

Quo Vadis, Industrial Production? Factories in the Global Environment

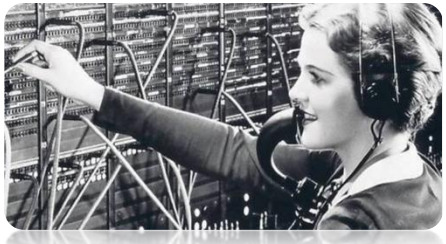
Dr.-Ing. Peter Burggräf

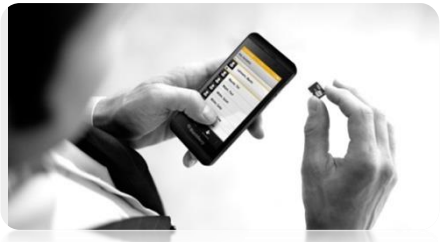
Berlin, July 25th, 2016

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Production infrastructure is built for decades – however, the requirements change with increasing time

1915 ***today*** ***2035***















During the next 20 years, the world will change as much as it has changed in the past 100 years

Sources: Supply Chain Management Review/ January/ February 2014/ AT Kearney; H+ Magazine June 2014; pictures: Volkswagen; Vau-Max; Secusmart

New needs lead to a marginalization of the production sector – the quaternary (virtual) sector rises

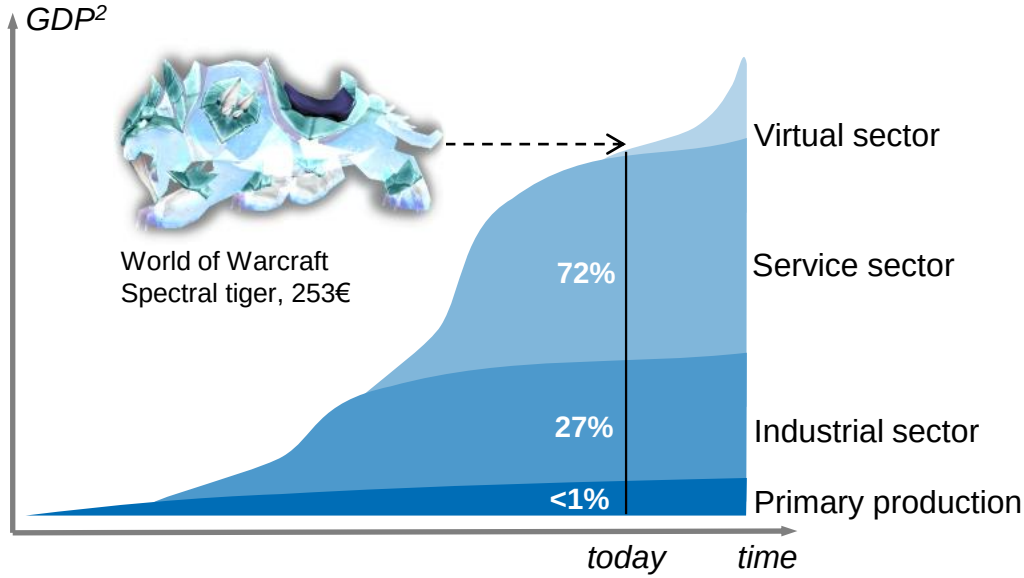
Market perspective

1943: Maslow hierarchy



Maslow hierarchy of modern society[1]

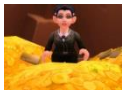




Examples



UBER 3x worth more than PSA[3]



100,000 people in China earn their money with virtual WoW-gold[4]

WhatsApp

Corporation with 55 employees sold for 19 billion $[5]

Pay

Mobile payment volume covers 330 billion $[6]

GDP = Gross Domestic Product PSA = Peugeot Société Anonyme WoW = World of Warcraft

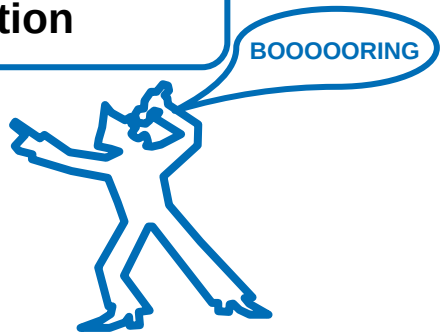
Sources: Selstad, T.: The rise of the quaternary sector. 1990 [1] Hilary Frazer, 2010 [2] eBay [3] manager-magazin; onvista.de [4] Kzero [5] Forbes [6] Statistisches Bundesamt

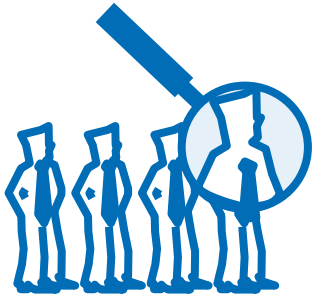
The consequences are severe: the ability to generate profits in production is in danger



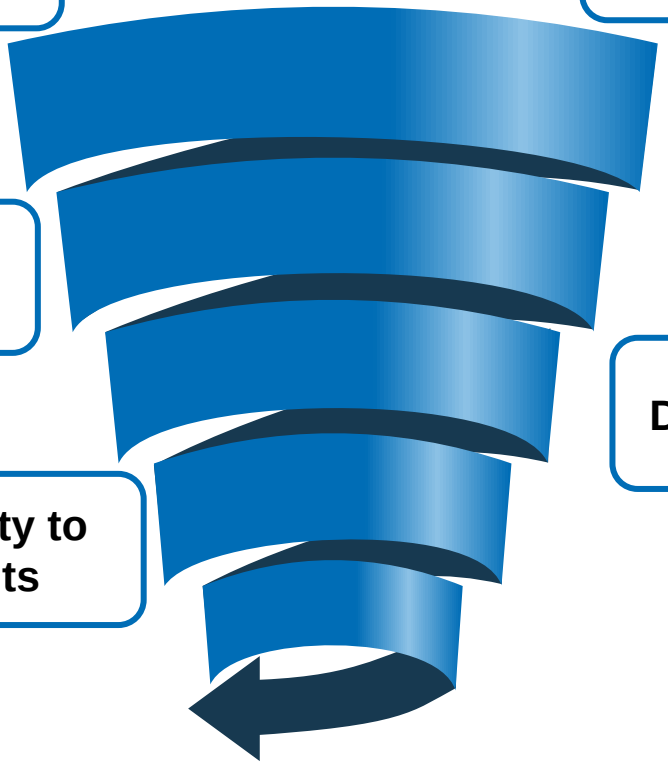
Production in existing structures is becoming more difficult

Decreasing interest in production





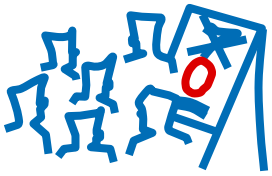
Increasing skills shortage



Decreasing innovation



Decreasing ability to generate profits



In the future, will production still be a promising business model?

Sources: Faculty of Mechanical Engineering, RWTH Aachen University, 2015, “Zeitreihe der Neueinschreibungen”

The visions of the Factory of the Future determines the normative guidelines and objectives

Factory of the Future



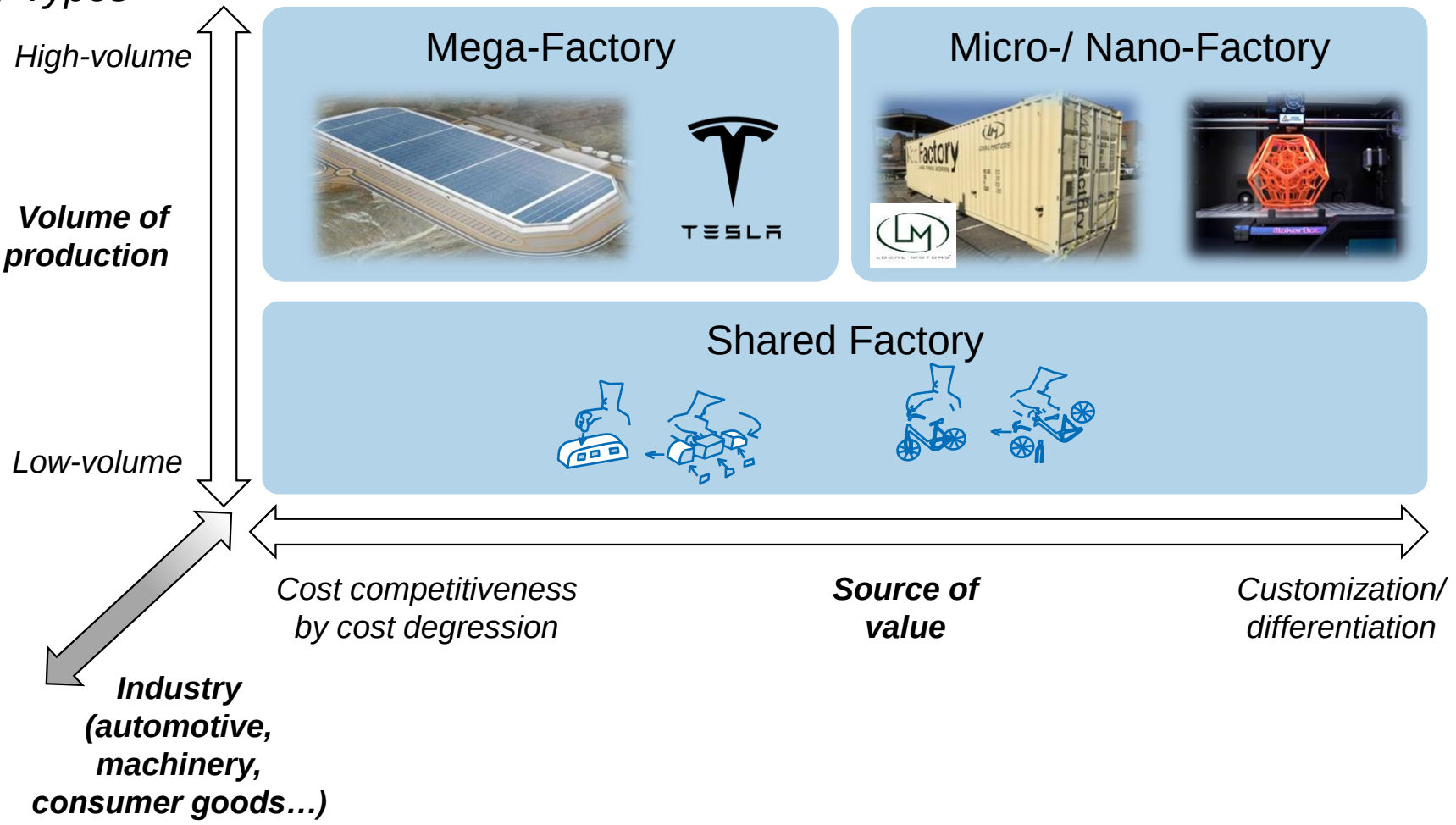
The Factory of the Future provides an answer to the question: What does our production signify?

ROI = Return on Investment p.a. = per annum

Sources: [1] StepStone Deutschland, 2013 [2] Bundesregierung 2013 [3] Houston Chronicle 2015 "ROI Calculation for a Manufacturing Company" [4] Kampker, A. et al., 2015, "Planungszeit Halbe" [5] Siemens AG, 2014, "Von Big Data zu Smart Data"

Three factory archetypes can be distinguished in the future

Factory Types



Sources: own illustration, pictures: Tesla Motors, Local Motors

Virtual & Augmented Reality – Collaborative planning and support in production processes for the flexibilisation of employees



Integration of augmented and digital tools in daily work

By superposition of the reality allocation efforts of information can be reduced → Information on demand

Digital planning and development enables the reduction of coordination processes by collaborative work and an intuitive visualisation of components, systems and work environments → Faster approval and ramp-up

Current developments and next steps in Aachen

- The factory planning table enables a participatory planning approach
- Digital tools for the visualization of the prototype production make primo- and virtual prototypes possible
- The automated generation of assembly sequences from CAD is developed up to a maturity level for series production

StreetScooter Research

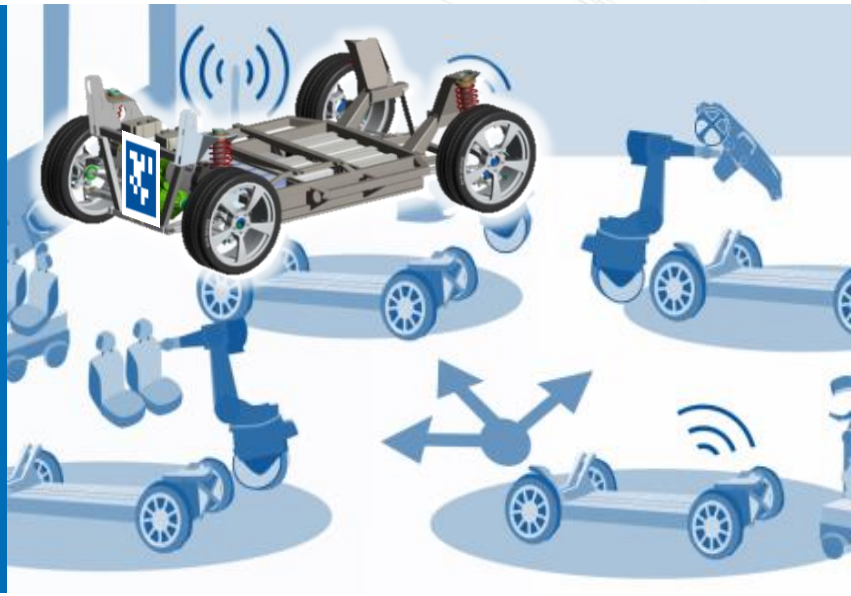


Autonomous systems in production – Self-driving chassis after first startup and autonomous transporters in the plant

Smart logistics, reduction of path-widths and autonomous startup

Self-driving chassis lead to autonomous check processes after initial startup, by reduced conveyor techologies the sequence of the final assembly can be flexibilised (car sequencing problem)

Autonomous transporters deliver parts and transport waste and chips



Current developments and next steps in Aachen

- The StreetScooter can already perform autonomous delivering processes
- Self-driving chassis are key for low cost assembly, cost-intensive conveyor technologies can be omitted from intial startup
- The Campus Shuttle at RWTH Aachen Campus is qualified as an autonomous support for the final mile (person transport at plant)

StreetScooter Research

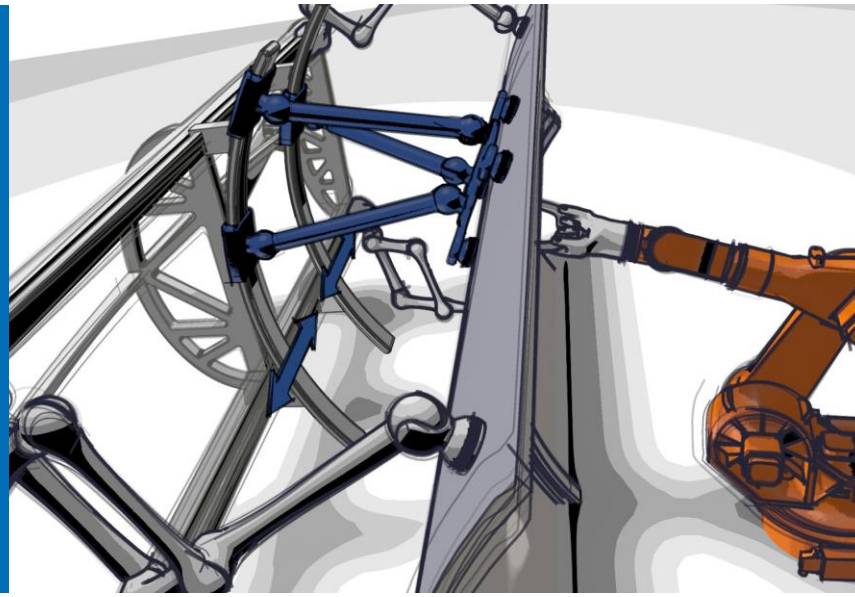


Smart Robots – Self-optimizing assembly systems make autonomous decisions regarding the compensation of manufacturing tolerances

Learning and self-optimizing systems react on tolerance situations

By detection of deviations in the component the target tolerances are achieved with flexible equipment

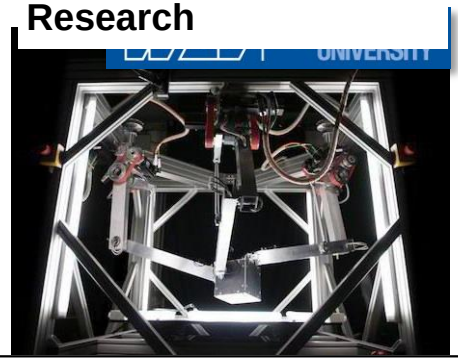
In case of deviations in single components, compensation elements are automatically produced by additive technologies so that higher tolerances can be processed and single components can be produced and transported more cheaply



Current developments and next steps in Aachen

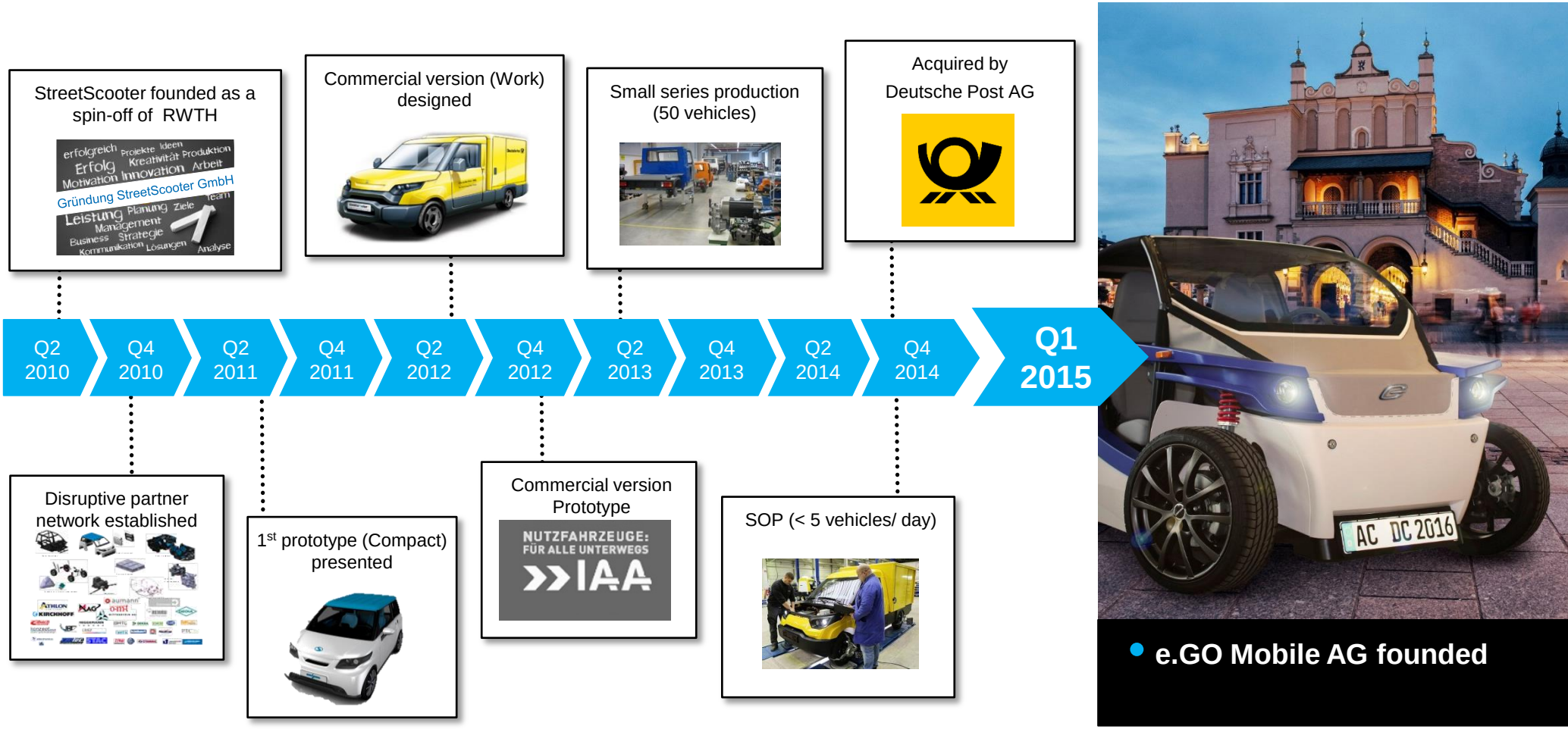
- Series ready 3D-printed tolerance compensation elements for add-on parts in final assembly
- Automated calculation of tolerance compensation geometries on the basis of measuring data
- Rapid fixture elements for interfaces in equipment for reduction of ramp-up risks

StreetScooter Research



StreetScooter is the perfect example of the disruptive network approach

Disruptive network approach



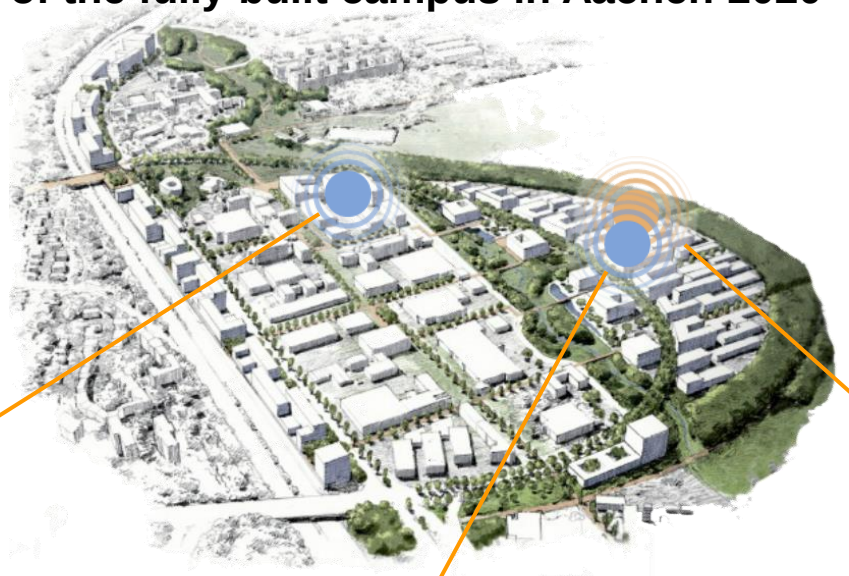
The infrastructure on the RWTH Aachen campus enables the development of solutions for the Factory of the Future by linking research with industry

Vision of the fully built campus in Aachen 2020

Ramp-up factory







Demonstration factory



eLAB



Thank you for your attention.

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