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the mind of movement

IMPACTS OF AUTONOMOUS DRIVING

SIMULATION-BASED FORECASTING

www.ptvgroup.com

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OVERVIEW

1. Context
2. Approach and background info
3. Examples/Simulation outputs

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CONTEXT:

- Road Safety

crash and fatality reduction, ethical questions

- Security issues

higher automation AVs -> more hackable vehicles than today's cars, terrorism issues

- Mobility sharing

Not a new topic, but: AV & mobility sharing can create together an increased efficiency and increased level of service, e.g. by using AV taxi fleets

- Mobility patterns

AV trips: might be considered more attractive, costs might be different -> impact on destination, route and mode choice

- Capacity/Effectiveness

Also often expected: AVs will lead to increased capacities due to higher effectiveness.


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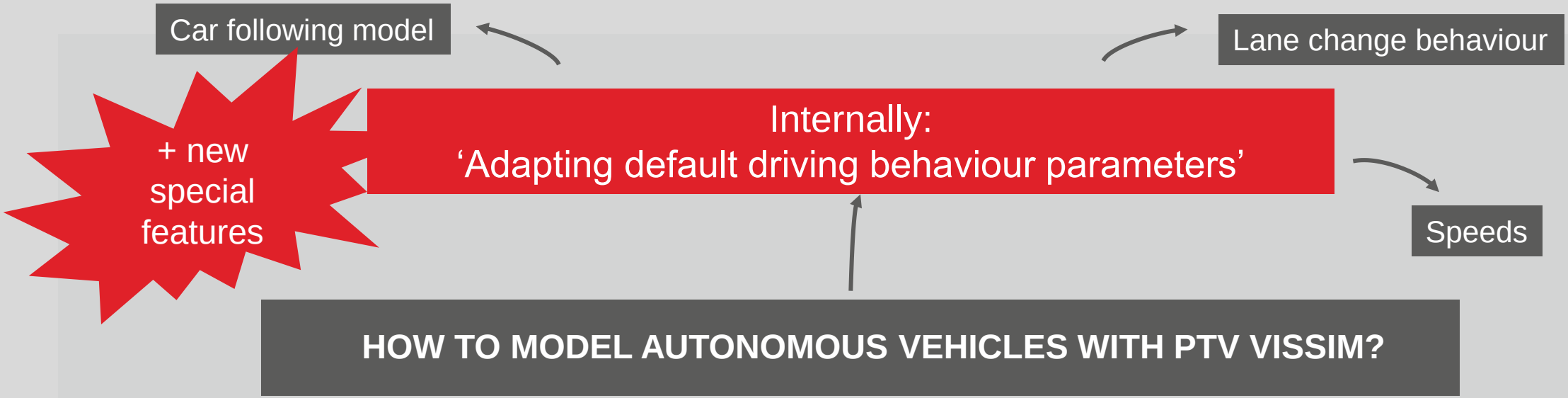
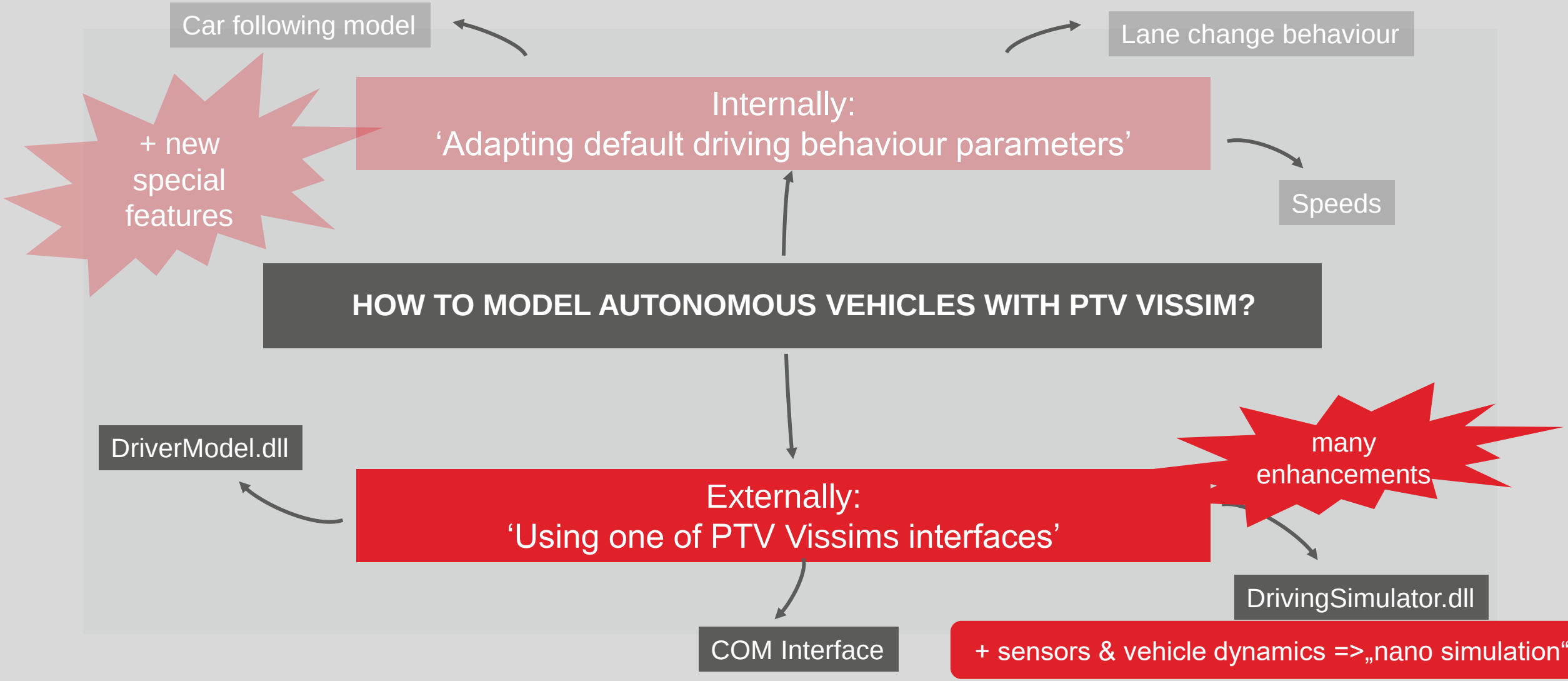
PTV VISSIM & CONNECTED AUTONOMOUS VEHICLES



PTV VISSIM & CONNECTED AUTONOMOUS VEHICLES



KEY QUESTIONS

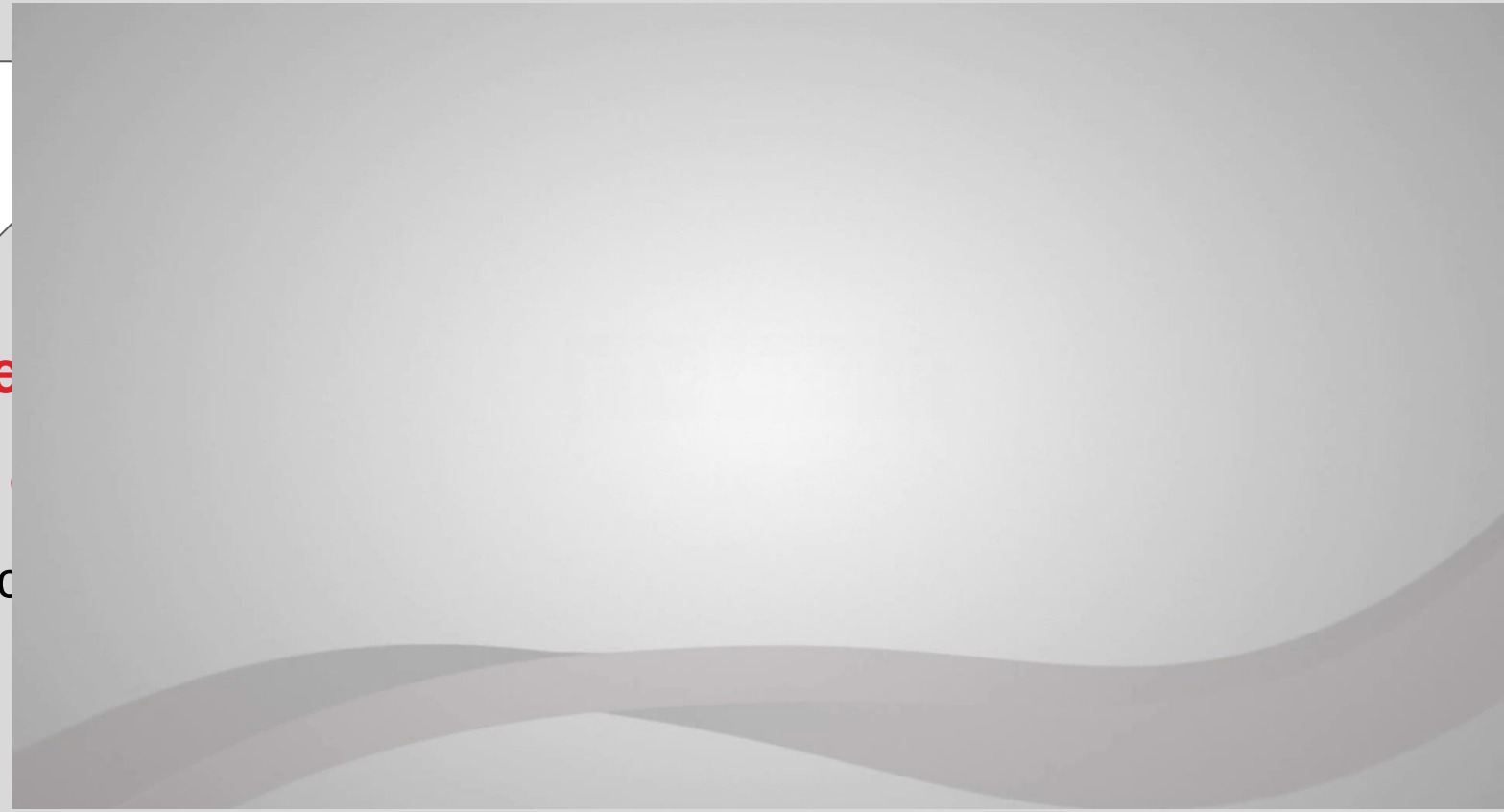
What are the differences in driving behavior between conventional and automated vehicles?

data needed => empirical data & virtual co-simulations

Is it possible/how to simulate

… without knowing all exact

realistic assumption & generalized c



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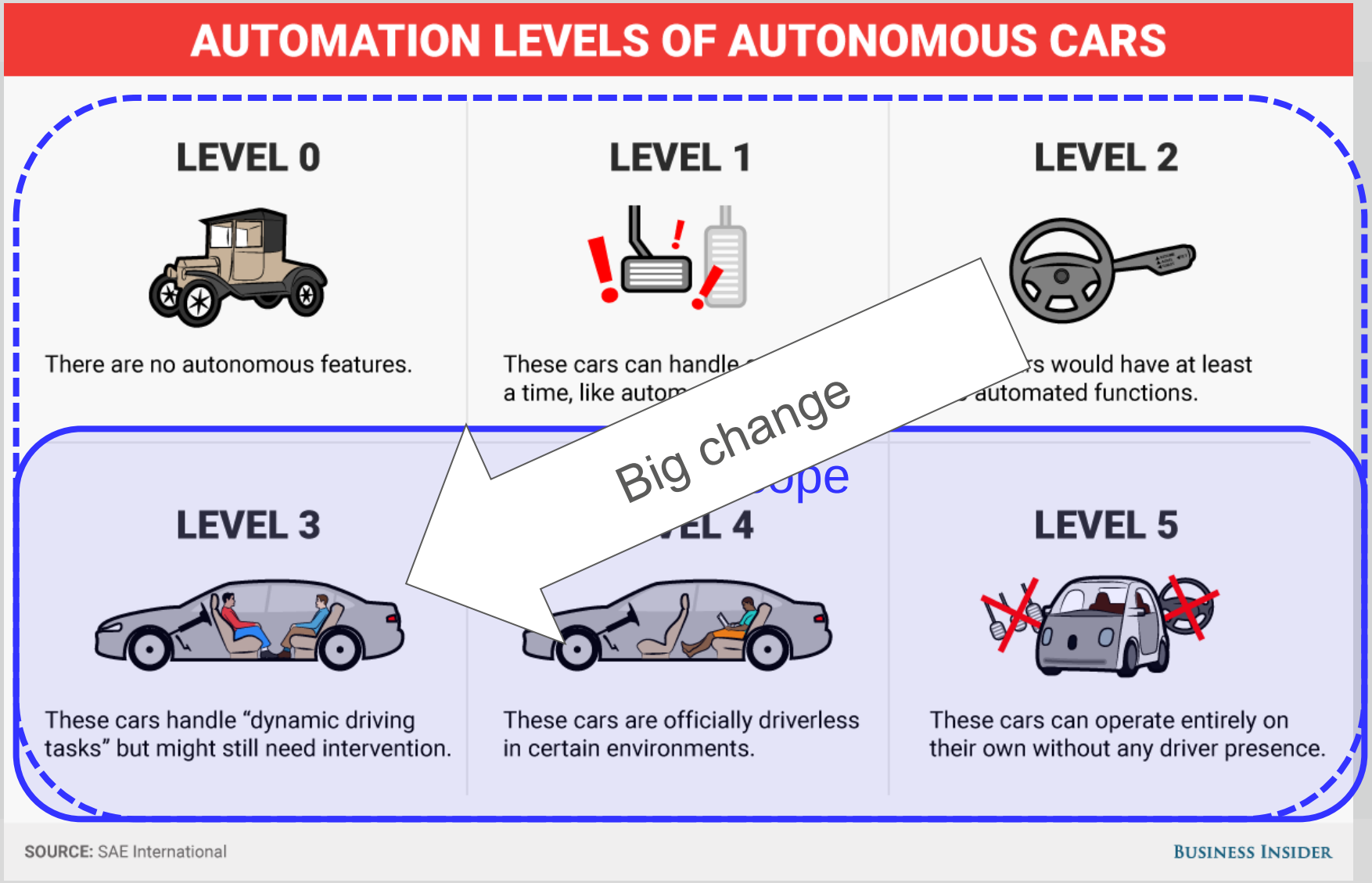
AUTOMATION LEVELS

How to interact

How to model



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URBAN ROAD CAPACITY/ SIMULATION WITH WIEDEMANN 74 MODEL

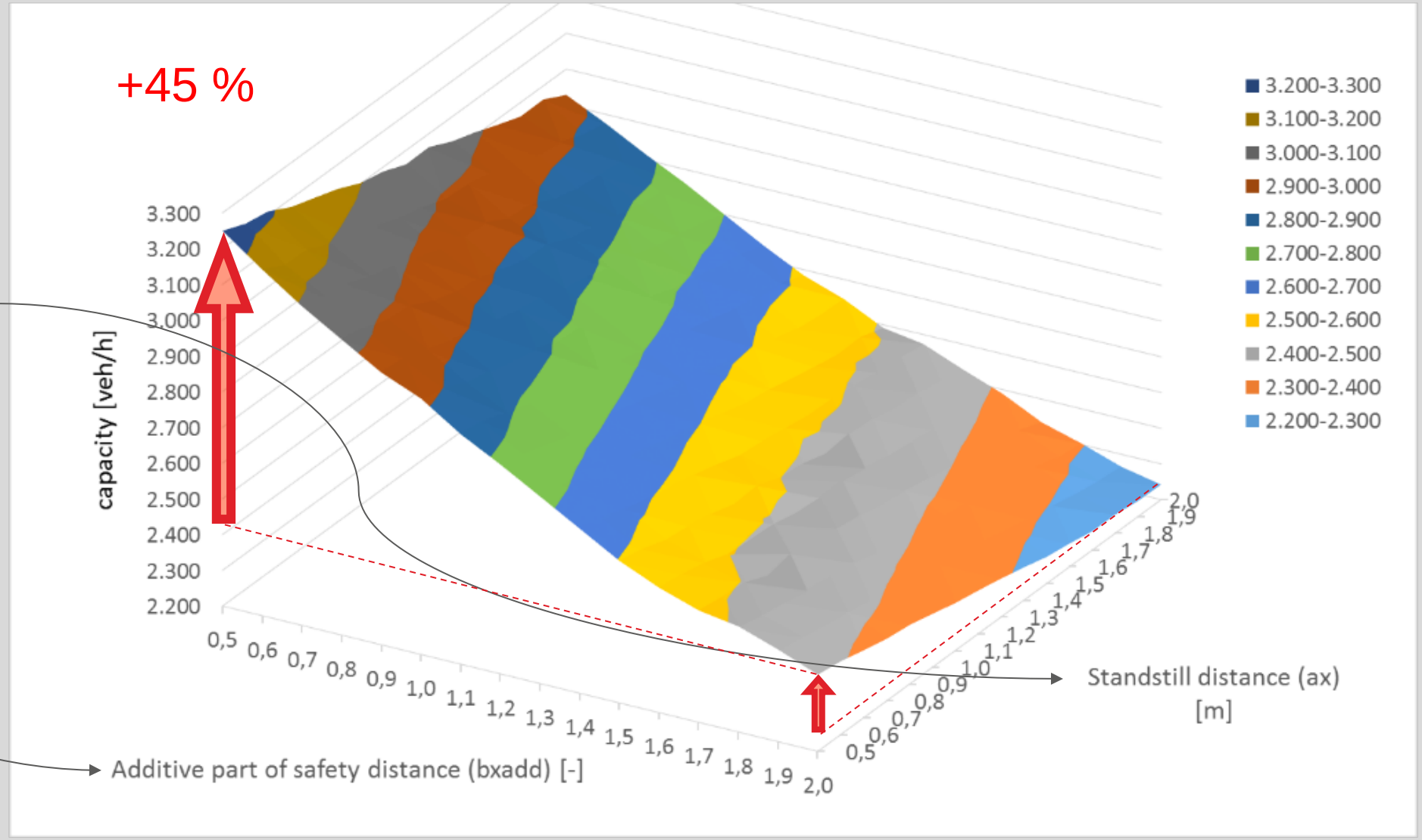
Stochastic term

Desired distance:

$d = ax + bx$

$bx = (bx_{add} + bx_{mult} * z) * \sqrt{v}$

speed



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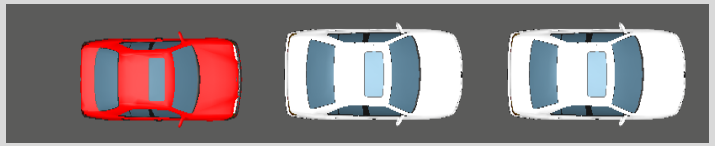
FREEWAY CAPACITY / SIMULATION WITH WIEDEMANN 99 MODEL

CC0

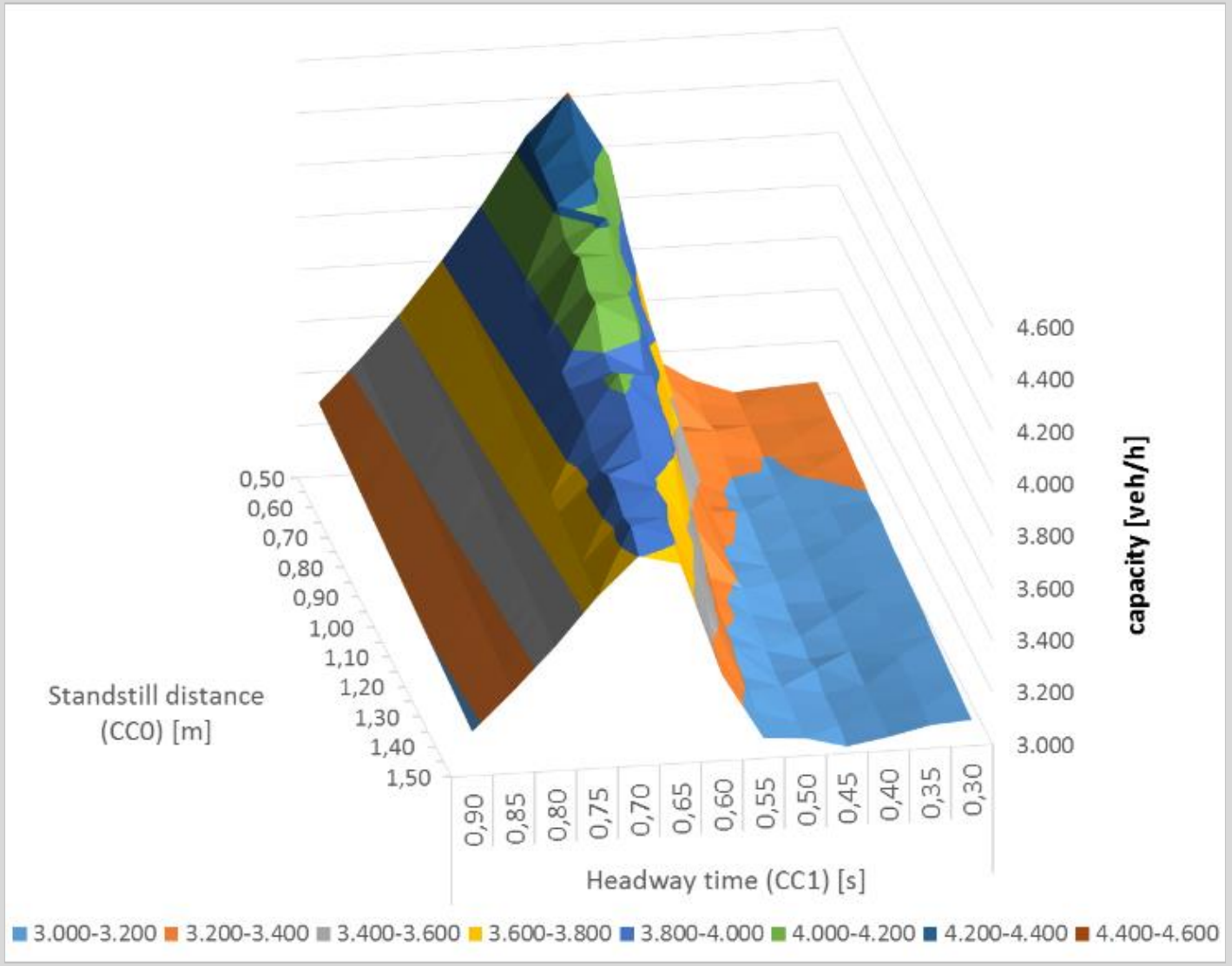
Standstill distance (Jam Density)



CC0

CC1

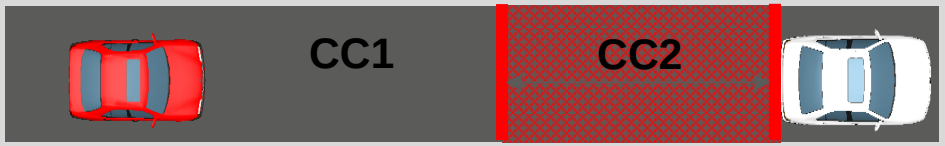
Desired minimum safety distance to the leading vehicle

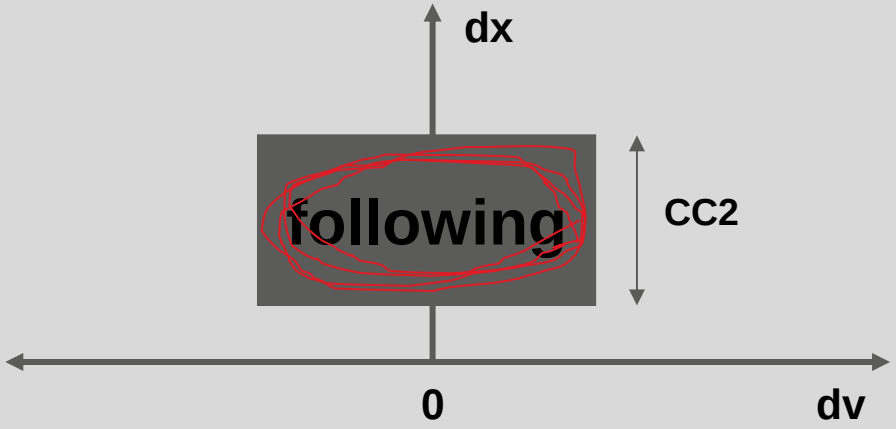


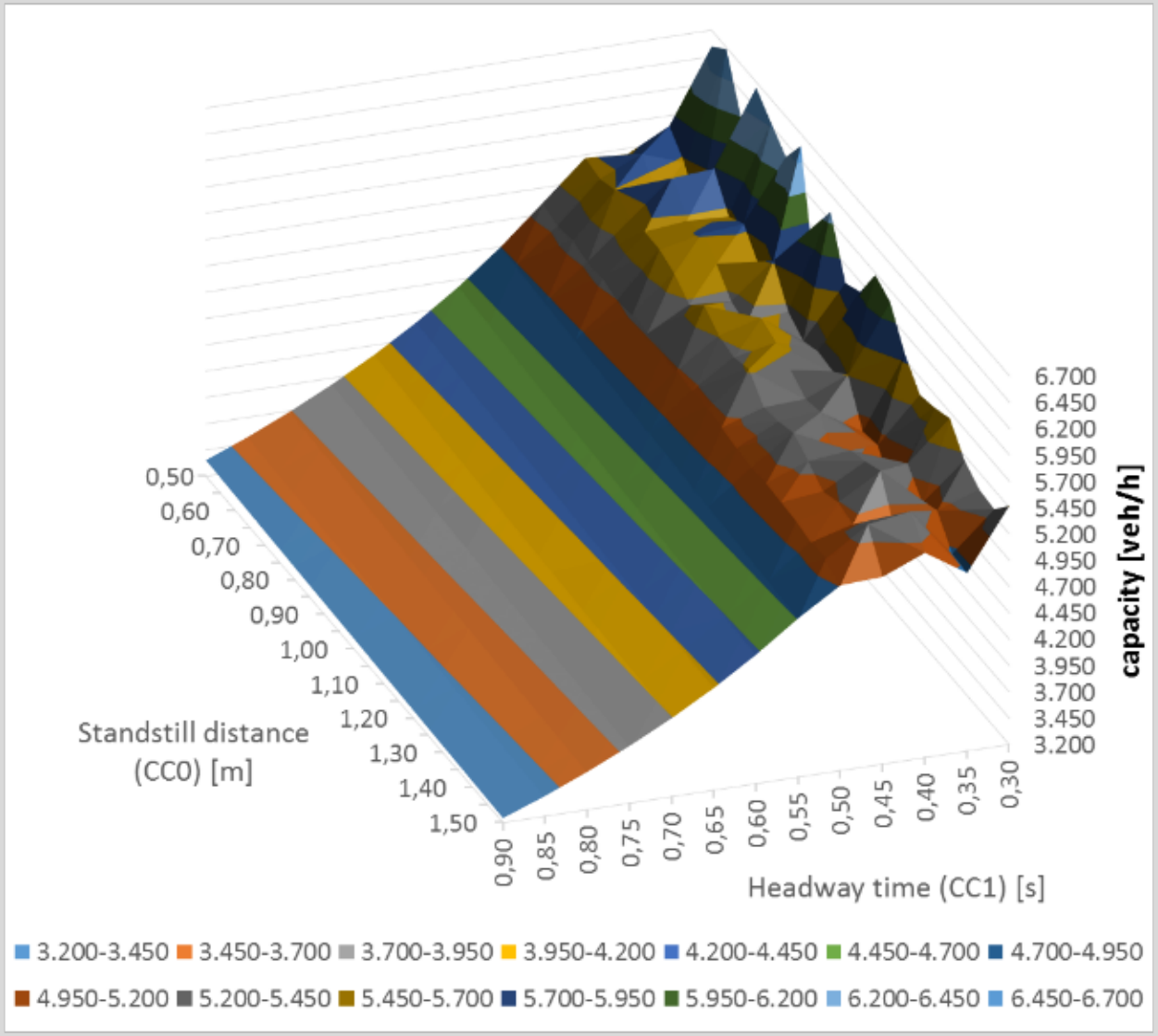
FREEWAY CAPACITY / WIEDEMANN 99 MODEL / ZERO OSCILLATION

CC2

Oscillation of the distance while following at the same speed (in meters)







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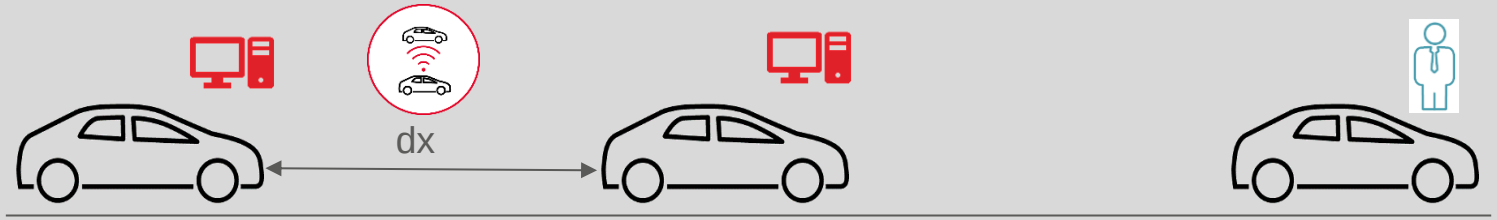
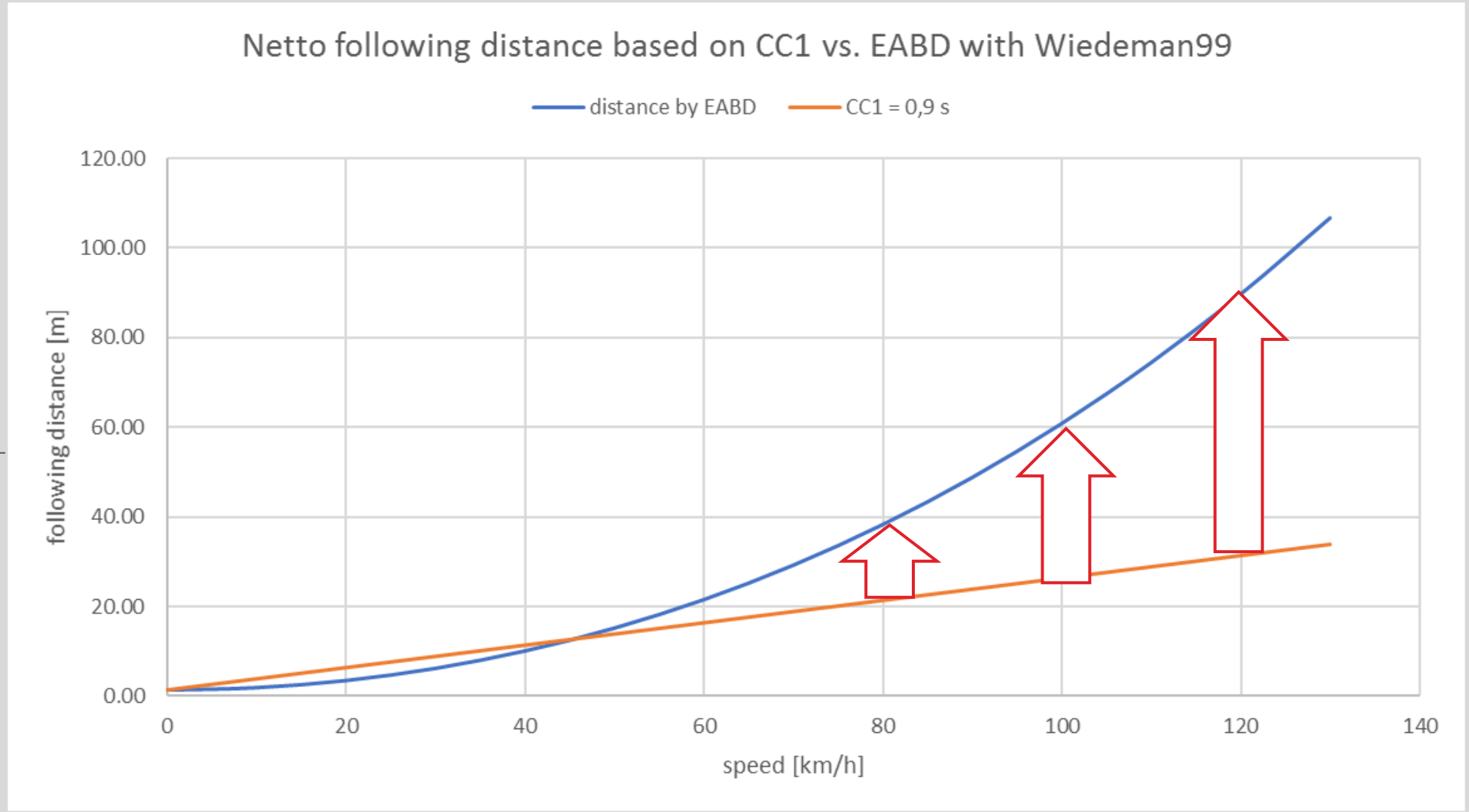
WHAT IS A REALISTIC ASSUMPTION FOR A HEADWAY?

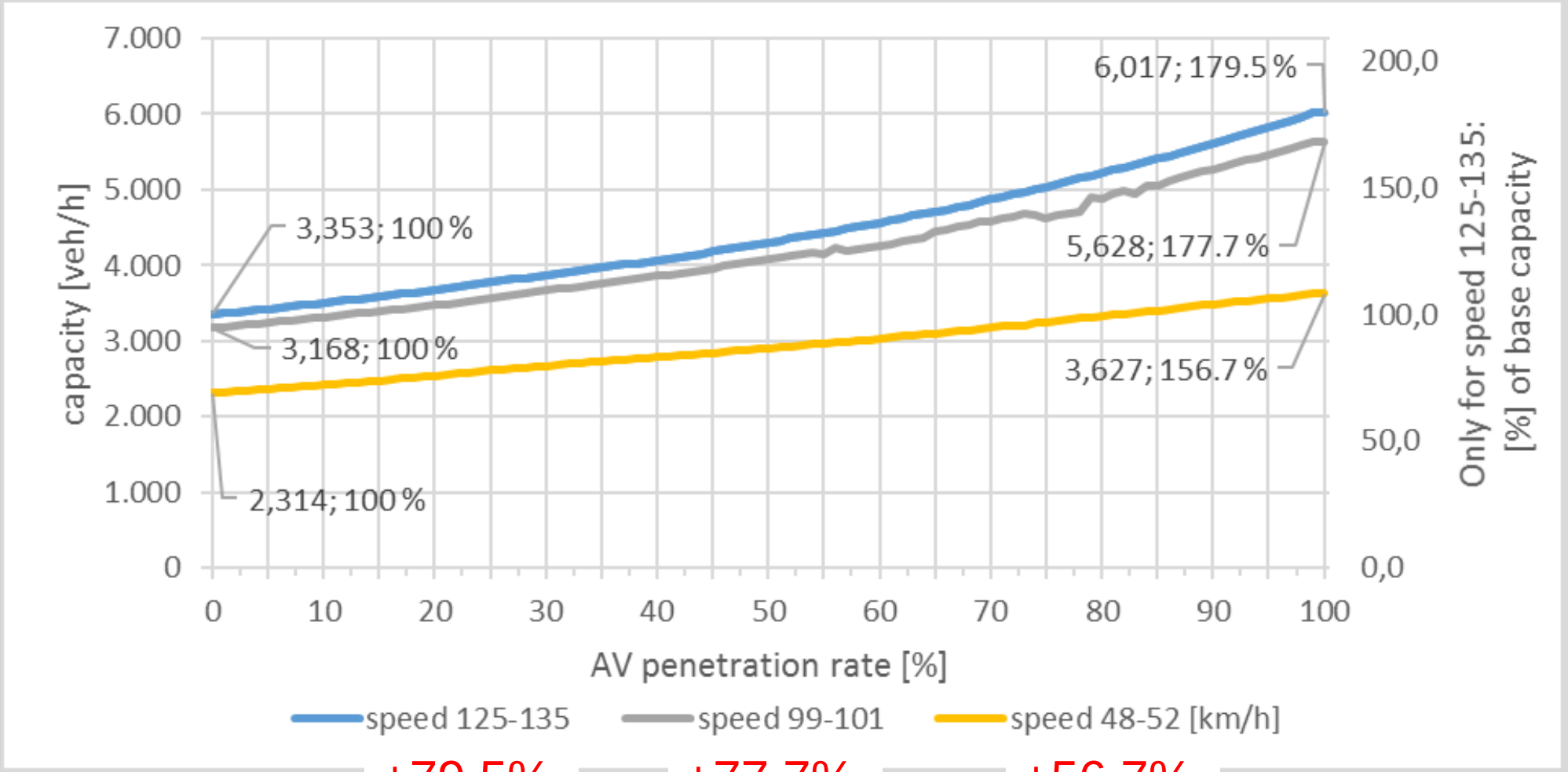
• Safety recommendation	1 – 2
• PTV Vissim default (driving parameter)	0,9
• Human driver (real traffic)	0,5 – 1,5
• Automated vehicles in test (CoExist)	1,0
• Automated vehicles in test with communication (CoExist)	0,3 – 1,0
• What about brick wall stop distance?	



BRICK WALL STOP DISTANCE?



AV PENETRATION RATE (WITH 50 % FOLLOWING DISTANCE REDUCTION)



+79,5%

+77,7%

+56,7%

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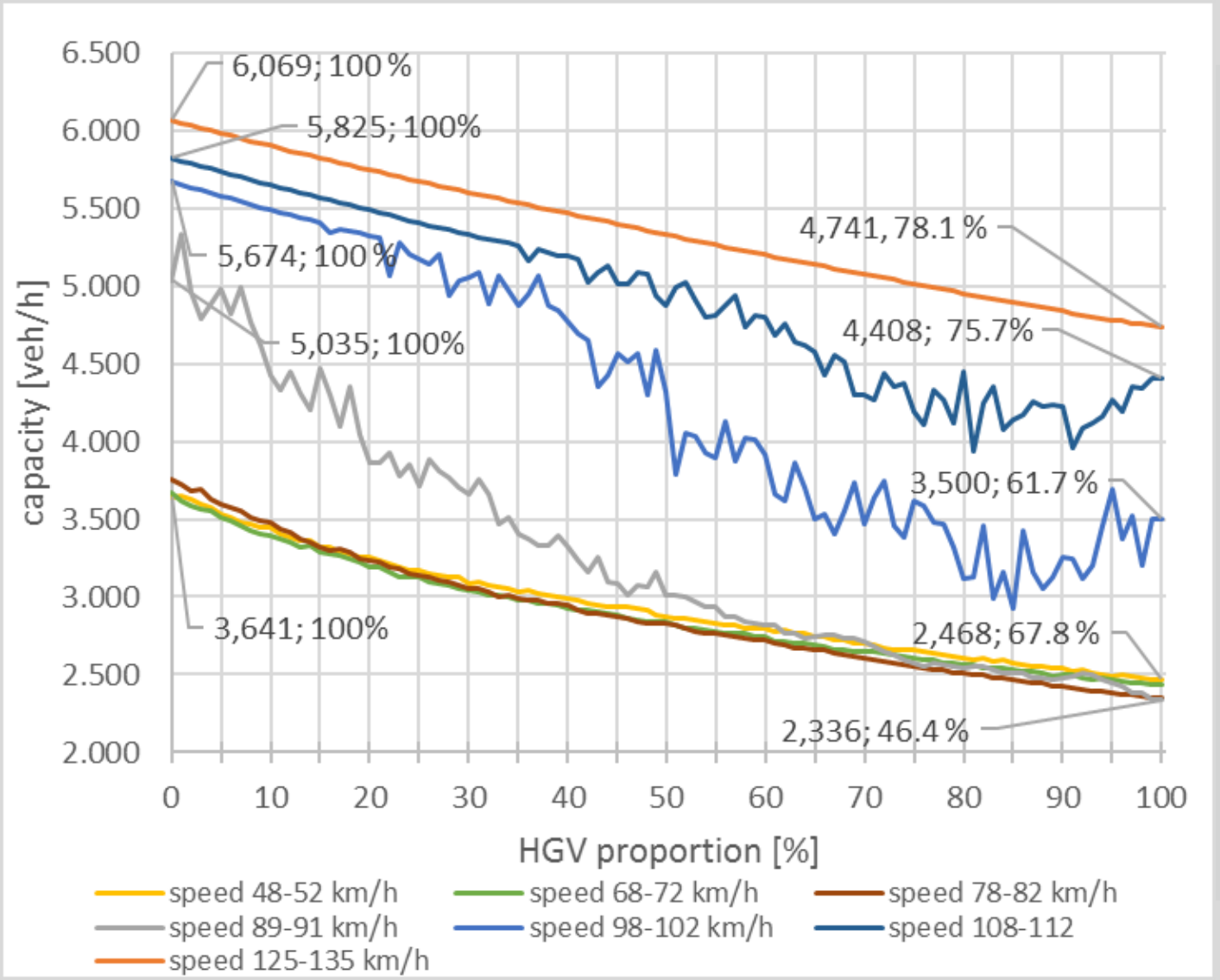
HGV PROPORTION



FLOW STABILITY WITH DIFFERENT DESIRED SPEEDS

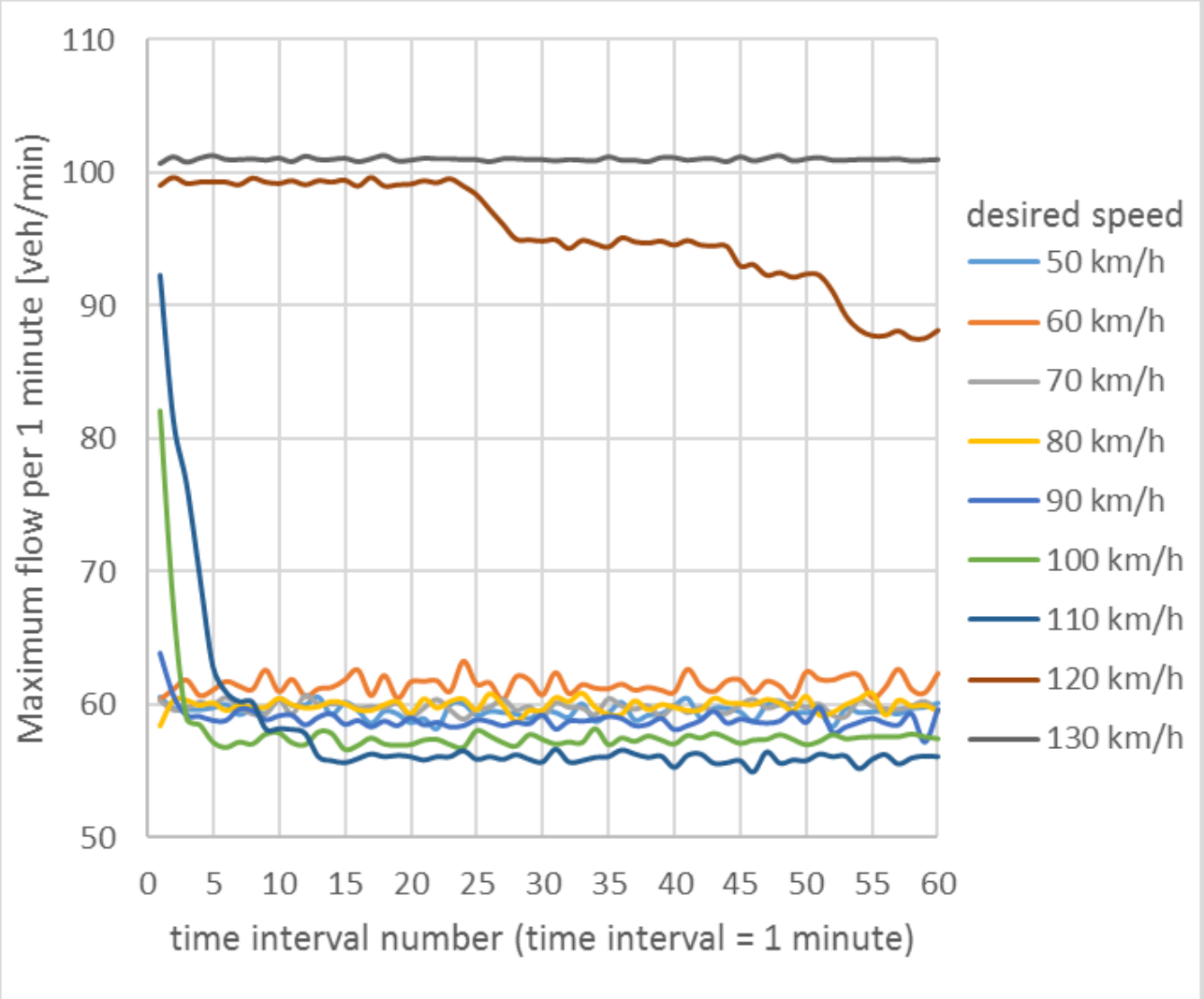
Higher speed =

Higher flow stability?

Higher speed &

constant headway =

higher following distance



SIMULATION TESTS SUMMARY

Theoretic capacity gains

…on simple link

…with 50 % following gap of a conventional vehicle

urban roads

freeways

+48,2%

+56,7%

+77,7%

+79,5%

…but:

- Impact of intersection remains decisive
- Introductory phase can lead to lower performance
- Communication & cooperation features can be the big game changers

SIMULATIONS ON REAL NETWORKS -> COEXIST PROJECT

With new PTV Vissim features (e.g. deactivation of stochastic terms)

& proposed driver behavior parameters
(for different driving logics)

More info:

https://www.h2020-coexist.eu/

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