Digital Transformation in the Automotive Industry
Digitale Transformation in der Automobilindustrie

Dr. Michael Nolting

Lecture 5

Tutorials

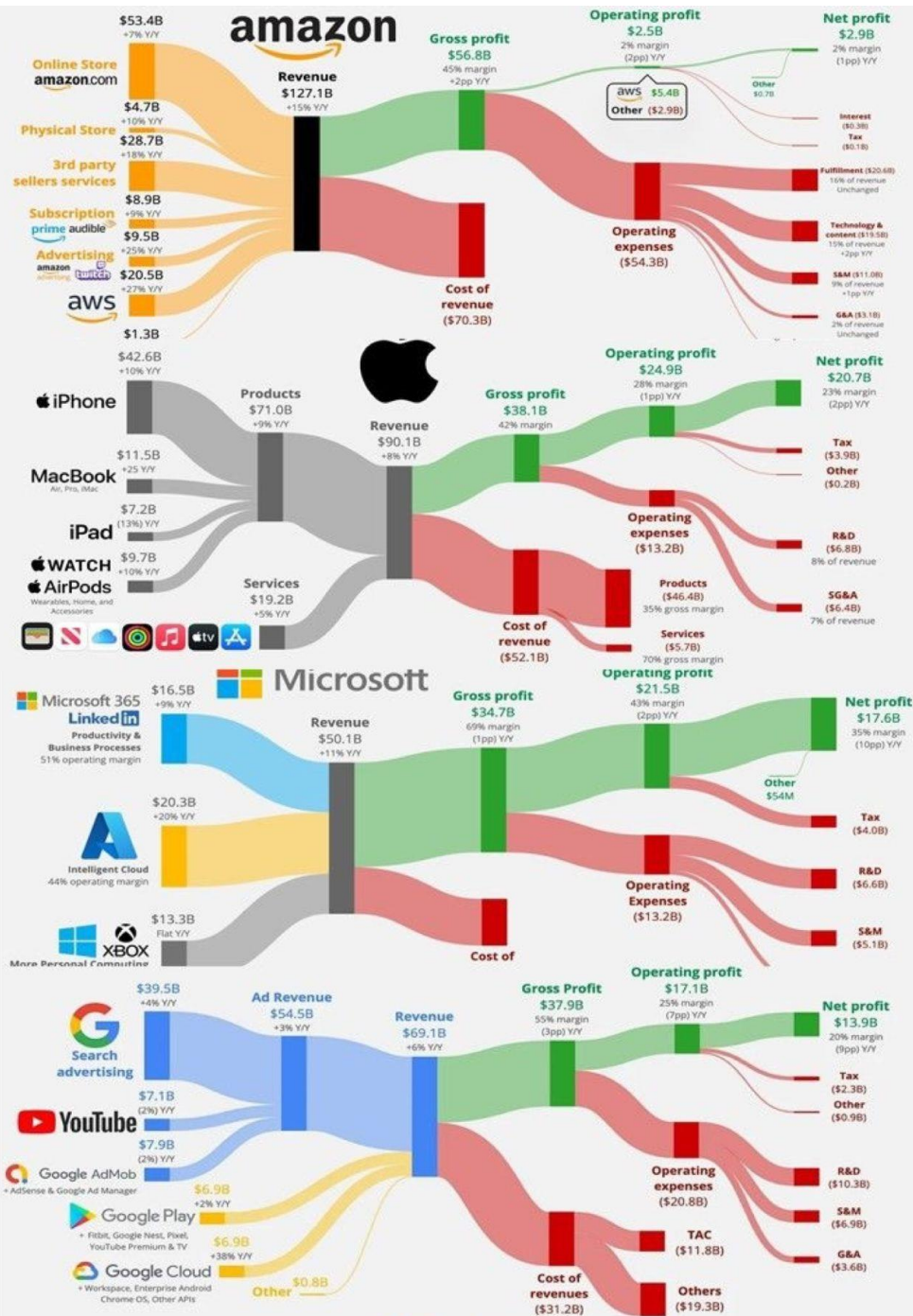- Homework will be reading the book from
  Gene Kim „The Phoenix Project"

The homeworks are optional and not relevant for the exam

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Lecture Overview

1. Introduction: Why Digital & Data Transformation	7. Culture & Organization
Homework 1: Reading 60 mins the Phoenix Project	Homework 7: Reading 60 mins the Phoenix Project
2. The World is Changing: ACES & VUCA	8. Examples of Digitalization Projects I
Homework 2: Reading 60 mins the Phoenix Project	Homework 8: Reading 60 mins the Phoenix Project
3. The Technological Disruption	9. Examples of Digitalization Projects II
Homework 3: Reading 60 mins the Phoenix Project	Homework 9: Reading 60 mins the Phoenix Project
4. Challenges for the Transformation - Innovation	10. TESLA as THE Digital Player
Homework 4: Reading 60 mins the Phoenix Project	Homework 10: Reading 60 mins the Phoenix Project
5. Challenges for the Transformation - Legacy	11. Q & A – Exam
Homework 5: Reading 60 mins the Phoenix Project	
6. How to Transform Into a Techgiant	
Homework 6: Reading 60 mins the Phoenix Project	

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Amazon

$53.4B +7% Y/Y — Online Store amazon.com
$4.7B +10% Y/Y — Physical Store
$28.7B +18% Y/Y — 3rd party sellers services
$8.9B +9% Y/Y — Subscription prime audible
$9.5B +25% Y/Y — Advertising amazon advertising twitch
$20.5B +27% Y/Y — aws
$1.3B

Revenue $127.1B +15% Y/Y
Cost of revenue ($70.3B)
Gross profit $56.8B 45% margin +2pp Y/Y
Operating expenses ($54.3B)
Operating profit $2.5B 2% margin (2pp) Y/Y
aws $5.4B Other ($2.9B)
Net profit $2.9B 2% margin (1pp) Y/Y
Other ($0.7B)
Interest ($0.3B)
Tax ($0.1B)
Fulfillment ($20.6B) 16% of revenue Unchanged
Technology & content ($19.5B) 15% of revenue +2pp Y/Y
S&M ($11.0B) 9% of revenue +1pp Y/Y
G&A ($3.1B) 2% of revenue Unchanged

Apple

$42.6B +10% Y/Y — iPhone
$11.5B +25 Y/Y — MacBook Air, Pro, iMac
$7.2B (13%) Y/Y — iPad
$9.7B +10% Y/Y — WATCH AirPods Wearables, Home, and Accessories

Products $71.0B +9% Y/Y
Services $19.2B +5% Y/Y
Revenue $90.1B +8% Y/Y
Cost of revenue ($52.1B)
Gross profit $38.1B 42% margin
Operating expenses ($13.2B)
Operating profit $24.9B 28% margin (1pp) Y/Y
Net profit $20.7B 23% margin (2pp) Y/Y
Tax ($3.9B)
Other ($0.2B)
R&D ($6.8B) 8% of revenue
SG&A ($6.4B) 7% of revenue
Products ($46.4B) 35% gross margin
Services ($5.7B) 70% gross margin

Microsoft

$16.5B +9% Y/Y — Microsoft 365 LinkedIn Productivity & Business Processes 51% operating margin
$20.3B +20% Y/Y — Intelligent Cloud 44% operating margin
$13.3B Flat Y/Y — XBOX More Personal Computing

Revenue $50.1B +11% Y/Y
Cost of
Gross profit $34.7B 69% margin (1pp) Y/Y
Operating Expenses ($13.2B)
Operating profit $21.5B 43% margin (2pp) Y/Y
Net profit $17.6B 35% margin (10pp) Y/Y
Other $54M
Tax ($4.0B)
R&D ($6.6B)
S&M ($5.1B)

Google (G)

$39.5B +4% Y/Y — Search advertising
$7.1B (2%) Y/Y — YouTube
$7.9B (2%) Y/Y — Google AdMob + AdSense & Google Ad Manager
$6.9B +2% Y/Y — Google Play + Fitbit, Google Nest, Pixel, YouTube Premium & TV
$6.9B +38% Y/Y — Google Cloud + Workspace, Enterprise Android Chrome OS, Other APIs
Other $0.8B

Ad Revenue $54.5B +3% Y/Y
Revenue $69.1B +6% Y/Y
Cost of revenues ($31.2B)
Gross Profit $37.9B 55% margin (3pp) Y/Y
Operating expenses ($20.8B)
Operating profit $17.1B 25% margin (7pp) Y/Y
Net profit $13.9B 20% margin (9pp) Y/Y
Tax ($2.3B)
Other ($0.9B)
R&D ($10.3B)
S&M ($6.9B)
G&A ($3.6B)
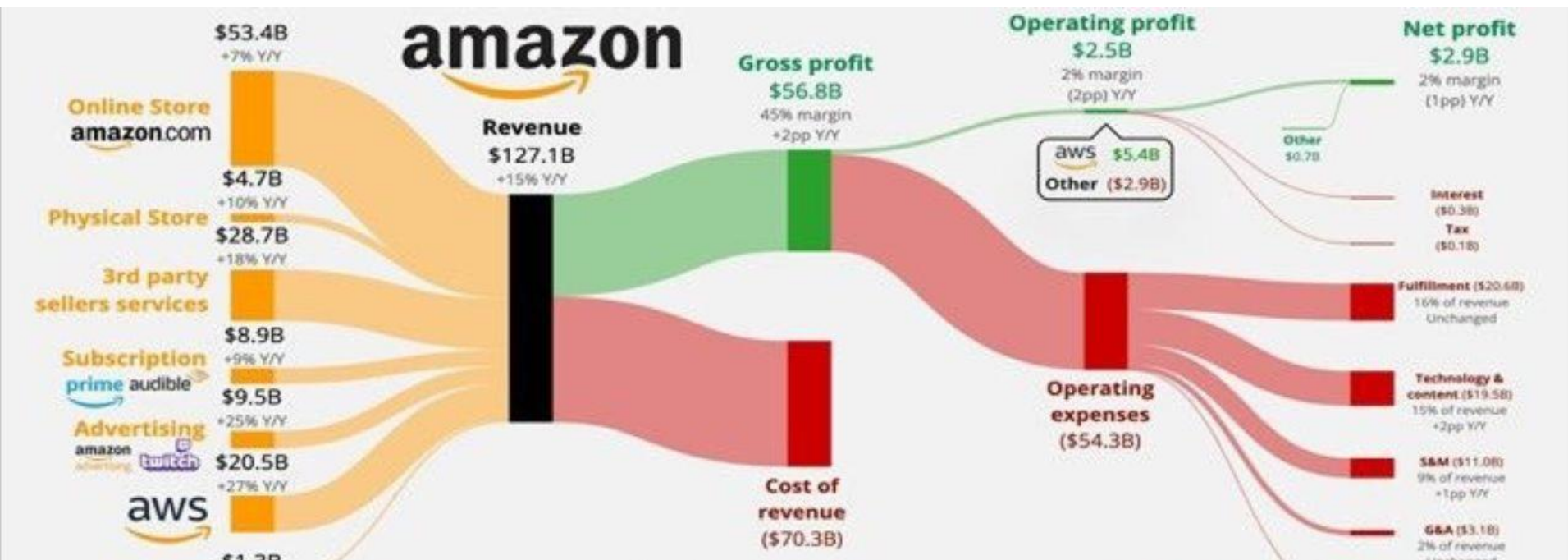TAC ($11.8B)
Others ($19.3B)

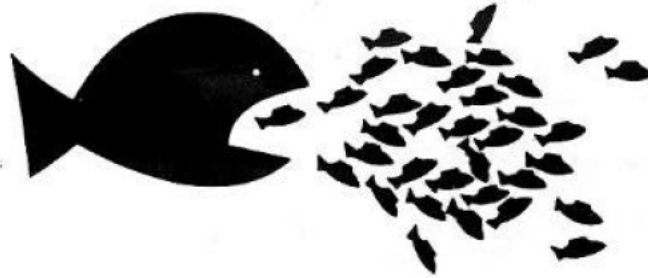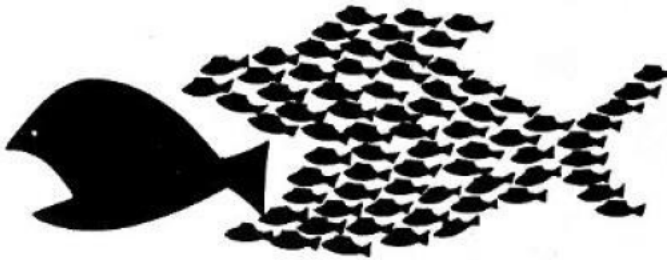Source: Quarterly results @EconomyApp APP ECONOMY INSIGHTS
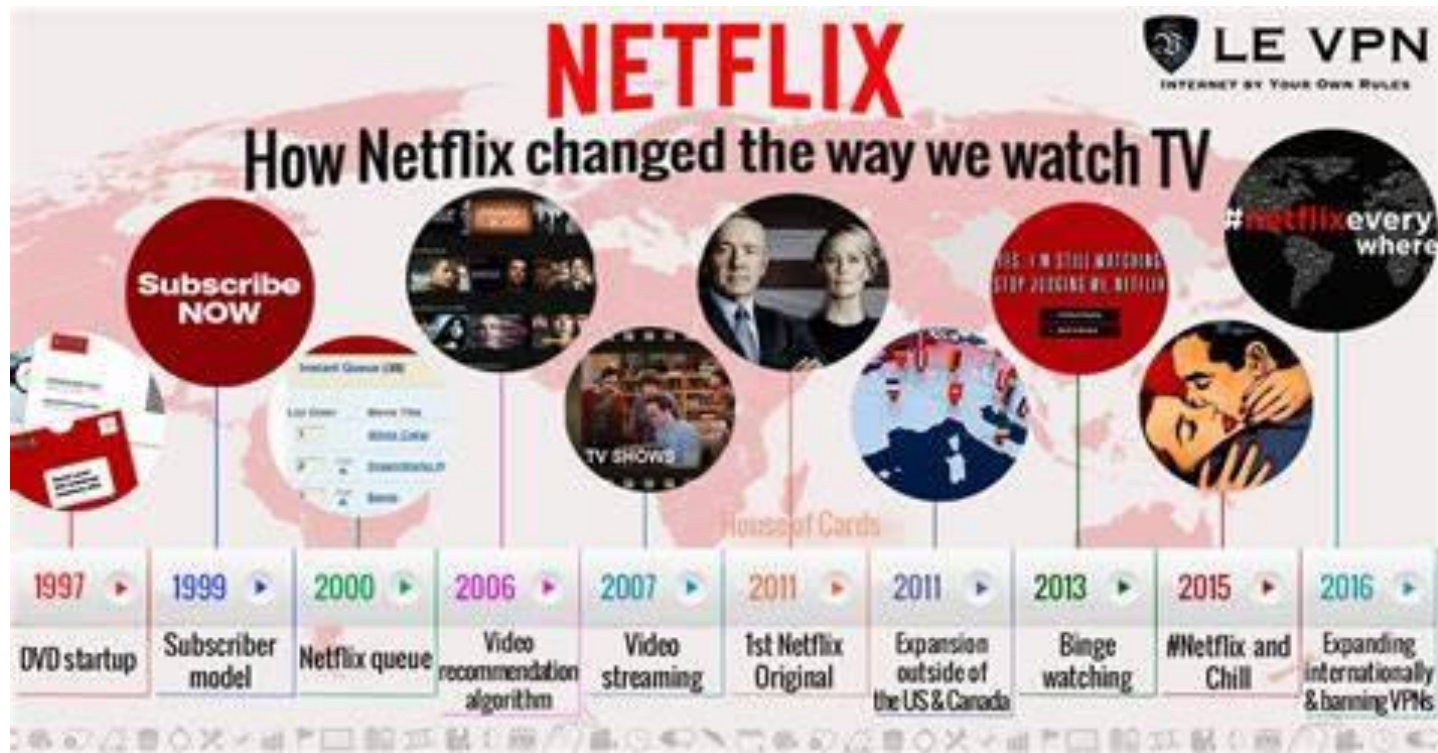
4

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Mindset

„It is sometimes difficult in a big successful organization to have the sense of urgency and hunger. (…) However, if you have a high market share and you are a market leader, if you start defending, you cannot sustain."
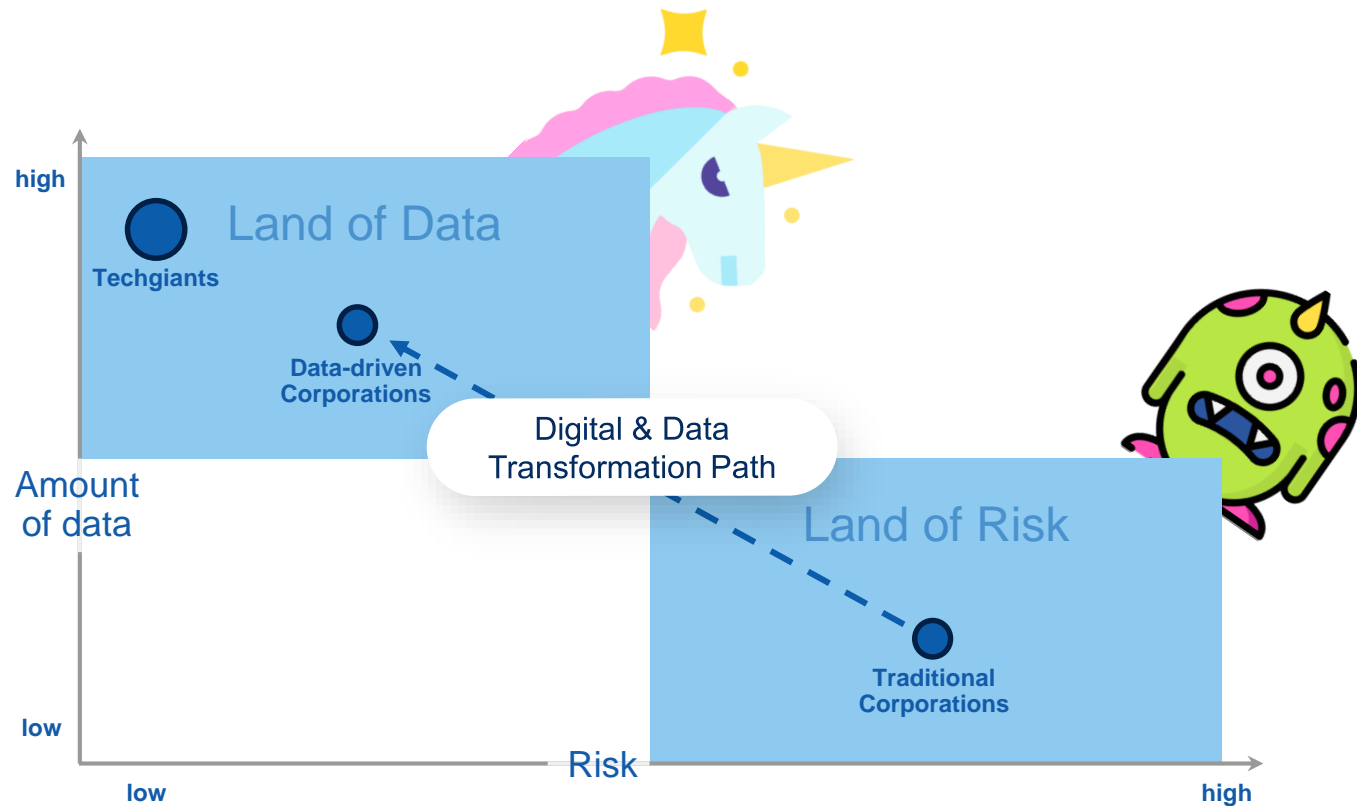*(O.-P. Kallasvuo, former CEO Nokia)*

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Netflix

https://www.le-vpn.com/wp-content/uploads/2016/05/netflixinf1200x628x-2.jpg

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Take Aways

- **"Innovation is (...) the life blood of corporate survival and growth"** (Zahra & Covin, 1994, p. 183)

- **Speed and the right timing are very important components for today's innovation processes**

- **"There are three stages of innovation: innovation as a process, innovation as a discrete item including, products, programs or services; and innovation as an attribute of organizations."** (Kimberly, 1981, p. 108)

Lead Time of Techgigants and Corporations

Company	Deployment frequency	Lead time	Stability	Customer-centricity
Amazon	23,000 / day	minutes	high	high
Google	5,500 / day	minutes	high	high
Netflix	500 / day	minutes	high	high
Facebook	1 / day	hours	high	high
Twitter	3 / week	hours	high	High
Typical enterprise	Every 9 months	months	Low/medium	Low/medium

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How to leave the Land of Risk ASAP

Land of Data

Techgiants

Data-driven Corporations

Digital & Data Transformation Path

Land of Risk

Traditional Corporations

Amount of data

high

low

Risk

low   high

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Challenges for Car Manufacturers

1. Legacy
   - IT for production vs. IT for digital services

2. Complexity
   - Software complexity
   - traditional TIER-business

3. Bottlenecks
   - Legacy systems
   - Mindset for agile development
   - Transformation and transactional leadership
   - Finding people

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Agenda

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Legacy

Complexity

Bottlenecks

Summary

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The New Automotive Value Chain

| R&D | Procure-ment | Logistic, Produc-tion | Marketing/Sales | Digital Services | After Sales | Sup-port | Financial Services | Data Analytics |

Suppliers	Traditional OEM-playground	Traditional OEM-playground
Competitors		
Customers		
Dealer		
Investors		
Regulators		

Infrastructure Provider

IT Service Provider

Tech Player

Mobility Provider

Data Service Partner

Content Provider

The new playground

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Volkswagens PEP48
at a glance…

The **PEP48 (Produkt- Entstehungs- Prozess; engl: Product- Creation- Process)** is a standardized process model for the entire vehicle manufacturing at Volkswagen. This process model defines phases, milestones, shareholders and deliveries of each part, module, process and vehicle related software. It ensures and improves the ability to deliver in terms of deadline, scope/quality, budget and law.

From study …   *… via **PEP** …*   *… to production.*

Source: Studie ID. | Volkswagen Newsroom
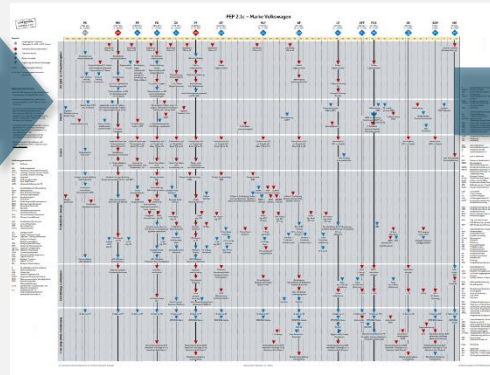
Source: PEP 2.1c, Marke Volkswagen

Source: Volkswagen Deutschland

Closer look into the PEP- phases…

Market Research –48 Product Definition –42 Planning –39 Concept –39 Design –23 Sourcing –18 Production Launch –12 Pre-Series –8 Pre-Production –6 Pilot Run –3 **Start of Production** SOP 0 Market Launch 3

◆ : milestones for freezes and approvals in months. SOP as reference.

Challenges are as follows …

There are more than <u>five vehicle platforms</u> in the Volkswagen group. Each platform has <u>several, so called, vehicle hats</u> in <u>plenty of variants</u> to serve nearly every customer needs <u>all over the world</u>. In addition each <u>platform and/or hat</u> has at least <u>one major and one minor facelift and or technical update per year</u> with its own SOP to keep the product up to date in terms of design, functionality, latest judicature and road legalization aspects. Side Info: 2700+ parts and modules are relevant to build a modern car.

Facing this challenge in this highly complex environment while shaping the future, realizing the present and dealing with the past is the key to being 'best in class'. Being the world market leader since years is proof of this continuous success.

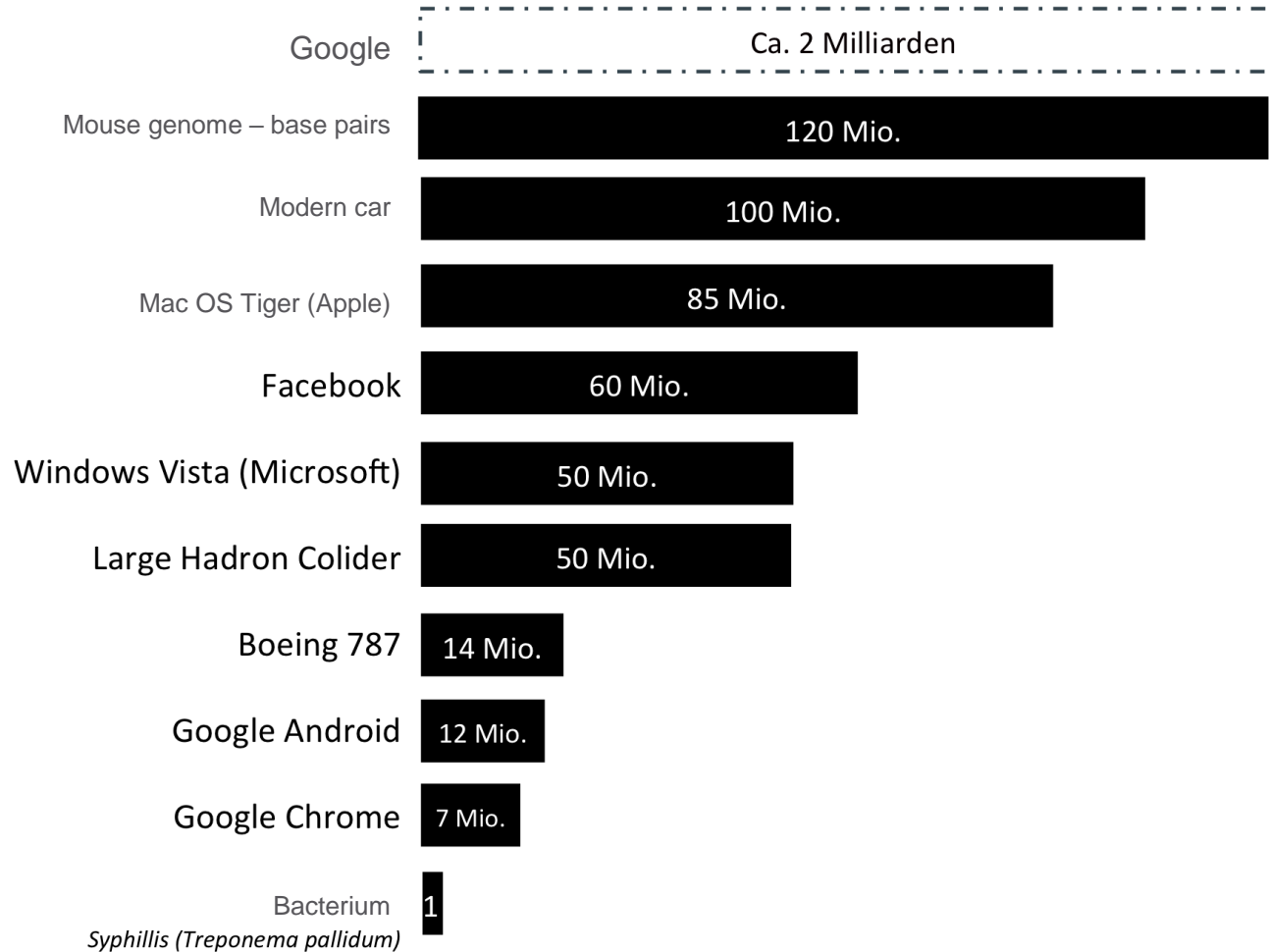# Customer Centricity

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Bottlenecks

Summary

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Complexity - Lines of Code

Google	Ca. 2 Milliarden
Mouse genome – base pairs	120 Mio.
Modern car	100 Mio.
Mac OS Tiger (Apple)	85 Mio.
Facebook	60 Mio.
Windows Vista (Microsoft)	50 Mio.
Large Hadron Colider	50 Mio.
Boeing 787	14 Mio.
Google Android	12 Mio.
Google Chrome	7 Mio.
Bacterium *Syphillis (Treponema pallidum)*	1

https://www.visualcapitalist.com/millions-lines-of-code/

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Projects vs. Products

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DevOps – q over time
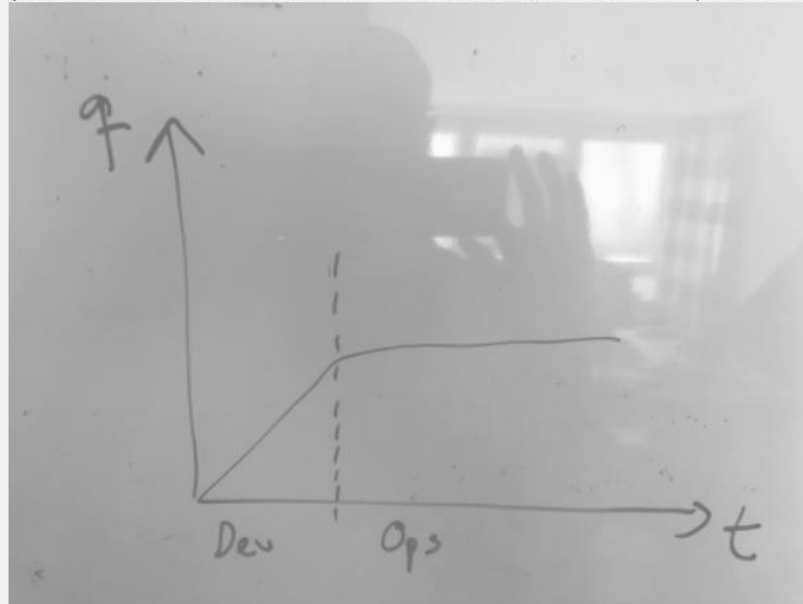
Software Products

UX, business processes

Data	▶	AI	▶	Action

Backend and frontend development

Data platform and APIs (interfaces)

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Software Products

Production

UX, business processes

Data → AI → Action

Brand Digital Unit

Backend and frontend development

Brand IT

Data platform and APIs (interfaces)

Production IT

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Manual testing

Automated GUI tests

Integration-Tests

Unit
Test
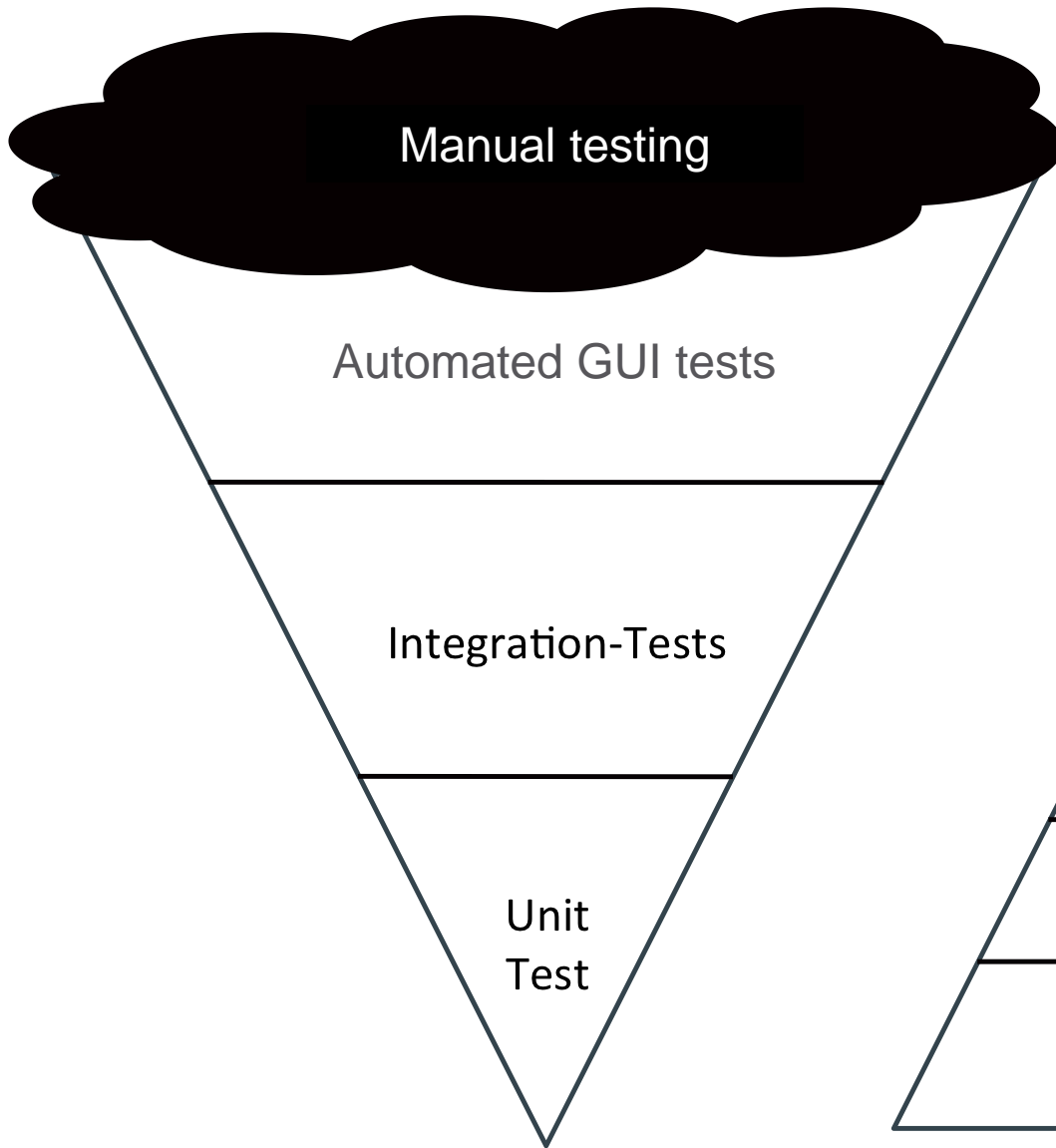
Non-ideal testing pyramid
(car manufacturers)

Manual testing

Automated GUI tests

Automated API tests

Automated Integration tests

Automated Component tests

Automated Unit tests
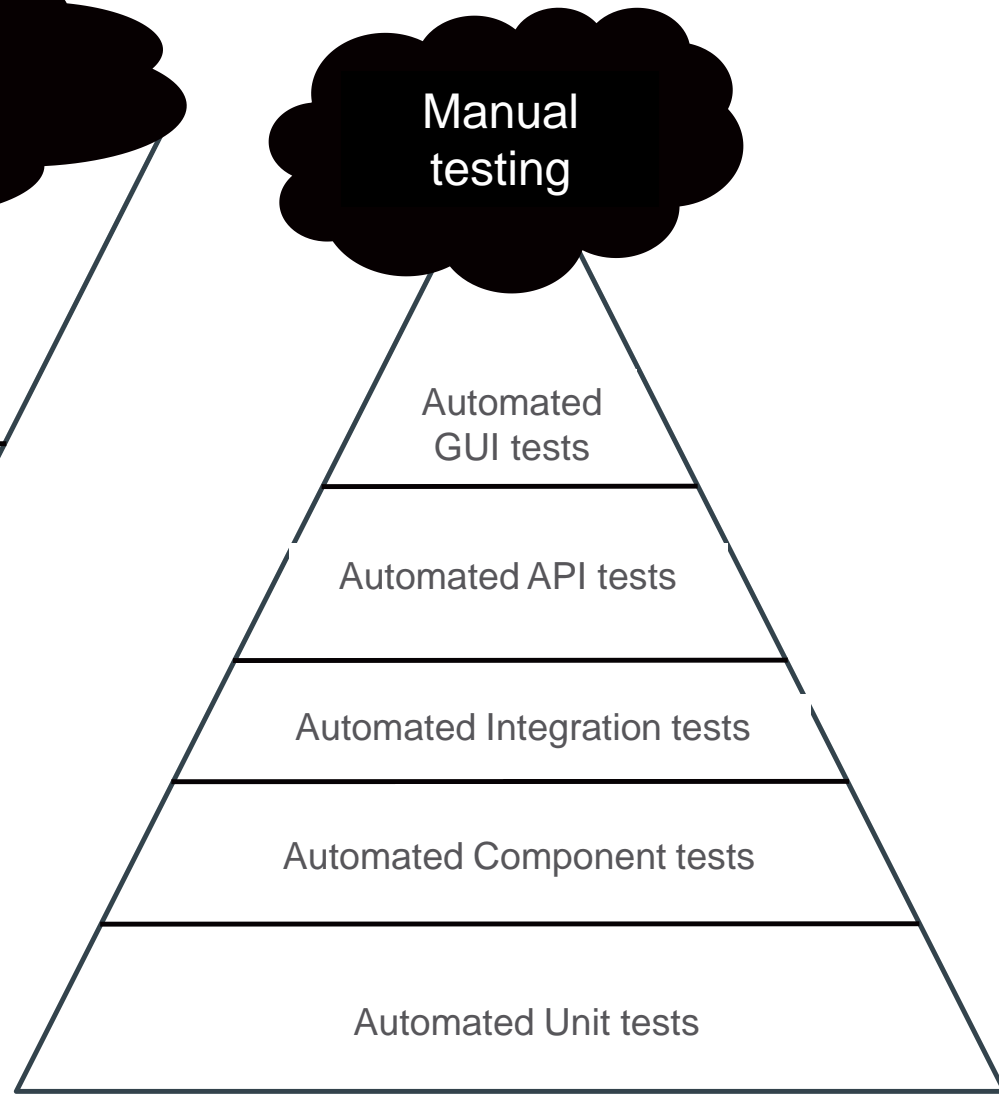
Ideal testing pyramid
(tech companies)

Scaling Products – e.g. Instagram

[Scaling the Data Infrastructure at Instagram - YouTube](#)
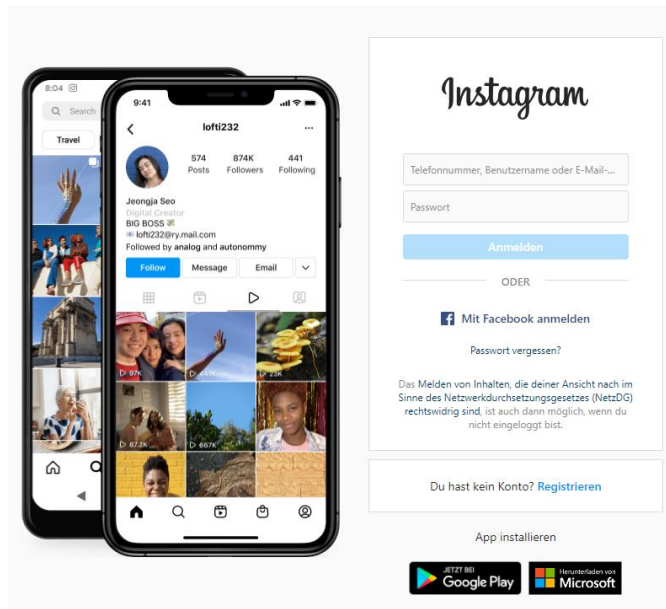
Database snapshots: V1

1. ~~Spawn new~~ Use dedicated database instances
2. Continuously load data from incremental backups
3. Export table data to csv files
4. Import files in Hive as staging tables
5. Copy staging data into new partitions/tables

Scaling the Data Infrastructure at Instagram

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Bottlenecks and Their Impact

$$\text{Wait Time} = (\% \text{ Busy})/(\% \text{ Idle})$$

Stacey-Matrix

Technology / Solution

unknown

Research (transformational)

Agile development (transactional & transformational)

Series (transactional)

known

known   unknown

Requirements

Potential for new business models

Potential for cost reduction

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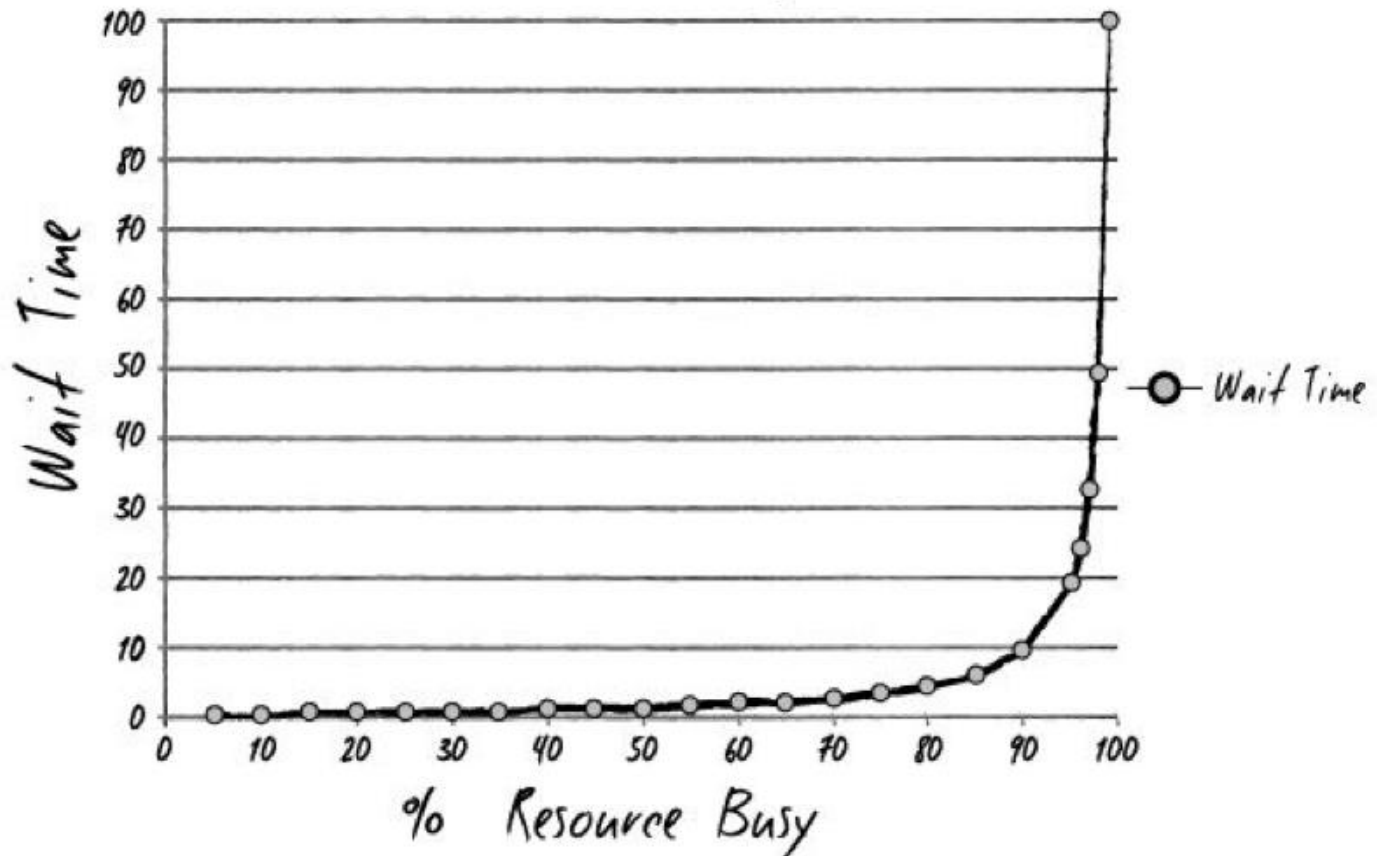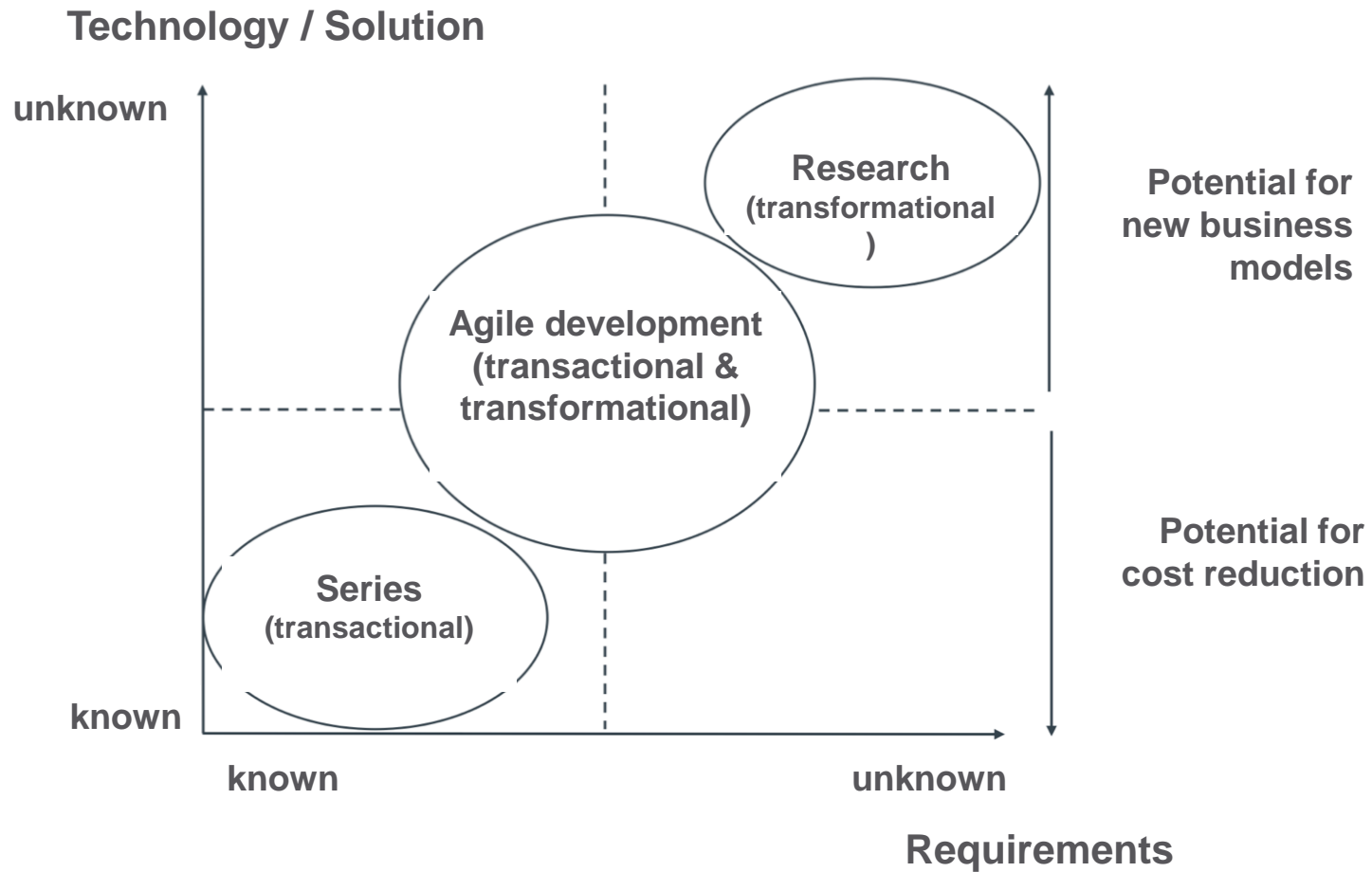
SAFeScrum – Large Solution (CarSoftware.Org)

SAFe® for Lean Enterprises 5.0

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Car manufacturer

Business guy of OEM

Technical/ IT guy of OEM

Requirements

Review (functional)

Legacy systems / Enterprise IT of the car manufacturer

X 1,000

Code

Code

Commits

Commits

Operations

Warranty

Supplier

Supplier

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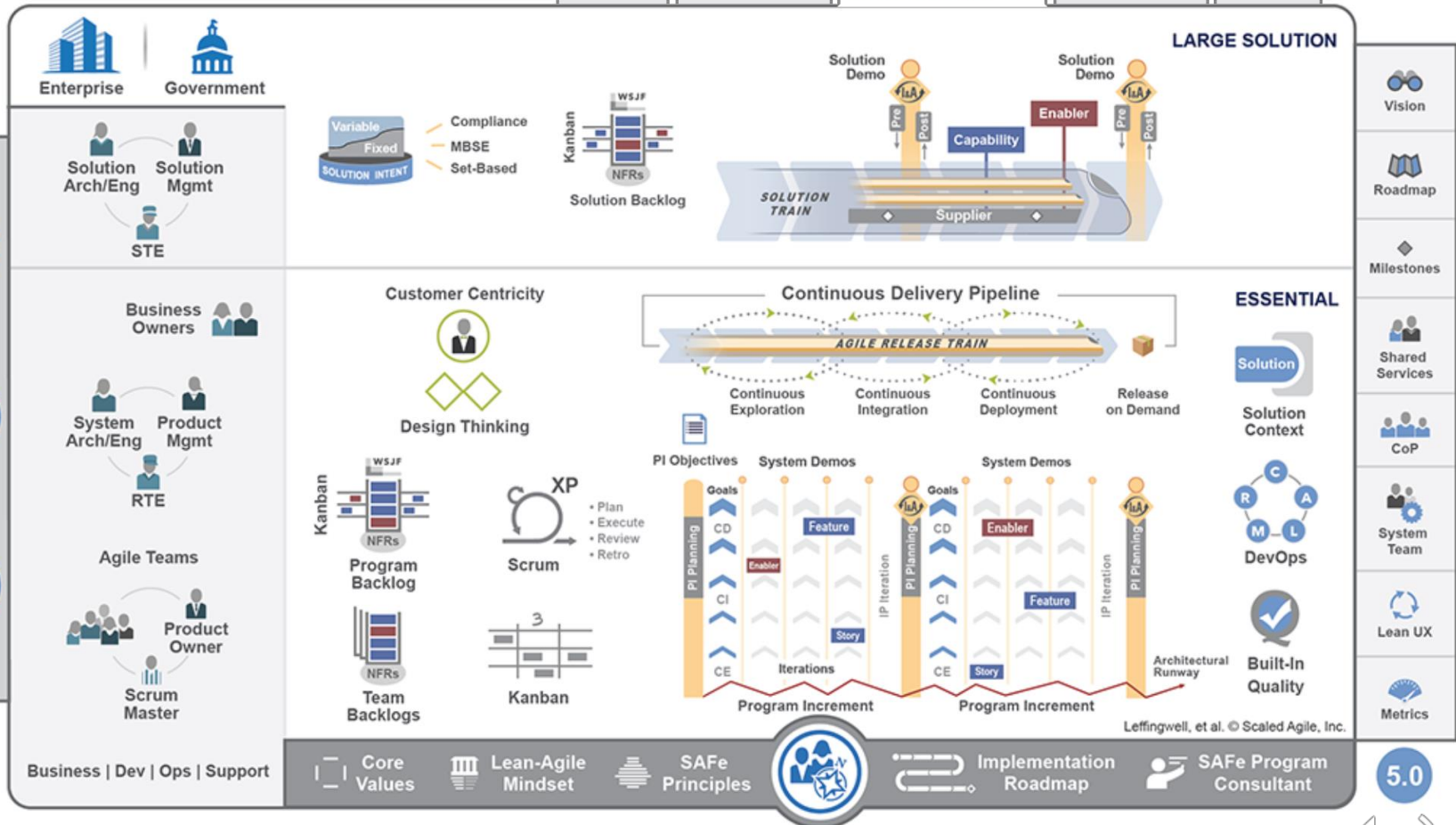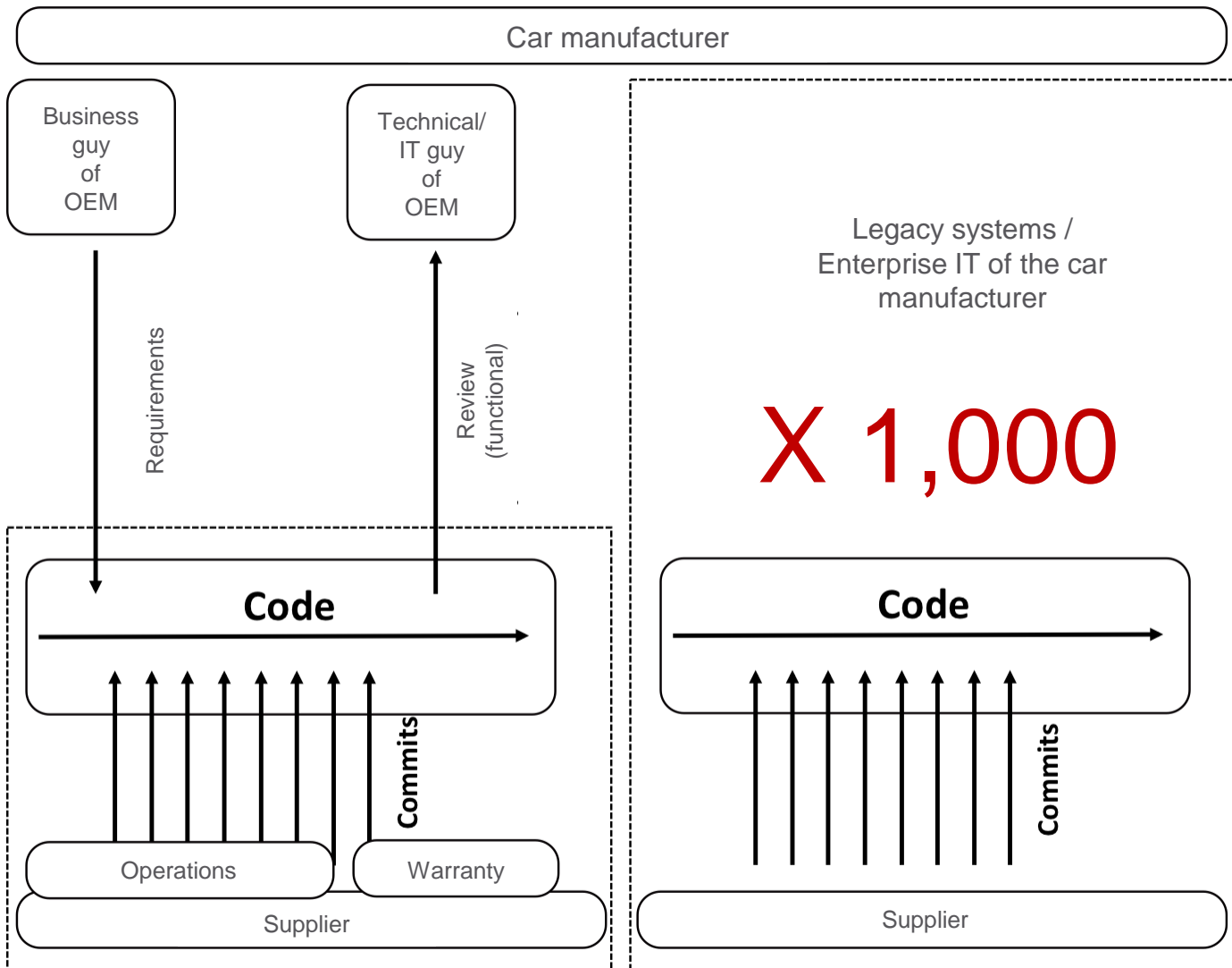
Integration time explodes

Integration time B

Integration time A

Dev

Change Legacy
System A
needed

Change Legacy
System B
needed

...

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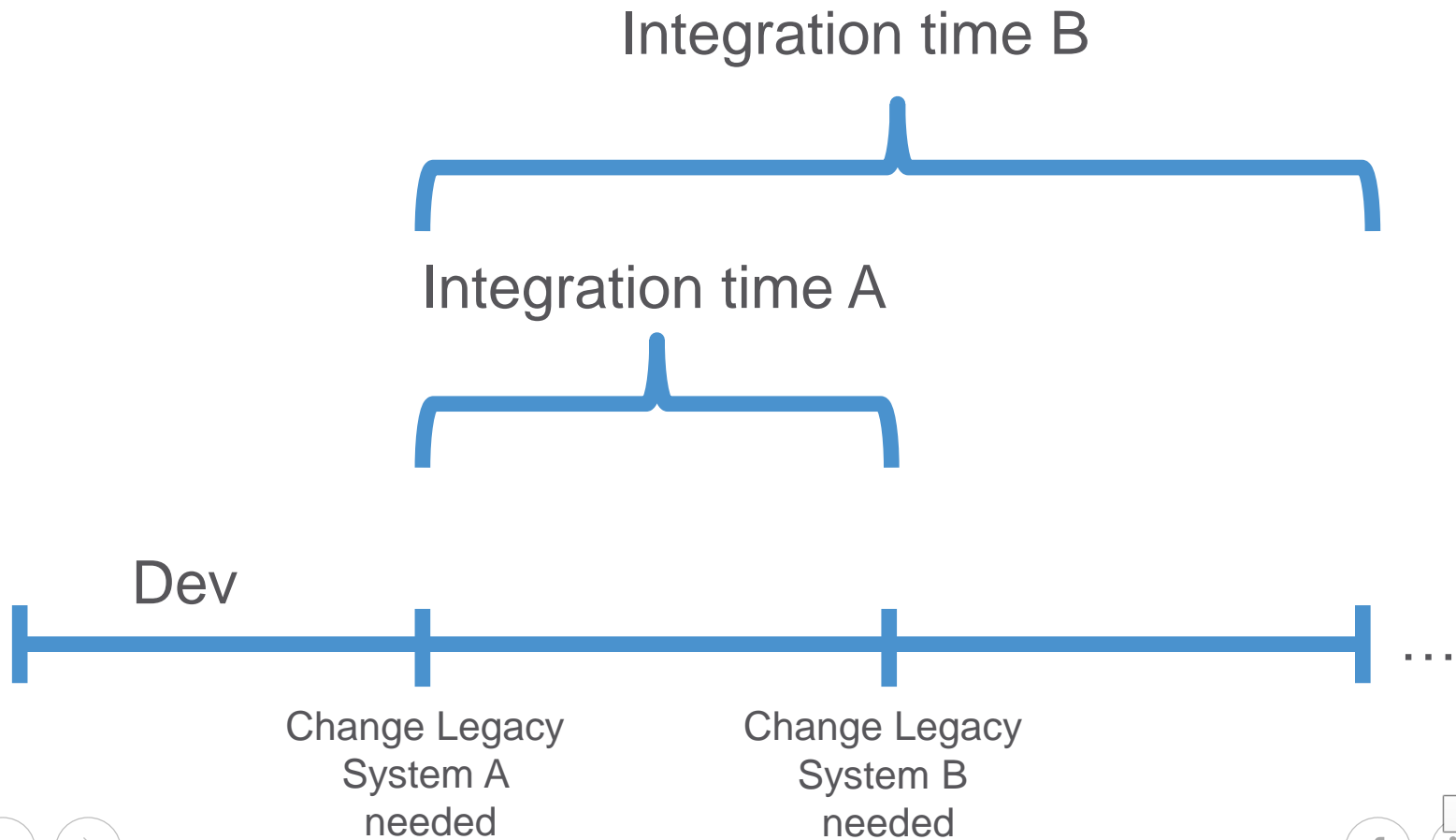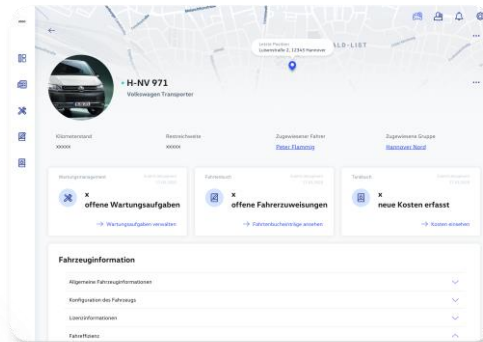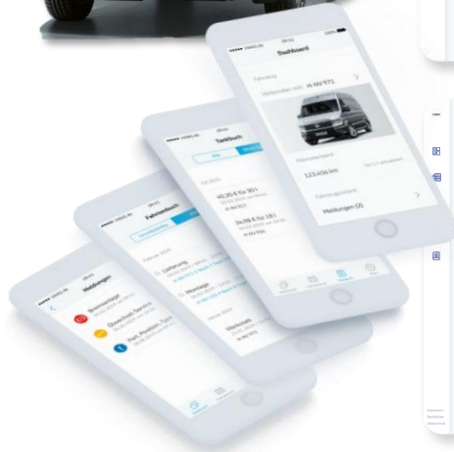
Connect Fleet – Fleet Management System
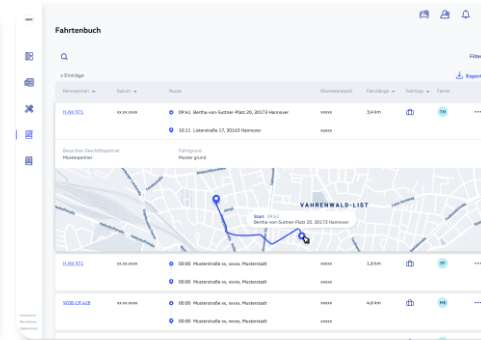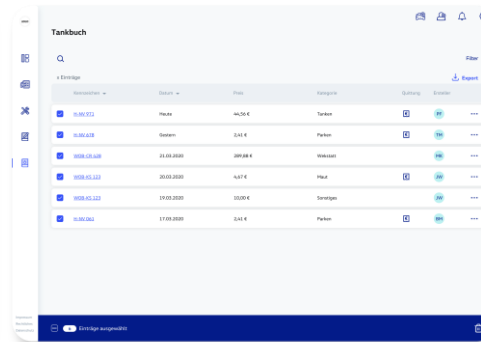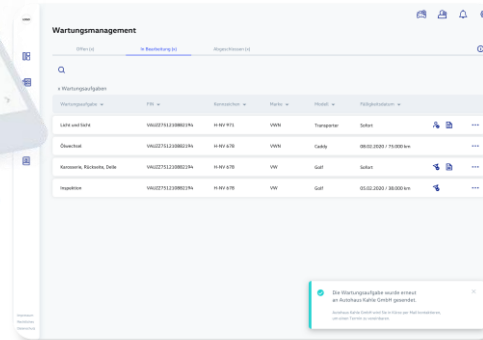
Connect Fleet

Digital Logbook

Business Maintenance Scheduling

GPS Tracking

...

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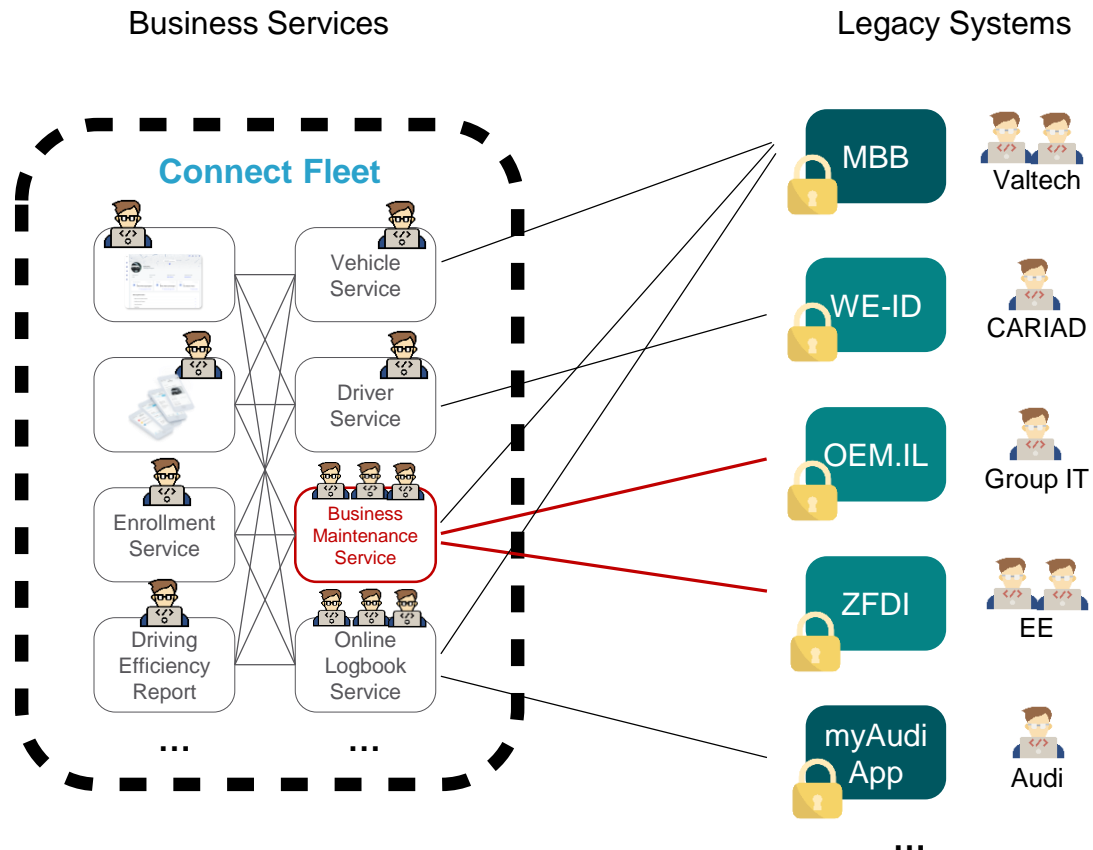
The Developer Journey: „I am Susi and I love CODING."

Business Services

Legacy Systems

Connect Fleet

Vehicle Service

Driver Service

Enrollment Service

Business Maintenance Service

Driving Efficiency Report

Online Logbook Service

...   ...

MBB — Valtech

WE-ID — CARIAD

OEM.IL — Group IT

ZFDI — EE

myAudi App — Audi

...

Nutzfahrzeuge

The Developer Journey: „I am Susi and I STILL love CODING."

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...   ...

MBB

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...

Nutzfahrzeuge

The Developer Journey of Susi: „I am Susi and I STILL love CODING."

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...

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Nutzfahrzeuge

The Developer Journey: „I am Susi and I STILL love CODING."

Customer

Business Services

Legacy Systems

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Online Logbook Service

...   ...

MBB — Valtech

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OEM.IL — Group IT
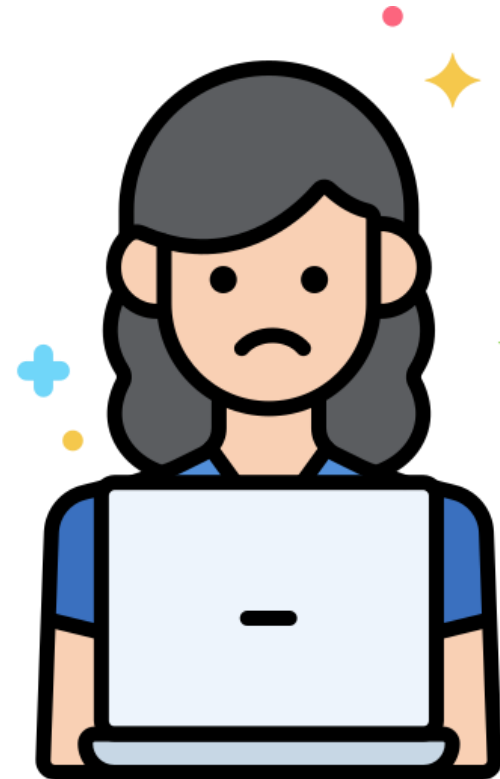
ZFDI — EE

myAudi App — Audi

...

Nutzfahrzeuge

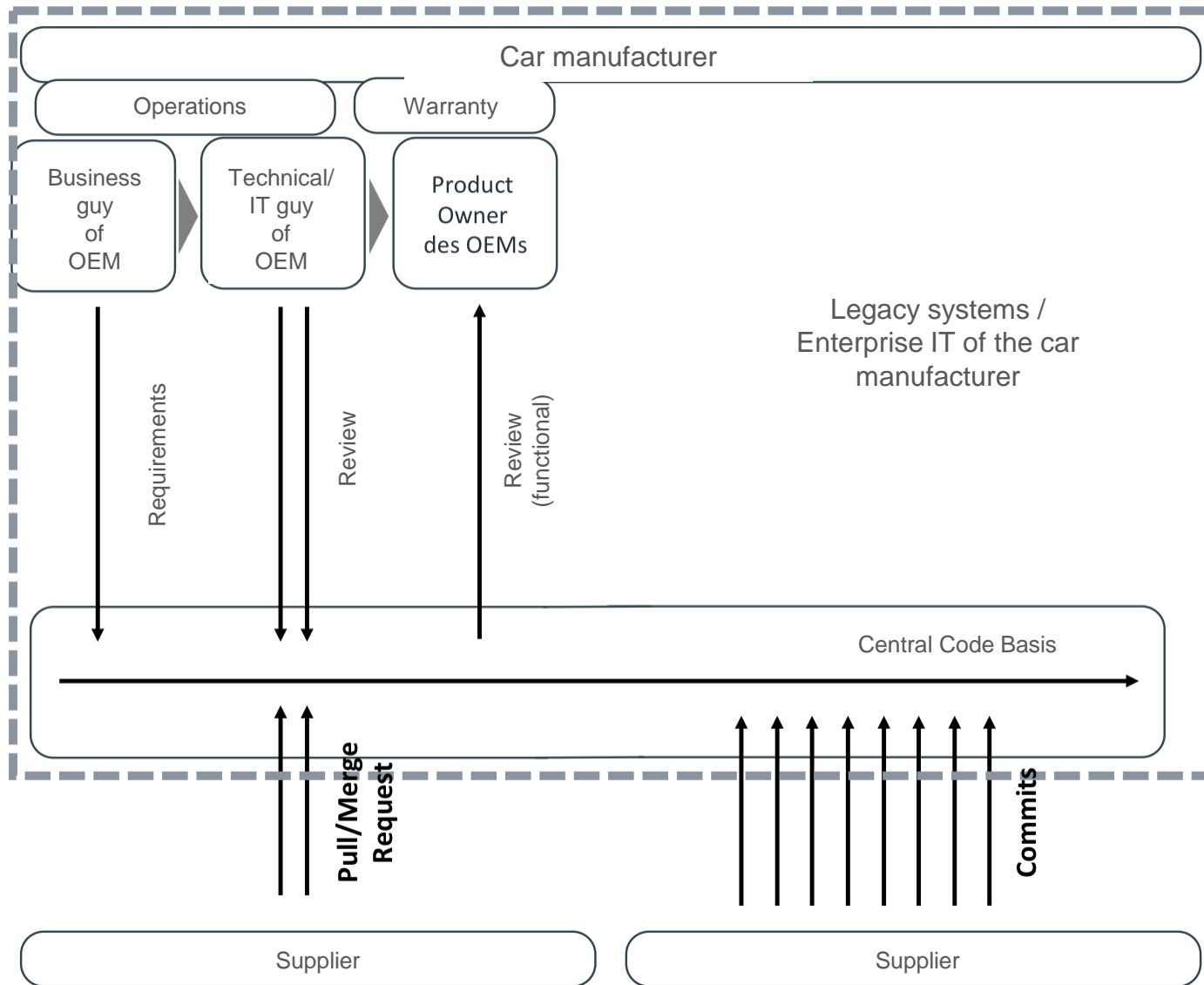# "I wanted to write code! Not requirements!"
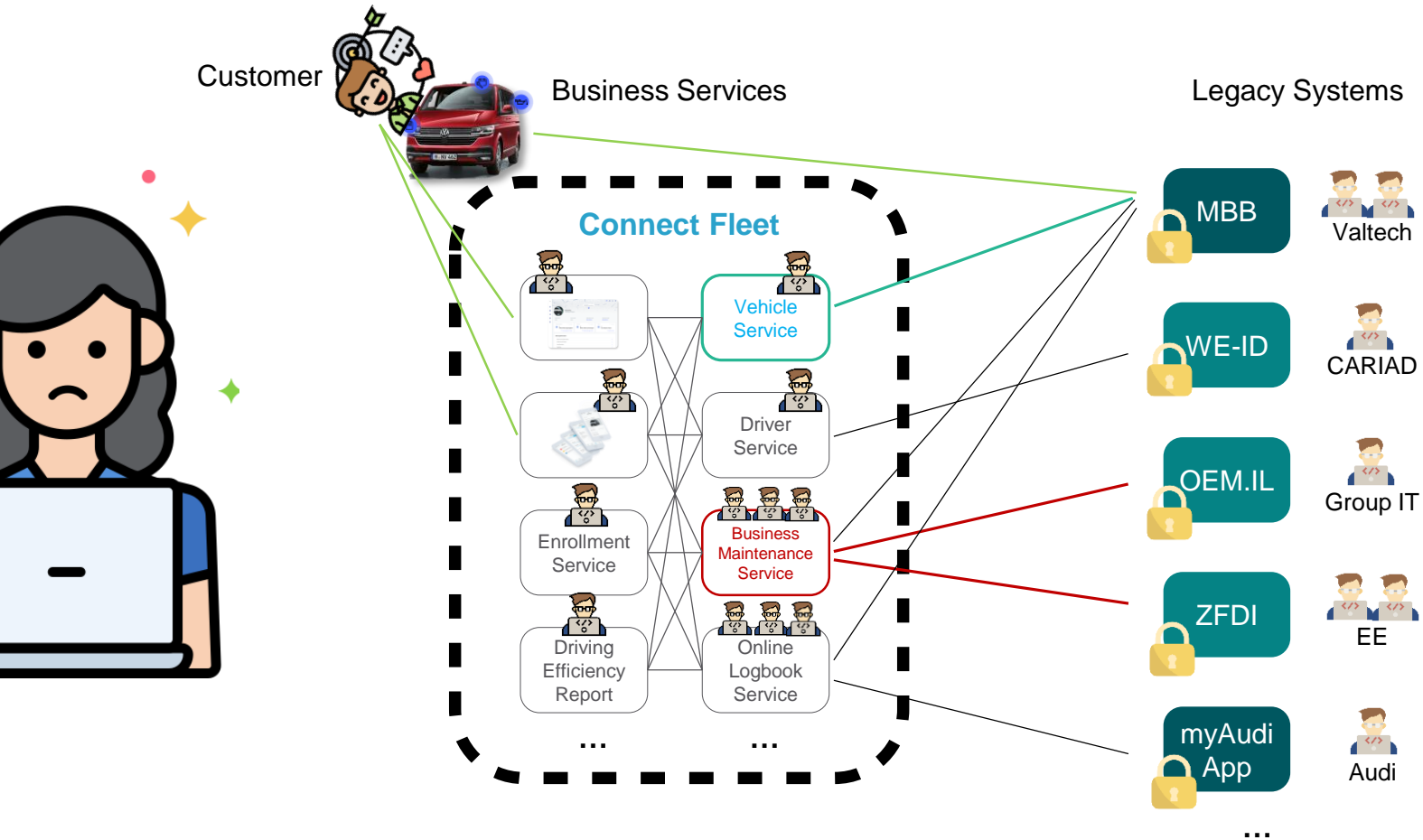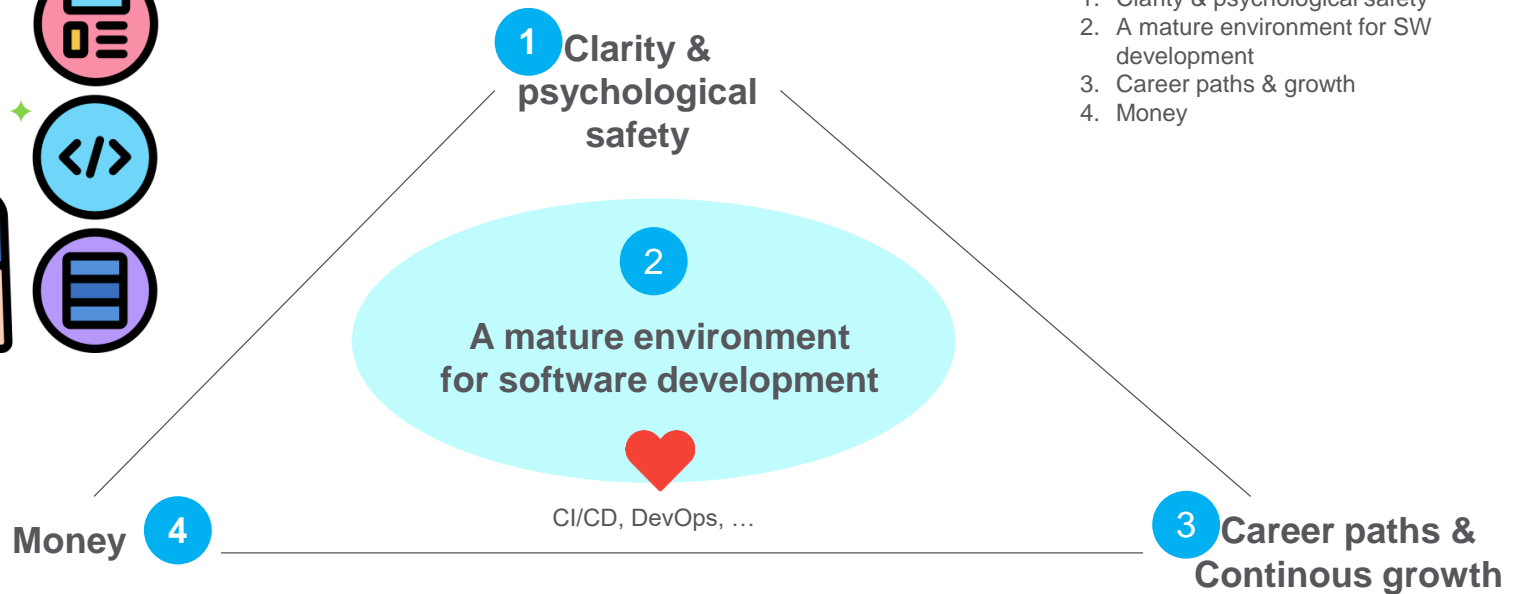
Why is Susi unhappy now?

1. No end-to-end-testing during development phase
2. Many dependencies on legacy systems
3. Integration happens briefly for going live
4. A lot of effort for the simulation of interfaces
5. Every error leads to delays
6. No automated end-to-end testing is possible

- → She mainly writes requirements instead of code. She hast to talk to requirements engineers of other departments / groups etc.

Nutzfahrzeuge

Car manufacturer

Operations

Warranty

Business guy of OEM

Technical/ IT guy of OEM

Product Owner des OEMs

Legacy systems / Enterprise IT of the car manufacturer

Requirements

Review

Review (functional)

Central Code Basis

Pull/Merge Request

Commits

Supplier

Supplier

How to attract talents?

Top priorities for the new generation of software developers:
1. Clarity & psychological safety
2. A mature environment for SW development
3. Career paths & growth
4. Money

1 Clarity & psychological safety

2 A mature environment for software development

CI/CD, DevOps, …

4 Money

3 Career paths & Continous growth

You have to see the employee as your customer

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Legacy

Complexity

Bottlenecks

Summary

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Summary

- Car manufacturers have legacy due to its history of producing cars in a highly efficient manner
- Legacy has been mainly driven by the optimization of corporate processes
- There is structural legacy, which is also reflected by the organizational structure, e.g. the car dealers
- The complexity rises due to the high amount of software, which goes into new cars; software is an team effort, which makes it even more complex
- You have to fix all bottlenecks; if there is just one bottleneck left, this will be the one slowing all down; the biggest bottleneck for software development are the legacy systems

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