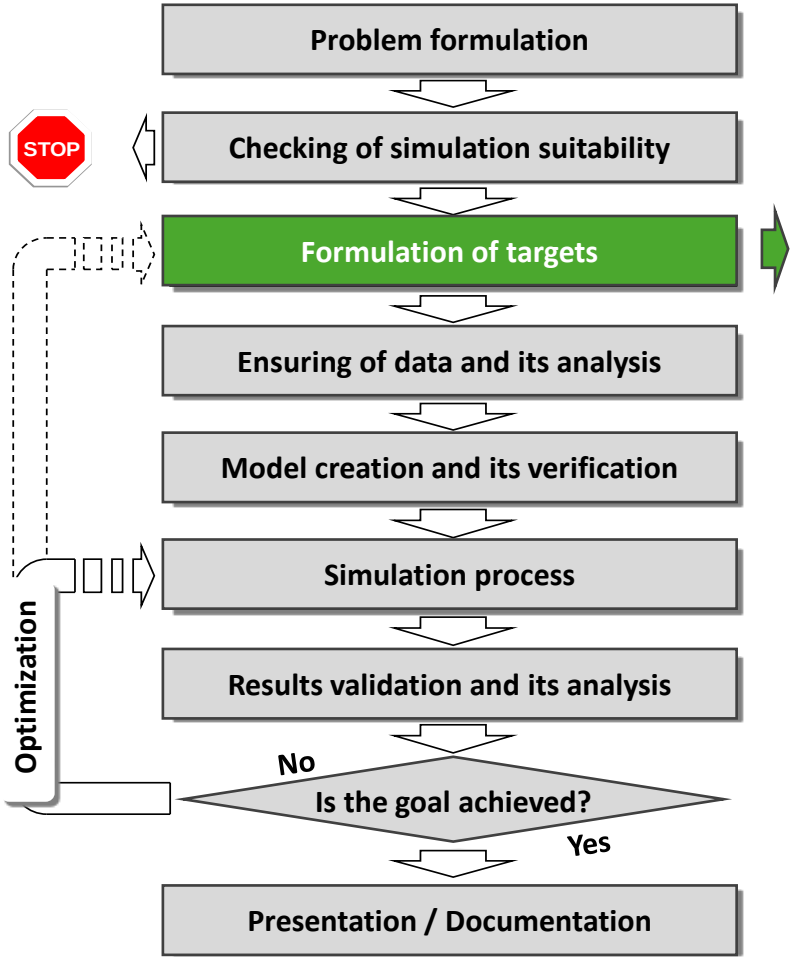


1) Analyze the defined problem with all participants.
2) Verify, what is necessary to simulate (scope simulation required).
3) Defining of possibilities and limits of the simulation.
4) Verify, whether it is possible to solve the problem with help of the simulation.

Methodology of the simulation project

ŠKODA AUTO University

Phase model of simulation project

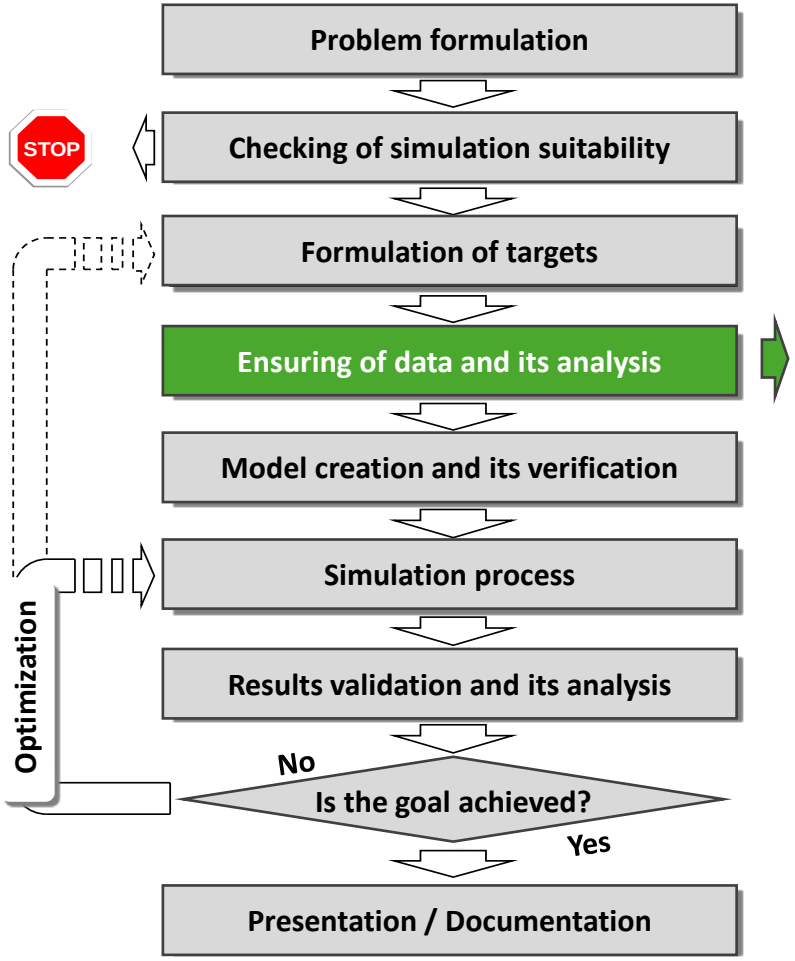


1) Set the superior targets.
2) Set sub-option tasks (define clear and simple tasks).
3) Set the superior targets.
4) Set system boundary and interface of system surroundings.
5) Set measures and indicators.
6) Is it single or repeated simulation?
7) Estimate the possibility of simulation implementation, done by supplier.
8) Written agreement regarding the lead time of simulation project. Must be confirmed by all participants.
9) Accepted agreement by all participants with defined plan and process of the project.
10) Approved agreement by all participants about the purpose and aim of the project.
11) Approved agreement by all participants with defined costs of the project.
12) Set the documents, which have to be elaborated.

Methodology of the simulation project

ŠKODA AUTO University

Phase model of simulation project

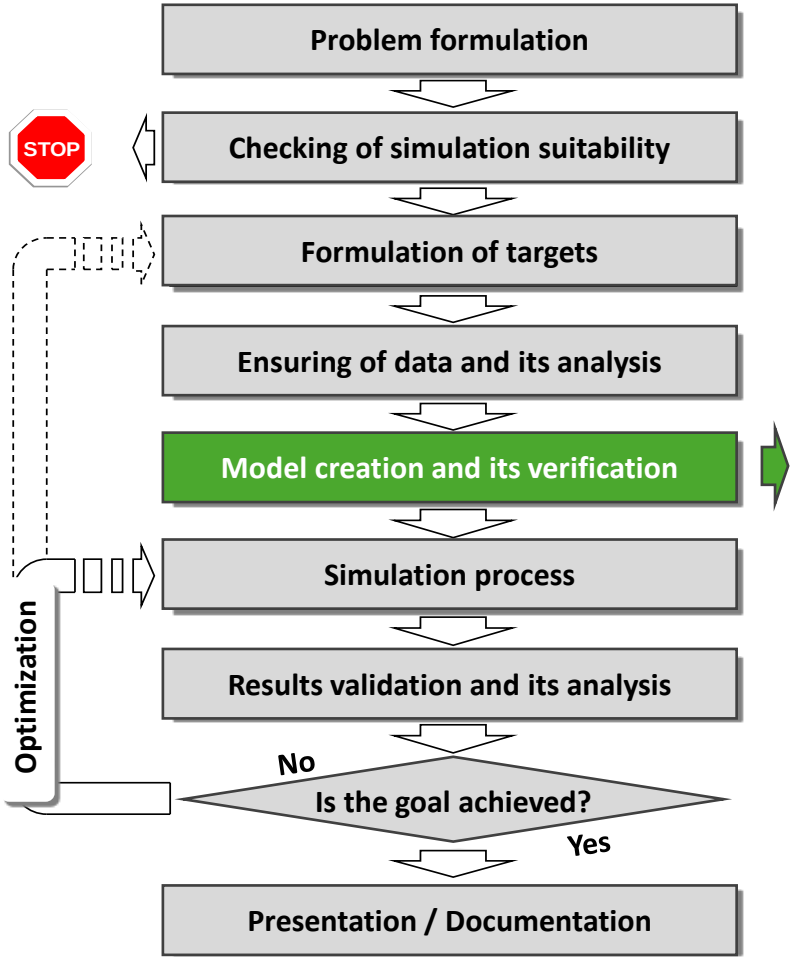


1) Departments of organization.
2) Personnel.
3) Product.
4) Set of products / Set of goods.
5) Working plan.
6) Workplace.
7) Purchase order.
8) Goods acceptance.
9) Buffer(s).
10) Warehouses.
11) Means of transport.

Methodology of the simulation project

ŠKODA AUTO University

Phase model of simulation project

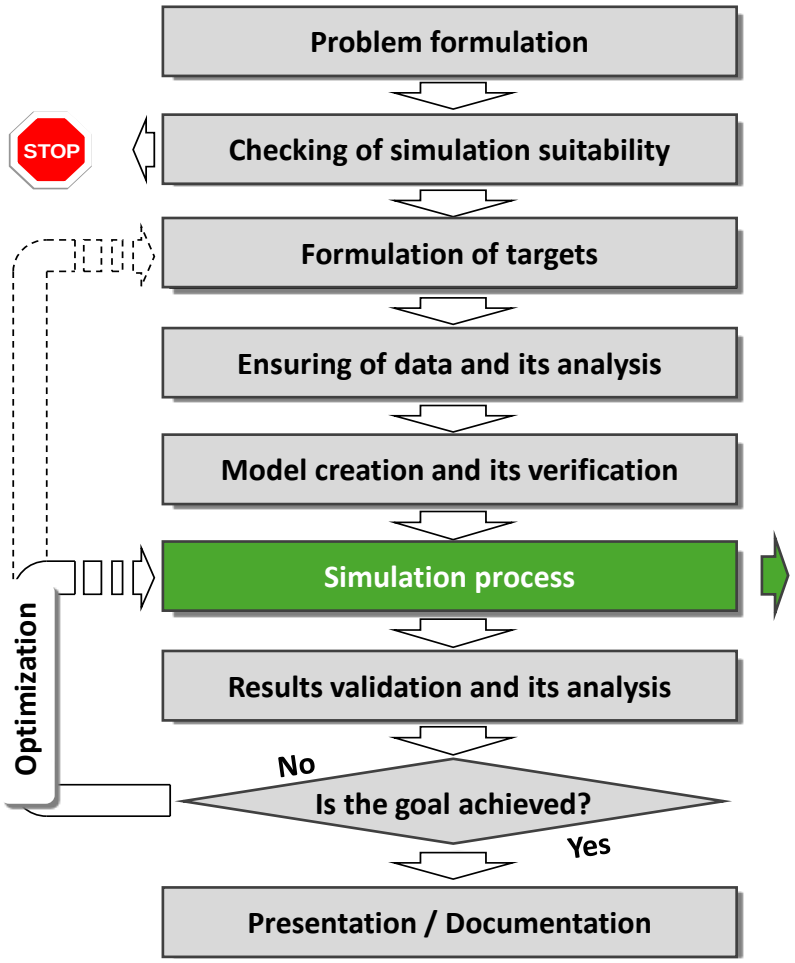


1) Elaboration of the conceptual model.
2) Start of the simulation model realization.
3) Consultation with the customer regarding the confirmation of solved problem.
4) Other data collection.
5) Elaboration of detailed conceptual model.
6) Partial presentation of the model to verify the model with the rest of the team.
7) Finishing of the draft version of the simulation model.
8) Implementation of the model.
9) Confirmation – validation and verification of the model.
10) Corrections of the model.
11) Finishing of the model, prepared to experiments.

Methodology of the simulation project

ŠKODA AUTO University

Phase model of simulation project

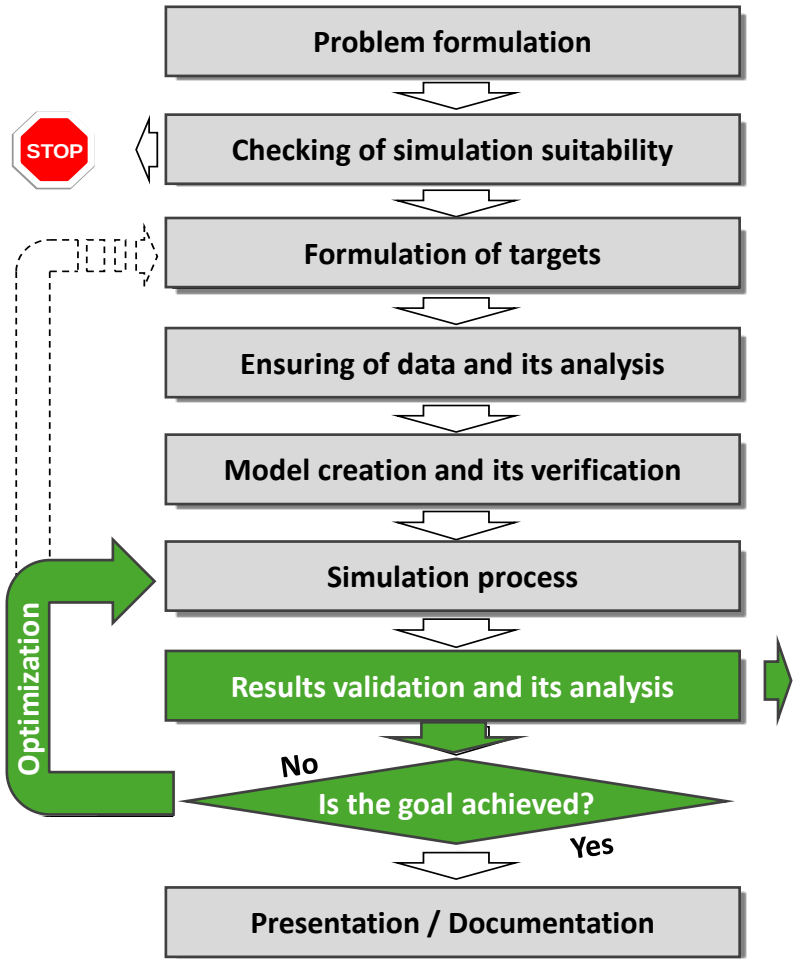


1) Creating of a test plan.
2) Consultation of the test plan with the customer.
3) Experiments realization.
4) Recording of experiments.

Methodology of the simulation project

ŠKODA AUTO University

Phase model of simulation project

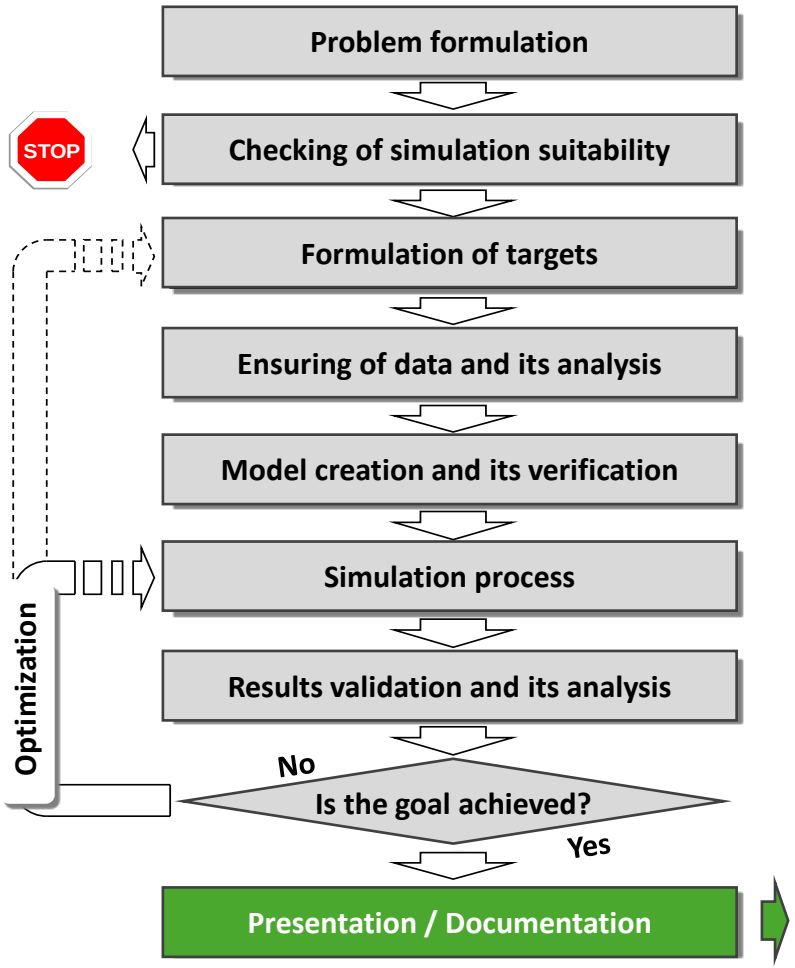


1) Results validation.
2) Discussion with customer regarding the next steps of the simulation.
3) Repeating of necessary steps until the full result validation.
4) Selection and classification of documents.
5) Simulation's results modification.
6) Results interpretation.
7) Costs & benefits analysis.

Methodology of the simulation project

ŠKODA AUTO University

Phase model of simulation project



1) Presentation of the results to the customer, incl. illustrative demonstration of the simulation processes.
2) Comparing of the situation “before” and “after”.
3) Discussion about reached targets.
4) Discussion about next steps.
5) Project documentation. Are all the results and solutions documented?
6) Documentation handover.

Methodology of the simulation project

ŠKODA AUTO University

Advantages of discrete simulations

- Created simulation model leads to easier understanding of the real system behavior.
- Years of experiences with a real system can be reduced on minutes or hours.
- Simulation does not interrupt processes in a real system.
- Simulation is more general than mathematical models.
- Simulation can be used as a game for obtaining of experiences.
- Simulation can be use for analysis of transients and boundary conditions (not always possible at mathematical models).
- Simulation often uses “what – if” questions for an answer searching.

Methodology of the simulation project

ŠKODA AUTO University

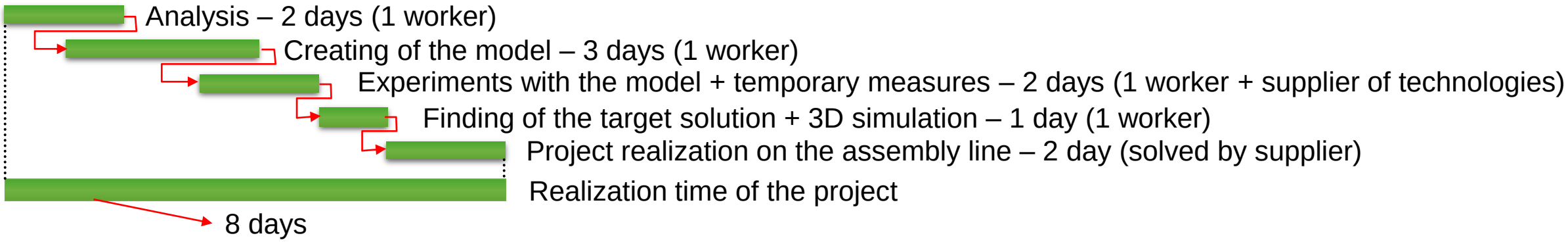
Disadvantages of discrete simulations

- There is not guarantee that the model will give correct results.
- Sometimes, there is no way to determine authenticity of a model.
- Creation of a simulation model can take a lot of time.
- Simulation run of more complex models need higher computer performance.
- Simulation techniques still suffer from an insufficiently standardize approach.
- In case of complex models, larger team of specialists could be needed.

Methodology of the simulation project

ŠKODA AUTO University

Project timeline – project example



Solution benefits:

- Reduction of main line blocking from 40 minutes per shift to 3 minutes.
- With additional investments, the possibility to reduce blocking to less than 1 minute.

Costs:

- Work of two simulations specialists.
- Software license.
- Programming of control logic on the assembly line (solved by supplier).

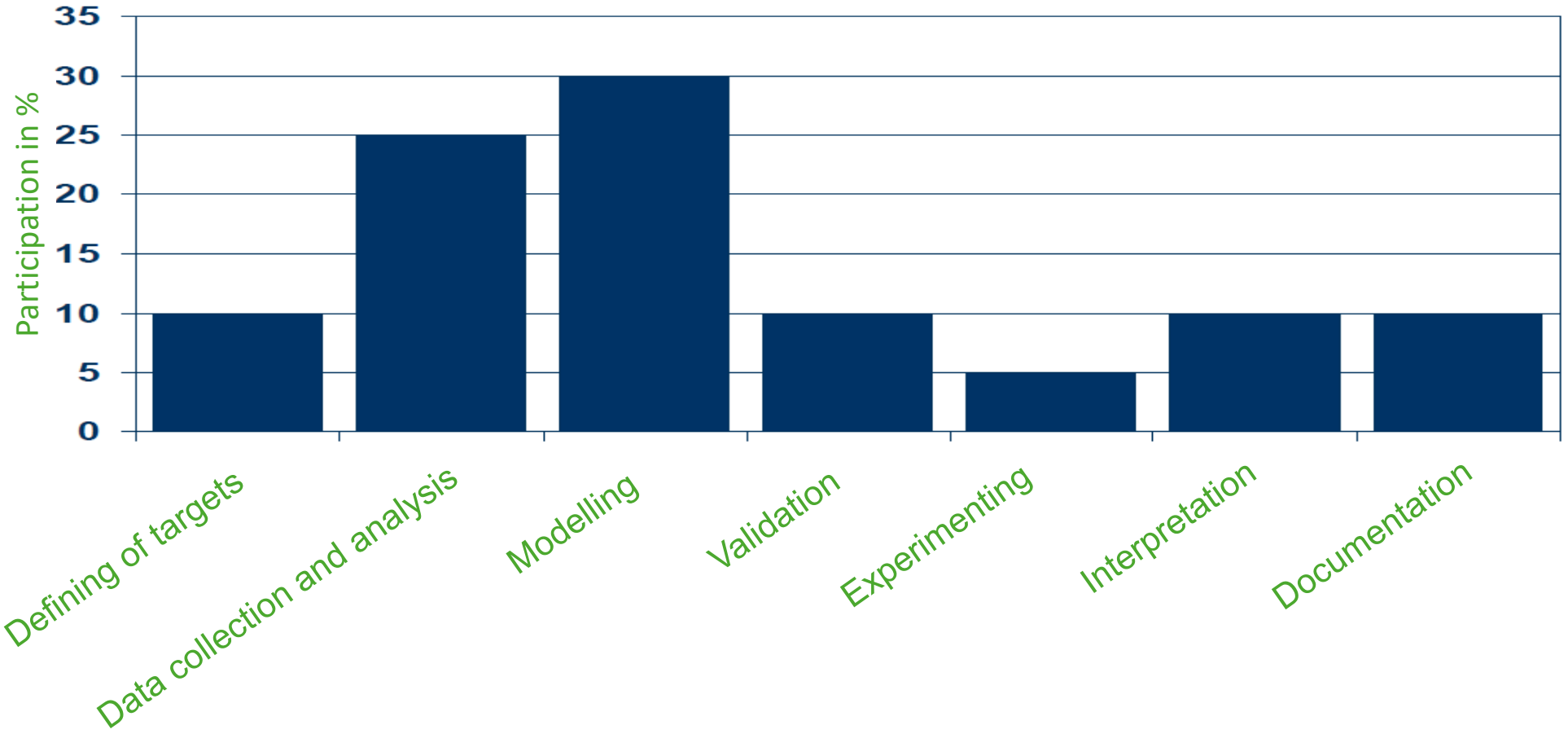
10 : 1

(typical benefit & cost ratio)

Methodology of the simulation project

ŠKODA AUTO University

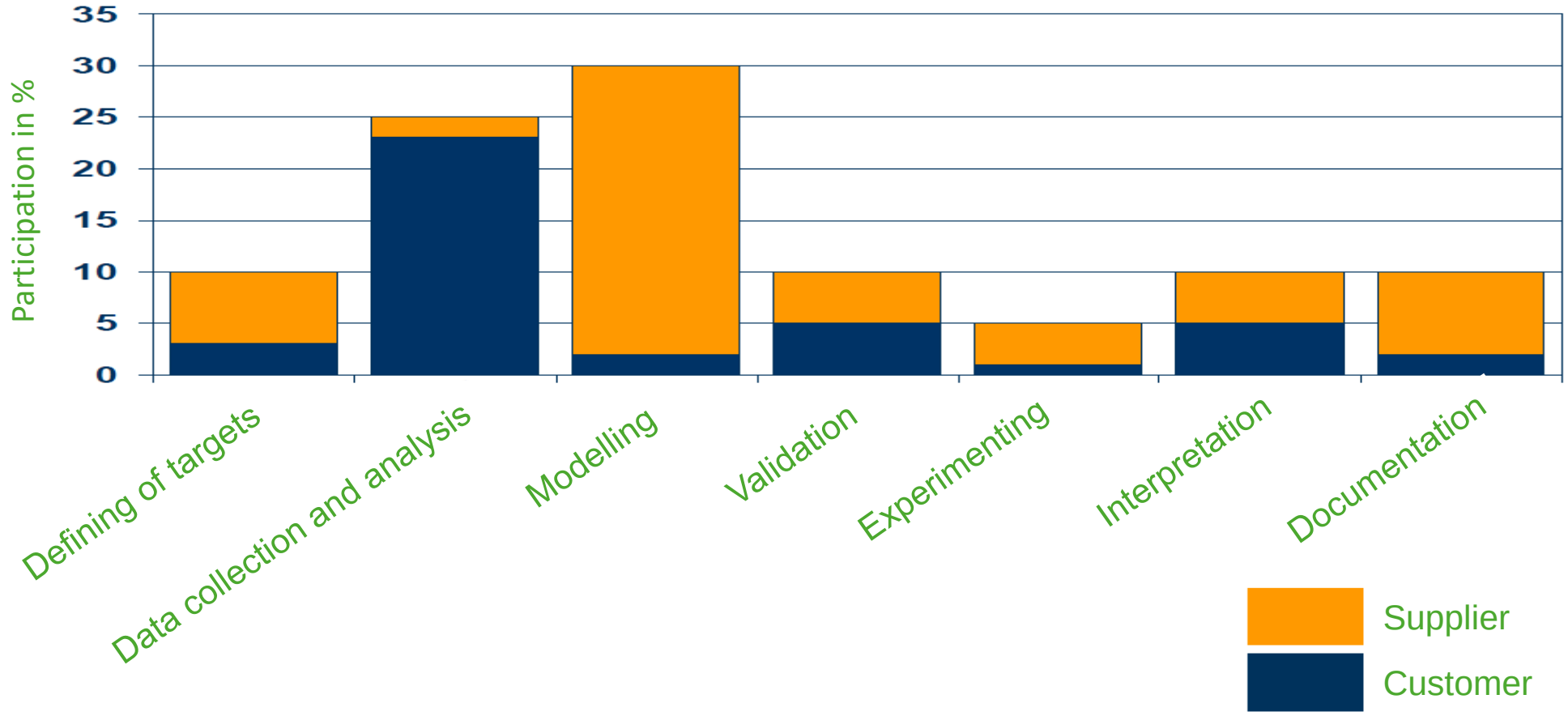
Participation of individual activities on the whole project



Methodology of the simulation project

ŠKODA AUTO University

Participation of individual activities – customer vs. supplier



Thank you for attention

Jan Fábry

Department of Production, Logistics and Quality Management

fabry@savs.cz www.janfabry.cz

www.savs.cz