

Countdown on a platform

Human Factors issues in innovation in a safety critical environment

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1 Unsafe behaviour at a level crossing

In Holland about 40% of all incidents on level crossings with lethal consequences are related to unsafe behaviour at a closed level crossing.

- about 8 lethal incidents a year (decreasing)

Waiting time at a closed level crossing is an important factor to predict unsafe behaviour.

- Station nearby level crossing is more hazardous

1 Departure of a train at a station near a level crossing: current situation

Process:

- Route setting triggers closure of the level crossing
- Departure of the train is only allowed after closure of the level crossing

Consequences:

- Train waits for closure of the level crossing
- Road users at closed level crossing wait for the departure of the train

2 The idea

Parallel performance, instead of serial performance, of the process of route setting, closure of the level crossing and departure of the train. Benefits:

- Shortening total processing time
- Decrease in waiting time of road users at closed level crossing
- Earlier departure of the train for higher punctuality in train service
- Kind of countdown device for train departure

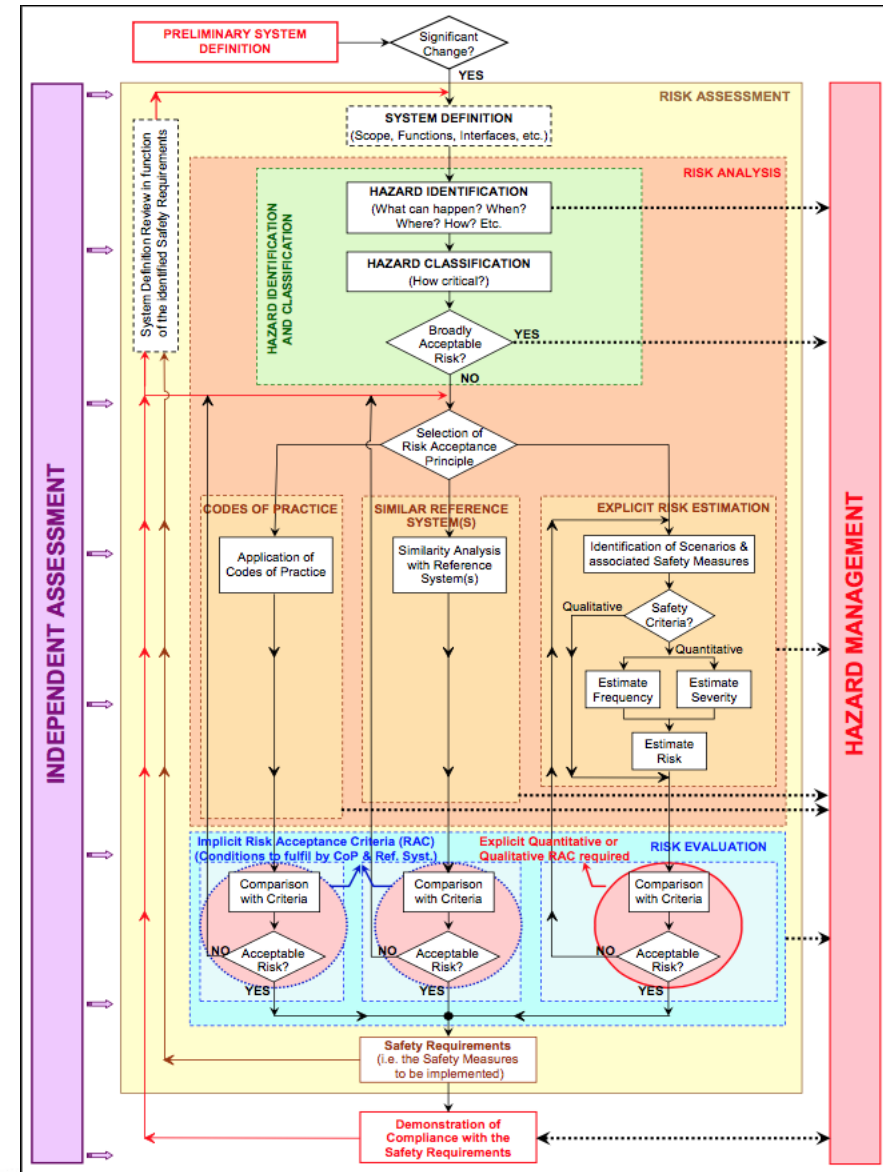
2 Animation of the concept



3 Development

Common safety method on Risk Evaluation and Assessment:

- System description
- Concept of use
- Interfaces: rail technology, processes, road-design, humans



3 Human Factors Assessments

Several 'interfaces' with human behaviour:

- Train staff for safe departure of the train
- Train passengers / travellers for safe boarding
- Road users related to level crossing safety
- Track workers using a level crossing as a warning system for arrival of a train at the working place

Assessment together with SME's (safety, train staff, ATP-systems)

3 Requirements for the countdown device

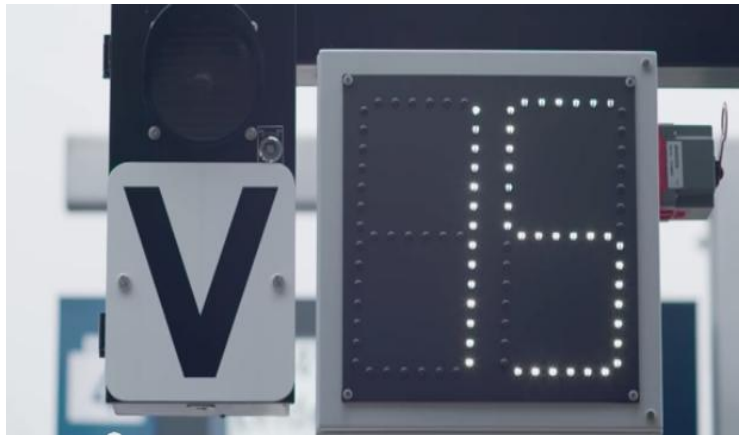
Rail technology

- Activation of countdown device dependent of:
 - safe closure of the level crossing
 - safe (automatic) route setting
- Countdown device visible, recognizable, readable

Processes train operating company

- Countdown dependent of process time for departure of a train
- Departure process of a train without a pause
- Actual departure of the train after published departure time

4 Departure of train with aid of countdown



15: start of departure procedure

- First safety check of train staff

> 8: auditory signal to passengers

- Close all but one doors of train
- Safety check alongside train

0: activation departure light

- Safety check
- Close last door of the train

4 Piloting in increasing scale

- Reference period without countdown 1 month 2014
- Piloting periods:
 1. Limited pilot with dedicated train staff and 1 train type, 2 locations, 2 months end of 2014
 - With countdown
 - Without countdown
 2. Maximum scale, 2 locations, 1 year 2015-2016

About 1000 train departures per month

4 Methods for evaluation

Monitoring with strong emphasis on human factors related issues

Human factors role:

- Monitoring plan and checklists for observations representing human behaviour and hazards in behaviour
- Data-analysis

4 Methods for evaluation

Qualitative and quantitative data based on video images and observations:

- Behaviour of train staff
- Behaviour of passengers on platform
- Behaviour of road users at level crossing

Quantitative data:

- Process time for train departure
- Punctuality in departure of the train
- Closure time of level crossing

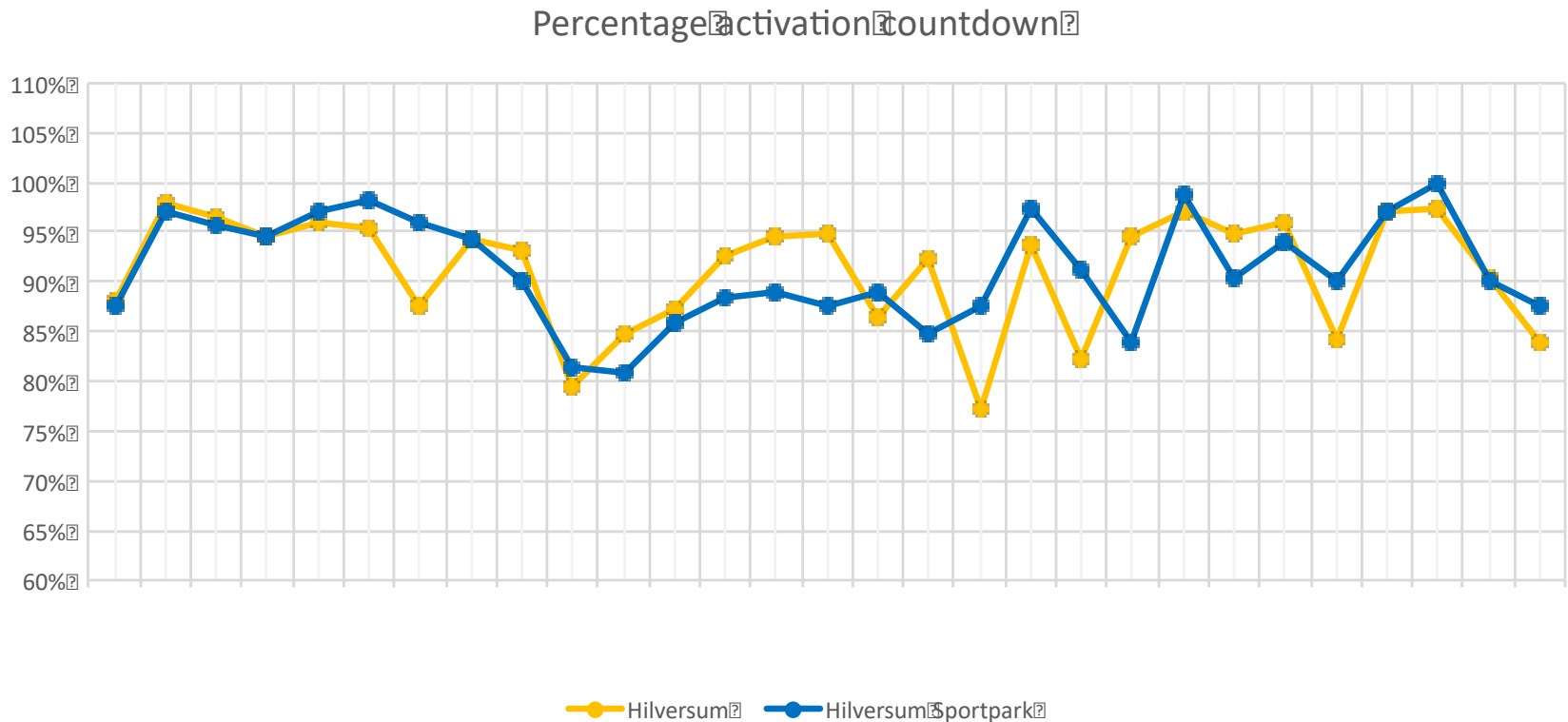
4 Behaviour of train staff and passengers

Behaviour at safety critical moments
during train departure procedure

- Train staff:
 - compliance with regulation based on risk assessment: new 'rule'
 - way of performing safety checks
- Passengers:
 - Possibly hazardous behaviour during closure of doors and during departure of train

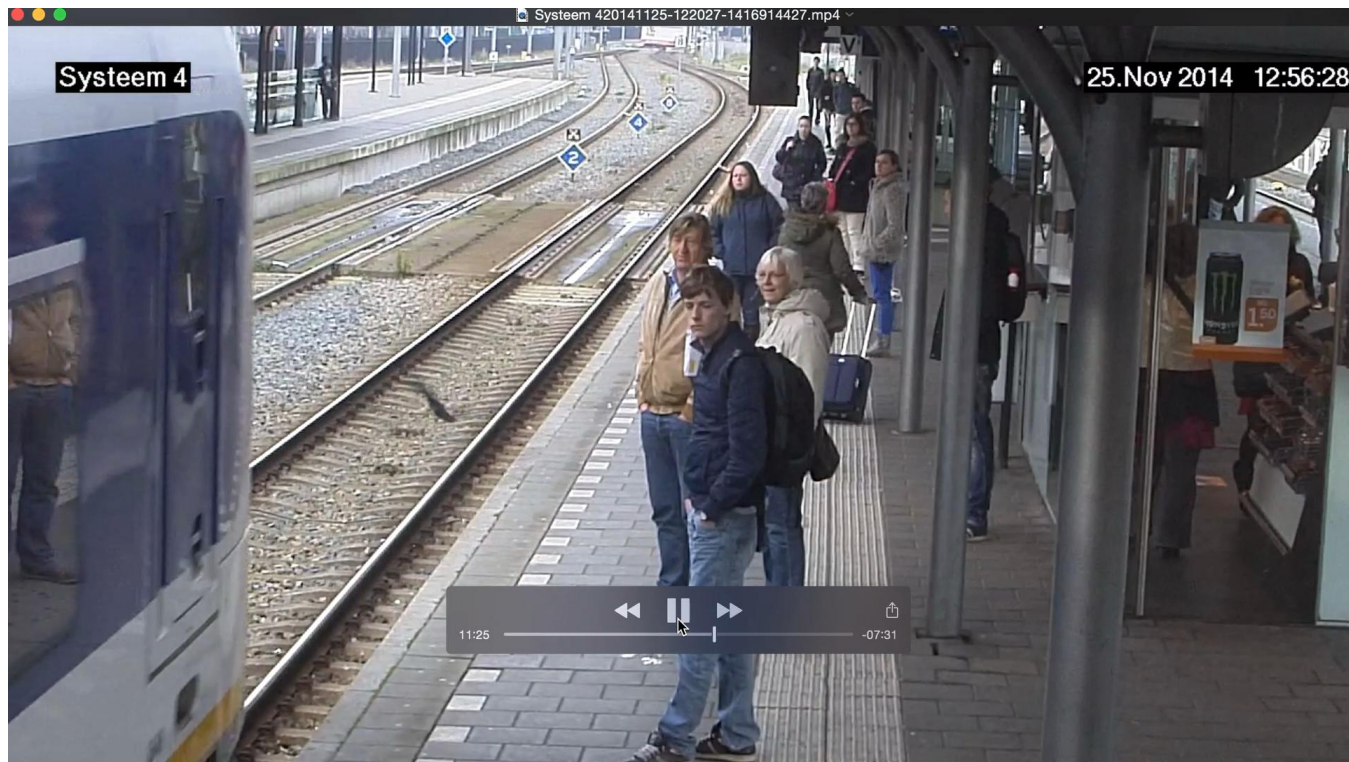


5 Results: Activation of the countdown



May-June 2016: 10% no activation because of train dispatching

5 Behaviour of train staff and passengers



5 Results: use of countdown

	Start departure process by auditive signal					
	15-21 sec	10-15 sec	5-10 sec	0 sec	after departure signal	No signal
Hilversum						
Pilot 2014	63%	15%	0%	-	22%	0%
Pilot nov. 2015	9%	18%	5%	11%	55%	2%
Pilot may-june 2016	13%	17%	10%	0%	54%	6%

- 2015-2016: Increasing amount of earlier start of departure process
- 2014: a dedicated extensive trained group of train staff performs much better

5 Results: behaviour of passengers

	Dangerous behaviour passengers at boarding			
Hilversum	Auditive signal	Closure of doors	Last safety check	All doors closed
Reference 2014	10%	10%	5%	17%
Pilot 2014	21%	32%	2%	5%
Pilot nov 2015	2%	2%	3%	1%
Pilot may-june 2016	-	2%	1%	1%

- No dangerous behaviour of passengers related to countdown
- Effect of campaign about safety during the departure process to public and train staff

5 Behaviour of train staff and passengers

- Train staff shows safe behaviour in compliance with dedicated regulation about use of the countdown.
- In situations with very little passengers boarding the train, train departure procedure cannot always be performed without a short pause.
- With use of countdown behaviour of passengers is comparable with situations without countdown, no dangerous situations (train is not moving).

5 Results: Behaviour at level crossing

November-December 2014

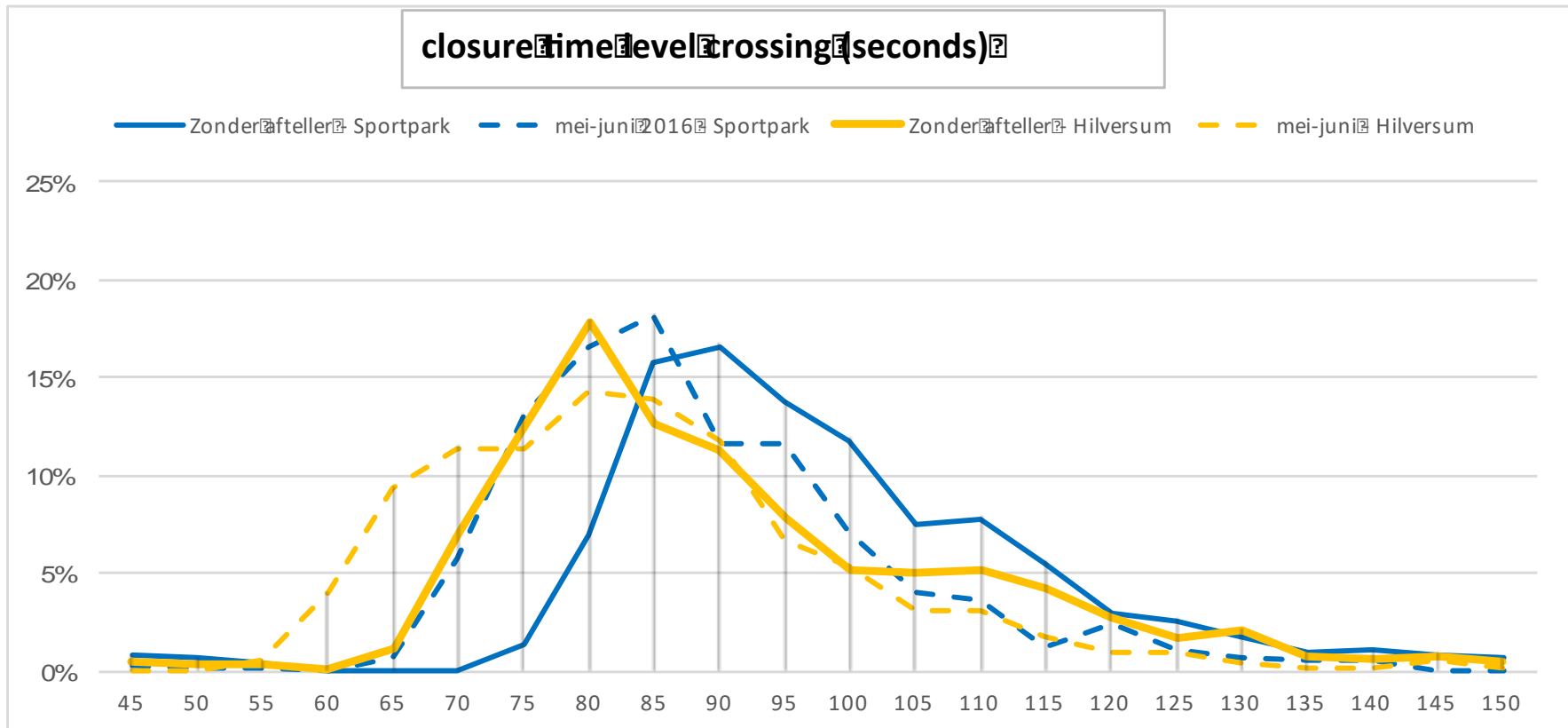
About 900 level crossing closures evaluated:
Not enough data for
statistic reliable results

Predictive factor:

Closure time of the level crossing with use of a
countdown is 16 seconds less then without
countdown ($p < 0.01$).



5 Results: closure time of level crossing



May-June 2016: 8 sec less waiting time for road users ($p < 0.01$)

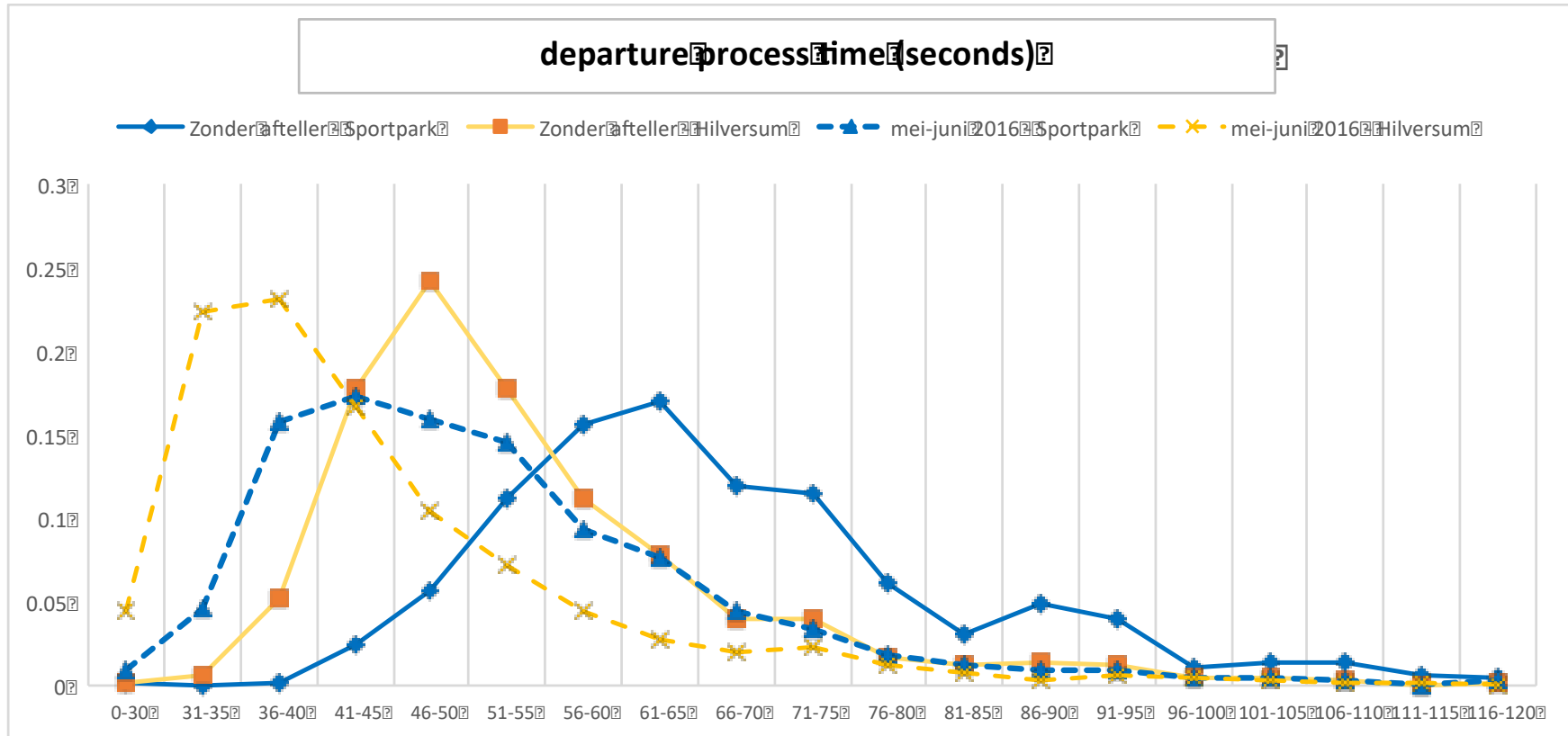
5 Closure time of level crossing

Closure time level crossing (seconds)		
	Hilversum	(N)
Without countdown: reference 2014	90,47	994
With countdown: pilot 2014	75,98	127
With countdown: nov 2015	87,86	957
With countdown: may-june 2016	82,34	528

With use of countdown closure time of level crossing:

- 8 seconds less then without countdown
- a potential up to 16 seconds less

5 Results: Process time for train departure



May-June 2016: 10 sec less departure process time of train ($p < 0.01$)

5 Process time for train departure

Departure process time (seconds)		
	Hilversum	(N)
Without countdown: reference 2014	54.46	748
With countdown: pilot 2014	36.98	118
With countdown: nov 2015	48.51	958
With countdown: may-june 2016	44.96	1628

With use of countdown process time for train departure:

- 10 seconds less then without countdown
- a potential up to 17 seconds less

5 Results: punctual departure of the train

	Hilversum		
	before dep.time	0-30 sec after dep.time	>30 sec after dep.time
Without countdown: reference 2014	0%	17%	83%
With countdown: pilot 2014	0%	60%	40%
With countdown: nov 2015	0%	37%	63%
With countdown: may-june 2016	1%	44%	55%

With use of countdown:

- more departures in 0-30 seconds after departure time
- less departures > 30 seconds after departure time

6 Follow up: implementation in Holland

- Design specs are met: potential for > 15 sec less process time
- Increase in level crossing safety
- Increase in punctual departure of the train
- No change in safety during train departure process
- Support for the use of the countdown in practice



Follow up: lessons learned

Lesson 1

- Change of behaviour of train staff with heavily rule based task performance is an extensive process.

Lesson 2

- A participative innovation process with strong emphasis on human factors and controlled piloting with increasing scale of piloting is not a guarantee for success for full implementation.

Lesson 3

- Incorporations of human factors in the implementation process is required.

Thank you

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