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A Collection of Aspects Why Optimization Projects for Railway Companies Could Risk Not to Succeed – A Multi-Perspective Approach

joint work with **Hanno Schülldorf**, DB Analytics

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Contents

Observation of a Certain Gap

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"Success Stories"
which **attain this goal**

Project **goal** in the beginning:
application of the developed mathematical
optimization methods on a regular[1] basis

Projects in which **mathematical optimization experts and railway practitioners work together**

1 not limited to daily operations, only, but **also include strategic questions** (such as in the context of public tenders), if the methods were applied on a regular basis

Key Question

Let's try to answer it by means of a survey

- In the projects which
  - in the beginning had the goal to apply the developed mathematical optimization methods on a regular basis but
  - did *not* attain this goal...

Gorman (Interfaces, 2016) provides a highly interesting detailed „Lessons Learned" report

- **... are there any common patterns?**

- To find out, we set up an anonymous **survey** and
  - asked 100+ railway managers and optimization experts
  - to weigh the importance of 15 possible project-specific properties why their project did not attain its goal

Problem-specific Properties of the Projects (1/4)

Full list of properties – selected full text of the questions

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(1) Data

The available input data finally did not meet the quality that was necessary to be able to come up with high-quality optimization results

(2) Partial Fixing

The optimization missed the ability to accept some particular fixation for certain “variables” that were key in the point of view of the railway practitioners

(3) Features

During the project timeline, the optimization model had been confronted with more and more detailed requirements, which finally let the performance and/or quality of the optimization methods collapse

Problem-specific Properties of the Projects (2/4)

Full list of properties – selected full text of the questions

(4) Validation

The railway company didn't allocate a sufficient amount of expert staff to validate in detail the results of the optimization methods during the entire project timeline

(5) Post-processing[1]

(6) Quality

(7) Regularity

(8) Transparency

(9) Integration

1 Please refer to the 14-pages ICROMA 2019 abstract for the precise formulation of the other properties

Problem-specific Properties of the Projects (3/4)

Full list of properties – selected full text of the questions

(10) Strict Feasibility

The optimized solution satisfied all constraints – but other "solutions" have been preferred (e.g. designed manually by railway practitioners), although they violated some less important constraints

(11) Reliability

(12) Obsolescence

During the project duration, there have been new algorithmic findings which made the optimization methods in the project obsolete

Problem-specific Properties of the Projects (4/4)

Full list of properties – selected full text of the questions

(13) Cost

The cost to make the optimization methods available in a productive context blast the cost which has been assumed in the cost-benefit-analysis that had been the basis to initiate the project.

(14) Attention

During the project duration, the “management attention” decreased, e.g. because some protagonist within the railway company left the project.

(15) Others

Observe that many of these properties are not railway-specific, but apply to OR in general – or even to project management

Parameters of the Survey

Design

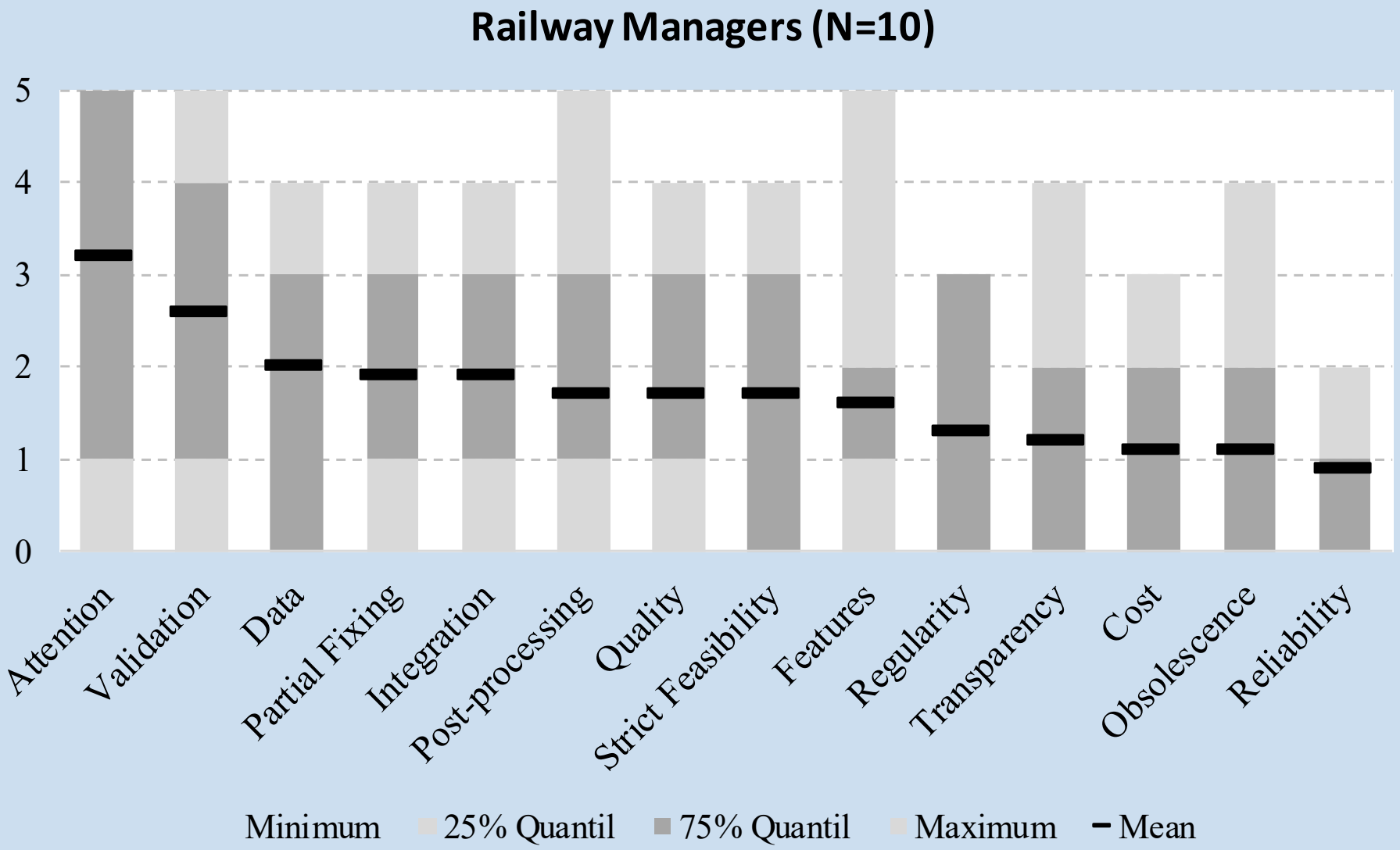
- Two groups
  - railway managers and
  - optimization experts
- Anonymous[1]
- 2 weeks online using LamaPoll (January 2019)
- 100+ protagonists in the field invited

Replies

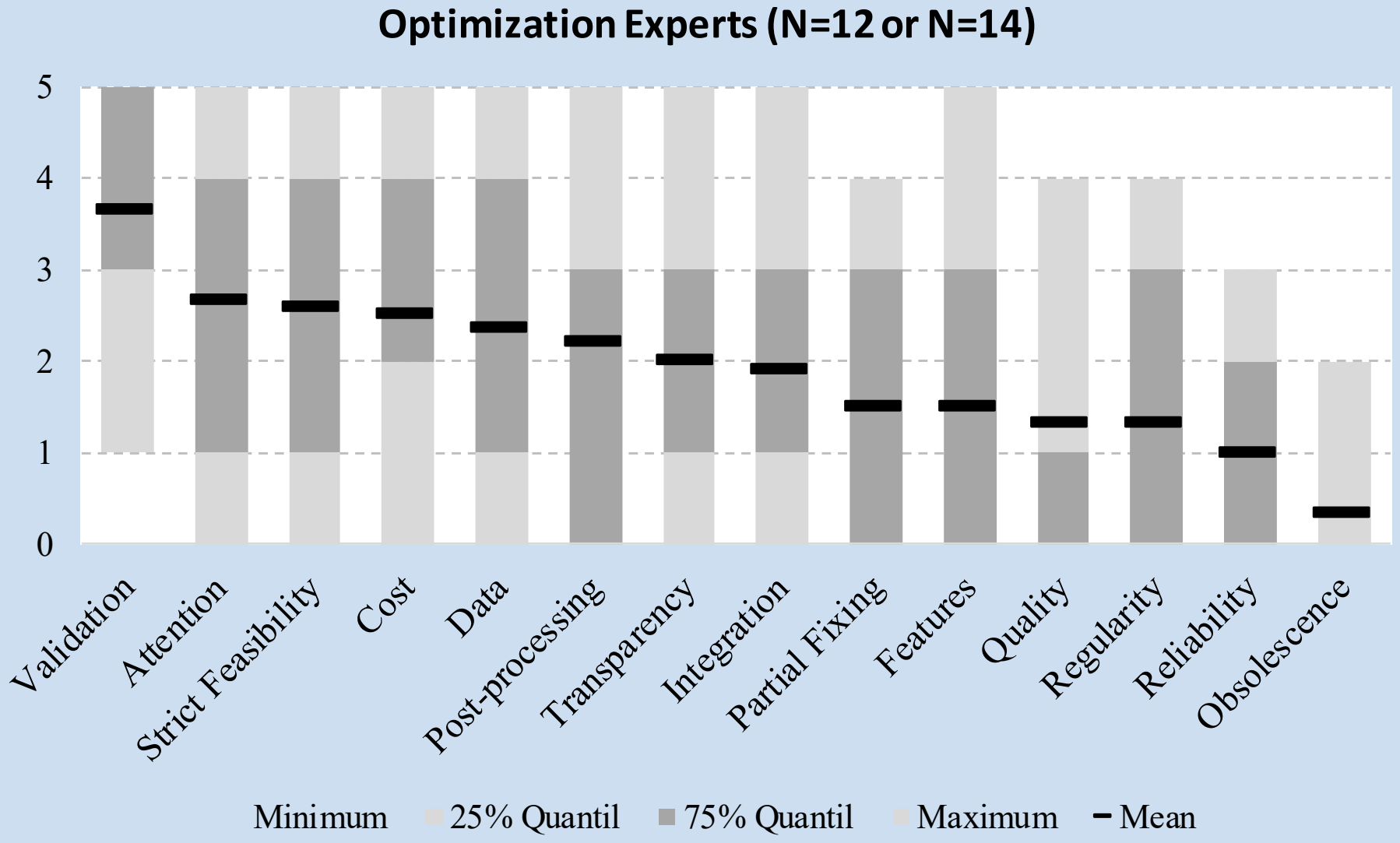
- **24[2] filled questionnaires**
- **5 late** informal **replies** were NOT included in results (some **extra aspects** that were raised in their messages)

1 but participants could provide the name of the project they were reporting on (optionally)
2 the authors provided four filled online questionnaires

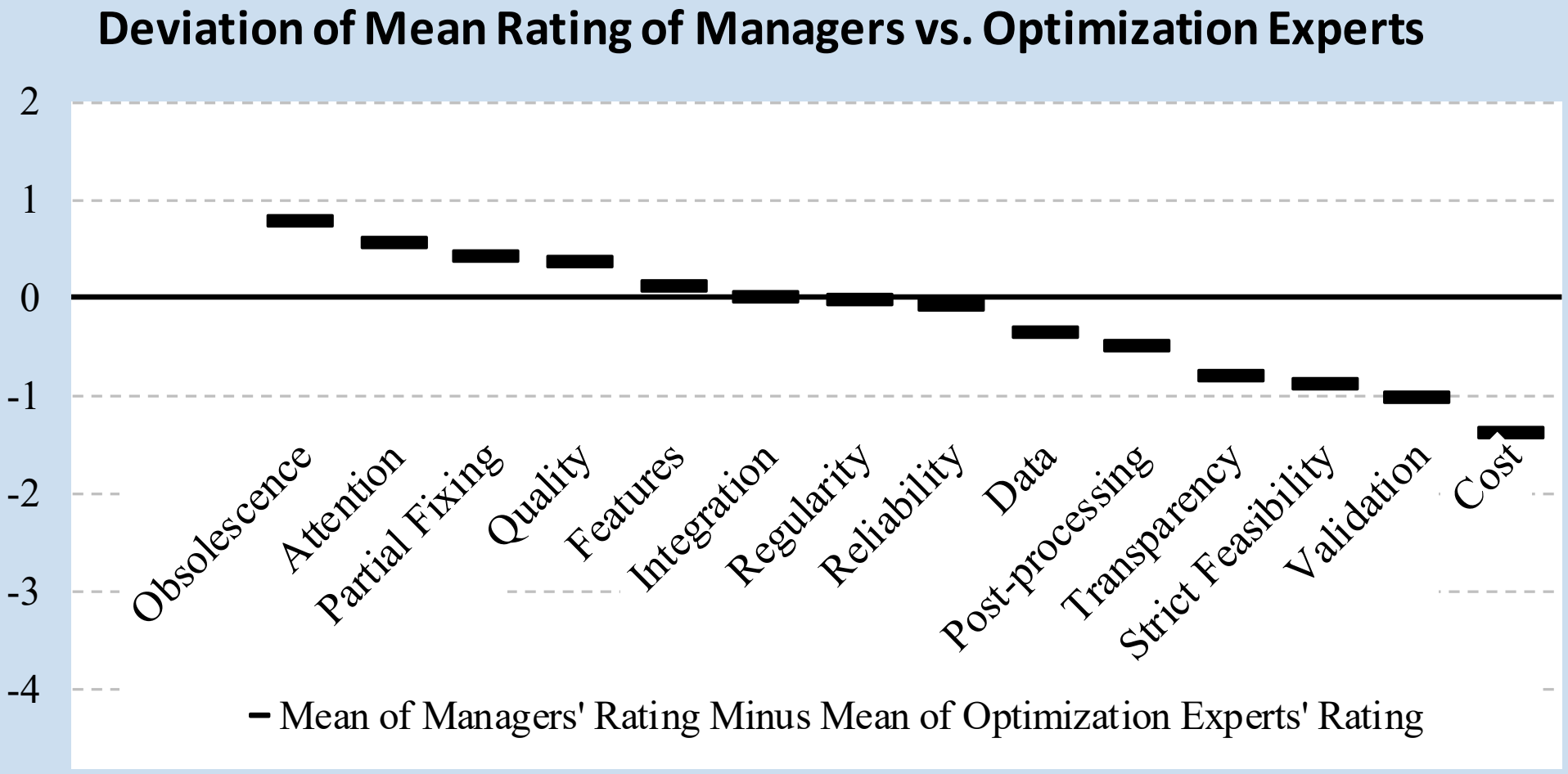
Rating of the Properties by Railway Managers



Rating of the Properties by Optimiz. Experts



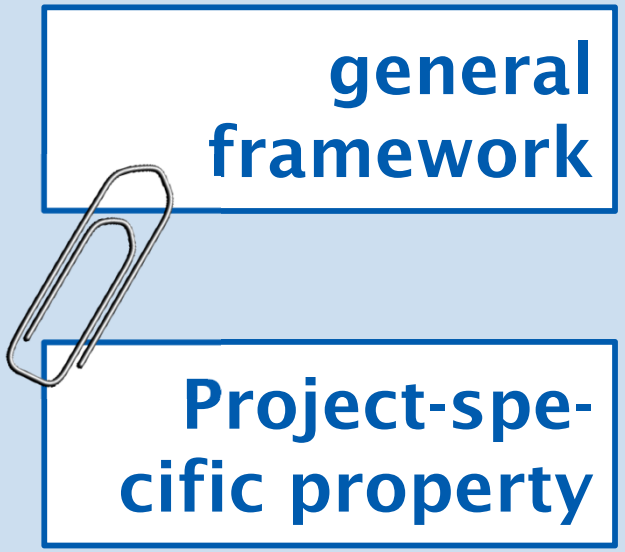
Deviations Railway Managers / Optimiz. Experts



Selected Correlation between…

… General Framework and Selected Properties of the Projects

- 0.65
  The more academic the partner who has been mainly responsible for the R&D part (3 = university, 2 = research institution, 1 = software company)…
  … the more severe the lack of railway expert capacity for **validation**



Further Comments by the Experts...

... including those of experts whose answers unfortunately reached us too late

- Complexity of control
- Employee participation (unions etc.)
- Management implementation
- Managerial consistency
- Organizational changes
- Performance
- Rolling horizon
- to be continued...

Conclusions (1/2)

Things worth to have in mind from the very start of any project

- Avoid a lack of expert capacity within the railway companies for the validation of intermediate results

Validation

- Pay significant attention to the
  - availability,
  - consistency, and
  - quality

  of input data: The R&D partner shall evaluate the quality of the input data in detail *prior to* launching the actual project for the development of algorithms – occasionally postpone the optimization project until the input required for it is available

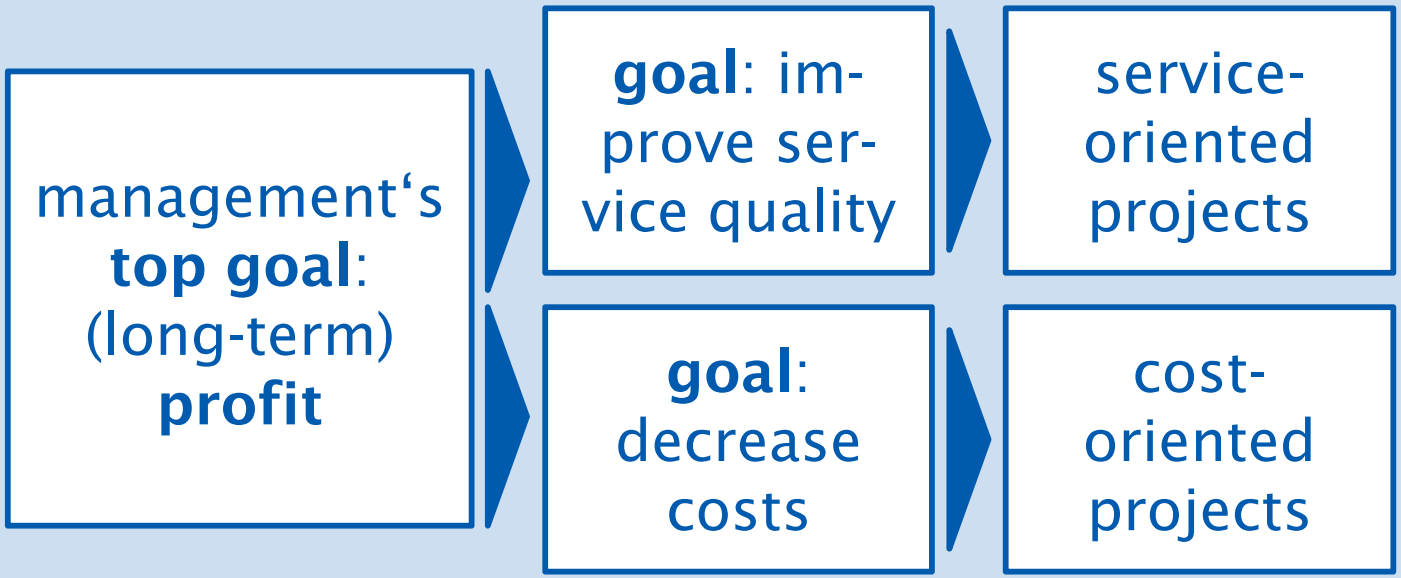
Data

Conclusions (2/2)

Things worth to have in mind from the very start of any project

- Railway managers shall put much emphasis on detailed description of requirements for the optimization tool, prevent any “lazy specification”
- A thought on “**management attention**”

moving target



Is management attention (goals) likely to change?
Only, if **company‘s strategy** changes (or the project was not conform to it)
Well…?

Questions & Comments?

- **Thank you…**
  - … to the audience, for your attention!
  - … to the participants, for sharing their experience with us!

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Observation

- First field of success stories: Vehicle Scheduling
- In particular in service design (including timetabling for railway networks): VERY FEW
- Überschrift 2
  - Unterabschnitt 3
  - Unterabschnitt 4