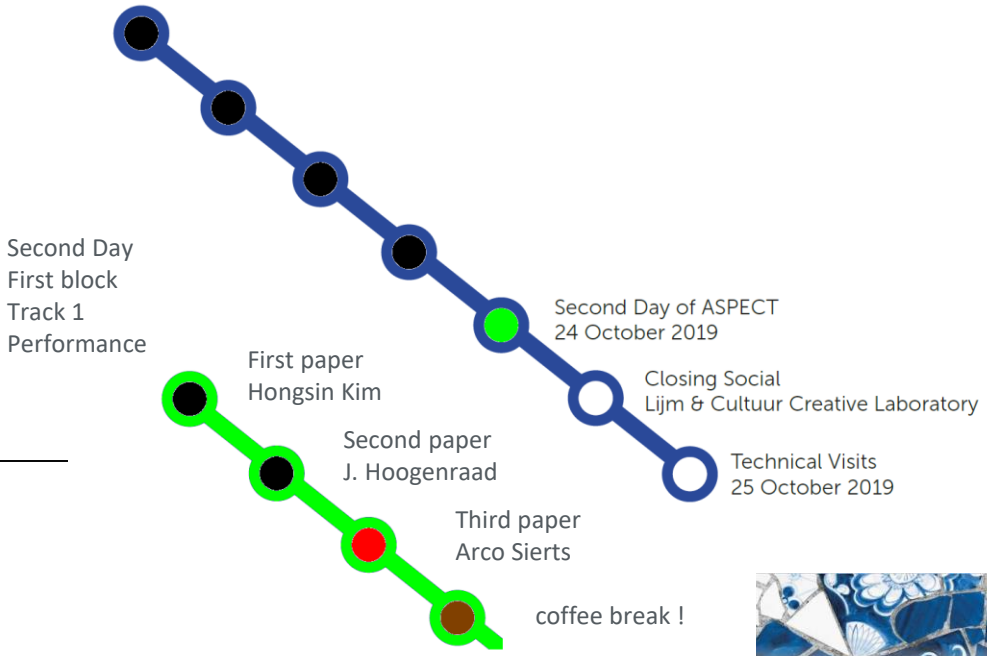
Improved system modelling for better railway performance

your toolkit for ‘out-of-the-signalbox’-design



InteVice

connecting different worlds

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ASPECT2019///

Institution of Railway Signal Engineers | Delft University of Technology | IRSE Nederland

Overview presentation paper

1. Introduction
   - Robustness versus resilience & control *(in paper: chapter 2)*
   - *About the author ('fast forward')*
   - *Context & motivation of this reseach & development*
     - *winds of change*
     - *invisible walls*
     - *business value CCS-innovation*

3. Basics on modelling and abstract system architecture
   3.1 Make the invisible visible
   3.2 *Business- and IT-architects (skipped in presentation)*
   3.3 Architectural models for effective governance

Overview presentation paper

4. User-centred railway system modelling

   4.2 An abstract model example
   4.1 Requirements new railway system model

5. Analysis of existing abstract railway systems models

   5.1 *Introduction (skipped in presentation)*
   5.4 Extended Cascade Model (Van den Top - TU Delft)
   5.3 *Generic Transport Layer Model (replaced by basic version in presentation)*
   5.3 *Basic Transport Layer Model (Schoemaker - TU Delft)*
   5.2 Triangle-model (TU Braunschweig)
   5.5 Evaluation existing models

Overview presentation paper

6. Building the new model

7. *Conclusions of this* ***presentation***

Public questions & discussion

1. Introduction - robustness versus resilience & control

- Robustness: make your construction strong enough
  - classic railway construction, also timetabling & capacity
  - technical driven

- Resilience: adapt in a quick, co-ordinated and controlled way
  - user/business/market/model-driven railway
  - requires fundamental change in culture and control
  - start thinking from user perspective
  - railways must re-invent themselves; cannot be forced by law or regulations

1. Introduction - about the author

- 18.09.1970 born as curious technician *(Winsum / Groningen-NL)*
- 82-88: Atheneum Beta *(Ichthus College - Drachten)*
- 83-today: parttime audio eng. *(start: drive-in-disco; still: PA & live mixing)*

- 88-94: Analog & digital electronics *(HTS Leeuwarden)*
- 95: Military service *(154 AfdVA 't Harde - artillery)*
- 95-96: Electrical Engineering + Philosophy of Science, Technology & Society *(@ University of Twente - unfinished)*
  - *volunteer @ Dutch public transport passengers union 'ROVER'*
    - *example: re-opening Enschede-Gronau (D) cross-border railway line*
    - *background political lobby, media contacts, press messages*
    - *background 'technical support' municipality of Enschede and Euregio: time tabling, costs/benefits, techn. rules, interoperability issues e.q. Indusi vs ATB, platform height, level crossing safety etc.*

1. Introduction - about the author

- 1996-2000 Projectmanager Alcatel Telecom Rijswijk NL *(mainly telecom network mgt; occasionally support Transport Automation Systems*
  - @ ROVER: working group Railways
    - deliberations with NS / ProRail / authorities
    - lobby 'High Speed Line East'
    - contacts with several NS depts, TU Delft Civil Engineering, Railned Innovation & RIB Innovation (later: ProRail Innovation)

- 2000-2004 startup, self employed *(innovative railway solutions, incl. solutions for Level 3 Moving Block, patent study, business analysis)*
  - @ ROVER 2001: project team 'railway crisis 2001'
  - Dutch parliament & Ministry of Transp. : building network, lobby
  - assist with writing parliamentary questions, amendments, speeches
  - investigate Dutch SPAD-issue; lobby for technical & political action

1. Introduction - about the author

- 2004-12 System design engineer Alstom TIS - Utrecht NL
  - e.g. Rotterdam metro / VPI datalogger / test drive coord. HSL South / Hanzeline safetycase / Req. Eng. / Hanzeline ETCS comm. datalogger

- 06-07 final ProRail Prijsvraag *(innovation contest - private participation)*
- 07 won Railforum Young Profess. Innovation Cup *(joint team Alstom + Arcadis + NS Project Consult - idea: integrate speed advice into ETCS DMI)*
- 07-09 co-writing 4 articles for Dutch magazine *'Op de Rails'* about ERTMS

- 2009 parttime own consultancy 'PTADC' - focus regional rail + safety
  - customers e.g. Connexxion, regional authorities, Ministry, NS Safety
  - start background parliamental lobby for speeding up ERTMS in NL
- 2013 fulltime self employed
- 2019 parttime working on plan for doctoral thesis, writing papers

1. Introduction - winds of change

- Major challenges for railways
  - cost effectiveness
  - performance
  - competitive position
  - more focus on user perspective

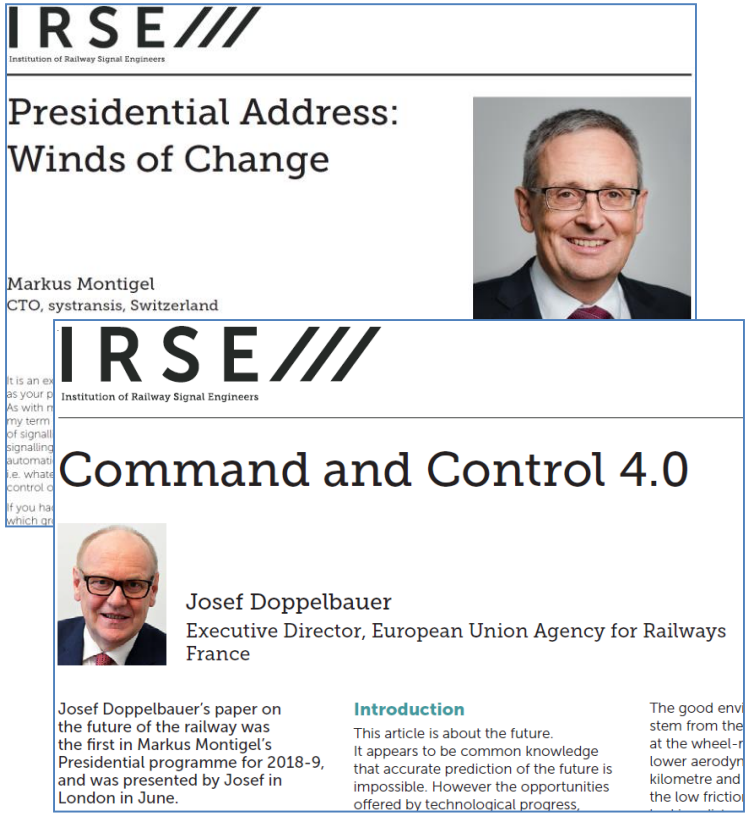
- EU- objectives and policy
  - major shift to rail & other PT modes
  - improved system economy
  - competition / separation railway infrastructure<>transport
  - technical interoperability

1. Introduction - winds of change

Some issues railway sector :

- ‘highly complex’
- ‘burocracy’ <> ‘island management’
- tend to focus on impressive technology
- poor attention to end user wishes
- live by rules & traditions
- heavily competed by road & airplane
- innovate (problematic) slow
- lack money for strong investments
- depend on government & politics

1. **Introduction** - winds of change



1. Introduction - winds of change

https://www.railengineer.co.uk/2019/06/10/delivering-change-george-clark-deliver

Annual theme

As the theme for his presidential year, George has take
Change', with particular emphasis on how the institutio
of dedicated professional members, can rise to meet th
enable the opportunities ahead.

"As engineers, we
agents for the deli
continued, "and ou
been in more dem
today. We deliver
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many areas: data
factors and design
and integration/co

Engineers introduce new technology, which is a key en
change and always comes with its own inherent challe
George Clark is concerned that the wider people, proce
changes are often even more significant and the root c
cost. He believes that, not only must engineers deliver
functional performance enhancements for system cap
availability, they must also significantly reduce whole-l
through radical changes to maintenance and operatio

"As engineers, we are catalysts and agents for the delivery of change," he continued, "and our skills have never been in more demand than they are today. We deliver new tools, techniques and technology systems to colleagues (fellow engineers in other disciplines, signallers and operators). We lead in so many areas: data analytics, human factors and design, safety assurance and integration/commissioning."

1. **Introduction** - winds of change

Annual theme

As the theme for his presidential year, George has taken 'Delivering

Engineers introduce new technology, which is a key enabler to delivering change and always comes with its own inherent challenges and risks. But George Clark is concerned that the wider people, process and interface changes are often even more significant and the root cause of delays and cost. He believes that, not only must engineers deliver the required functional performance enhancements for system capacity

1. Introduction - invisible walls

- 2016: (technological?) momentum in Switserland
  - Was it technology push? Or ...
  - Other factors ?
    - Vision ? What kind of vision ?
    - Management / politics / budget ?
- EU & CCS: ‘pushing tech’ against invisible walls?
- 2014: political momentum in the netherlands

Dutch government to invest €2.5bn in ERTMS rollout | International Railway Journal - Mozilla Firefox

Bestand Bewerken Beeld Geschiedenis Bladwijzers Extra Help

Dutch government to invest €2.5bn in ERTM...

www.railjournal.com/index.php/signalling/dutch-government-to-invest-€25bn-in-ertms-rollout.html?channel=532

IRJ International Railway Journal

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Tuesday, April 15, 2014

Dutch government to invest €2.5bn in ERTMS rollout

Written by David Briginshaw

DELEN DELEN DELEN DELEN 3

The Betuwe line is already equipped with ERTMS.

Quintus Vosman

THE Dutch cabinet has approved a €2.5bn budget to install ERTMS on all trains by 2022 and on the busiest sections of the national rail network by 2030.

The proposal was put forward by the secretary of state for infrastructure and the environment, Mrs Wilma Mansveld, and it is a commitment of the coalition government to start the installation of ERTMS in 2016. The government has opted to install ETCS Level 2 which it says will make it possible to improve the use of existing capacity.

ETRMS is already installed on the Betuwe freight line, the HSL South high-speed line, between Amsterdam and Utrecht, and on the recently-opened Hanse Line, as well as on about 20% of the train fleet. ERTMS will now be extended to the dense network of lines serving the area around Amsterdam, The Hague, Rotterdam and Utrecht, as well as on lines to Almelo, Arnhem, and Vlissingen, and international routes to Germany and Belgium.

Mansveld says that care is a higher priority than speed in introducing new train safety systems. In late 2013, the ministry decided to equip all lines with ATB-Vv, an improved version of the national ATB train protection system, except on routes which will be converted to ERTMS in the near future. ATB-Vv will automatically stop trains in danger of passing a red signal provided they are travelling at less than 40km/h.

1. Introduction - business value CCS-innovation

- What does this all mean for CCS ?
  - develop new technologies ? - *or:*
  - what contributes best to market performance ?

- End-user-centred business focus:
  - Customer decides on railways service attractiveness from their *personal perspective*
  - Technology is never a goal in itself
  - CCS (and safety / punctuality / availability) are no ‘sales-items’ - they ‘simply’ must be ‘well enough’

1. Introduction - business value CCS-innovation

Current CCS technology has serious drawbacks:

1. waste of expensive *traffic capacity*
    - CCS + classic timetabling principles 'leak' valuable traffic time & traffic space
2. classic principle *'fail-safe' vs 'fail-OK' (redundancy)*
3. unflexible
4. costs are way to high
    - *'niche market'*
    - *limited economies of scale*
    - *knowledge- & labour-intensive*

1. **Introduction** - business value CCS-innovation

- CCS does not *directly* improve customer services
- No *direct* customer value for innovative CCS
- No *direct* business arguments for innovation ?!
- *How to really convince non-CCS-experts ?!?*

Idea : modelling 'full-chain' system innovation

3. Basics on modelling and abstract system architecture

3.1 Why modelling ?

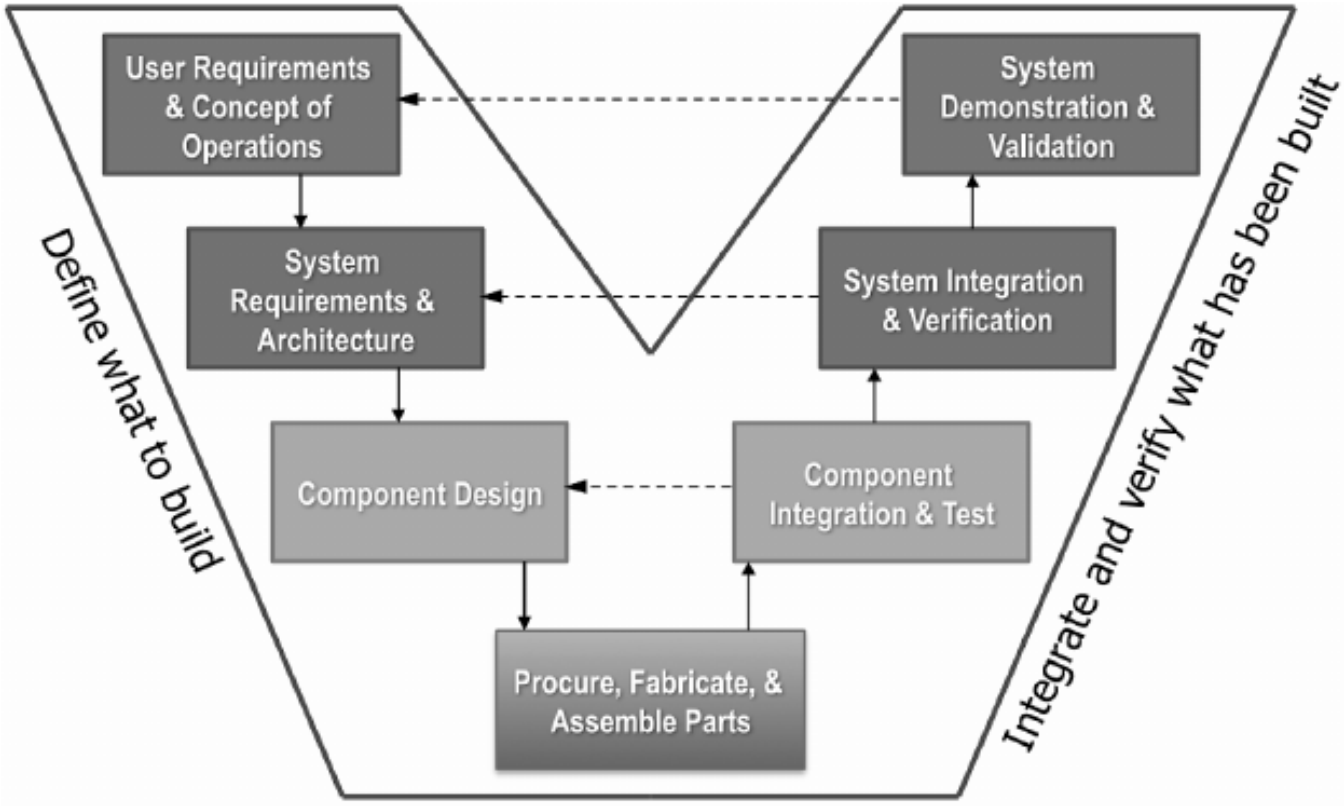
3.2 *Business- and IT-architects (skipped in presentation)*

3.3 Architectural models for effective governance

3.1 Why modelling ?

- Makes the invisible (or 'difficult-to-see') visible
- Highlights certain aspects
- Reduces complexity - with the help of:
  - focus
  - abstraction
  - systematisation
  - visualisation

3.3 Architectural models for effective governance



3.3 Architectural models for effective governance

Conclusions:

- Systems Engin. V-cycle-model is an *abstract process model*
- Originally invented for software - now broader applied
- It models the *generic process of (re-)creating systems*
- Left side of th 'V' is in fact about *"doing the right"*
- Right side of th 'V' is about *"doing it right"*
- Feedback lines are for *checking "was it right" ?*

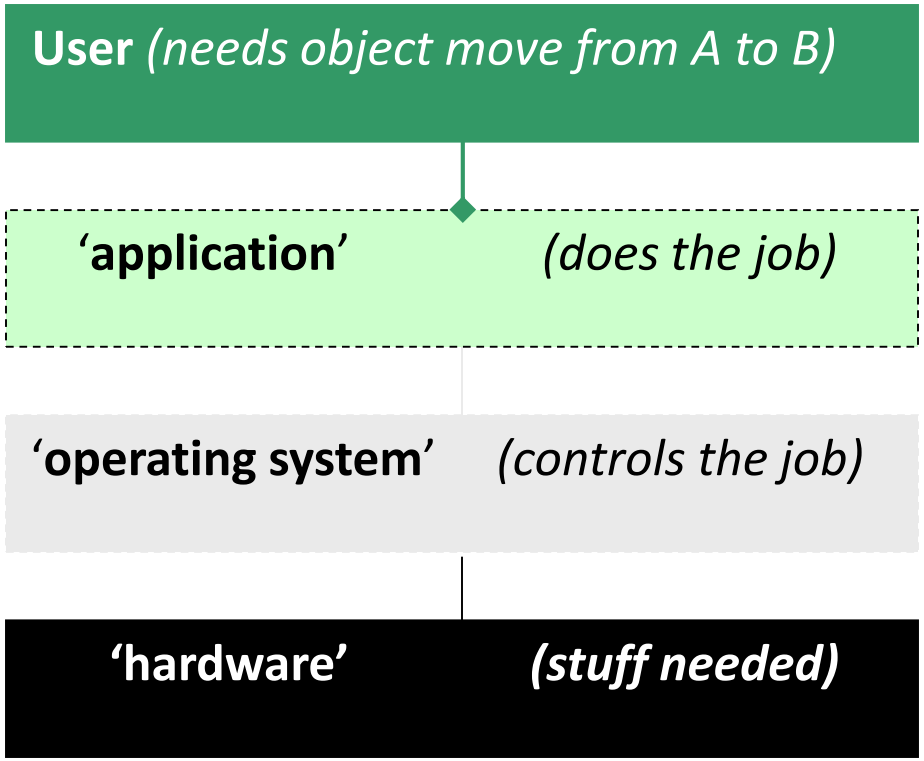
- Important for effective governance
- Crucial for coherent & systematic (safety) managent
- Helps users, managers, marketeers, architects, engineers, ...

4. User-centred railway system modelling

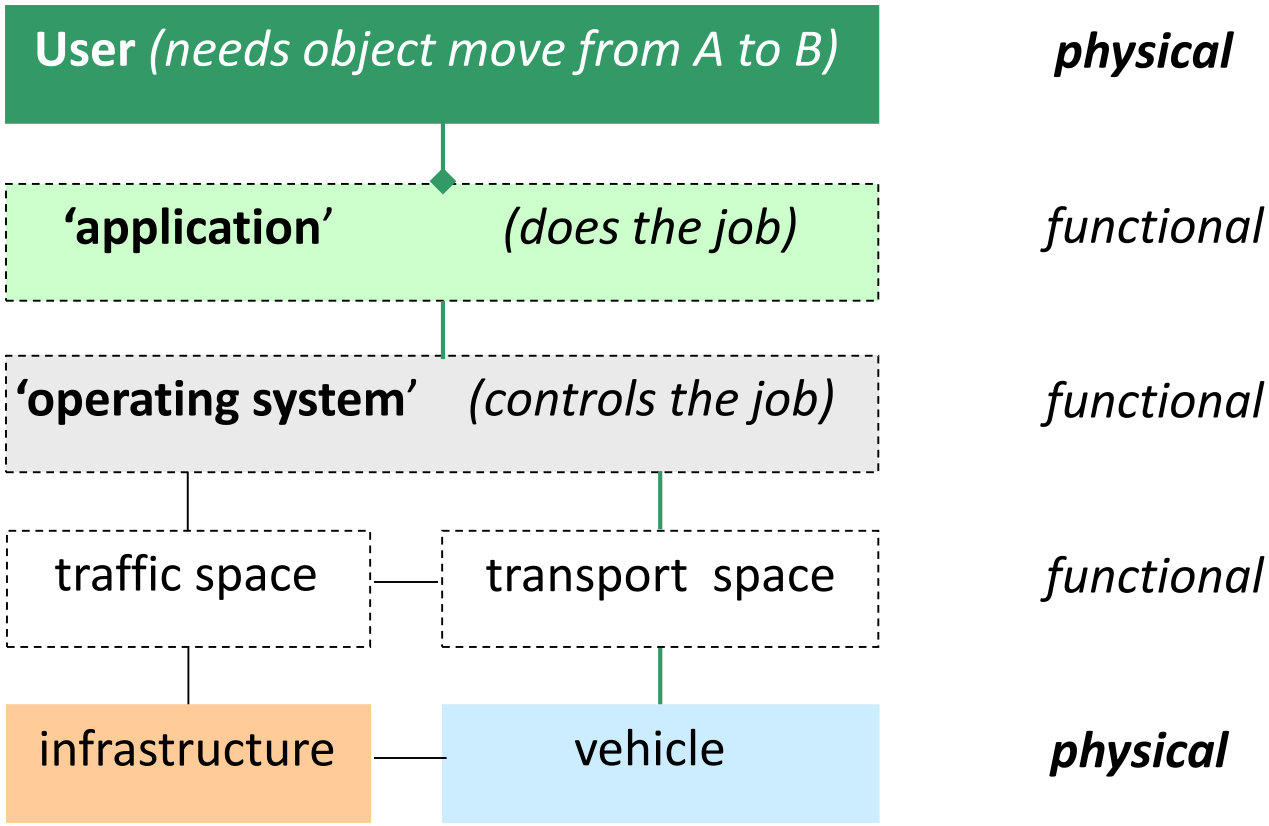
4.2 An abstract model example

4.1 Requirements new railway system model

4.2 Abstract mobility model (basic model)



4.2 Abstract mobility model (second step)



4.1 Requirements new railway system model

- Individual user perspective must be clear
- Integration with other modes of transport *(> user-oriented)*
- Central position system control *(essential for rail)*
- System environment, interfaces and interoperability modeled
- Possible to model separation infra & transportation *(EU-rules)*

5. Analysis existing abstract railway systems models

5.1 Introduction *(skipped in presentation)*

5.4 Extended Cascade Model *(Van den Top - TU Delft)*

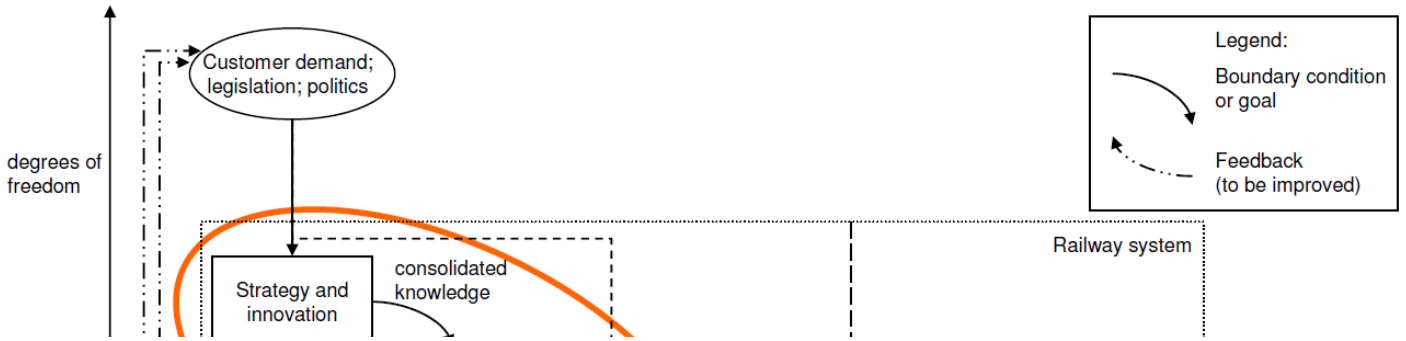
5.3 *Generic Transport Layer Model (replaced in presentation)*

5.3 *Basic Transport Layer Model (Schoemaker - TU Delft)*

5.2 Triangle-model *(TU Braunschweig)*

5.5 Evaluation analysed models

5.4 Extended Cascade Model (vd Top / TU Delft)



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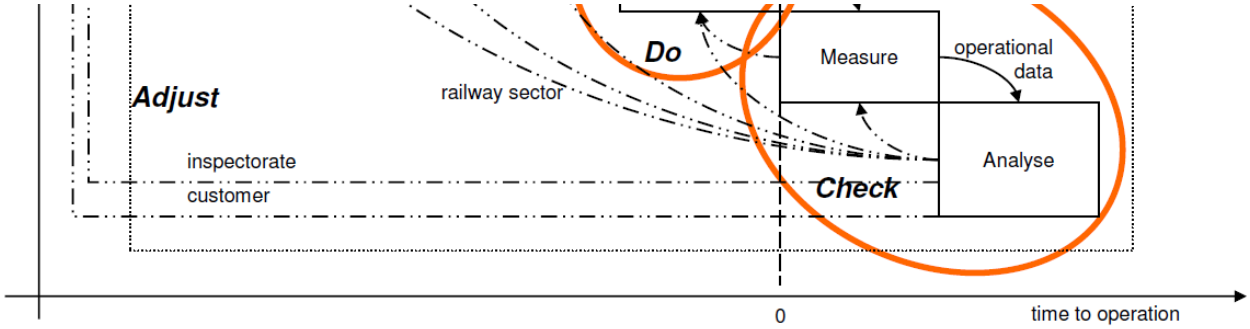

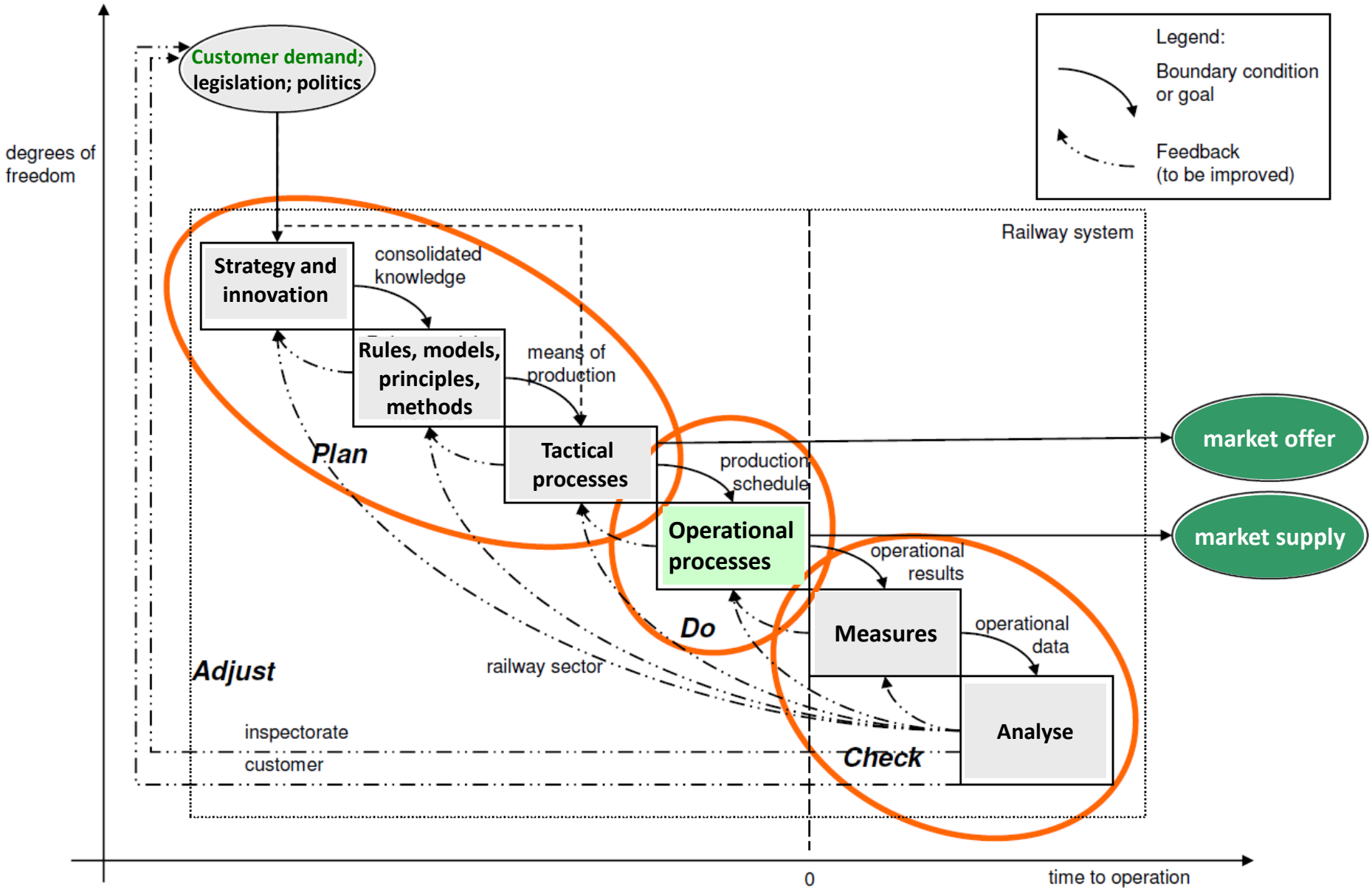
Customer demand; legislation; politics
degrees of freedom
Legend:
Boundary condition or goal
Feedback (to be improved)
Railway system
Strategy and innovation
consolidated knowledge
Rules, models, principles, methods
means of production
Tactical processes
production schedule
Operational processes
operational results
Measures
operational data
Analyse
Plan
Do
Check
Adjust
railway sector
inspectorate
customer
market offer
market supply
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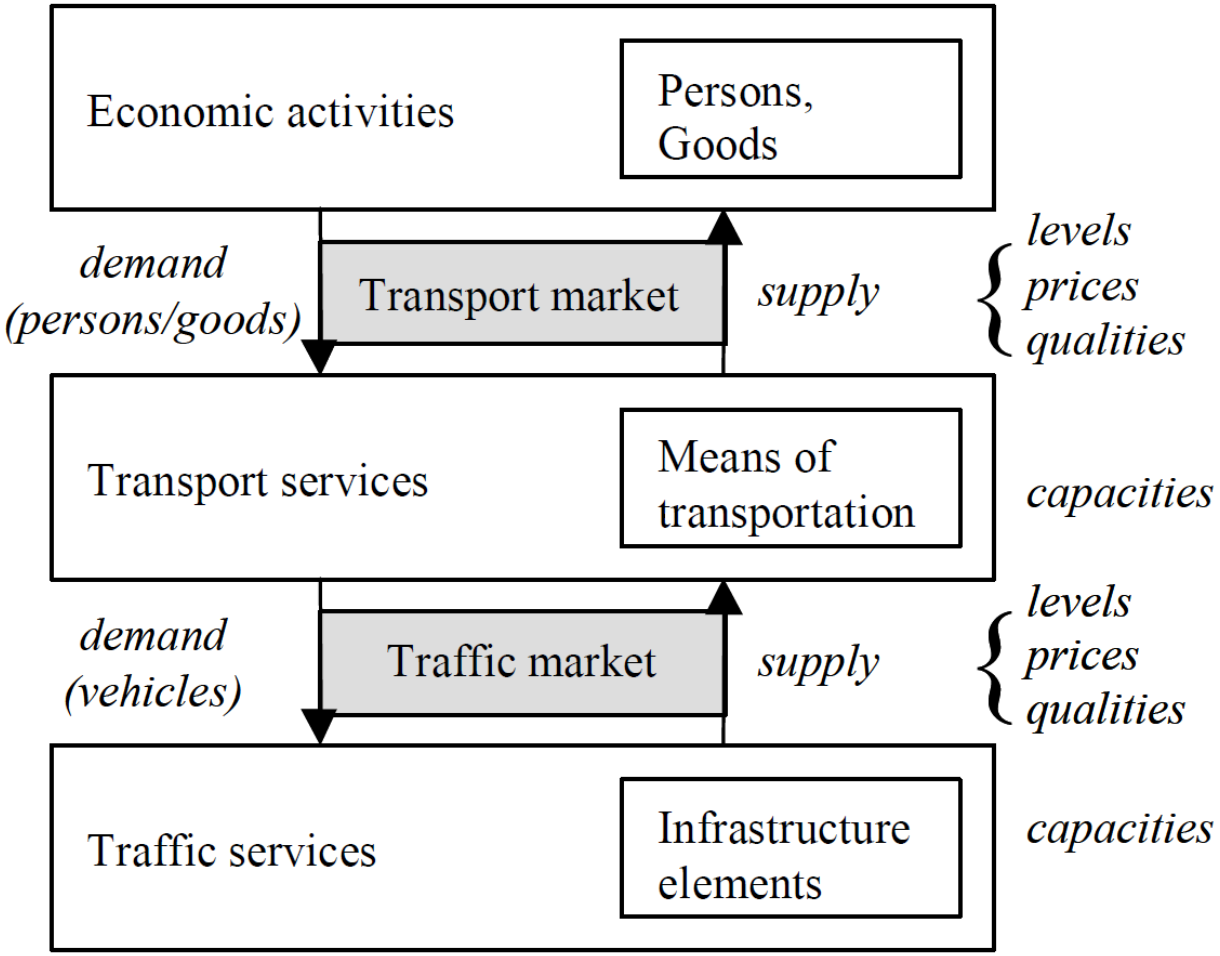
time to operation

5.3 *Basic Transport Layer Model* (*Schoemaker e.a./TU Delft*)



5.3 *Transport Layer Model - important notice*

5.2 Triangle-model (TU Braunschweig)

5.5 Evaluation existing models

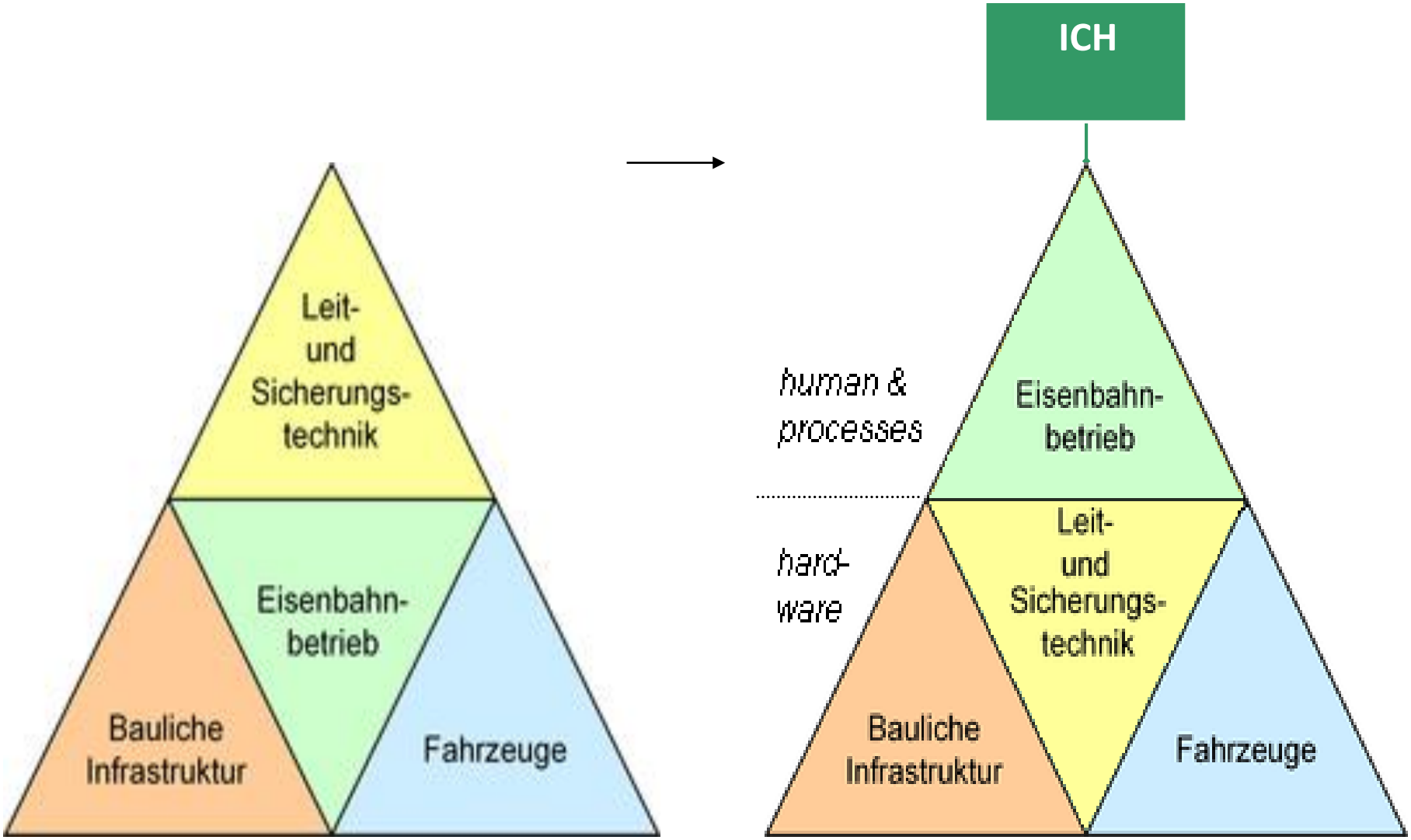
(highly compressed compared to text in paper)

- Triangle-model:
  - focus on CCS + business + basic physical blocks
  - *missing: process abstractions, user, separation*
- Transport Layer Model
  - strong: process ('subservice') layering
  - focus on traffic & transport process layer
  - *missing: system control, individual user*
- Extended Cascade Model
  - pure railway system control model - no system model
  - interesting similarities with S.E. V-cycle model

6. Building the new model

Used recepy:

- Use Triangle-model TU Braunschweig as solid base
- Add strong points Transport Layer Model TU Delft *(process abstractions, service perspective)*
- Add individual client perspective & user interface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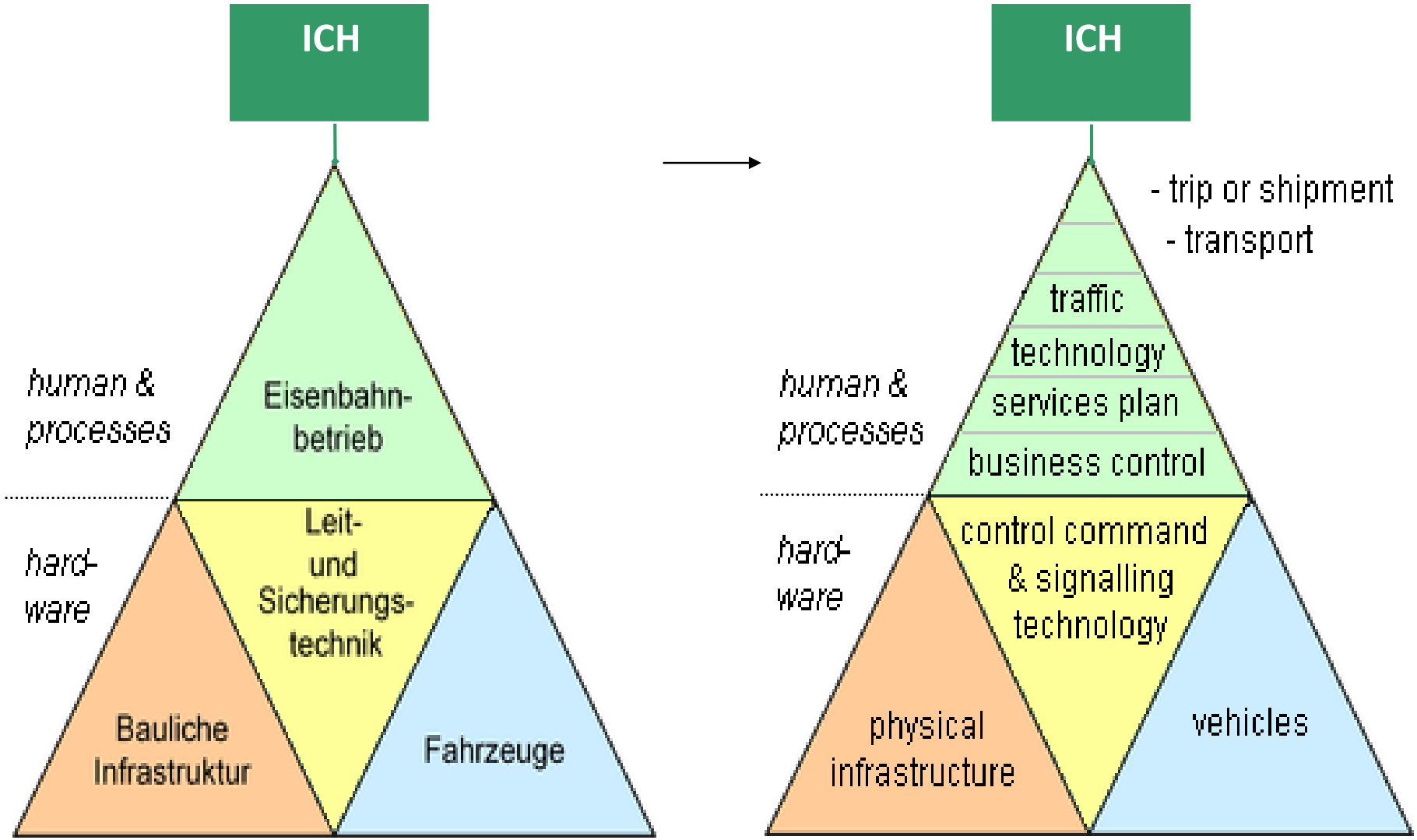
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Fahrzeuge
ICH
- trip or shipment
- transport
traffic
technology
services plan
business control
human &
processes
hard-
ware
control command
& signalling
technology
physical
infrastructure
vehicles

7. ***Conclusions presentation*** *(& possible discussion points)*

1. The EU-enforced separation infrastructure <> transportation business complicates an effective strategy on CCS-innovation
2. Due to the separation, an 'invisible wall' appeared between 'business', 'capacity planning' and 'CCS-innovation'
3. 'technology' tries to push new technology 'upwards', but 'business' will not be convinced by 'technical arguments'.
4. 'business' simply wants direct game-changers: customer-attracting improvements and positive business cases.
5. User-centred system modelling and Business Process Re-engineering are crucial to identify direct game-changers

Public questions & discussion

Our chairman will now take the lead on the remaining part.
Possible subjects could be:

1. Specific questions about paper & presentation
2. Discussion about the 5 presentation's conclusions
3. Idea for easier calculation business profits CCS-innovation

Your questions and suggestions also welcome via email
aspect2019 [at] intevice.nl

coffee :-)