

Performance calculation for order picking systems

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1 Department for Materials Handling, Material Flow, Logistics (fml)

2 Planning of order picking systems

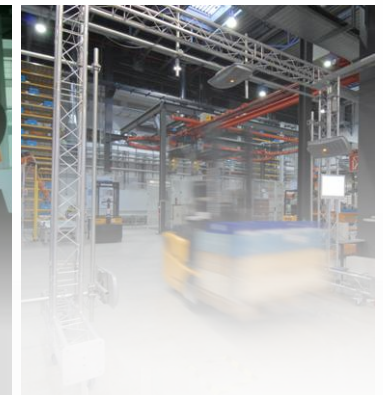
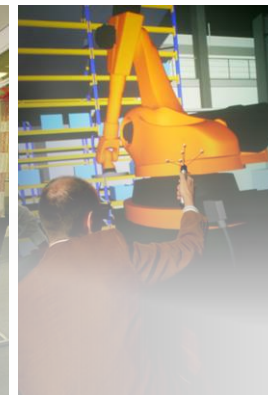
3 Tools for the planning of order picking systems

4 Toolbox of the department fml

5 Case study

6 Summary

- 44 employees, therefrom 33 scientific assistants
- assisted by 60 auxiliary student assistants
- Some key aspects of the research activities at our department:
 - RFID
 - Computer-integrated planning and logistics systems simulation
 - Flexible material-flow-systems for production
 - Technology of stocks- and material-flow-systems



What means order picking?

Order picking is taking subsets (contents of the shopping bag) due to the requirements (shopping list) from a total quantity of items (assortment of the supermarket).



Picking system spectrum



rising manual processes portion

rising automation degree

Picking system organization areas

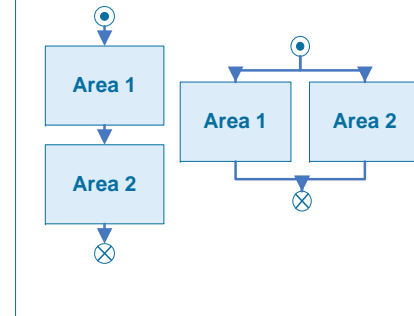
information system



material flow system



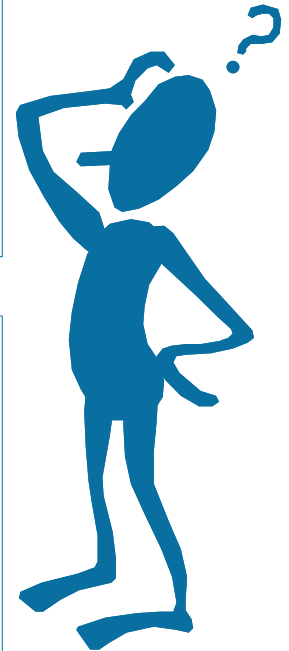
organisation system



order picking system

requirements

influencing variables



Rough planning of Picking system = search for the best individual solution.

Individual solution vs. standard solution.

- In the phase of rough planning (system identification) it can be worked with a degree of abstraction, without revisiting the planning quality.
- This abstraction makes possible to work with standardized models from different order picking processes (modules).
- By the individual combination of different modules, picking system organization possibilities can be provided and their performance can be determined.

Simulation bases rough planning

- *Standardized* preprocessing and evaluation for input data for the planning.
- Development of *standardized* simulation modules for a fast simulation models creation.
- *Standardized* simulation results evaluation (computation of key figure).

Analytic methods for rough planning

- *Standardized* preprocessing and evaluation for input data for the planning.
- Development of *standardized* calculation methods for different order picking processes.

Simulating or analytical calculation?

- This question must be answered in dependence of planning or investigation task.

PlanKom

- User interface for the planner
- Planning process supports

DatKom

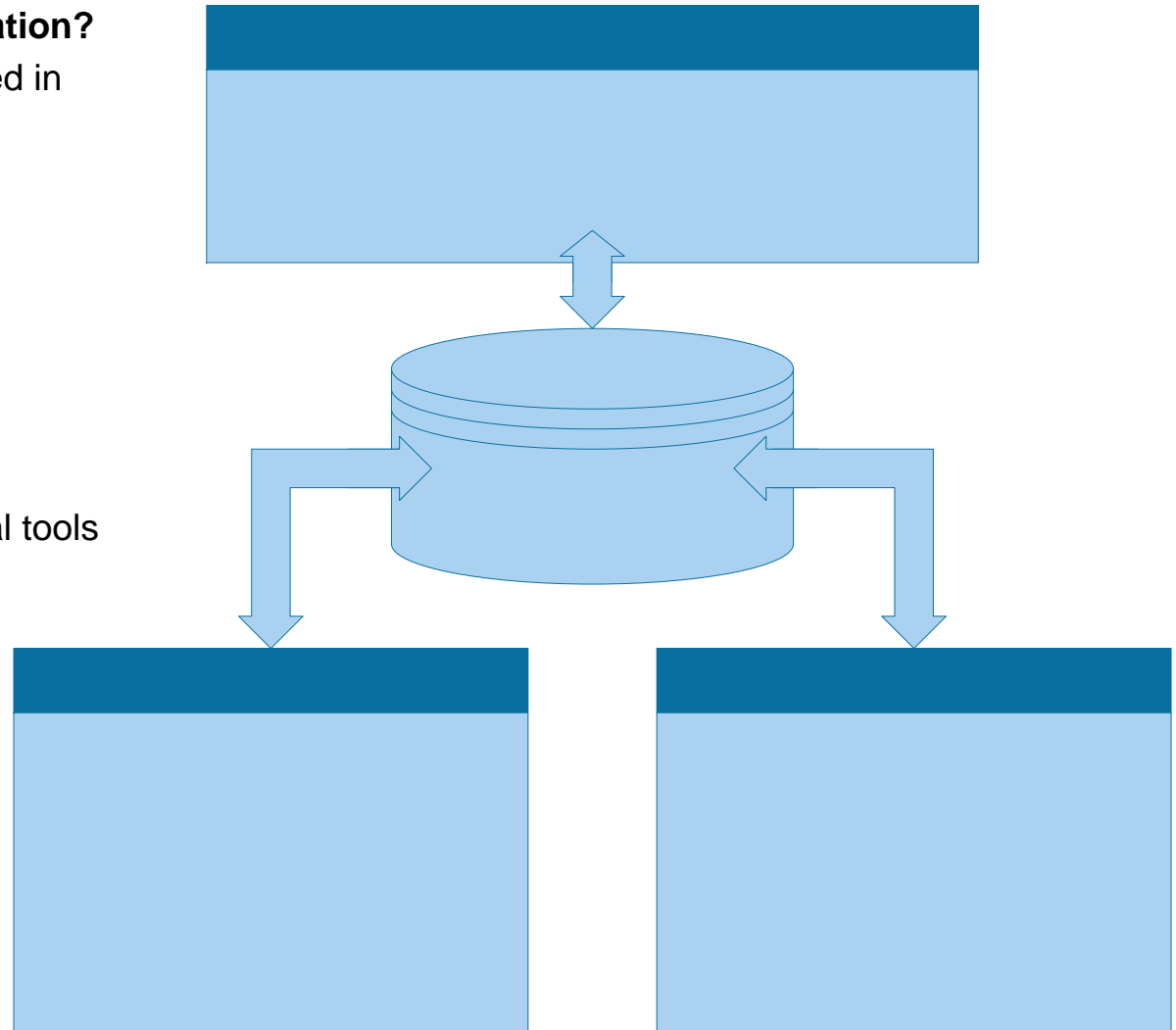
- Storage of all data
- Interface between the individual tools

SimKom

- Standard simulation modules on eM-Plant

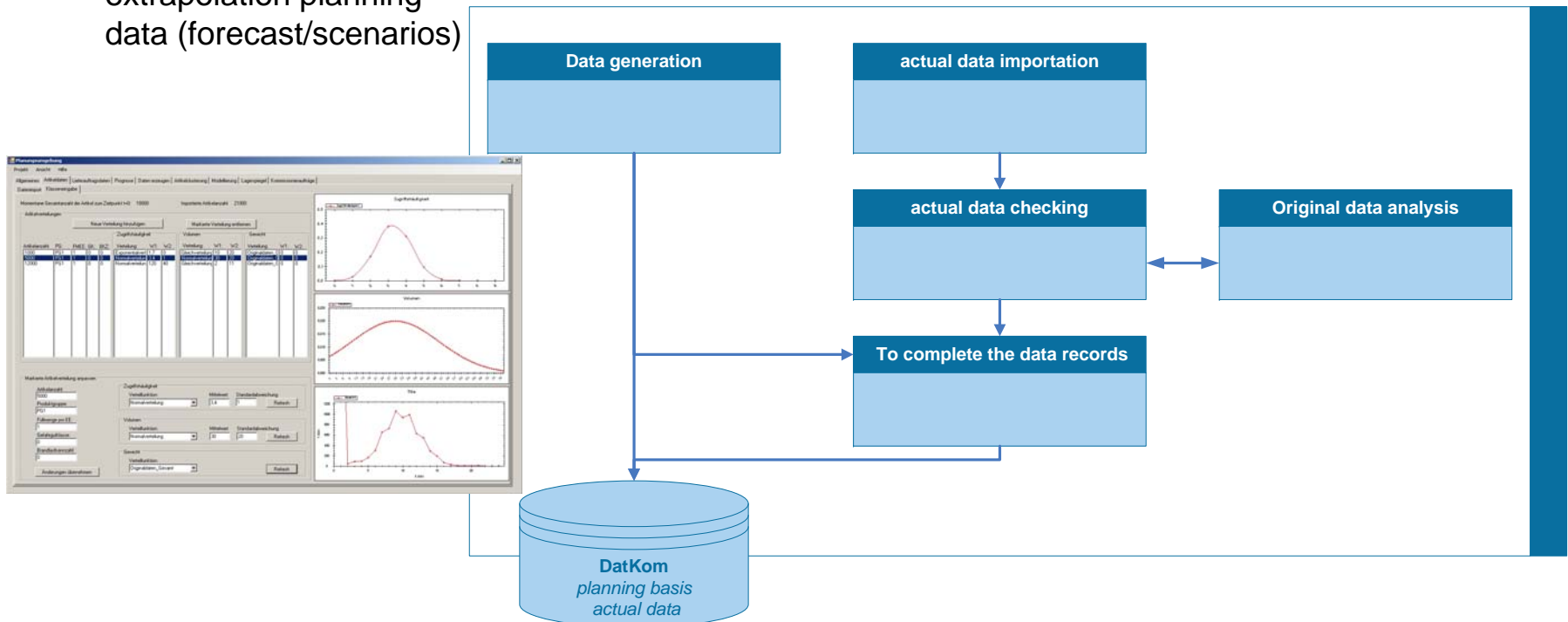
AnKom

- Calculation methods
- Allocation between calculation methods and picking proceed



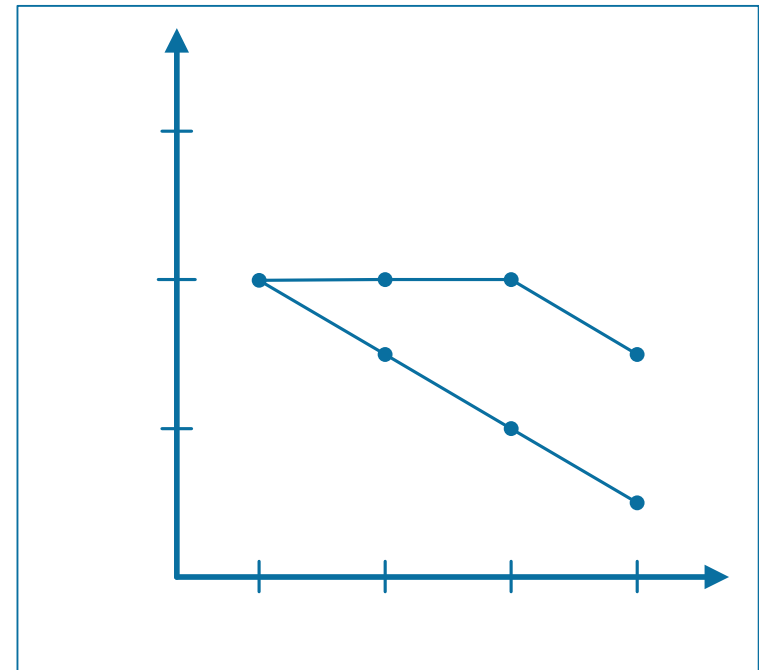
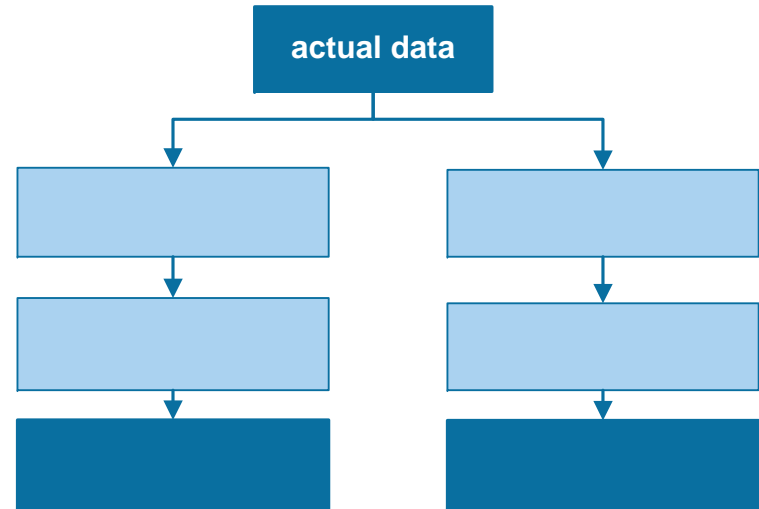
Therewith simulation or performance calculation without large adaptation expenditure can take place, the project data must be prepared and be brought into a standardized data format.

- Import of actual data (original data) and their allocation
- Check the complete of actual data
- Partial or complete data generation based on the actual data or the distribution functions
- extrapolation planning data (forecast/scenarios)



More importantly than the actual numbers is the requirements extrapolation for the planning horizon.

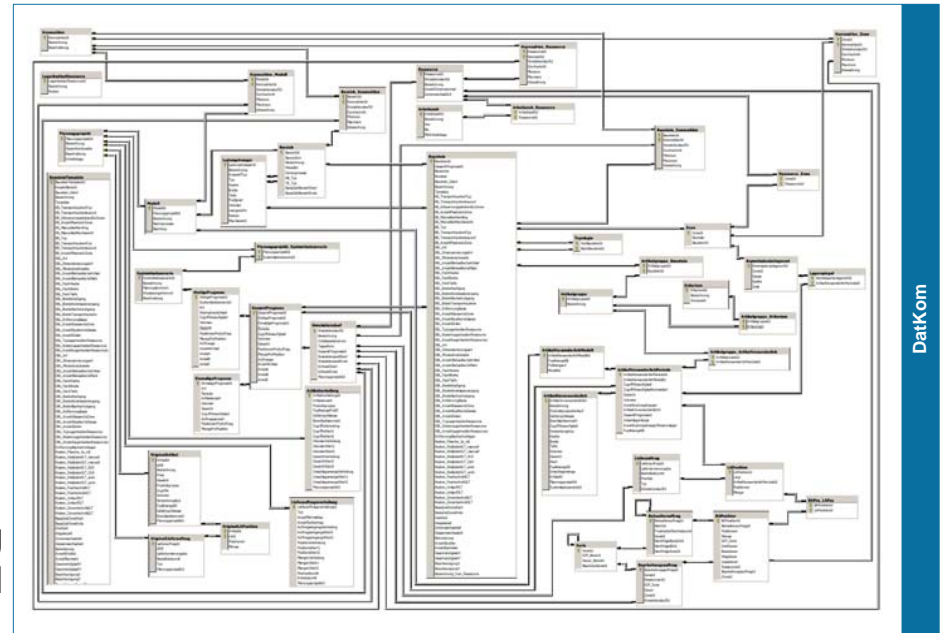
- Extrapolation of the requirements is based on assumptions and describes the requirements to the picking system over the planning horizon.
- The assumptions are subject to an uncertainty, so planning time cannot yet be described with 100% security requirements.
- In order to reduce the risk of an insufficient planning, different assumptions (scenarios) can be consulted and be judged thus the adaptability by planning variants for decision can be made.
- Up to three different scenarios can be described by PlanKom. Thereby different parameters can be changed.

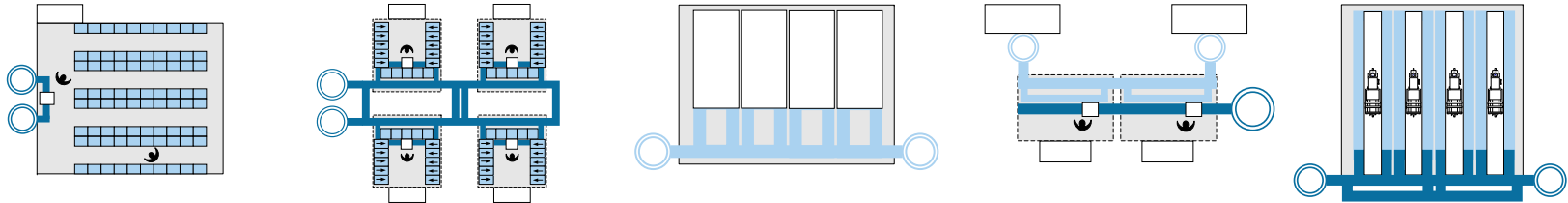


The main toolbox constructs the DatKom-data base. The main function with the toolbox development is to build a data structure, so all usual picking systems (layout and requirements) can be described.

- The data base consists of 7 different ranges. These are:
 - picking system description,
 - picking processes description,
 - requirements description,
 - system load description,
 - coworker administration for simulation,
 - simulation results,
 - calculation results.

- Parts of the data apply to the entire planning horizon and other data records apply to special time periods.





- the classical person-to-goods picking with providing articles statically in small parts storage racks or pallet racks without automation technology
- the local picking with providing articles statically supported by materials handling (container loop), also referred to as “zone-picking”
- automatic small-parts warehouse or automatic high rack warehouse
- the classical goods-to-person picking in a picking station
- the inverse picking in a picking station
- the person-to-goods picking with manned rack feeders

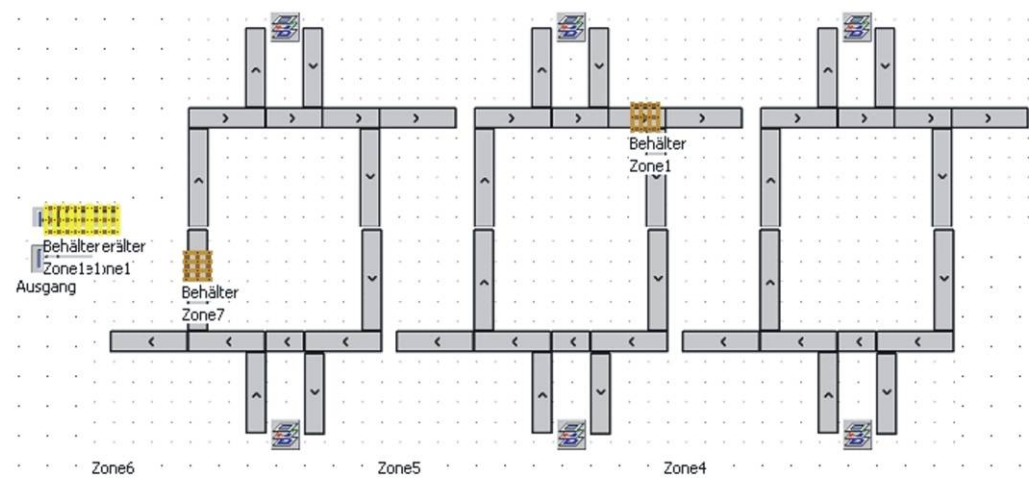


Anzahl_Zonen=6
Abkürzungsabstand=1

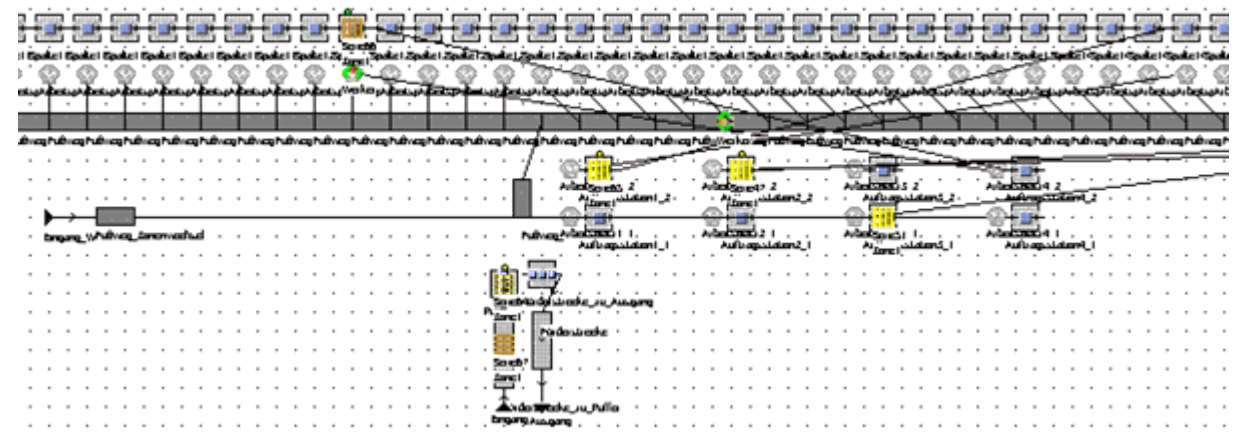


Anzahl_Behälter=2
Anzahl_Behälter_max=2

Container loop: Supporting materials handling system



Detailed view of a zone

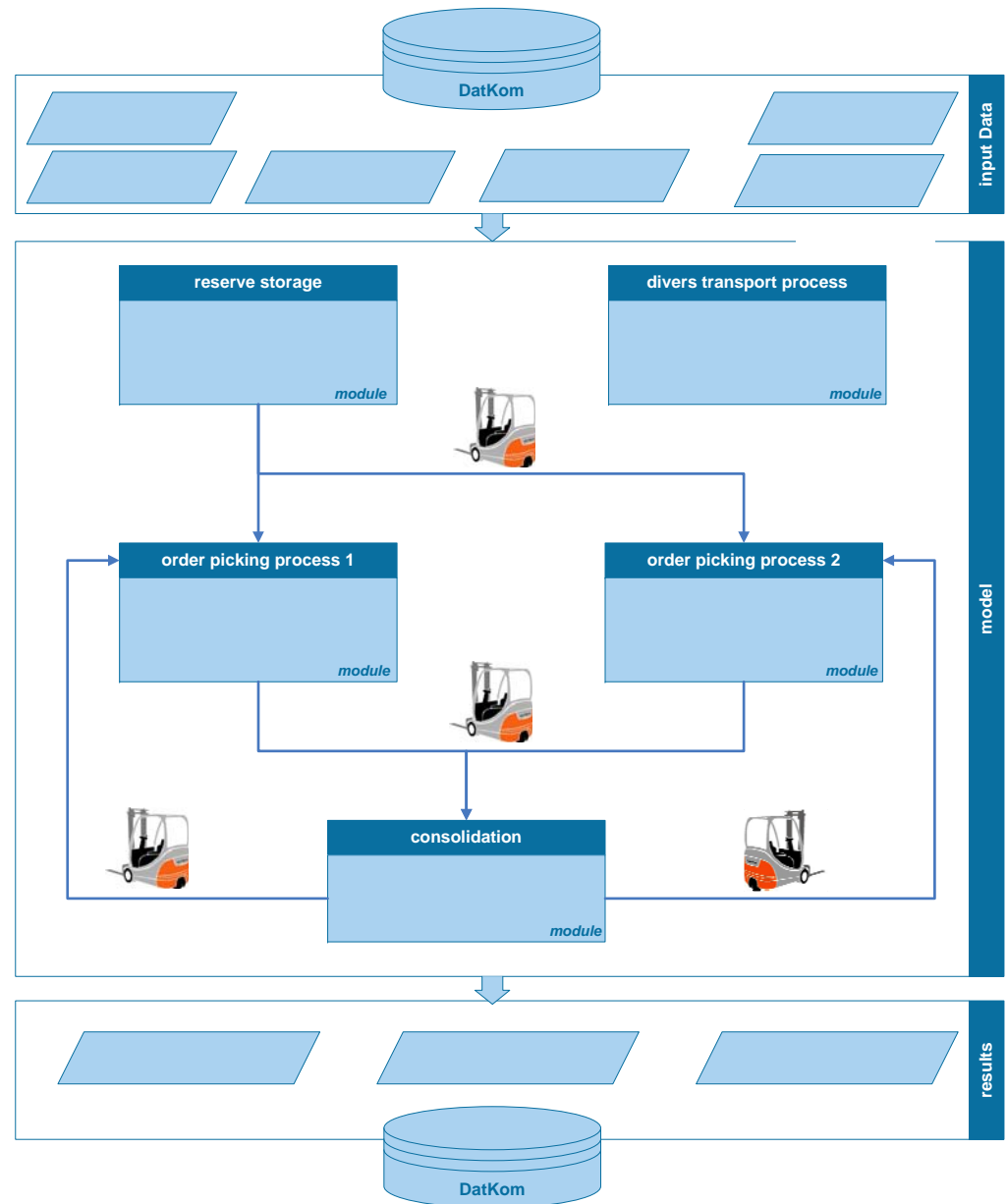


Realisation of modules

- the classical person-to-goods picking with providing articles statically without automation technology, linear motion and central delivery. (1)
- person-to-goods picking with providing articles statically, two-dimensional motion with special rack feeders, manual taking and central delivery. (2)
- goods-to-person picking with providing articles dynamically , manual taking and central delivery. (3)

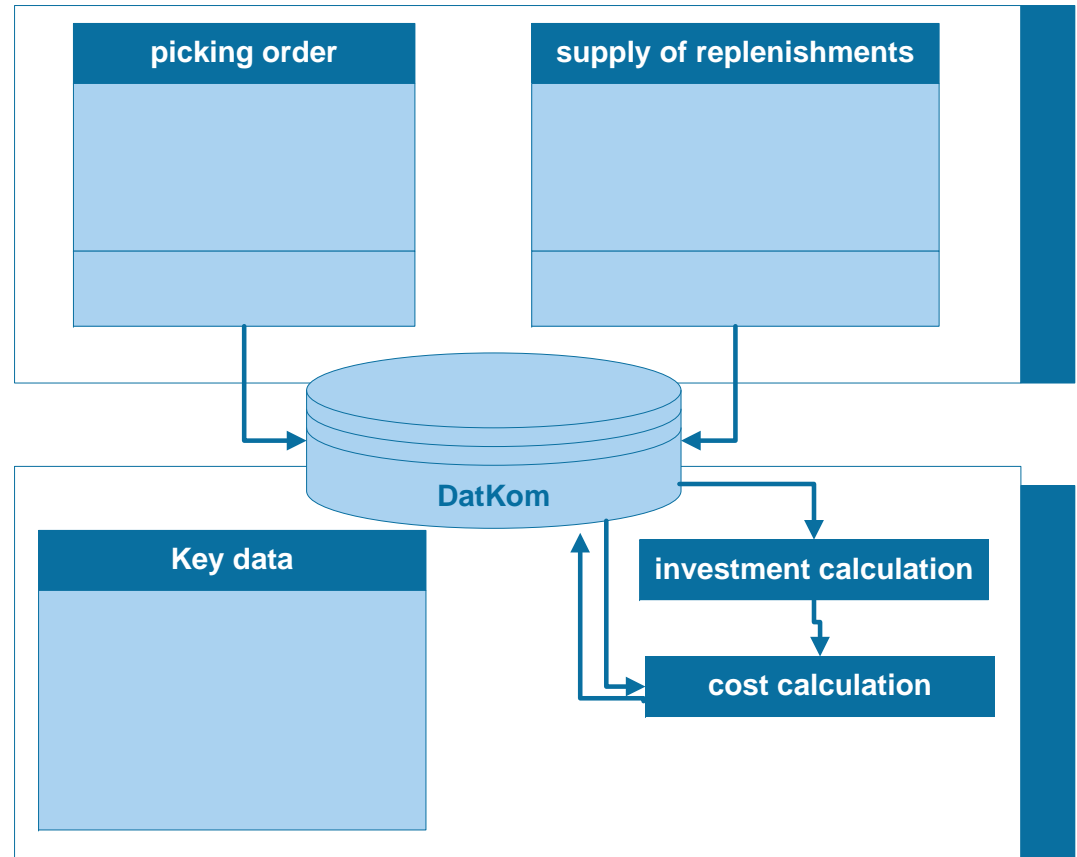


- Models can be composed of several modules.
- The models core are the modules for the different picking processes.
- A module defined the analytical methods for calculation of the cost (time) for order picking and replenishment.
- Other types of modules exist for the processes in :
 - the reserve storage,
 - the consolidation
 - and for the transport between the modules.



Performance key data can be calculated monetary key data by an additional investment and cost appraisal.

- All calculated values will be stored in the data base.
- The values to key data can be abstracted by database queries .
- The data base DatKom includes cost rate for different investment goods (stored racks, ...). Based on this the investment and cost for a planning version can be calculated.



simulation advantage

- a detailed description of planning versions
- interaction will be respected (sequence of the orders)
- process allowance will be respected (dead times)
- visual inspection of the material flow is possible
- cycle time can be determined by the start and end time
-

simulation disadvantage

- longer computing time
- special software necessary
- statistical safety must be ensured

analytical calculation advantage

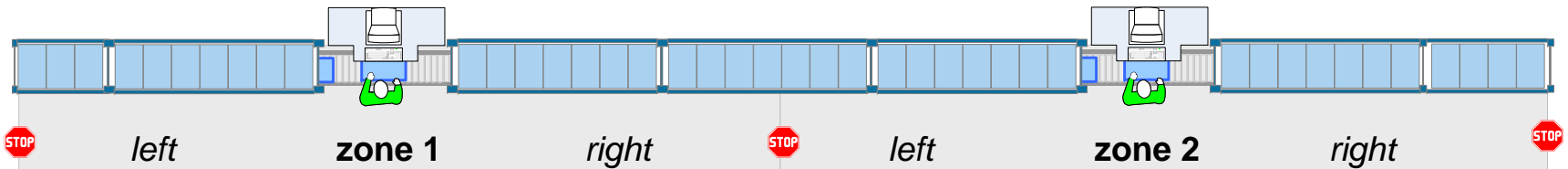
- short computing time
- special software is not necessary (possible to use MS Excel)
- Optimization (convergence) by the variation of input parameters, such as:
 - Allocation between articles and picking process (module)
 - Change of stock reach (Trade-off between supply frequency and walking time for the picking)

analytical calculation disadvantage

- A vague approximation of the distribution functions can affect the results sharpness.
- interaction will not be respected

Pick front must be investigated in this case study . This leads to the question: How long should be the front worked on by a picker or in how many zones should the pick front be divided?

- The picker takes the order at the base (in the middle of the zone).
- Following the order acceptance of the employees he picks first all parts on the right side of the base and then on the left side.
- The articles with the highest frequency of access are located in close proximity to the base.



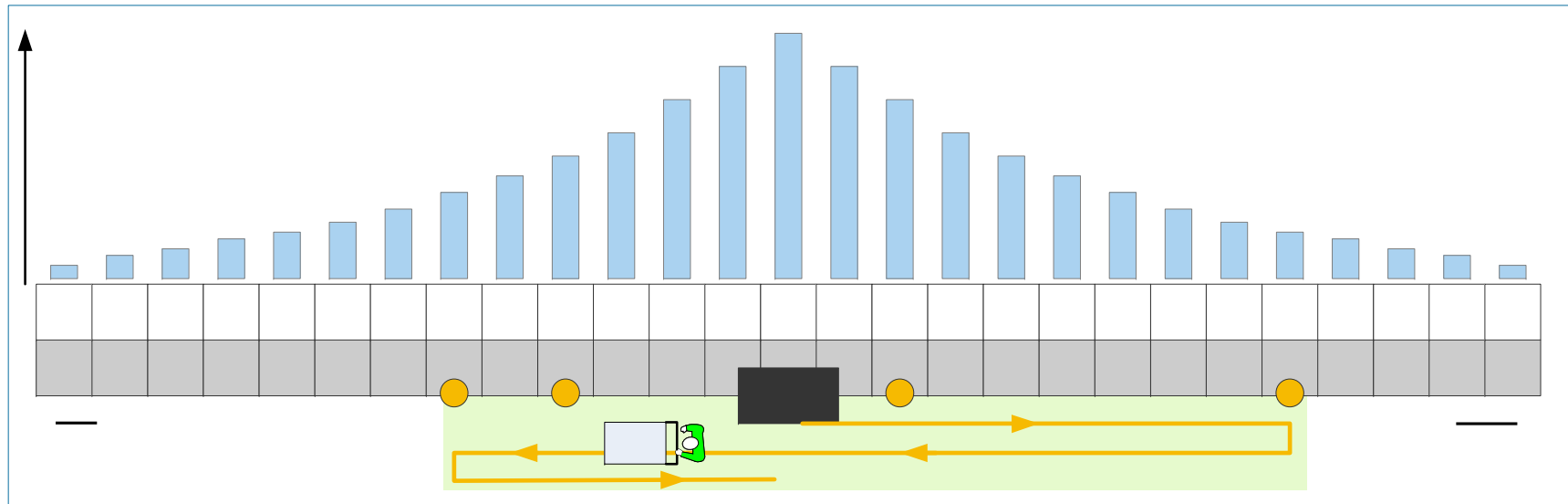
- modell 1: 1 zone with a length of 262,5 m
- modell 2: 2 zones with a length of 131,3 m
- modell 3: 4 zones with a length of 65,6 m
- modell 4: 8 zones with a length of 32,8 m
- modell 5: 16 zones with a length of 16,5 m
- modell 6: 32 zones with a length of 8,2 m

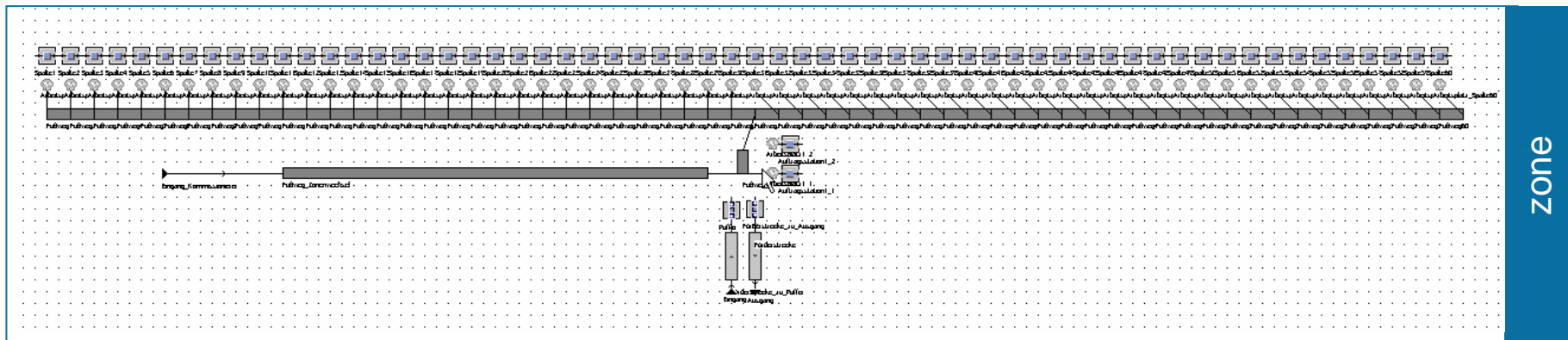
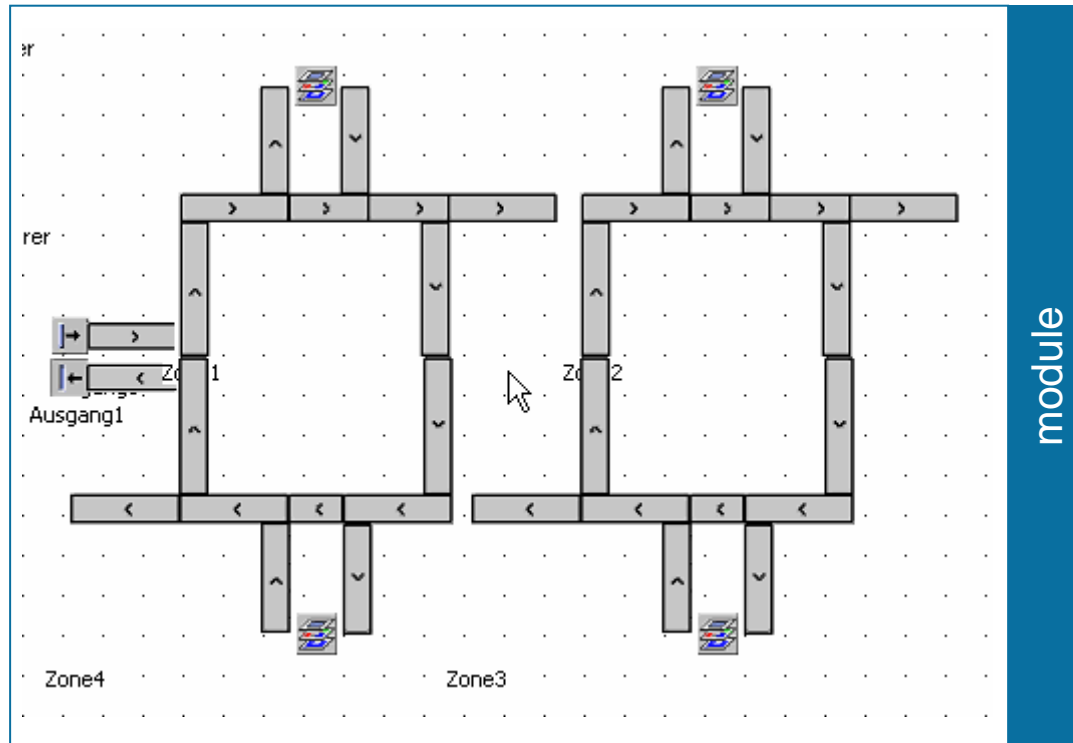
Article and stock structure

- 3.000 parts
- flat ABC-structure
- Ø weight per pick unit < 1 kg
- Ø dimensions per pick unit < 300x300x300 mm
- loading equipment, VDA KLT 6428 600x400x280 mm
- Fast mover concentration with close proximity to the base

Order structure

- scenario 1
 - 2.000 order per day
 - 4 order lines per order
- scenario 2
 - 1.000 order per day
 - 8 order lines per order

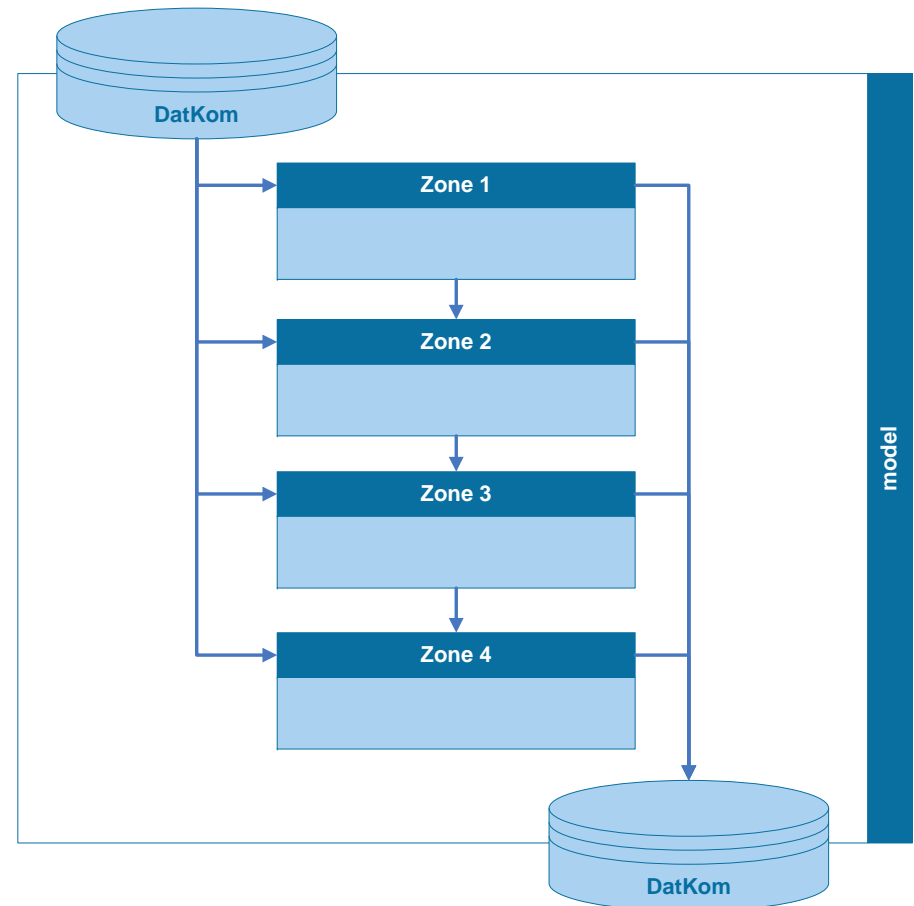
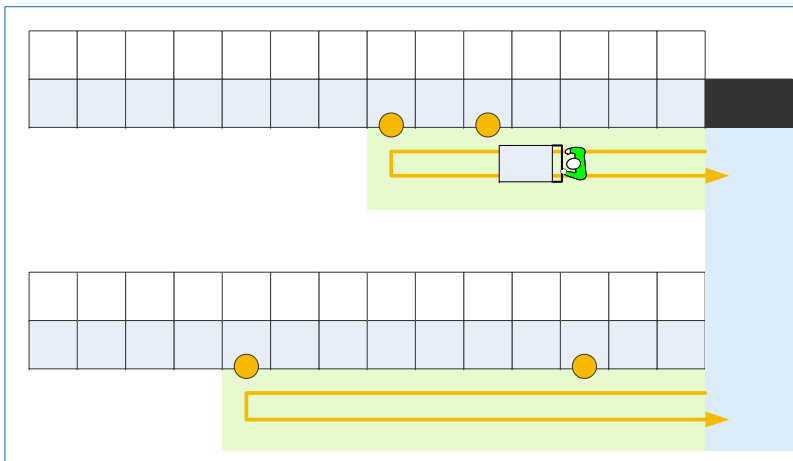




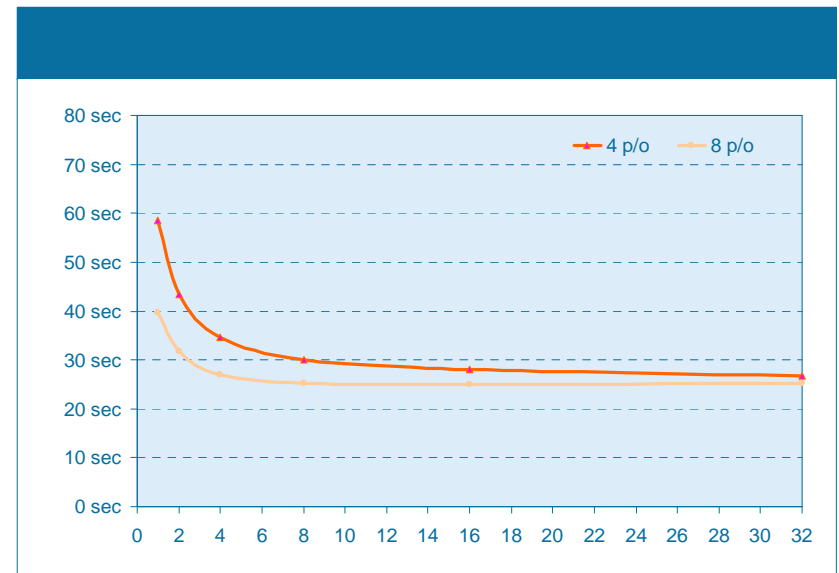
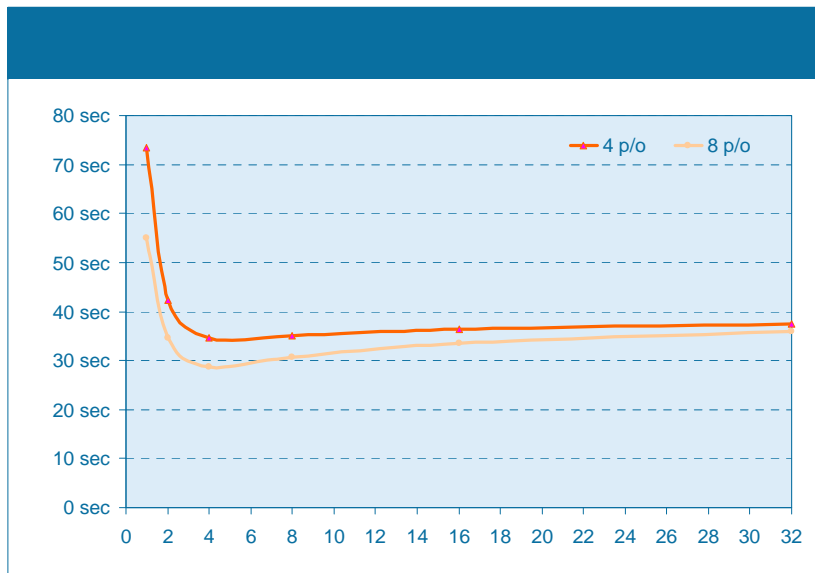
Each zone of the picking system model is mapped by a separate module.
The layout and the parameters of every module are equal.

Type of modules

- classical order-picking providing articles statically and moving in one dimension
- 2 lanes
- concentration of fast movers at the beginning of a lane

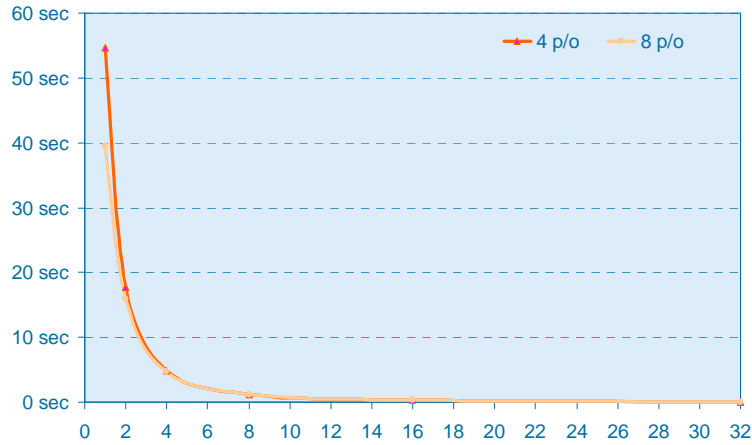


- The results show that the zones should be dimensioned as small as possible in order to increase the output.
- Under consideration of investments (materials handling system) this conclusion is qualified.

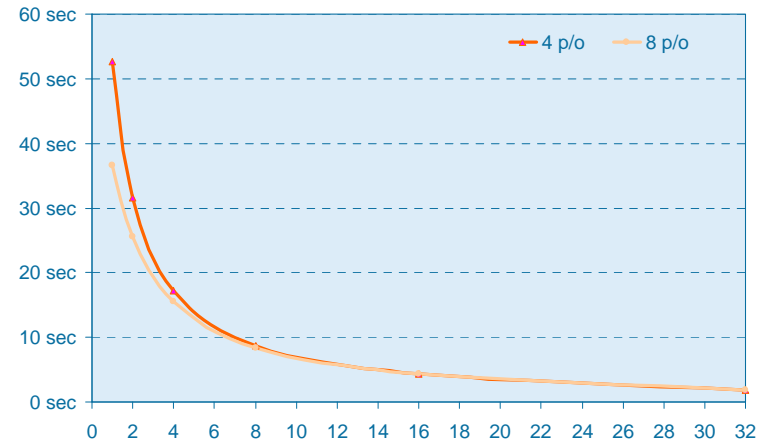


- For rough planning, number of zones would be set in a range between 4 and 6 zones
- In the next step a detailed investigation of the values 4, 5 and 6 for the number of zones should be followed up

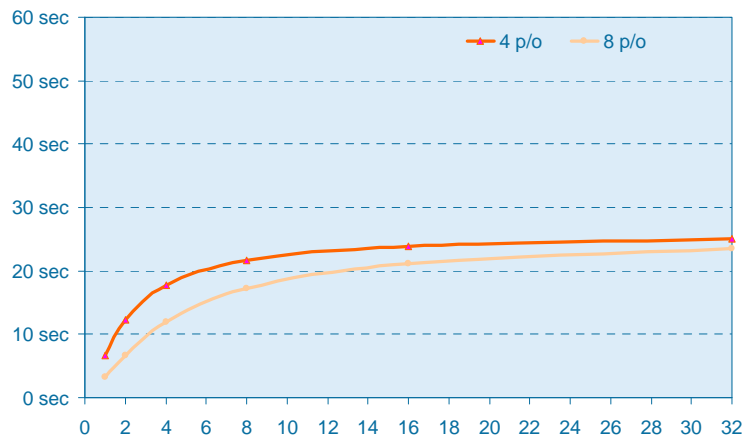
AnKom – walking time per position



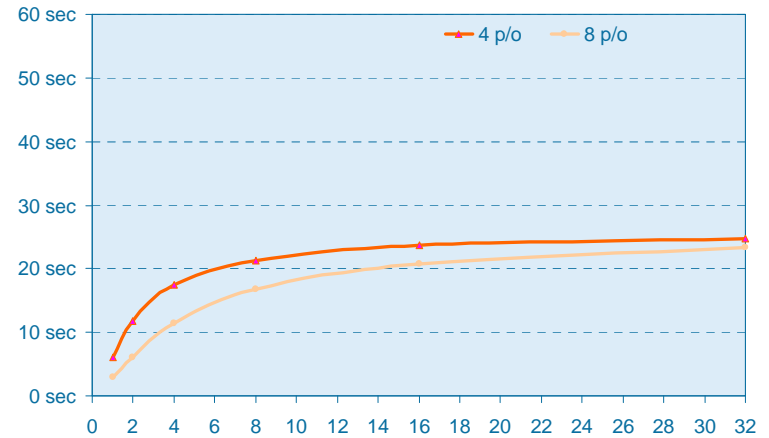
SimKom – walking time per position



AnKom – basis time per position



SimKom – basis time per position



- the developed tools support the planner
- the creativity of the planner is still focused
- in possibility to determine order-picking systems output, the planning process can be speeded up
- workflow of planning is guided so that important steps cannot be neglected
- both the simulation and the analytical methods are qualified for determining order-picking-systems output
- based on the modularity of this library the tool can be amplified
- for determination of processing time simulation is qualified
- by applications in industry the practicability is proofed

