

Performance analysis of manufacturing systems:

a practitioner's point of view

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About CQM

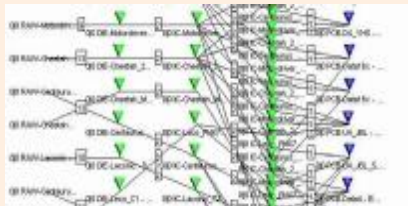
- Specialists in fact-based design and improvement of industrial, administrative and logistic processes
- Focus:
 - planning
 - logistics
 - process improvement
- Knowledge base:
 - six sigma
 - optimization
 - logistic modeling
- Company profile
 - 25 consultants
 - fully owned by management and employees
 - located in Eindhoven
 - over 25 years of experience



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Expert areas



Planning
transport, maintenance, supply chain



Network design and analysis
logistics and traffic networks



Process improvement
six sigma



Product and process design
design for six sigma

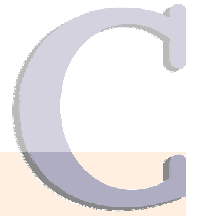
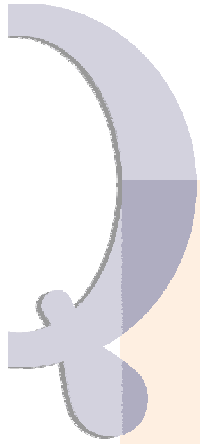
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References



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View on performance analysis and EPT

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Performance analysis: why?

Our customers ask for performance analysis of manufacturing systems, when

- they want to (re)design their manufacturing system
- they need a business case in order to get budget for large investments

Provide certainty with respect to

- expected output and throughput times, required buffer sizes
- consequences for the rest of the factory

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Performance analysis: how?

Real world (spaghetti)



Formulas

$$C = \frac{\int_{t_1}^{t_2} s^2(t) dt}{\int_{t_0}^{t_1} s^2(t) dt}$$

To give high-level insight, use queueing formulas

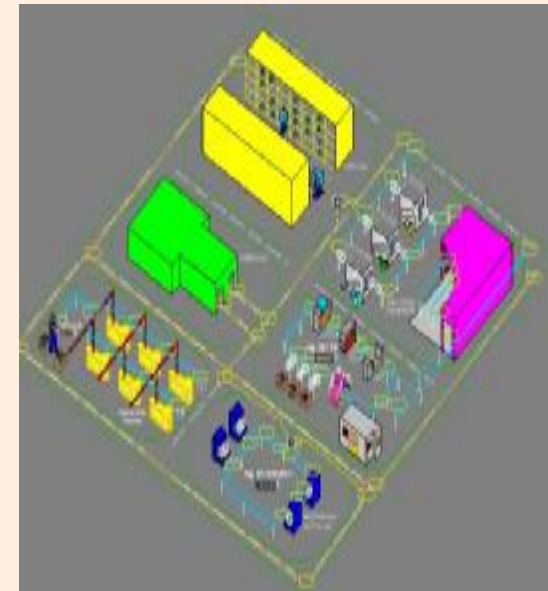
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Performance analysis: how?

Real world (spaghetti)



Simulation



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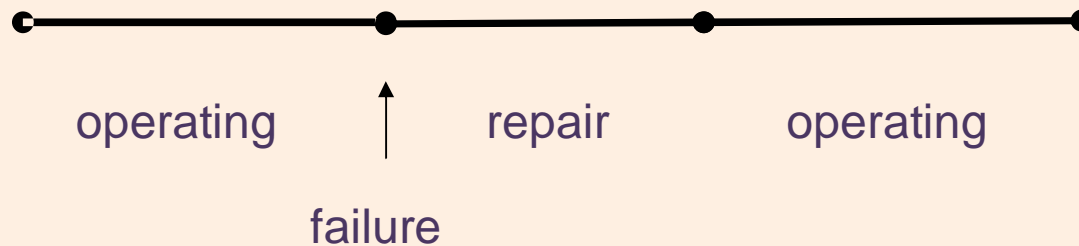
To take detailed design decisions, use simulation (planning, buffer sizes)

Performance analysis: how?

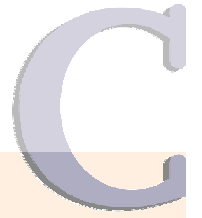
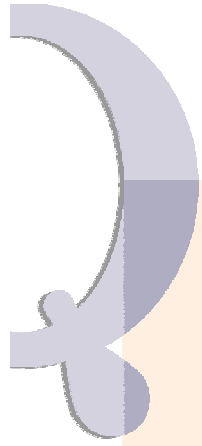
EPT or explicit modeling?

EPT: t_e c_e^2

Explicit: t_o, c_o^2 t_f, c_f^2 t_r, c_r^2



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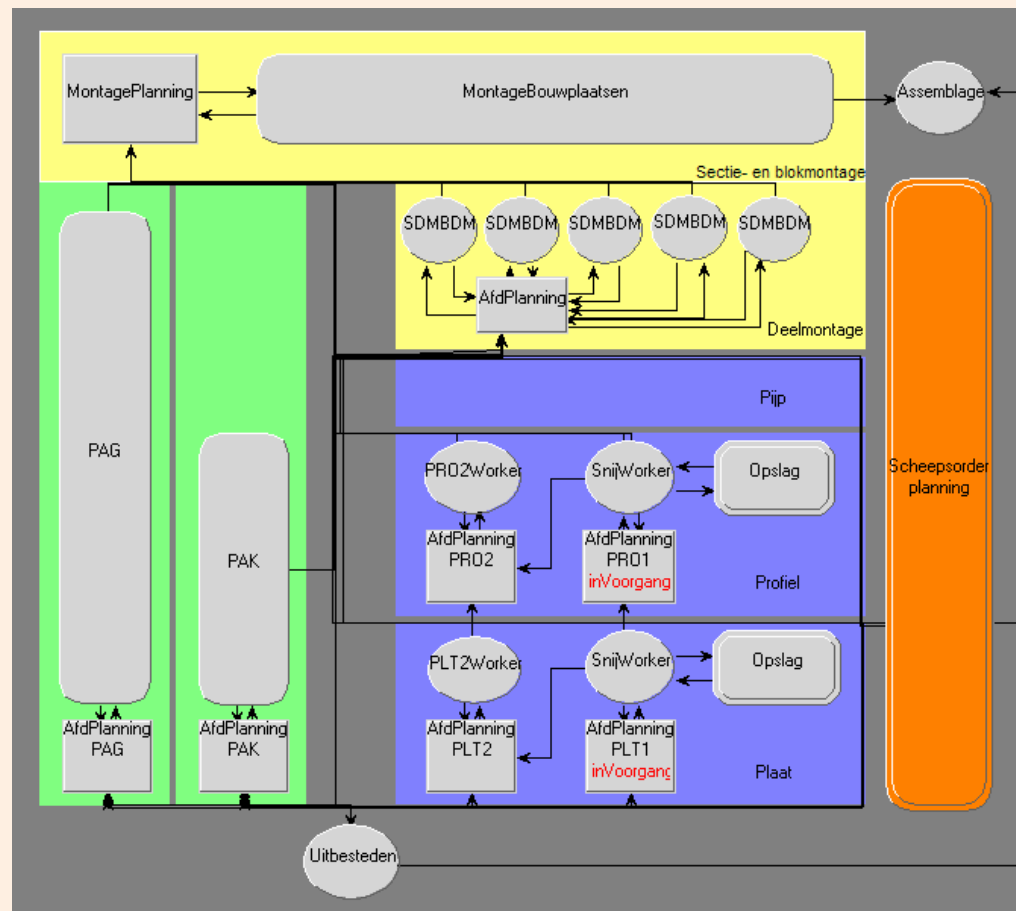


Projects

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1. Shipbuilding

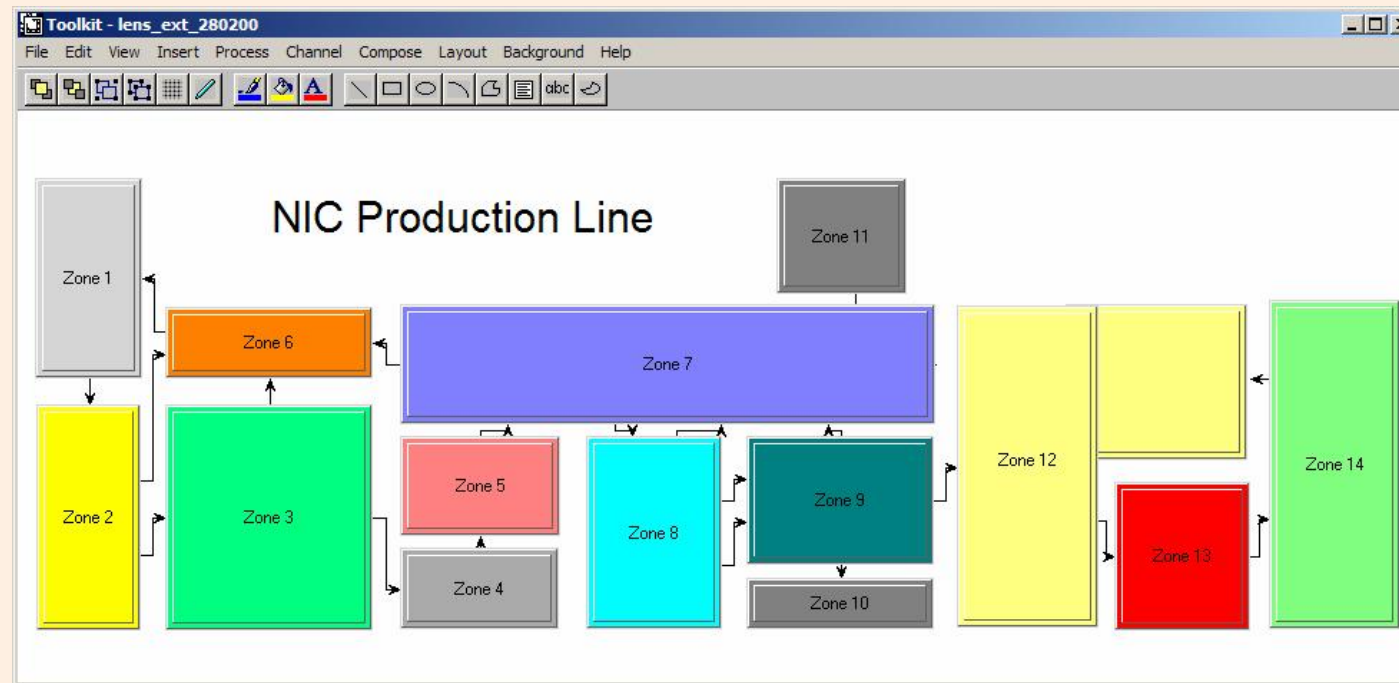
Consequences of planning on required space



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2. Designing a machine for production of contact lenses

Consequences of design choices for logistic process inside the machine (mini-factory)



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3. Producer of boxes of corrugated board

Consequences of new, faster machine on transportation and buffer system



Situation C

- Main buffer



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Conclusion

- Simulation and animation helps a lot to provide certainty
- Real world is very complex, many relevant characteristics cannot yet be captured by ready-to-use formulas
- We are very much interested in
 - further development of formulas for finite buffer manufacturing lines
 - using EPT instead of modeling the explicit occurrence of breakdowns

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