Engineering Trends

1st Training in Bahia Blanca, ARG

12-14th of November 2018

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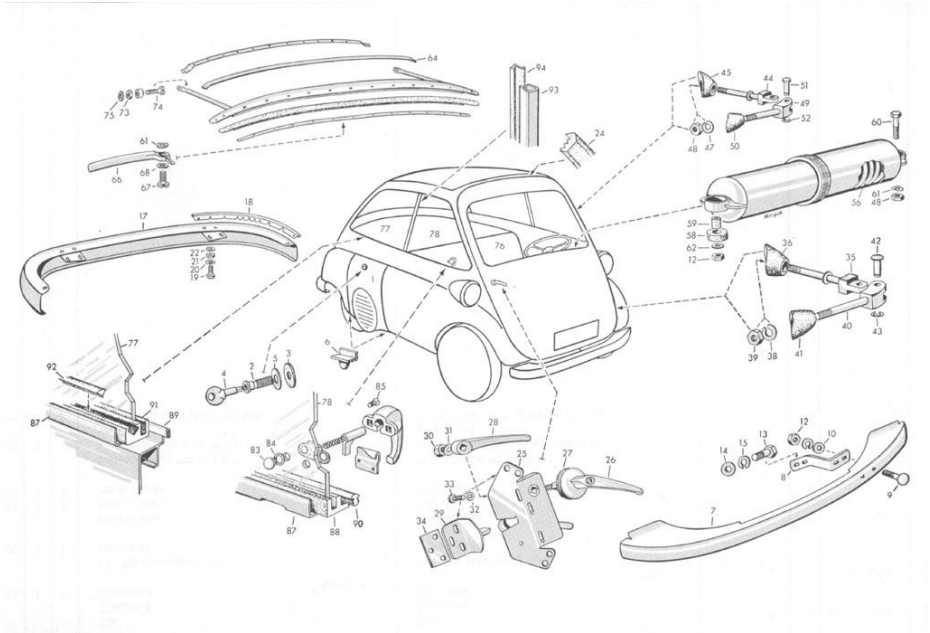
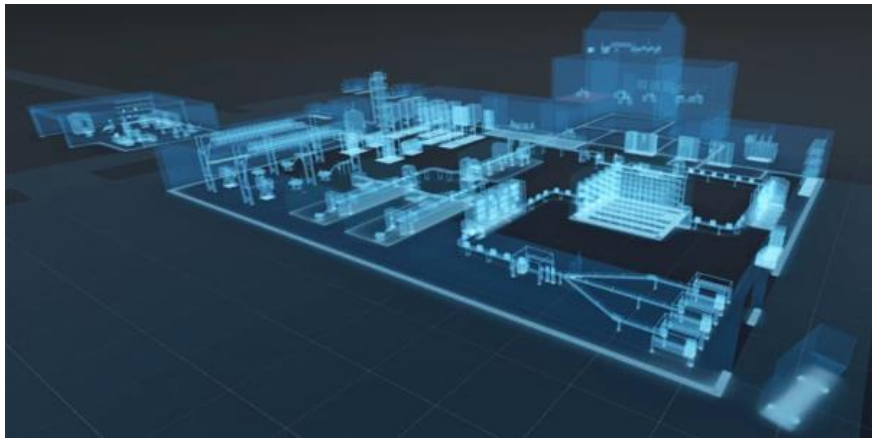
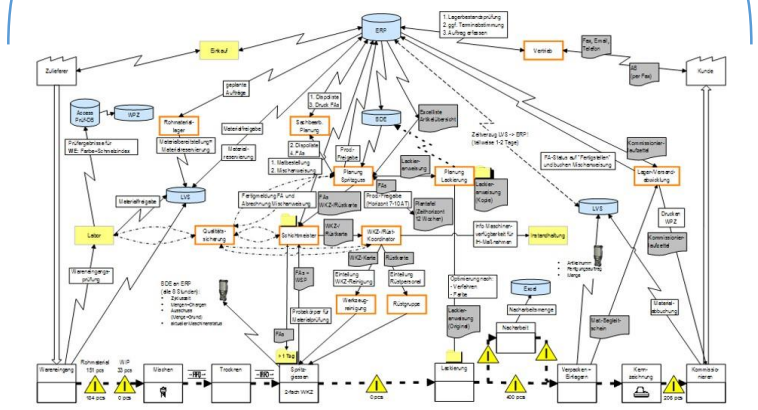
From product to production







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Content

Production Management

Quality Management
&
Innovation Management

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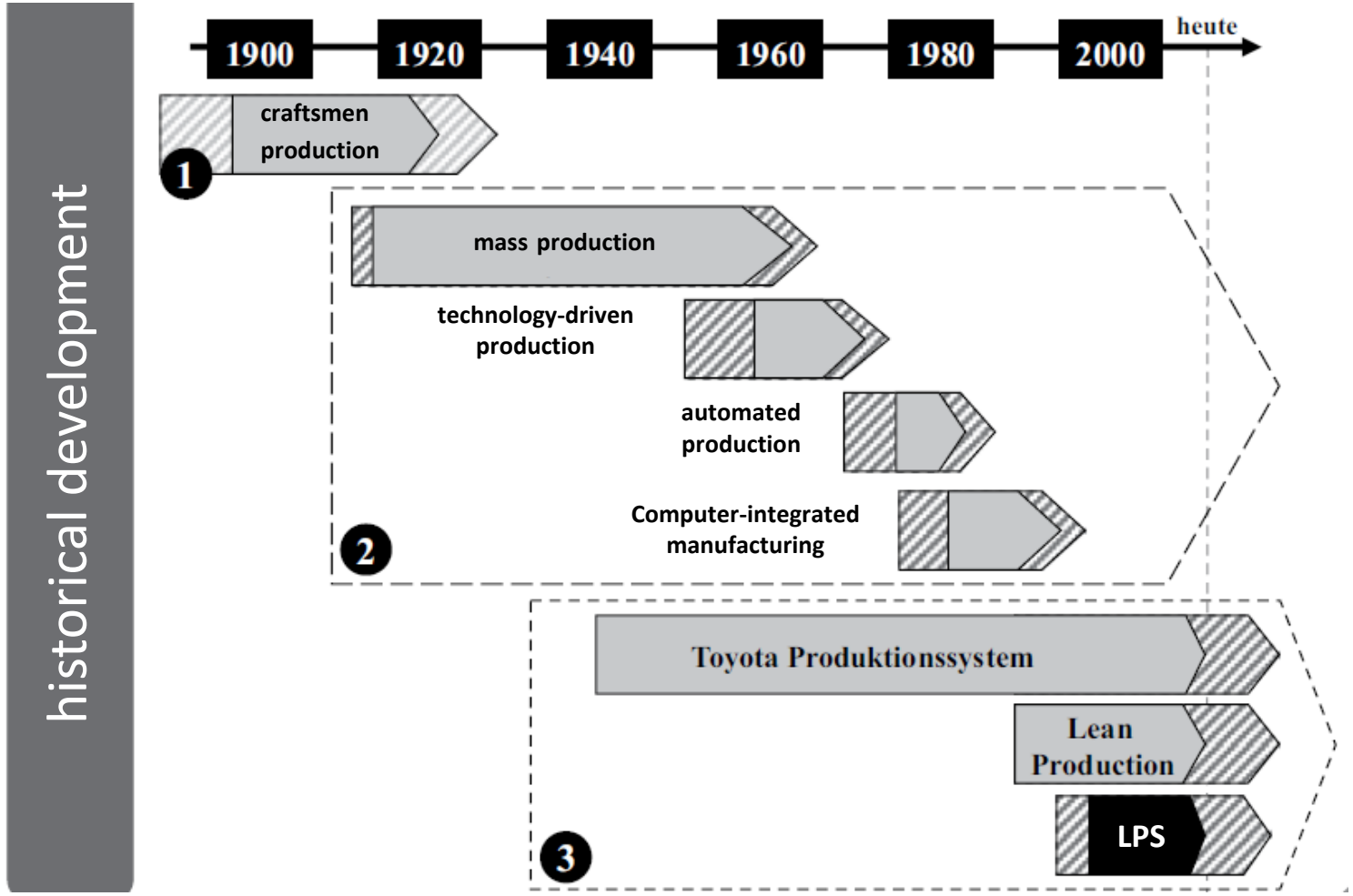
Historical development of production systems



Source: Dombrowski, U.; Mielke T.: Ganzheitliche Produktionssysteme, 2015

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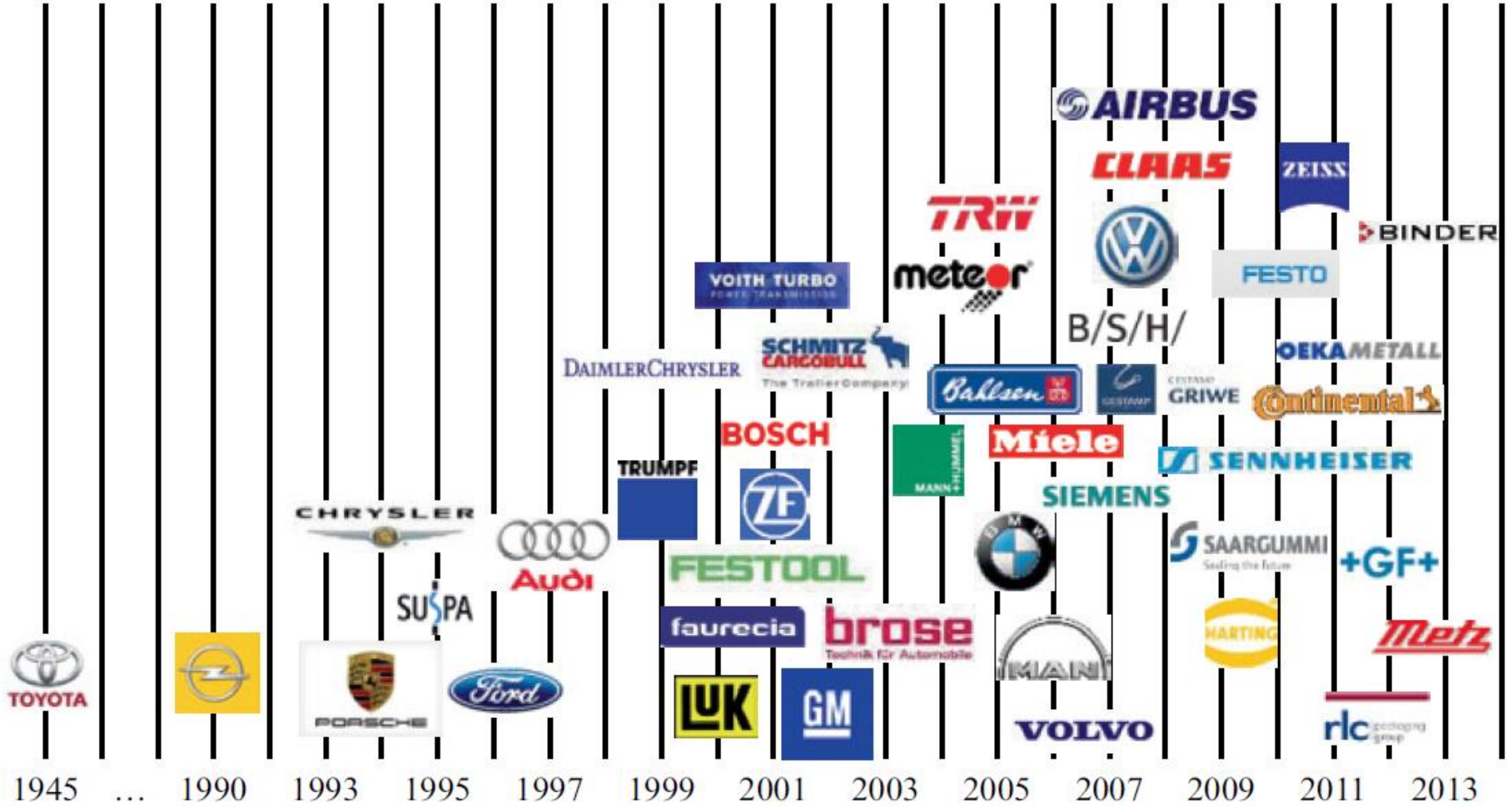
Introduction of LPS



Source: Dombrowski, U.; Mielke T.: Ganzheitliche Produktionssysteme, 2015

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AUDI

For more than 100 years, the assembly line in the automotive industry has set the pace. However, now modular assembly enabling companies to handle the increasing complexity and diversity of variants better, more flexibly and more efficiently.

- manufacturing islands
- just in time through driverless transport system (DTS)
- highly flexible

Component:

Example: air conditioning
So far: 102 variants in 220 models
New: 28 variants

Construction:

Example: fixing the motor
So far: 309 positions
New: 36 position

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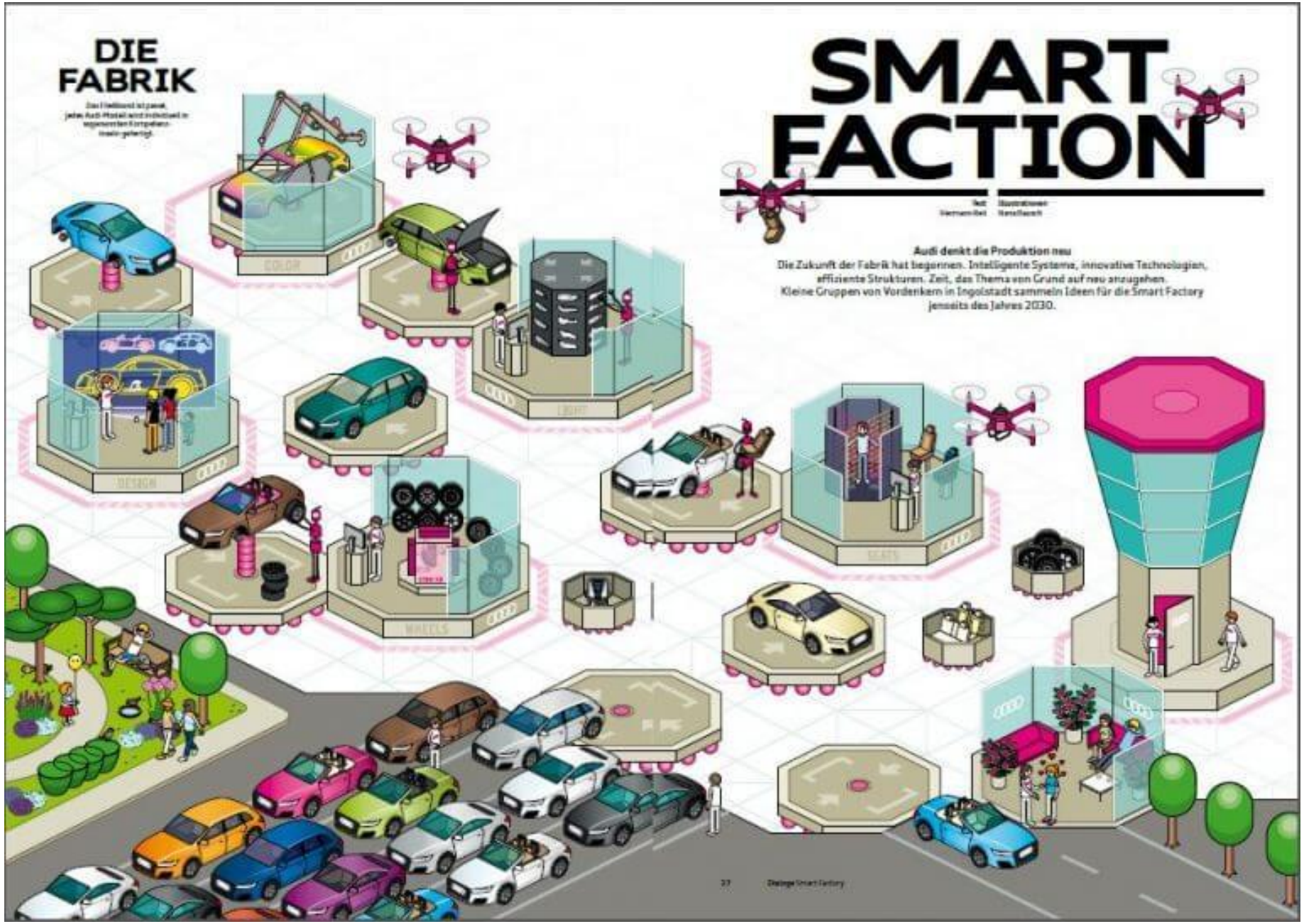

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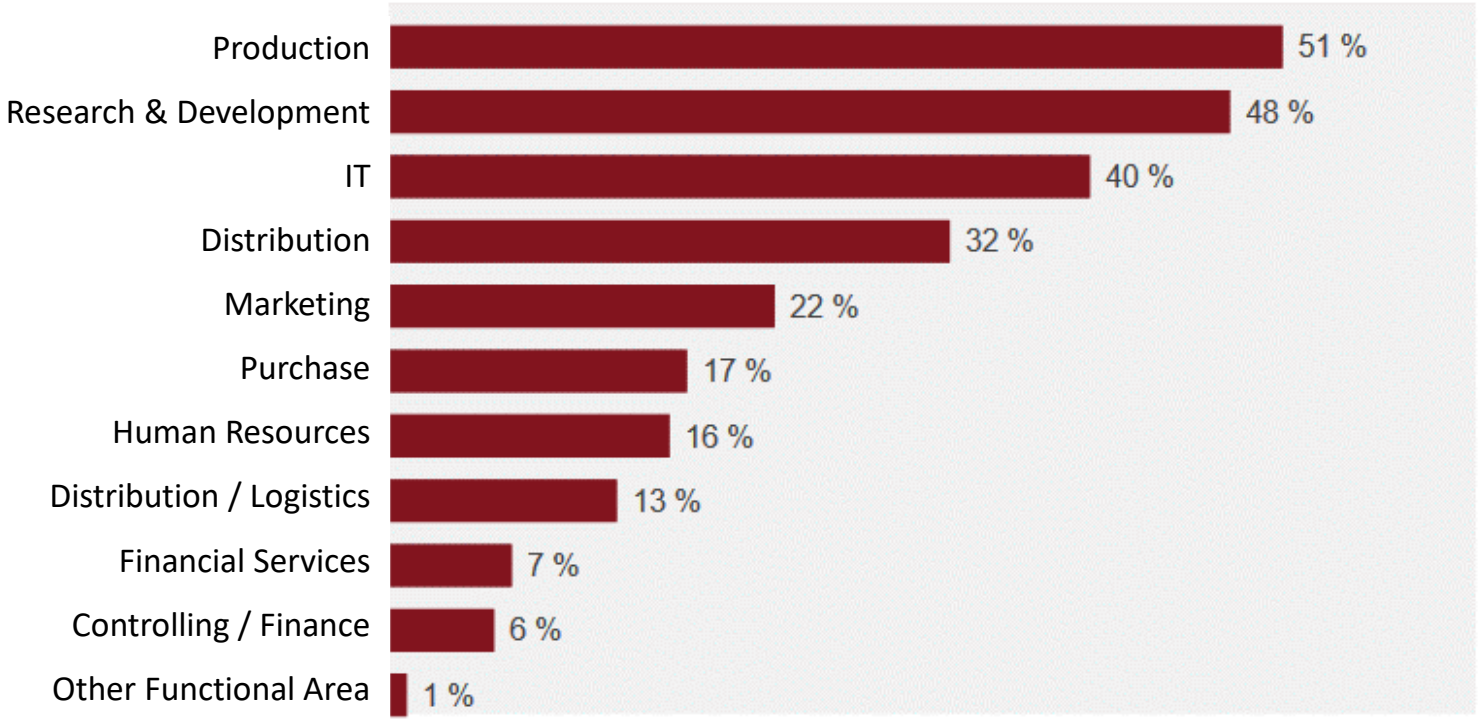
Automotive Trend Barometer

The strongest changes are expected in the departments production, research & development and IT

Functional areas with biggest changes due to new business models / digitization



Source: PWC, B2B-Survey “Stimmungsbarometer Automotive”, Februar 2017

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Group Work

What are the main manufacturing trends in your country?

10 min

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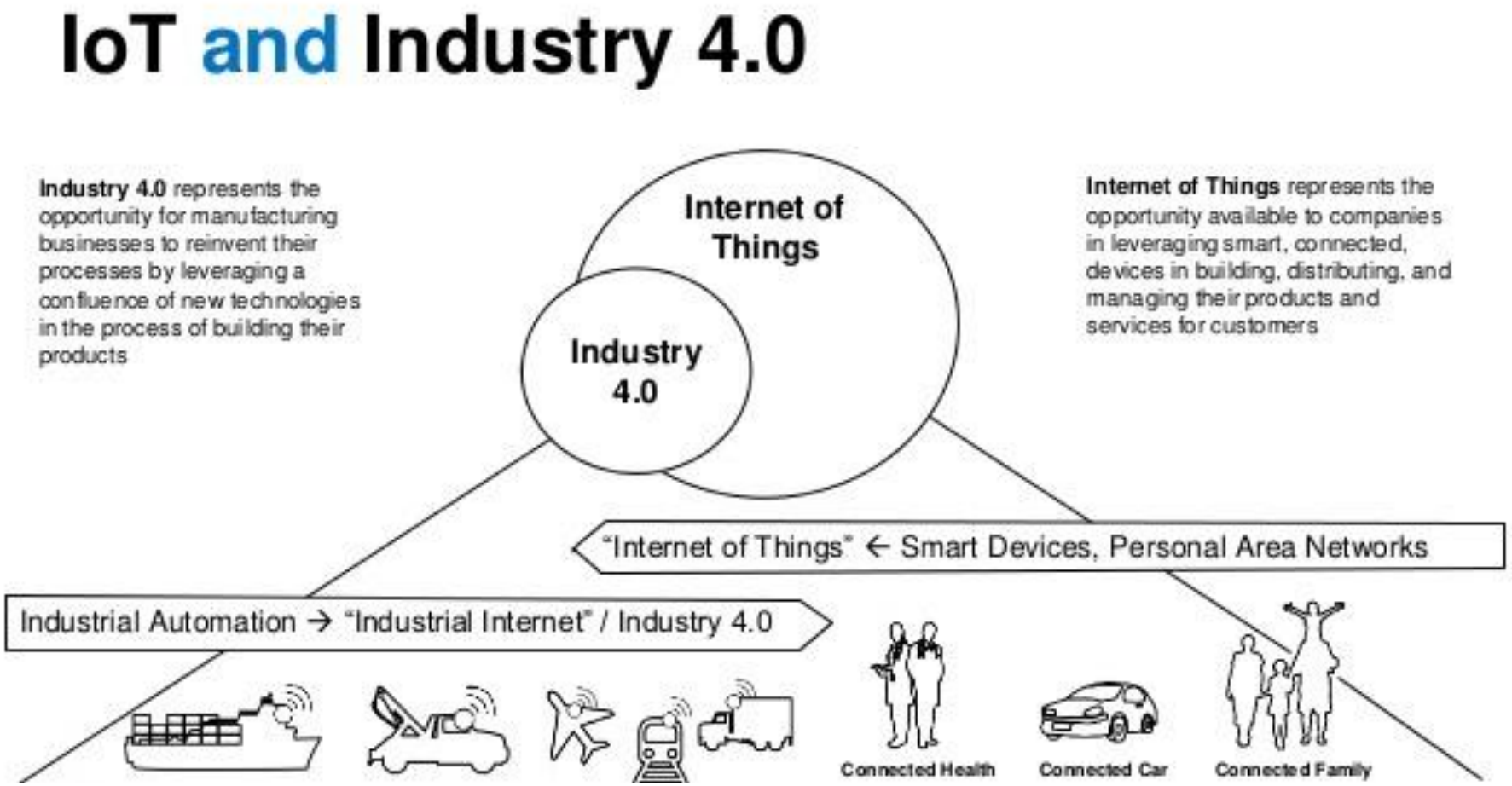
Definition Iot & Industry 4.0



Source: https://www.slideshare.net/thomasgr/connecting-developers-with-things-developer-relations-for-internet-of-things

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BMW

Objectives:

- R&D for further improvement in lightweight construction
- mass production: intelligent networking, improve quality by reducing cost
- support projects or new production structures with digital factory approaches.

Areas of activity:

- simulation in production
- assistance systems in production
- robotics and autonomous systems
- networked value chain
- digital factory
- human-robot systems
- mobile assistance systems
- sustainability

Source:
- Dunckern, C.: Industrie der Zukunft – Zukunft der Industrie?, Fachtagung IG Metall (2014)
- Michael Ebner, Industrie 4.0: Nachhaltige Produktion durch intelligentes Energie- Datenmanagement, Presse-Information, 11/2014.

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Daimler

Objectives:

- shortening of start-up times through digital security,
- horizontal and vertical integration,
- reduced procurement times for production facilities,
- optimization of production and assembly,
- Increasing automation through human-robot interaction
- flexibilization of production through adaptable production,
- global optimization of processes.

Areas of activity:

- digital life at work,
- integrated IT processes (PLM, ERP, CAD, MES),
- digital factory and virtual commissioning,
- versatile factory,
- sensitive robots.

Source: Stefan Kienzle, Implikationen für die Automobilproduktion durch Industrie 4.0, Vortrag, Stuttgart 7/2014.

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High manual activity level

Characteristics:

- small amount of robots,
- recurring activities for employees,
- high flexibility in production,
- high staff costs and
- low machine costs.

Trends:

- sensitive industrial robots
- assistance systems,
- quality in production and
- augmented reality

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High degree of automation

Characteristics:

- high machine costs
- low flexibility,
- high degree of standardization and
- high robot application

Trends:

- predictive maintenance,
- big data,
- M2M communication and
- sustainability issues

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Commonalities

- autonomous transport units,
- digital factory (planning and simulation),
- smart Data for predictive quality,
- data lifecycle,
- KPIs via mobile dash boards,
- horizontal and vertical integration,
- OPC UA (as a synonym for standards) for communication,
- transparency in production with RFID,
- cloud and IT security.

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Trends in production

Industry 4.0

Resource-efficient production

Human integration

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Industry 4.0

Transparency and controllability of processes, machines and plants through intelligent networking, targeted digitalisation and value-oriented reorganization of processes

SmartFactory

Data management and analysis

Component identification and tracking

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Human integration

Promote efficiency and ergonomics for the workplace of the future through the use of established deployment methods, lean organizational structures and intuitive mobile IT-assistance systems

Workplace design	**Capacity and order planning**
Process organization	**Production assistant**

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Resource-efficient production

Supporting energy and resource efficient value creation through individual planning approaches, innovative process control and integrated management.

Energy efficiency

Material and energy flow simulation

Planning and operating resource efficient factories

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Group Work

How to prepare students for ever-changing and complex environments?

10 min

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“The understanding of fundamental production strategies and methods as well as their influence on innovative approaches lead to a fast adaption and transfer into new situations.”

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Subjects in curricula of HSD

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Subjects

https://michilot.com/wp-content/uploads/2018/05/mano-de-obra-presencial.jpg

- Production planning and control
- Methods for production optimization
- Operations Management
- Factory planning and quality management

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Production planning and control

Courses: lecture 2h per week / practical training 2h per week	
Learning outcomes / Competencies The students are familiar with the basic tasks of production management and the use of PPS / ERP software in industrial operations: • programming • quantity planning • Schedule and capacity planning • Production control	
Forms of teaching • lecture (a) • expand of the applications in the PPS / ERP - EDP practical training under guidance and independent processing of a simulated order	

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Factory planning and quality management

Lehrveranstaltungen lecture 2h per week / exercise 2h per week / practical training 2h per week	
Learning outcomes / Competencies • systematically carry out smaller operational planning tasks; analyze, design, evaluate and realize solutions, Market - u. Derive, • Derive, evaluate and implement market strategies and production strategies • Implement assembly tasks, • Implement lean philosophies, • Implement optimizations in the quality area, • Evaluate and classify current market developments.	
Forms of teaching • Lecture, (introductory explanation of the facts and methods) • Exercise, (self-application of planning and analysis methods) • practical training: introductory explanation of the facts and building blocks, subsequent self-application of the planning u. Analysis tool, independent programming	

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Methods for production optimization

Lehrveranstaltungen Vorlesung 2 SWS / Übung 2 SWS / Praktikum 1 SWS	**Zuordnung zu den Curricula**
Learning outcomes / Competencies • Explain and evaluate the benefits of globally standardized production systems ("holistic production systems") • Evaluate and select, internationally used methods of production optimization with regard to their operational capability for the optimization of problems in production • Operatively apply and implement independently in the industrial environment. • Method training selected methods for your fellow students and have built skills as a trainer and moderator of groups • Evaluate current production strategies (opportunities and risks, organizational form) and propose and select targeted for factory output planning	
Forms of teaching • Problem-based learning (PBL) with group work	

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Operations Management

Lehrveranstaltungen Seminar 2 SWS / Praktikum 2 SWS	**Zuordnung zu den Curricula**

Learning outcomes / Competencies

- Students will gain a fundamental working knowledge of the operations side in the firm. They will recognize, that operations management is a blend of topics from accounting, industrial engineering, management, management science and statistics, including use the of it-tools such like ERP systems.
- Students will be able to apply fundamental terms and methods for managing production and service processes.
- Students will be able to identify, quantify and optimize production planning and operation scheduling systems with emphasis on ERP Enterprise Resource Planning

Forms of teaching

- In a typical session, one or more students will be asked to begin each discussion by addressing the case or reading. You should have no difficulty in handling such a lead-off request. After the discussion will be opened to the rest of the class. As a group, we will try to build a complete analysis of the situation and address the problem implementation of those recommendations (a).
- Besides this there will be IT based work on an ERP System (b)

Topic
Introduction
Inventory Management
Demand Forecasting
From MRP to ERP
Short-term Scheduling
Airplane Game (Production Layout)
Location Decision & Network Design
Supply Chain Management
Beer Distribution Game (Bullwhip Effect)
Inventory in the Supply Chain
Quality Management & Statistical Process Control
Maintenance
Lean Production & Toyota Production System (TPS)
Recapitulation

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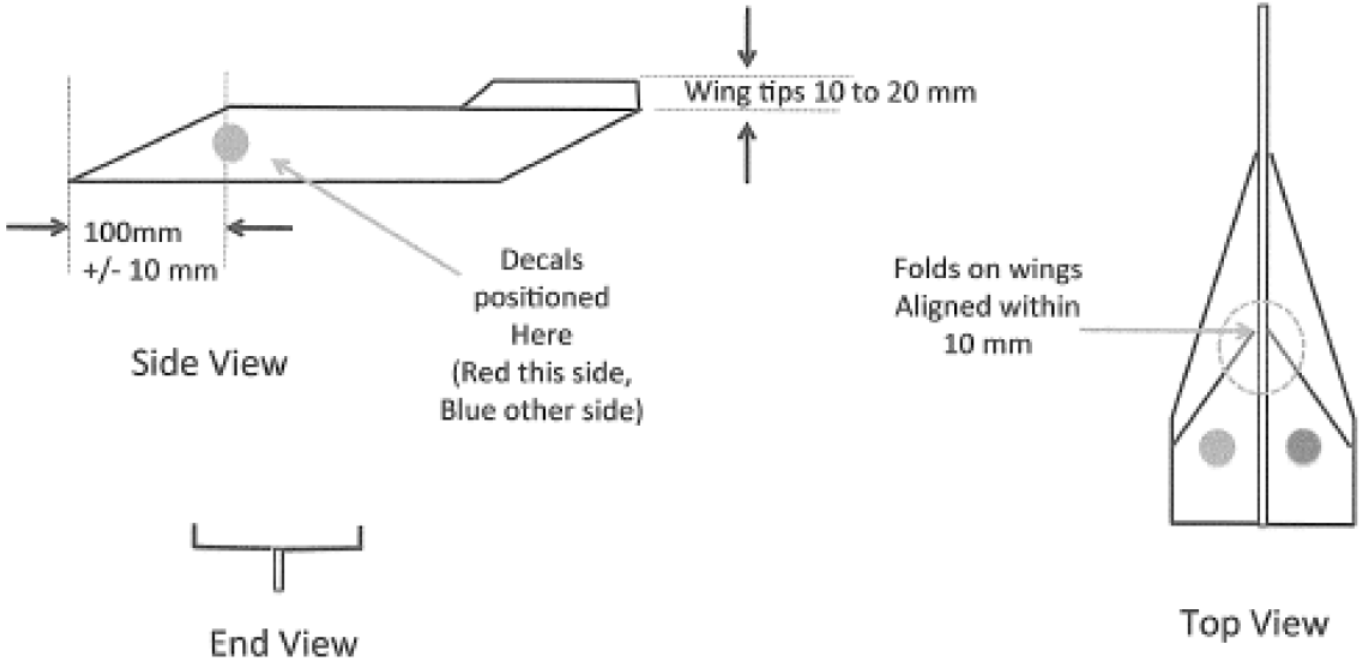
Airplanegame

Design the production layout for the production of paper planes.



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Methods for production optimization

- You prepare your training session within the group. Working time is at least the event time
- The lecturer assumes the role of a consultant and is available during the lecture period.
- Each group has a team leader: This one tells me by mail the members of his group (name, mat. No.)
- For the consultation appointments there is compulsory attendance. Here the group reports on the state of affairs. (2x missing allowed)
- Each group will conduct their "method training" with all other participants on ONE lecture date (= examination date). The exam dates are also mandatory dates.
- Participation will be documented by signature !! (more than 2 times missing automatically for non-abiding !!! (reason no matter)

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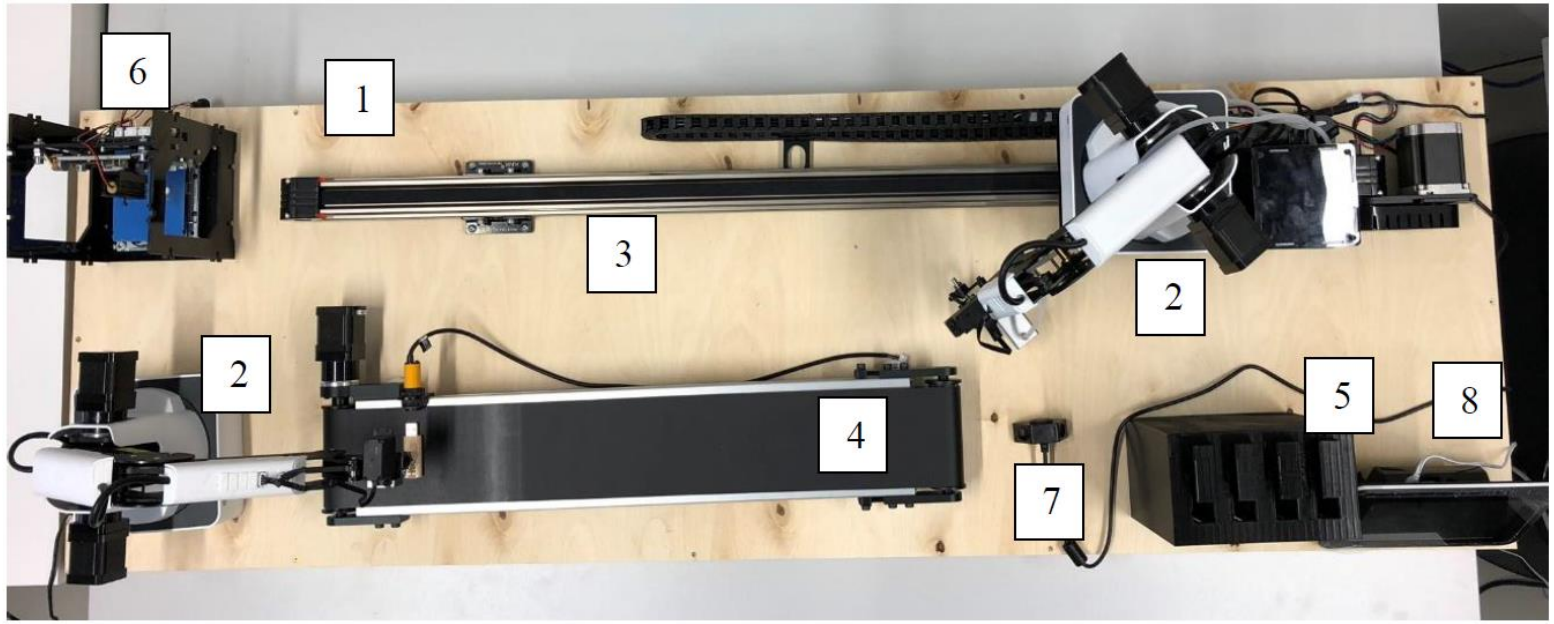
miniFab



Number	Component	Task
1	Base plate	Basis
2	Robots	Moving parts
3	Sliding rail	Range extension
4	Conveyor belt system	Connection workstations

Number	Component	Task
5	Storage system	Raw material supply
6	Engraving machine	Engraving HSD logo
7	USB Port	Data transmission
8	Raspberry Pi	Central control unit

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Witness

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innovative Fabrikplanungswerkzeuge

witness
BY
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Quality Managment and Innovation Methods & Trends

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Content

Production Management

Quality Management
&
Innovation Management

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Where to start

5S

1 – Structure

- Work environment
- Procedures & instructions
- Abnormalities visible

Kaizen

2 – Overview & Insight

- Visual Management KPI's
- WIP control
- Continuous improvement culture

Lean

3 – Stability

- Stable processes
- Eliminating Waste
- Flow & Pull

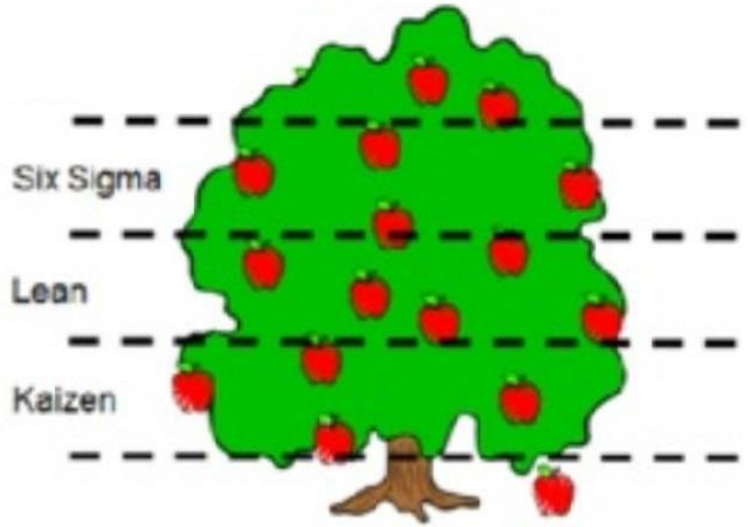
6 Sigma

4 – Capability

- Reducing variation
- In-process control
- Statistical tools

5 – Robustness

- Robust processes
- Design for Six Sigma
- Quality Function Deployment



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TRIZ

Improve this one without making this one **worse**

39 Technical Parameters

Technical Contradictions

	Weight of moving object	Weight of Stationary Object	Length of moving object	Length of Stationary object	Area of moving object	Area of stationary object	Volume of moving object	Volume of stationary object	Speed	Force (intensity)	Stress or pressure	Shape	Stability of the object's composition	Strength	Duration of action of a moving object	Duration of action of a stationary object	Temperature	Illumination Intensity	Use of energy by a moving object	Use of energy by a stationary object	Power	Loss of energy	Loss of substance	Loss of Information	Loss of time	Quantity of substance	Reliability	Measurement accuracy	Manufacturing precision	Object-affected harmful factors	Object-generated harmful factors	Ease of manufacture	Convenience of Use	Ease of repair	Adaptability or versatility	Device complexity	Difficulty of detecting and measuring	Extent of automation	Productivity
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
1	Weight of moving object		-	15 8 29 34	-	29 17 38 34	-	29 2 40 28	-	2 8 15 38	8 10 18 37	10 36 37 40	10 14 35 40	1 35 19 39	28 27 18 40	5 34 31 35	-	6 29 4 38	19 1 32	35 12 34 31	-	12 36 18 31	6 2 34 19	5 35 3 31	10 24 35	10 35 20 28	3 26 18 31	3 11 1 27	28 27 35 26	28 35 26 18	22 21 18 27	22 35 31 39	27 28 1 36	35 3 2 24	2 27 28 11	29 5 15 8	26 30 36 34	28 29 26 32	26 35 18 19	35 3 24 37
2	Weight of stationary object	-		-	10 1 29 35	-	35 30 13 2	-	5 35 14 2	-	8 10 19 35	13 29 10 18	13 10 29 14	26 39 1 40	28 2 10 27	-	2 27 19 6	28 19 32 22	19 32 35	-	18 19 28 1	15 19 18	18 19 28 15	5 8 13 30	10 15 35	10 20 35 26	19 6 18 26	10 28 8 3	18 26 28	10 1 35 27	2 19 22 37	35 22 1 39	28 1 9	6 13 1 32	2 27 28 11	19 15 29	1 10 26 39	25 28 17 15	2 26 35	1 28 15 35
3	Length of moving object	8 15 29 34	-		-	15 17 4	-	7 17 4 35	-	13 4 8	17 10 4	1 8 35	1 8 10 29	1 8 15 34	8 35 29 34	19	-	10 15 19	32	8 35 24	-	1 35	7 2 35 39	4 29 23 10	1 24	15 2 29	29 35	10 14 29 40	28 32 4	10 28 29 37	1 15 17 24	17 15	1 29 17	15 29 35 4	1 28 10	14 15 1 16	1 19 26 24	35 1 26 24	17 24 26 16	14 4 28 29
4	Length of stationary object		35 28 40 29	-		-	17 7 10 40	-	35 8 2 14	-	28 10	1 14 35	13 14 15 7	39 37 35	15 14 28 26	-	1 40 35	3 35 39 18	3 25	-		12 8	6 28	10 28 24 35	24 26	30 29 14		15 29 28	32 28 3	2 32 10	1 18		1 17 27	2 25	3	1 35	1 26	26		30 14 7 26
5	Area of moving object	2 17 29 4	-	14 15 18 4	-		-	7 14 17 4		29 30 4 34	19 30 35 2	10 15 36 28	5 34 29 4	11 2 13 39	3 15 40 14	6 3	-	2 15 16	15 32 19 13	19 32	-	19 10 32 18	15 17 30 26	10 35 2 39	30 26	26 4	29 30 6 13	29 9	26 28 32 3	2 32	22 33 28 1	17 2 18 39	13 1 26 24	15 17 13 16	15 13 10 1	15 30	14 1 13	2 36 26 18	14 30 28 23	10 26 34 2
6	Area of stationary object	-	30 2 14 18	-	26 7 9 39	-		-		-	1 18 35 36	10 15 36 37		2 38	40	-	2 10 19 30	35 39 38		-		17 32	17 7 30	10 14 18 39	30 16	10 35 4 18	2 18 40 4	32 35 40 4	26 28 32 3	2 29 18 36	27 2 39 35	22 1 40	40 16	16 4	16	15 16	1 18 36	2 35 30 18	23	10 15 17 7
7	Volume of moving object	2 26 29 40	-	1 7 4 35	-	1 7 4 17	-		-	29 4 38 34	15 35 36 37	6 35 36 37	1 15 29 4	28 10 1 39	9 14 15 7	6 35 4	-	34 39 10 18	2 13 10	35	-	35 6 13 18	7 15 13 16	36 39 34 10	2 22	2 6 34 10	29 30 7	14 1 40 11	26 28	25 28 2 16	22 21 27 35	17 2 40 1	29 1 40	15 13 30 12	10	15 29	26 1	29 26 4	35 34 16 24	10 6 2 34
8	Volume of stationary object	-	35 10 19 14	19 14	35 8 2 14	-		-		-	2 18 37	24 35	7 2 35	34 28 35 40	9 14 17 15	-	35 34 38	35 6 4		-		30 6		10 39 35 34		35 16 32 18	35 3	2 35 16		35 10 25	34 39 19 27	30 18 35 4	35		1		1 31	2 17 26		35 37 10 2
9	Speed	8 28 13 38	-	13 14 8	-	29 30 34	-	7 29 34	-		13 28 15 19	6 18 38 40	35 15 18 34	28 33 1 18	8 3 26 14	3 19 35 5	-	28 30 36 2	10 13 19	8 15 35 38	-	19 35 38 2	14 20 19 35	10 13 28 38	13 26		10 19 29 38	11 35 27 28	28 32 1 24	10 28 32 25	1 28 35 23	2 24 35 21	35 13 8 1	32 28 13 12	34 2 28 27	15 10 26	10 28 4 34	3 34 27 16	10 18	
10	Force (intensity)	8 1 37 18	18 13 1 28	17 19 9 36	28 10	19 10 15	1 18 36 37	15 9 12 37	2 36 18 37	13 28 15 12		18 21 11	10 35 40 34	35 10 21	35 10 14 27	19 2		35 10 21	-	19 1 7 10	1 16 36 37	19 35 18 37	14 15	8 35 40 5		10 37 36	14 29 18 36	3 35 13 21	35 10 23 24	28 29 37 36	1 35 40 18	13 3 36 24	15 37 18 1	1 28 3 25	15 1 11	15 17 18 20	26 35 10 18	36 37 10 19	2 35	3 28 35 37
11	Stress or pressure	10 36 37 40	13 29 10 18	35 10 36	35 1 14 16	10 15 36 28	10 15 36 37	6 35 10	35 24	6 35 36	36 35 21		35 4 15 10	35 33 2 40	9 18 3 40	19 3 27		35 39 19 2	-	14 24 10 37		10 35 14	2 36 25	10 35 3 37		37 36 4	10 14 36	10 13 19 35	6 28 25	3 35	22 2 37	2 33 27 18	1 35 16	11	2	35	19 1 35	2 36 37	35 24	10 14 35 37
12	Shape	8 10 29 40	15 10 26 3	29 34 5 4	13 14 10 7	5 34 4 10		14 4 15 22	7 2 35	35 15 34 18	35 10 37 40	34 15 10 14		33 1 18 4	30 14 10 40	14 26 9 25		22 14 19 32	13 15 32	26 34 14		4 6 2	14	35 29 3 5		14 10 34 17	36 22	10 40 16	28 32 1	32 30 40	22 1 2 35	35 1	17 32 1 28	32 15 26	2 13 1	1 15 29	16 29 1 28	15 13 39	15 1 32	17 26 34 10
13	Stability of the object's composition	21 35 2 39	26 39 1 40	13 15 1 28	37	2 11 13	39	28 10 19 39	34 28 35 40	33 15 28 18	10 35 21 16	2 35 40	22 1 18 4		17 9 15	13 27 10 35	39 3 35 23	35 1 32	32 3 27 15	13 19	27 4 29 18	32 35 27 31	14 2 39 6	2 14 30 40		35 27	15 32 35		13	18	35 24 30 18	35 40 27 39	35 19	32 35 30	2 35 10 16	35 30 34 2	2 35 22 26	35 22 39 23	1 8 35	23 35 40 3
14	Strength	1 8 40 15	40 26 27 1	1 15 8 35	15 14 28 26	3 34 40 29	9 40 28	10 15 14 7	9 14 17 15	8 13 26 14	10 18 3 14	10 3 18 40	10 30 35 40	13 17 35		27 3 26		30 10 40	35 19	19 35 10	35	10 26 35 28	35	35 28 31 40		29 3 28 10	29 10 27	11 3	3 27 16	3 27	18 35 37 1	15 35 22 2	11 3 10 32	32 40 28 2	27 11 3	15 3 32	2 13 28	27 3 15 40	15	29 35 10 14
15	Duration of action by moving object	19 5 34 31	-	2 19 9	-	3 17 19	-	10 2 19 30	-	3 35 5	19 2 16	19 3 27	14 26 28 25	13 3 35	27 3 10		-	19 35 39	2 19 4 35	28 6 35 18		19 10 35 38		28 27 3 18	10	20 10 28 18	3 35 10 40	11 2 13	3	3 27 16 40	22 15 33 28	21 39 16 22	27 1 4	12 27	29 10 27	1 35 13	10 4 28 15	19 29 39 35	6 10	35 17 14 19
16	Duration of action by Stationary object	-	6 27 19 16	-	1 40 35	-		-	35 34 38	-				39 35 3 23		-		19 18 36 40		-		16		27 16 18 38	10	28 20 10 16	3 35 31	34 27 6 40	10 26 24		17 1 40 33	22	35 10	1	1	2		25 34 6 35	1	20 10 16 38
17	Temperature	36 22 6 38	22 35 32	15 19 9	15 19 9	3 35 39 18	35 38	34 39 40 18	35 6 4	2 28 36 30	35 10 3 21	35 39 19 2	14 22 19 32	1 35 32	10 30 22 40	19 13 39	19 18 36 40		32 30 21 16	19 15 3 17		2 14 17 25	21 17 35 38	21 36 39 31		35 28 21 18	3 17 30 39	19 35 3 10	32 19 24	24	22 33 35 2	22 35 2 24	26 27	26 27	4 10 16	2 18 27	2 17 16	3 27 35 31	26 2 19 16	15 28 35
18	Illumination Intensity	19 1 32	2 35 32	19 32 16		19 32 26		2 13 10		13 19 10	26 19 6		32 30	32 3 27	35 19	2 19 6		32 35 19		32 1 19	32 35 1 15	32	13 16 1 6	13 1	1 6	19 1 26 17	1 19		11 15 32	3 32	15 19	35 19 32 39	19 35 28 26	28 26 19	15 17 13 16	15 1 19	6 32 13	32 15	2 26 10	2 25 16
19	Use of energy by moving object	12 18 28 31	-	12 28	-	15 19 25	-	35 13 18	-	8 15 35	16 26 21 2	23 14 25	12 2 29	19 13 17 24	5 19 9 35	28 35 6 18	-	19 24 3 14	2 15 19		-	6 19 3 7 18	12 22 15 24	35 24 18 5		35 38 19 18	34 23 16 18	19 21 11 27	3 1 32		1 35 6 27	2 35 6	28 26 30	19 35	1 15 17 28	15 17 13 16	2 29 27 28	35 38	32 2	12 28 35
			19 9											27 4					19 2					28 27			3 35	10 36			10 2	19 22						19 35		

40 Inventive Principles

1	Segmentation
2	Taking Out
3	Local Quality
4	Asymmetry
5	Merging
6	Universality
7	Nested Doll
8	Anti-Weight
9	Prior Counteraction
10	Prior Action
11	Cushion in Advance
12	Equipotentiality
13	The Other Way Round
14	Spheroidality - Curvature
15	Dynamics
16	Partial or Excessive Action
17	Another Dimension
18	Mechanical Vibration
19	Periodic Action

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“The auto industry will change more in the next five to 10 years than it has in the last 50,”

General Motors CEO Mary Barra

at the World Economic Forum 2016

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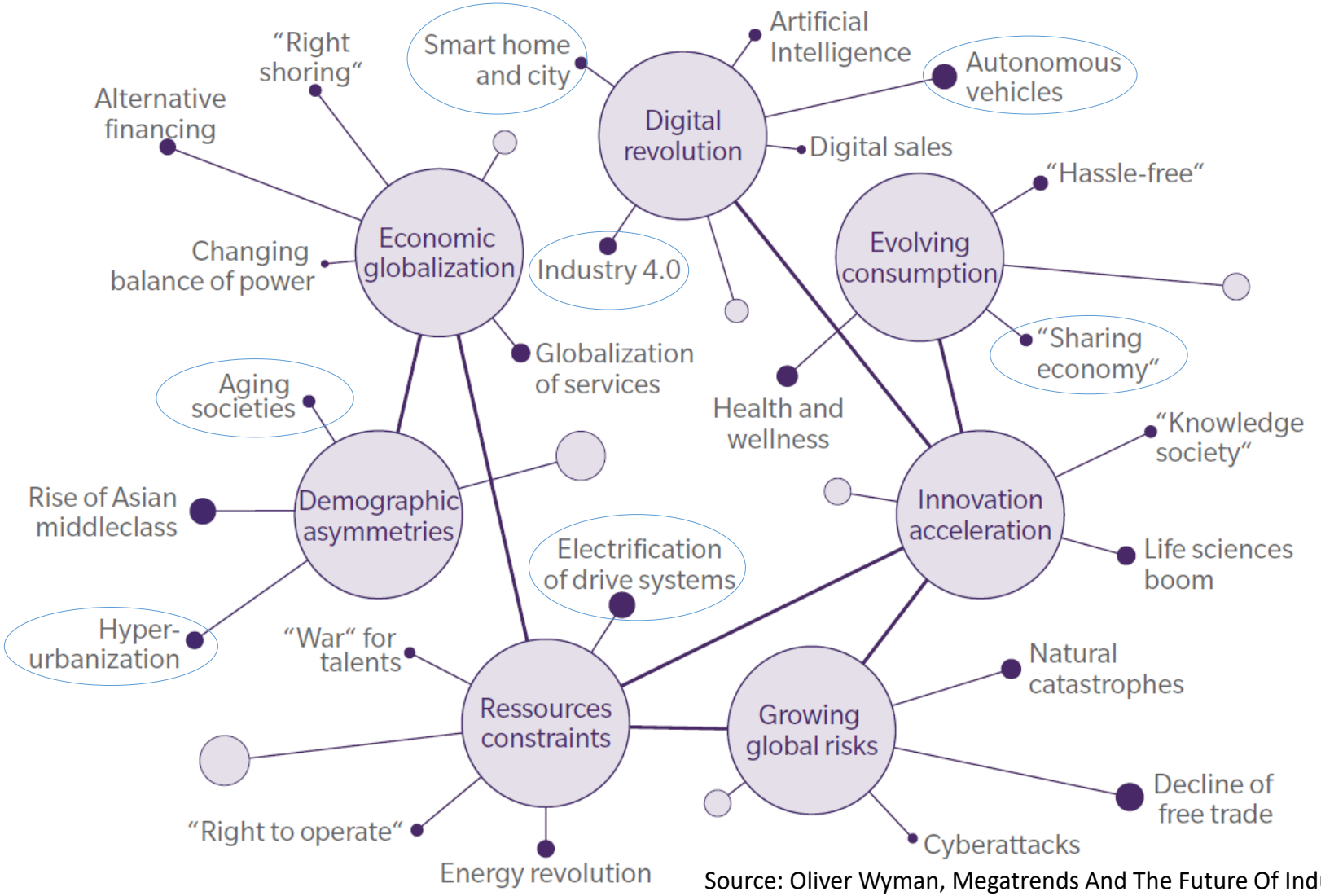
Megatrends in Innovation



Source: Oliver Wyman, Megatrends And The Future Of Industry, 2018

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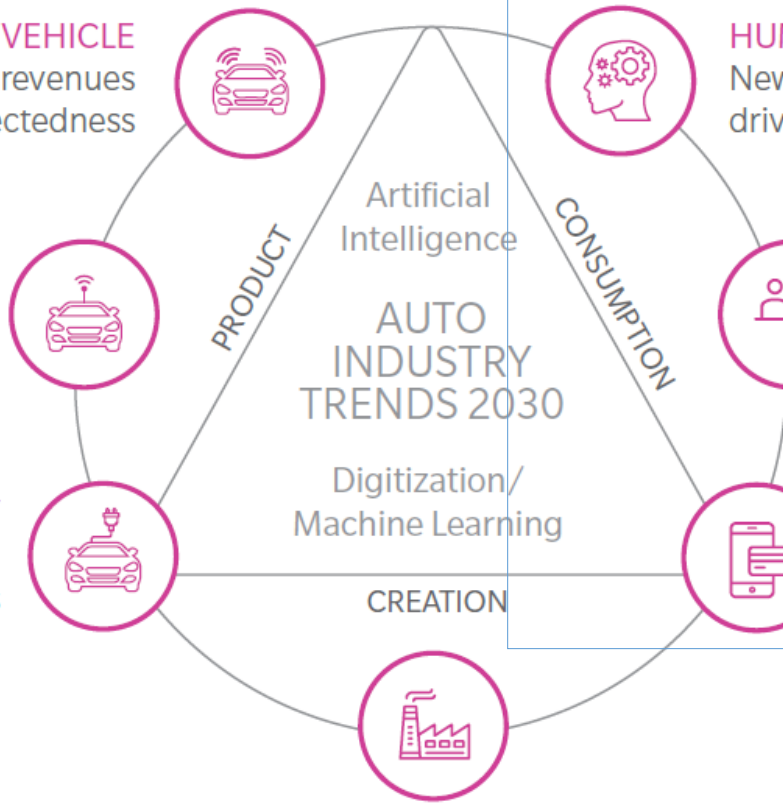
Automotive Trends through 2030

Seven fundamental trends drive the automotive industry, enabled and accelerated by digitization, AI and machine learning



CONNECTED VEHICLE
Additional safety and (services) revenues through increasing connectedness

AUTONOMOUS VEHICLES
Progression of today's partially automated driving into fully driver-less vehicles

E-MOBILITY
Increasing electrification of powertrains, resulting in decreasing penetration of ICEs

HUMAN-MACHINE-INTERFACE
New and digitized control concepts for driver/car interaction

CHANGING CUSTOMER STRUCTURE
Partial replacement of individual vehicle buyers by large fleet or group buying driven by mobility-on-demand services

NEW DISTRIBUTION CHANNEL PAY-PER-USE
Provision of selected vehicle features as pay-per-use for certain target groups of vehicle owners

DIGITAL INDUSTRY
Increasing digitization of processes through predictive and adaptive data capability

Source: Oliver Wyman, Automotive Manager, 2018

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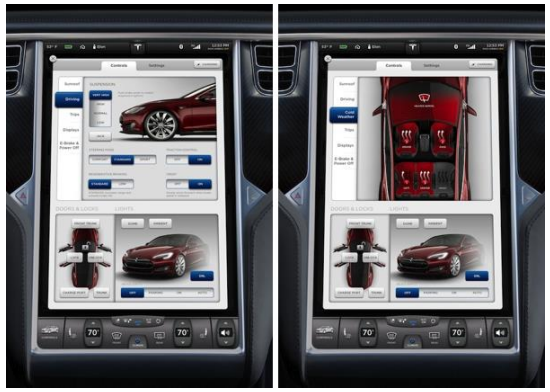
Human Machine Interface



Tesla HMI-Touchscreen

A colloage of presently available HMI

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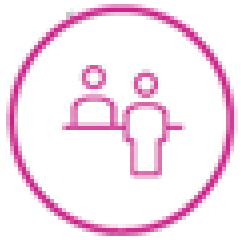
Group Work

What are new trends in customer structure and distribution channels ?



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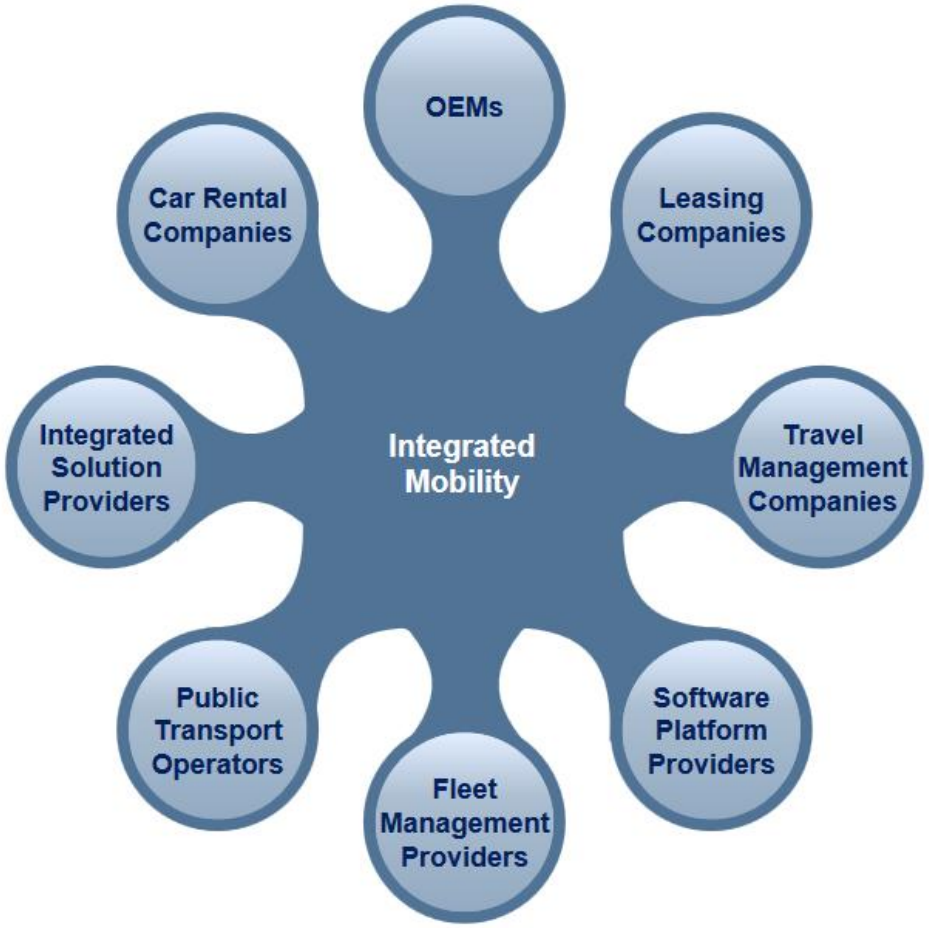
Changing Customer Structure



Taxi Services	UBER, HAIL, mytaxi
Bike Sharing	nextbike, velib', bicing
Micro-mobility	RENAULT, smart
Car Sharing	zipcar, CAR2GO, DriveNow
Corporate Car-Sharing	AlphaCity, ubeeqo
Car Rental	Hertz, avis budget
Ridesharing	BlaBlaCar, lyft
Parking	VINCI PARK, JustPark
E-Mobility	source LONDON, ChargeNow
Public Transport	DB, oyster, NS
Integrated Mobility	moovel, Qixxit
Ecosystem Partnership	NS-Business Card, REWE, DriveNow, UBER, CONCUR

Source: Martyn Briggs, Frost & Sullivan, Future of Mobility: Slide 4
https://ww2.frost.com/files/7114/3620/7732/FS_Future_of_Mobility_MBv5.pdf

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New distribution channels

Car Independent

Integrated Mobility: Journey Planning, Booking & Payment

City Planners & Lifestyle

Energy creation & storage

Car Services

Carsharing

Parking & Charging

Ride-sharing

Taxi & Limousine

Automated Driving

Car Ownership

Finance

Maintenance

Connected Services

Evolution & Expansion of OEM Services

Source: Martyn Briggs, Frost & Sullivan, Future of Mobility: Slide 9
https://ww2.frost.com/files/7114/3620/7732/FS_Future_of_Mobility_MBv5.pdf

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Subjects in curricula of HSD

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Subjects

- Factory planning and quality management
- Innovation and Technology Management
- Methods of quality management
- Product and change management

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certification courses

- SixSigma YelowBelt
- Sixisgma GreenBelt

- „QM Automotive by “AQUA Knowledge Alliance for Training Quality and Excellence in Automotive

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Innovation practical task

Re-design an everyday object!

- Mess Finding
- Problem Finding/Definition
- Problem Reframed(as the circumstances require)
- Idea Production
- Idea Development
- Evaluation
- Adoption-Stage Gate or Action Plan-Possible Obstacles

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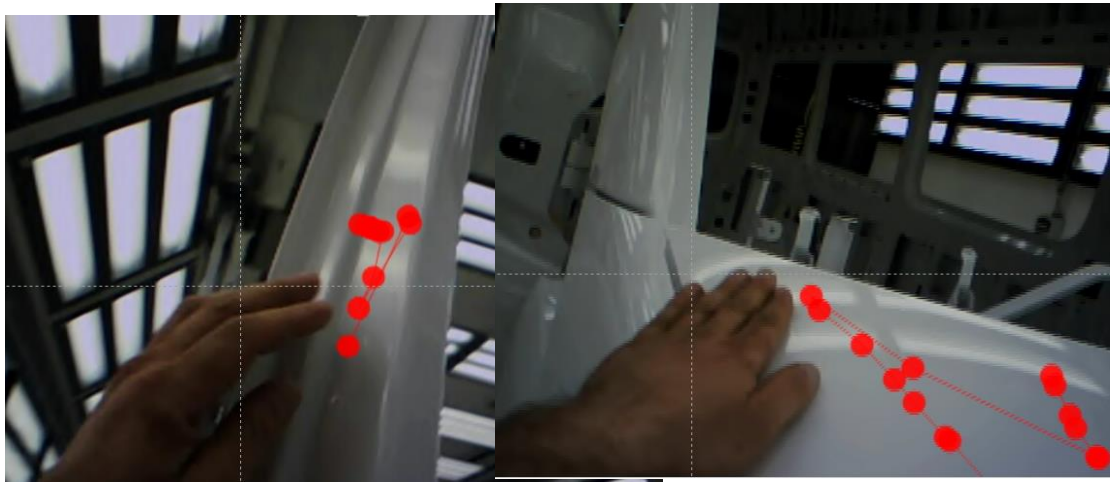
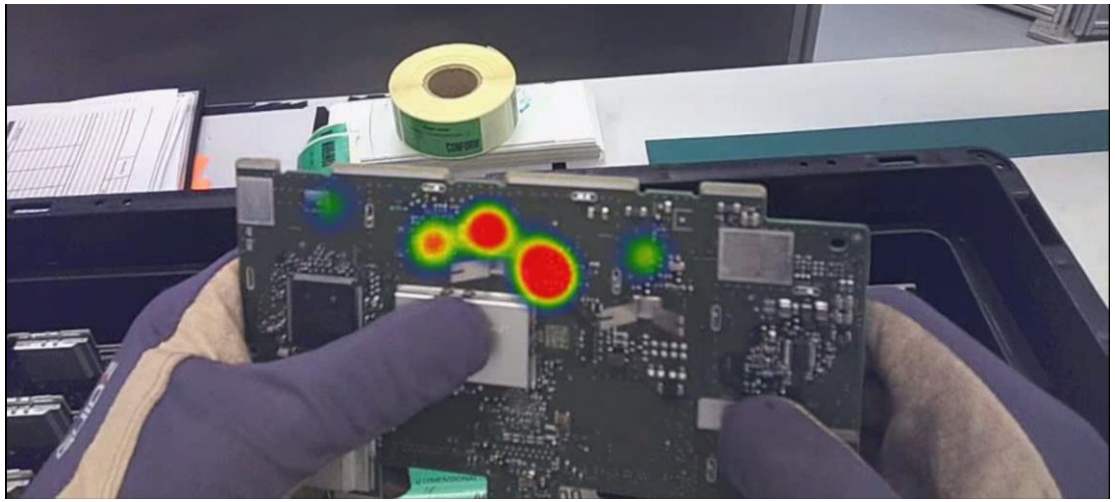
EyE-Tracking





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What trend is most important for the automotive sector in the future?

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Innovation at HSD

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Thank you for your attention

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