LESSONS FROM SCALING AGILE AT VOLVO CARS
DARKO DURISIC, VOLVO CARS

Who am I?

- Doctor of Philosophy in Technology University of Gothenburg [2017]

- Volvo Cars [2011-ongoing]
  - Program Manager – Architecture and System Design   [2023-ongoing]
  - Product Manager - System Architecture   [2021-2023]
  - Product Owner - System Architecture   [2020-2021]
  - Senior System Architect   [2019-2020]
  - Release Train Engineer   [2018-2019]
  - Agile Transformation Leader   [2017-2018]
  - (Senior) System Engineer   [2011-2017]

- Lecturer [2016-ongoing]
  - Kristiania University College
    - Agile Project Management (Master)   [2021-ongoing]
  - University of Gothenburg
    - Agile Development Processes (Master)   [2019-2020, 2023-ongoing]
    - Assisting other Bachelor and Master courses   [2016-2019]

Vision at Volvo Cars

Freedom to move in a personal, sustainable and safe way

Required knowledge for this course

- Agile principles and practices

- Agile methods (XP, Scrum, Lean, Kanban)

- Basics of TDD and CI/CD

- Basics of agile leadership

Traditional – Agile – Ad Hoc

traditional

- **Future is Predictable**
- **Nothing will substantially change**
- **We need to know everything ahead of time**

Therefore… → "Predict and Plan"

- **We plan everything up-front**
- **We make most decisions ahead of time**
- **If we build according to spec, we'll get what we expect**

AGILE

- **We can't predict the future**
- **Change is to be expected**
- **We can't know everything ahead of time**

Therefore… → "Sense and Respond"

- **We plan as we go**
- **We make decisions based on what we learn**
- **Everything is done from observation and experience**

Ad-hoc

- **Prediction is meaningless**
- **Everything is constantly changing**
- **We know when it has already happened**

Therefore… → "Just do something"

- **The plan is - what to do next**
- **We act (react) on problems**
- **We hope the problem will go away with last fix**

Moving Towards an Acceptance where 'change happens faster than we can predict.

Change happens faster than we can predict

"… the pace of change has never been this fast — yet it will never be this slow again."

Justin Trudeau, World Economic Forum in Davos, January 2018

New reality in the automotive domain

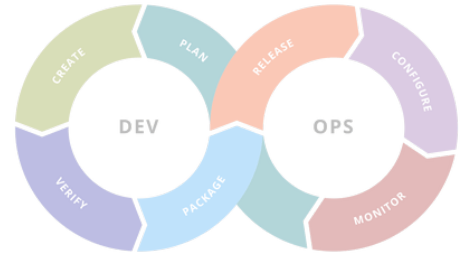Technology

Autonomy

Connectivity

Electrification

Silicon Valley

WoW

New players

New customer expectations

Continuous X

Big ideas behind different methods [Meyer2014]

- Lean: **Reduce waste**

- Kanban: **Limit WiP**

- XP: **Increment than simplify**

- Scrum: **Freeze requirements during short iterations**

Stairway to heaven [Jan Bosch]

If a problem develops:

1. Make sure that all feedback loops are in place.
2. Increase the frequency of feedback loops in problem areas.
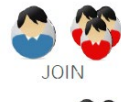
Levels of authority

PRACTICE
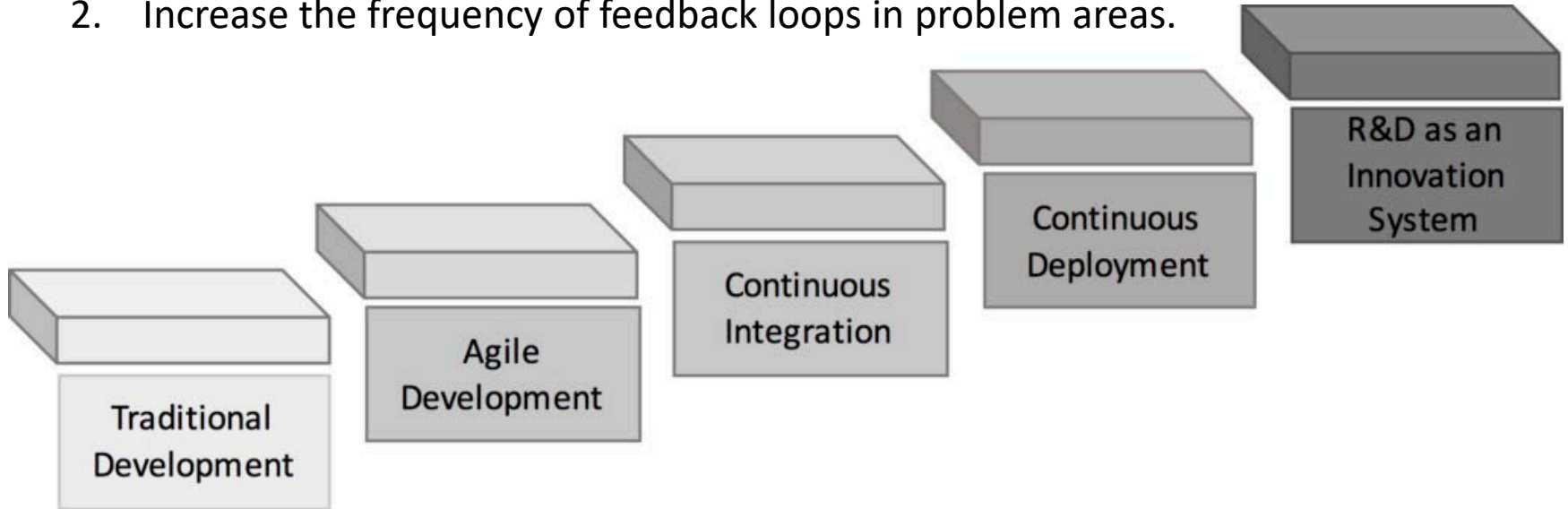
1. **Tell:** make decision as a leader

2. **Sell:** convince people about decision

3. **Consult:** get input from the team before decision

4. **Join:** make decision together with the team

5. **Advise:** influence decision made by the team

6. **Confirm:** check decision by the team

7. **Delegate:** no influence, let the team work it out

TELL

SELL

CONSULT

JOIN

ADVISE

CONFIRM

DELEGATE

Why scaling agile?
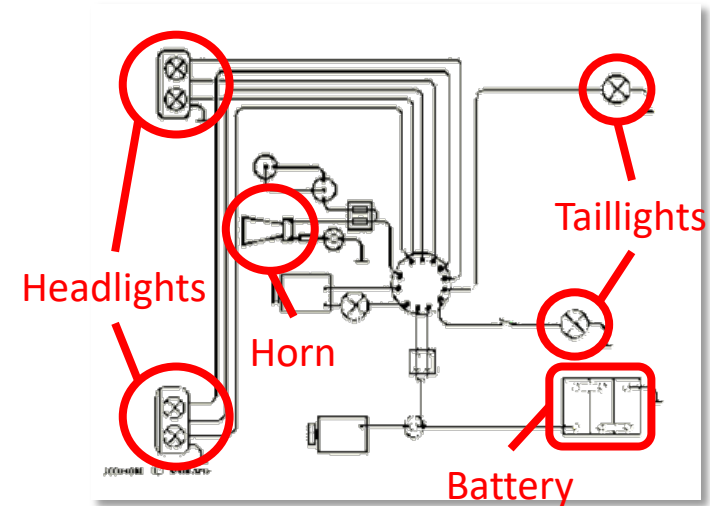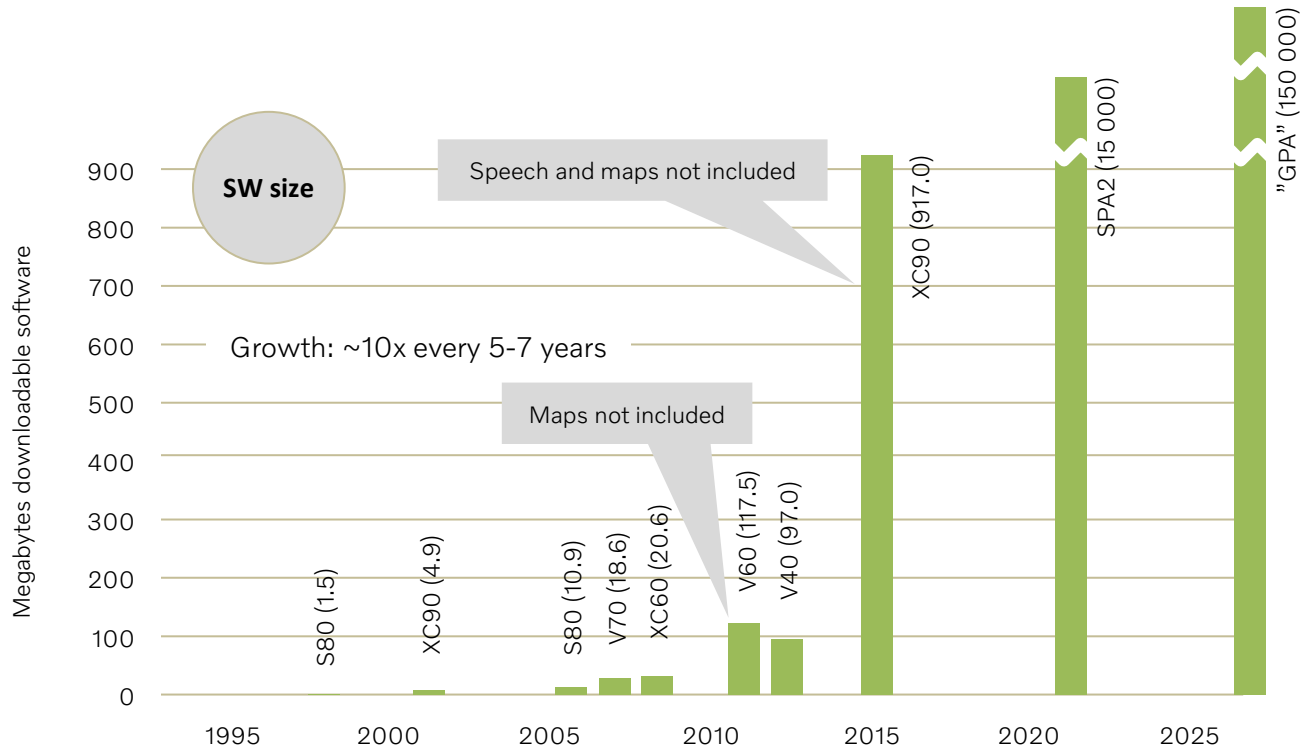

Rover Curiosity 2011
~2.5 MLOC

New luxury cars today
>100 MLOC

Airbus A380
~100 MLOC

Nothing beats an agile team, except for a team of agile teams!
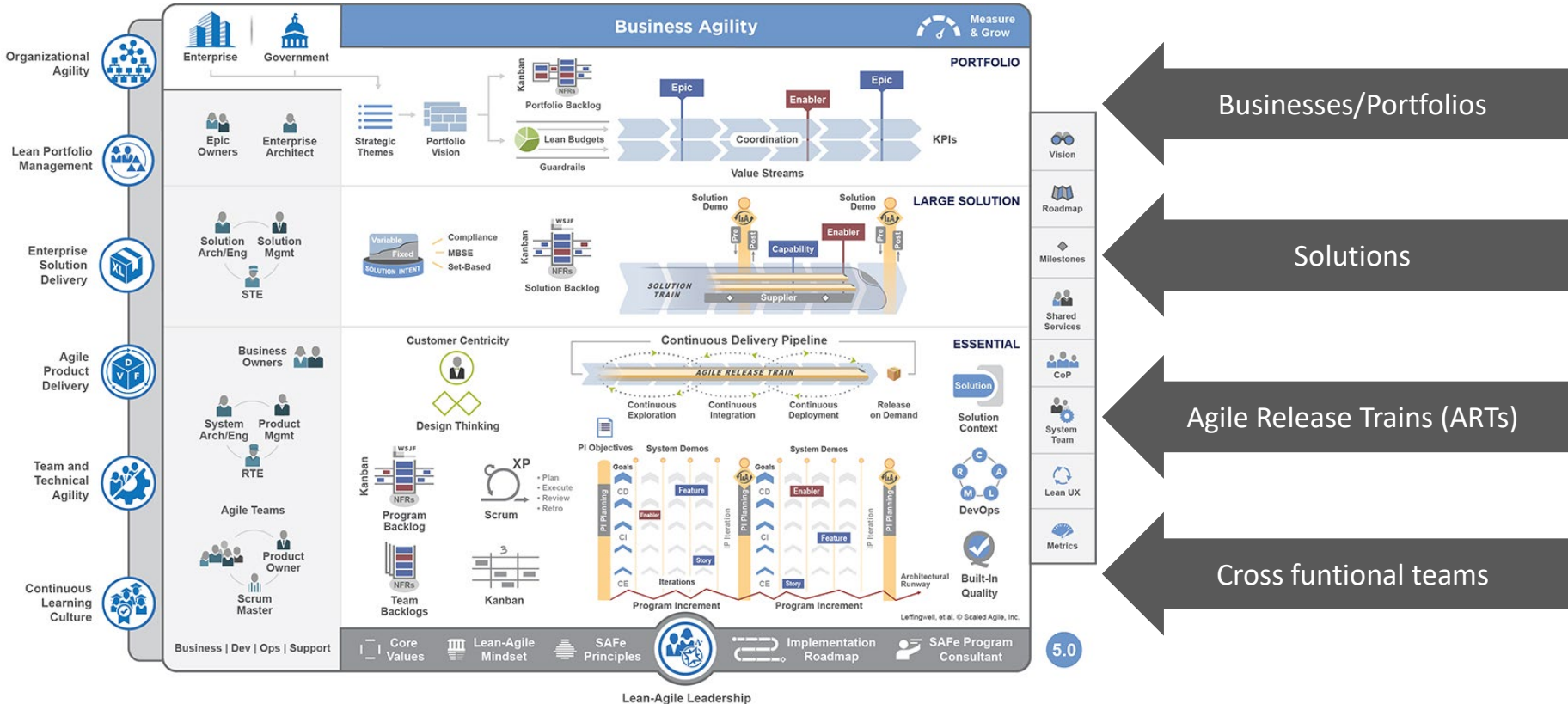
First E/E architecture at Volvo Cars (1927)

Headlights

Horn

Taillights

Battery

E/E architecture evolution at Volvo Cars

Full SAFe framework

Businesses/Portfolios

Solutions

Agile Release Trains (ARTs)

Cross funtional teams

Mindset behind development methods and frameworks
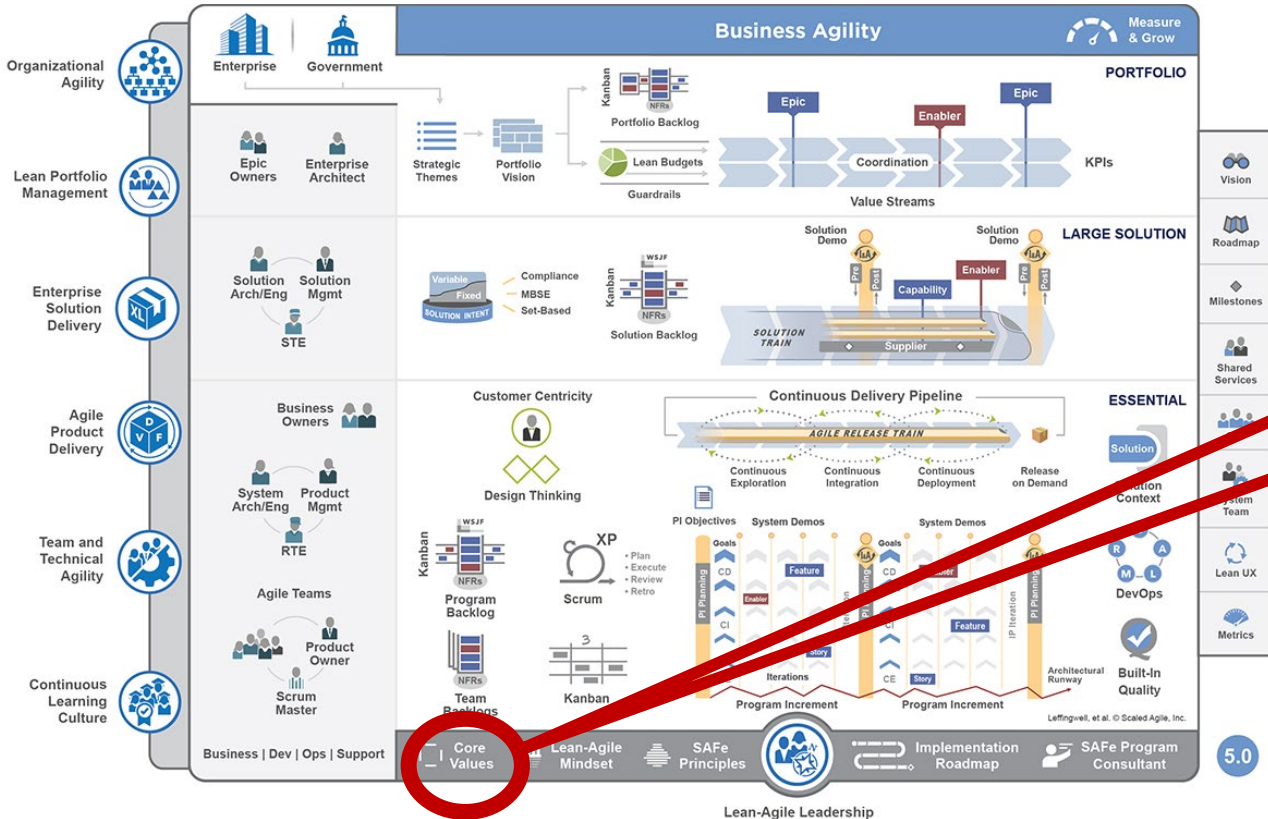
- In traditional development, you get what you   .

- In agile development, you get what you   .

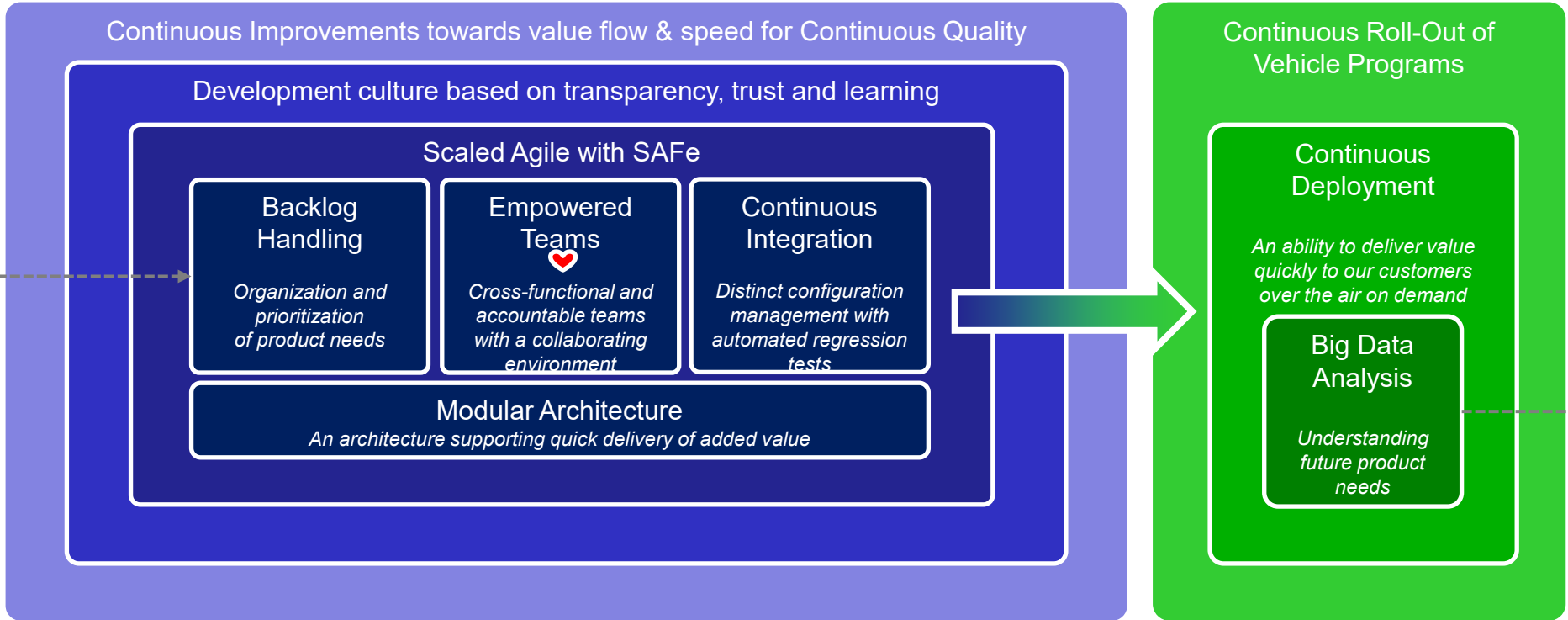- In SAFe, you get what you   .

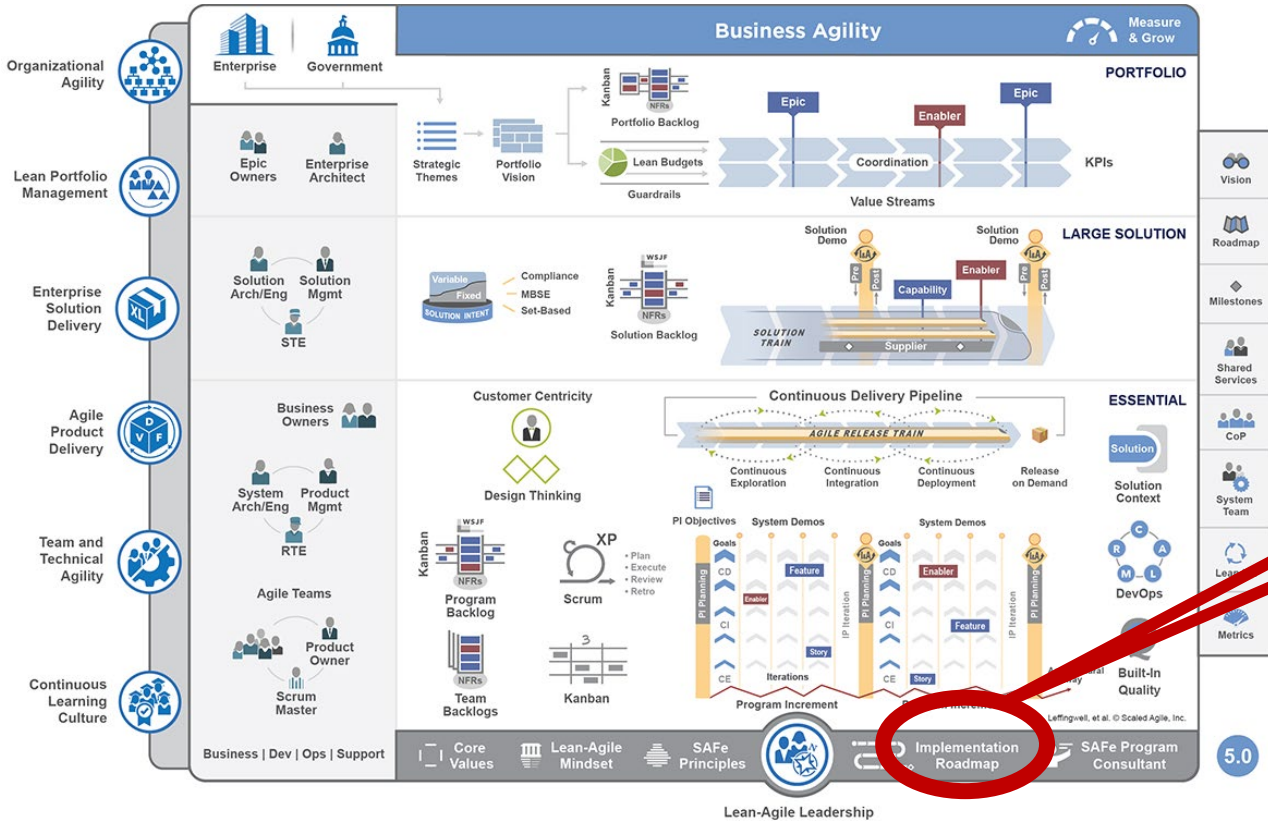test   specify   synchronize

Core values

SAFe is based on three bodies of knowledge: *Agile Development, Lean Product Development and Systems Thinking*

Core ingredients

Continuous Improvements towards value flow & speed for Continuous Quality

Development culture based on transparency, trust and learning

Scaled Agile with SAFe

Backlog Handling

Organization and prioritization of product needs

Empowered Teams

Cross-functional and accountable teams with a collaborating environment

Continuous Integration

Distinct configuration management with automated regression tests

Modular Architecture
An architecture supporting quick delivery of added value

Continuous Roll-Out of Vehicle Programs

Continuous Deployment

An ability to deliver value quickly to our customers over the air on demand

Big Data Analysis

Understanding future product needs
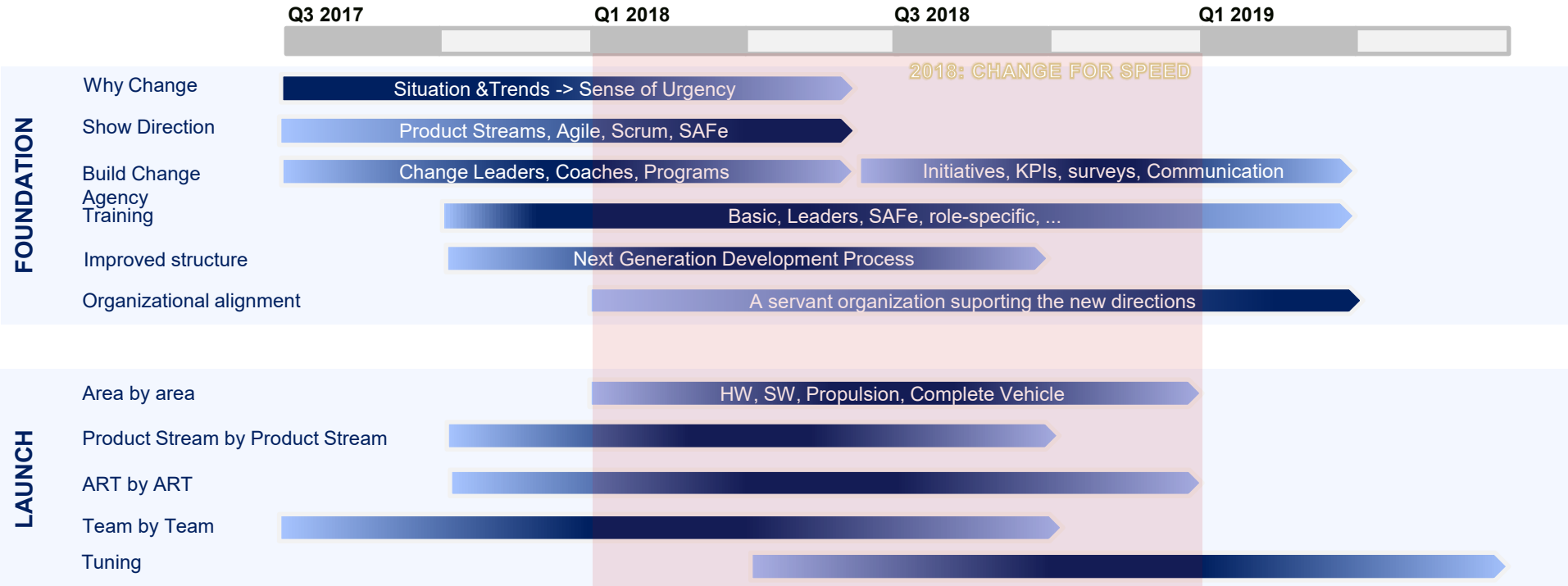
Implementation Roadmap

High level steps for the agile transformation of companies according to the framework of SAFe.

Decision, Fall 2017

Full speed towards full agile - Volvo cars large scale agile transformation

High level transformation plan

	Q3 2017	Q1 2018	Q3 2018	Q1 2019

2018: CHANGE FOR SPEED

FOUNDATION

- Why Change — Situation &Trends -> Sense of Urgency
- Show Direction — Product Streams, Agile, Scrum, SAFe
- Build Change Agency — Change Leaders, Coaches, Programs / Initiatives, KPIs, surveys, Communication
- Training — Basic, Leaders, SAFe, role-specific, ...
- Improved structure — Next Generation Development Process
- Organizational alignment — A servant organization suporting the new directions

LAUNCH

- Area by area — HW, SW, Propulsion, Complete Vehicle
- Product Stream by Product Stream
- ART by ART
- Team by Team
- Tuning

Volvo Cars Agile Trainings

Find new opportunities to learn and develop your skills

VOLVO

VCAT

VPDS introduction, Online

2021-11-05	09:00 – 11:30 Eng
2021-12-07	14.00 – 16:30 Eng
2,5 hours	ENG00640

Train the Trainer, Online

2021-10-05-06 + 12	08:30 – 12:00 Eng
2021-10-19-20 + 26	08:30 – 12:00 Swe

1,5 days via Teams   PED00724

CI Basics Training

2021-10-28	12:00 - 15:00
2021-11-25	9:00 - 12:00
2021-12-02	12:00 - 15:00

3 hours   ENG00738

ONE
Ci
EFFORT

Continuous Integration

Welcome to 3 hours Basics training

Purpose: Basic knowledge of CI

Audience: Everyone who is new to CI or need a refresh

Next opportunity:
9 November

Agile Scrum & SAFe for PO, PM, RTE and Scrum Masters

2021-10-05 — 06	8:30 – 16:30
2021-11-29 – 12-01	8:30 – 16:30
2021-12-14 — 15	8:30 – 16:30
2 days	ENG00754

Flow Principle
break down work to smaller batches

From: To:

Agile Introduction

2021-10-05 – 07	08:30 – 16:30
2021-10-11 – 13	08:30 – 16:30
2021-11-10 – 12	08:30 – 16:30
2 days training	ENG00865

Value Flow Basics

2021-10-19	08:00-10:00
2021-11-17	13:00-15:00

Also available on demand for 20+ persons

2 hours – via Teams   ENG00792

VALUE FLOW BASICS TRAINING

Welcome to 2 hours training

Value Flow

Sign up

The Developer, Engineering

2021-10-06 — 07	09:00 – 15:30
2021-10-27 — 28	09:00 – 15:30
2021-11-24 — 25	09:00 – 15:30

2 days via Teams   ENG00234

The 2-day Developer, Engineering training

Introduction to VCAF

2021-10-01	08:30 – 10:00 Eng
2021-10-08	08:30 – 10:00 Swe
2021-10-29	08:30 – 10:00 Eng

1.5 hours   ENG00822

Introduction to VCAF

Different people are in different stages
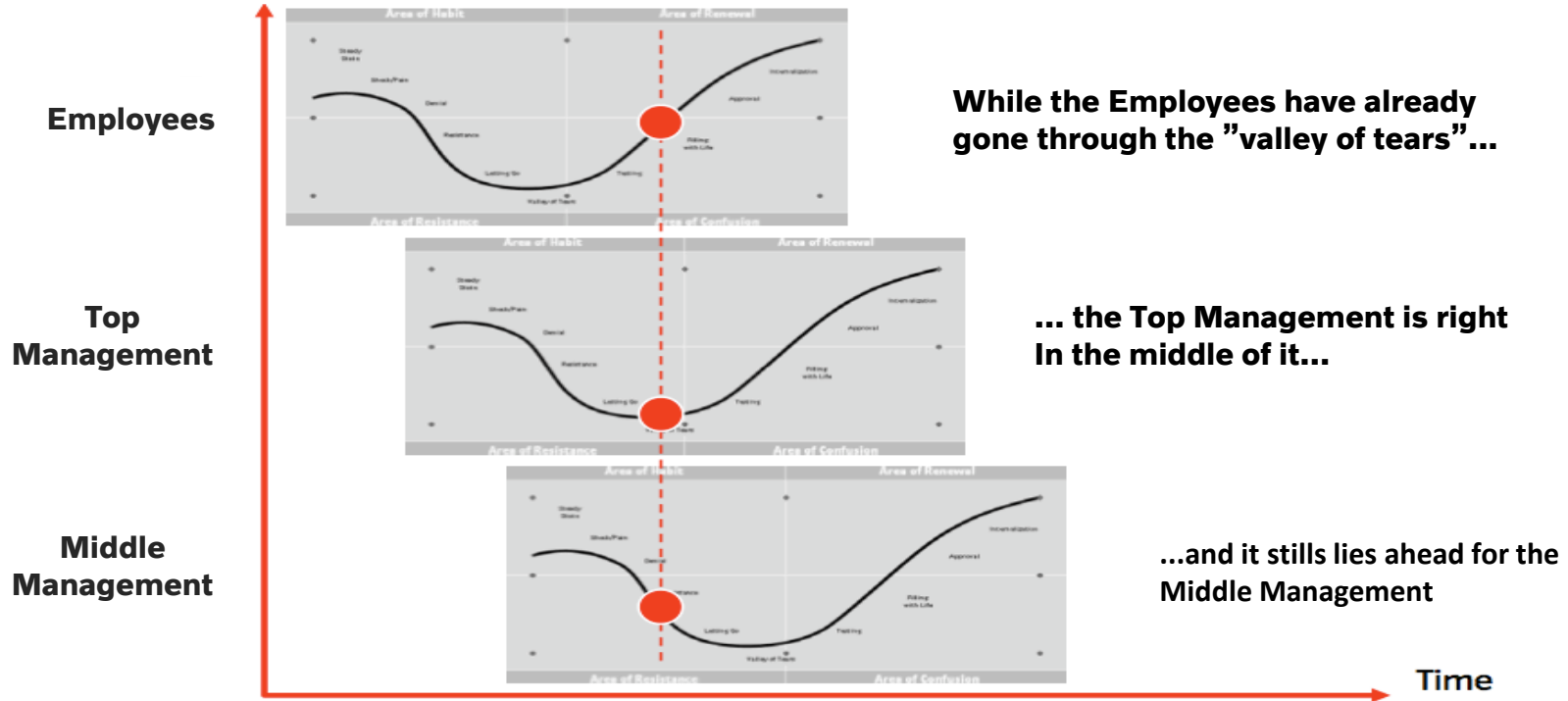
Employees

While the Employees have already gone through the "valley of tears"...

Top Management

... the Top Management is right In the middle of it...

Middle Management

...and it stills lies ahead for the Middle Management

What to do?

Make it simple to communicate good stuff!

Group managers vs. team managers

DURING TRANSFORMATION

Group Manager

Every group member will be part of a specific team"

Team

The group mgr having the most employees in one team takes the 'team manager' role. When unclear, the section manager decides (or futher escalated if needed)

AFTER TRANSFORMATION

Team Manager

Team

The group manager becomes the team manager for 2-3 teams
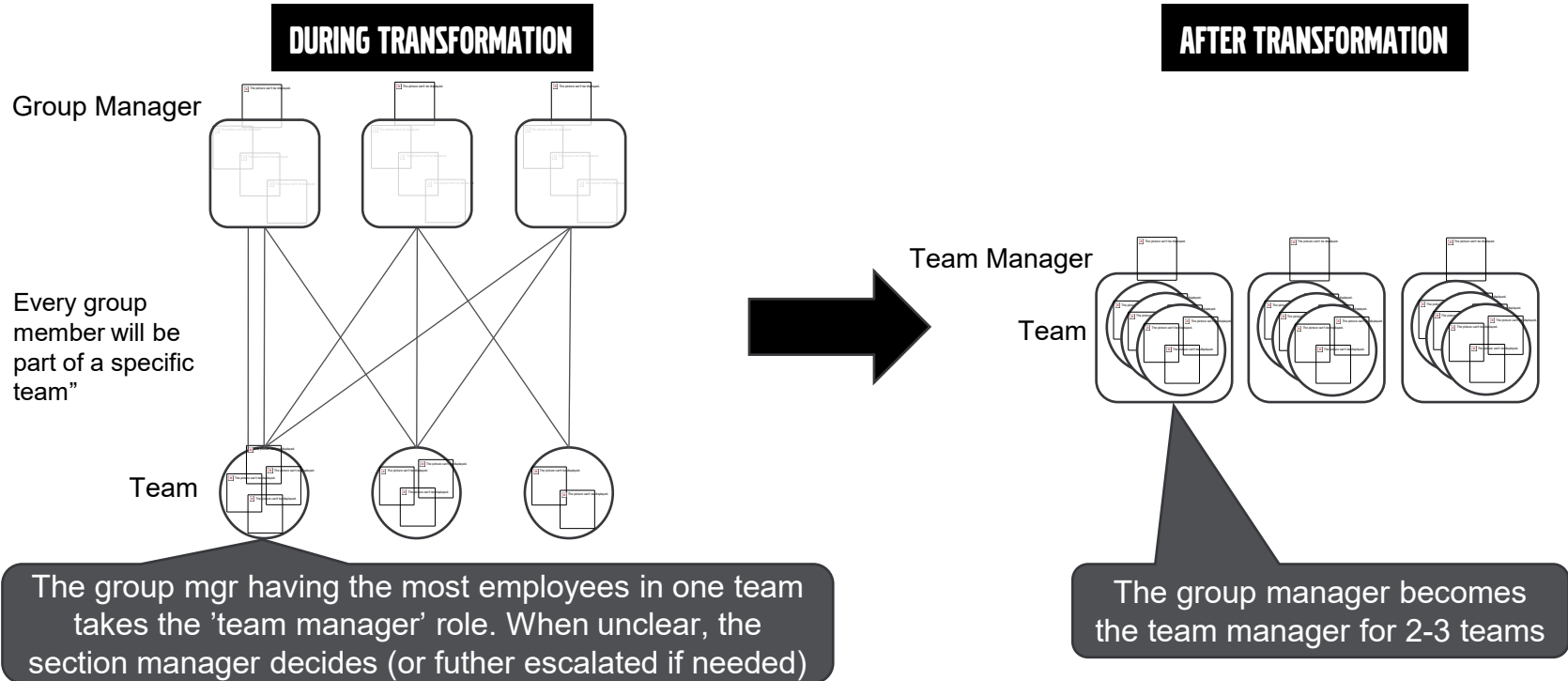
What to do? Status after 2 years.

Trained in Agile

730	
Leading SAFe	~ 1900
Agile leadership	~ 700
Start an ART	~ 4400
POs and ScMs	~ 1100
SW CI Basics	~ 1700
SW Complexity	~ 600
SAFe in one Day	~ 400
Value Flow Basics	~ 2200

CoPs

6 CoPs	17w43
16 CoPs	18w15
21 CoPs	18w35
26 CoPs	18w50
37 CoPs	19w13
44 CoPs	19w22
47 CoPs	19w37

ARTs in PI

3 ARTs	18w10
13 ARTs	18w22
24 ARTs	18w37
43 ARTs	18w49
49 ARTs	19w10
55 ARTs	19w22
59 ARTs	19w37
63 ARTs	19w49

Backlog management

- > 14 000 users
- 680 000 created items
- 4000 sessions/day at PI

By end 2019, we were probably so agile that we understand we are not!

Empowered teams
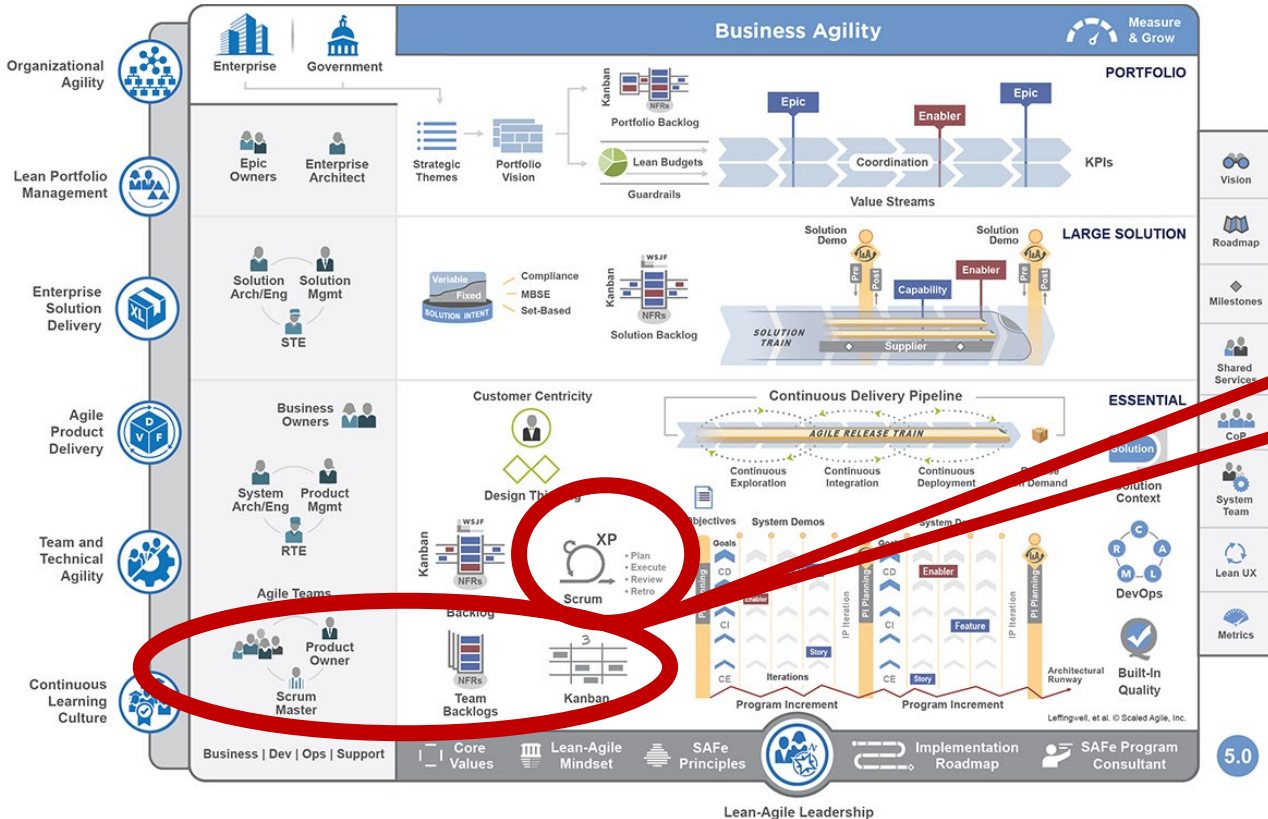
The foundation of SAFe is built on the belief that nothing beats an agile team

The cross funtional teams

Agile empowered teams

- "Assigning the next task to the next available developer" – benefits/drawbacks?

"I-shaped"
Expert at one thing

Generalist
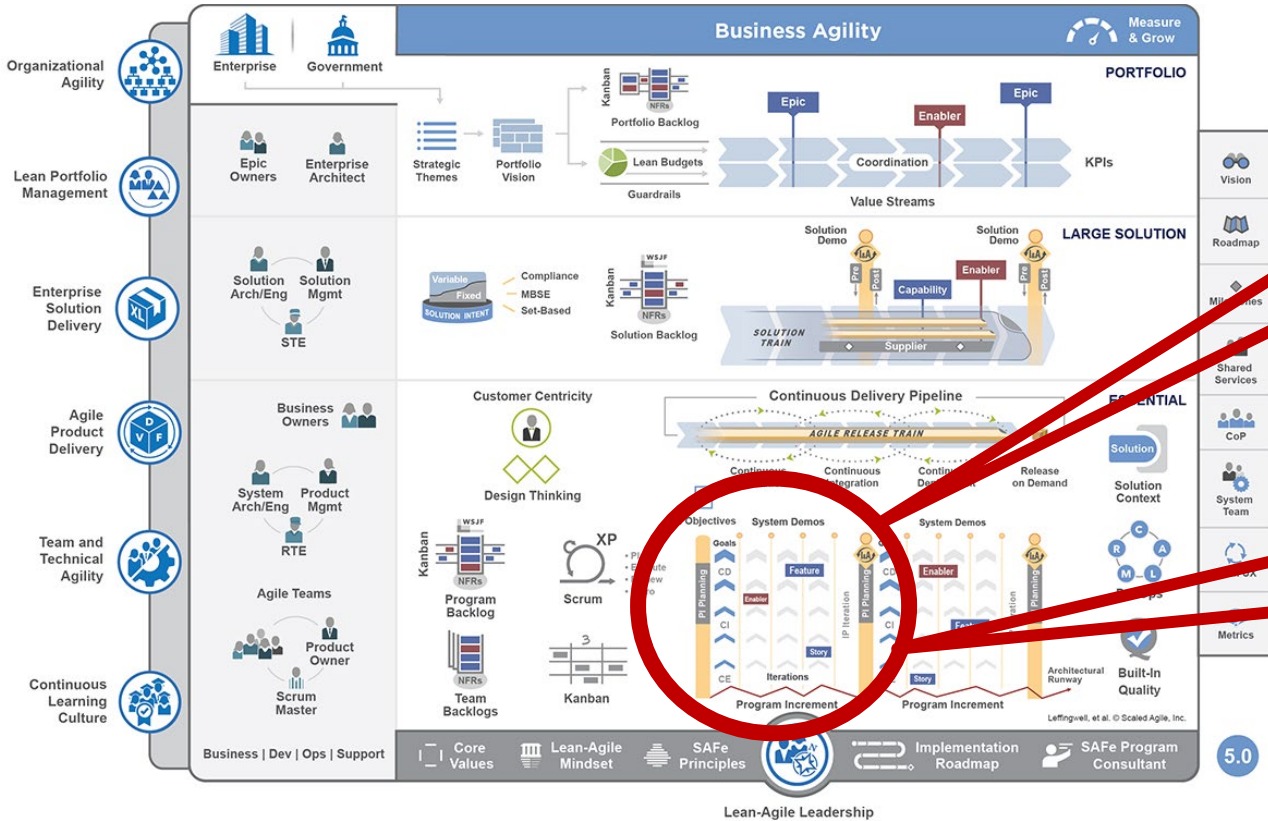Capable in a lot of things
but not expert in any
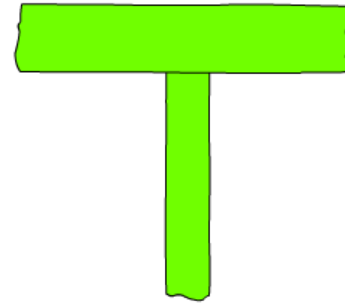
"T-shaped"
Capable in a lot of things
and expert in one of them

https://medium.com/@jchyip/why-t-shaped-people-e8706198e437

Improvement is an investment for the future!
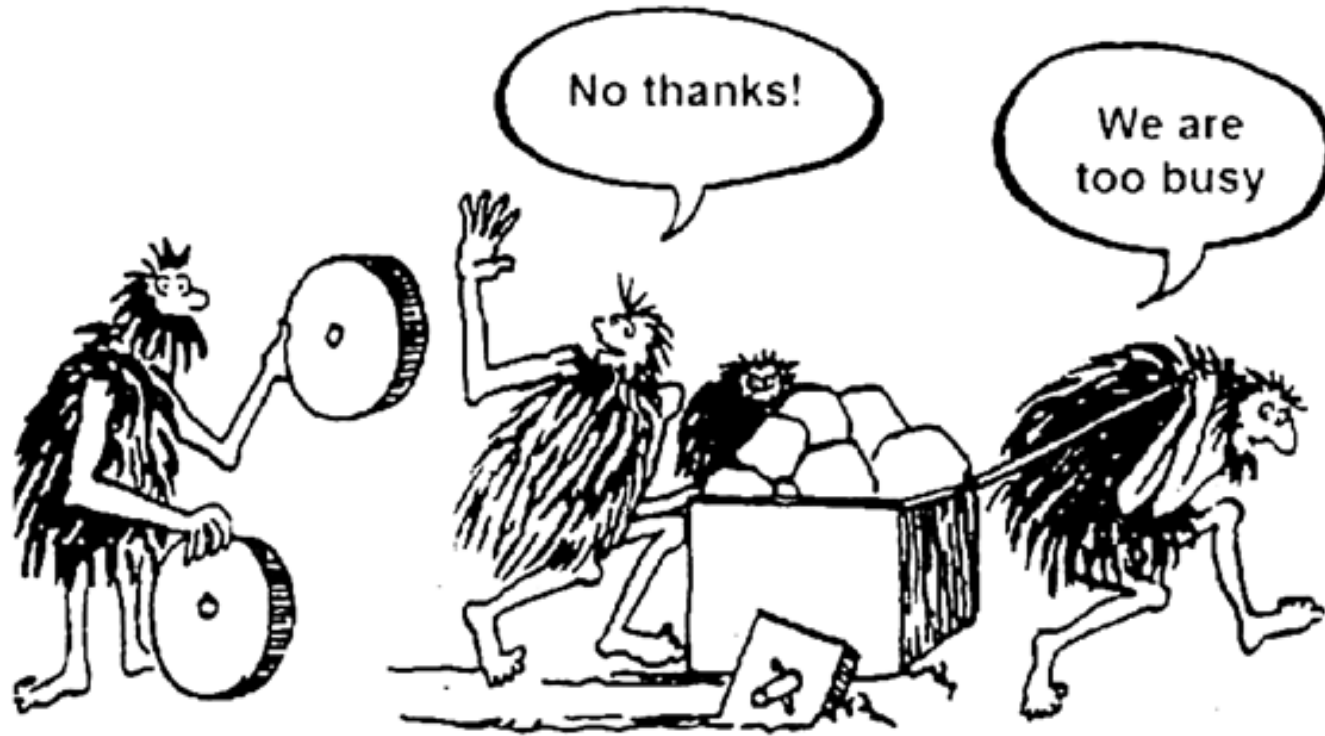
Continuous development and integration

Development and integration in small steps in a syncronized cadence

Early, frequent and automated regression tests are imperative for product quality

The cross funtional teams

Mindset change

Technical debt
Risk/Change
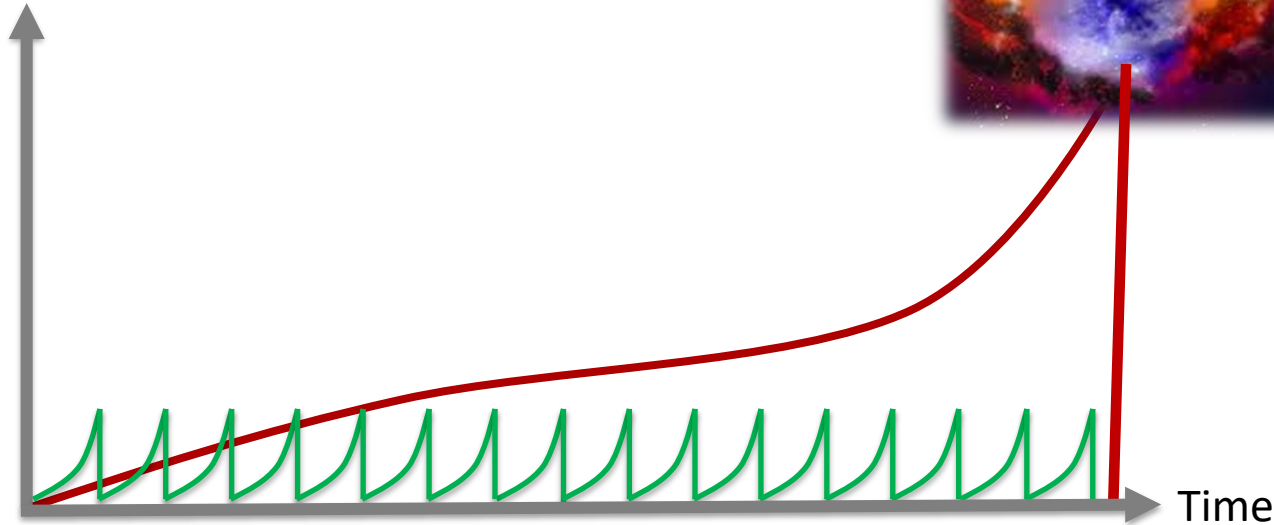
"Big bang" or
"Integration hell"
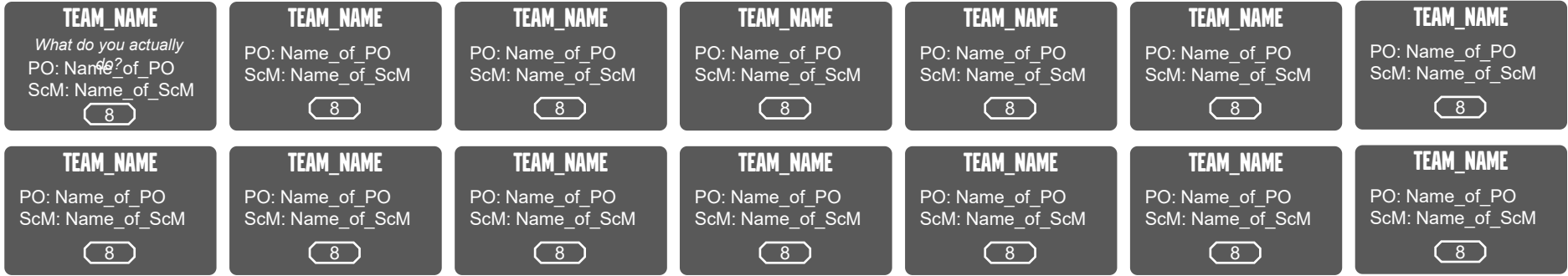
Time

Rigs

Agile Release Train (ART)
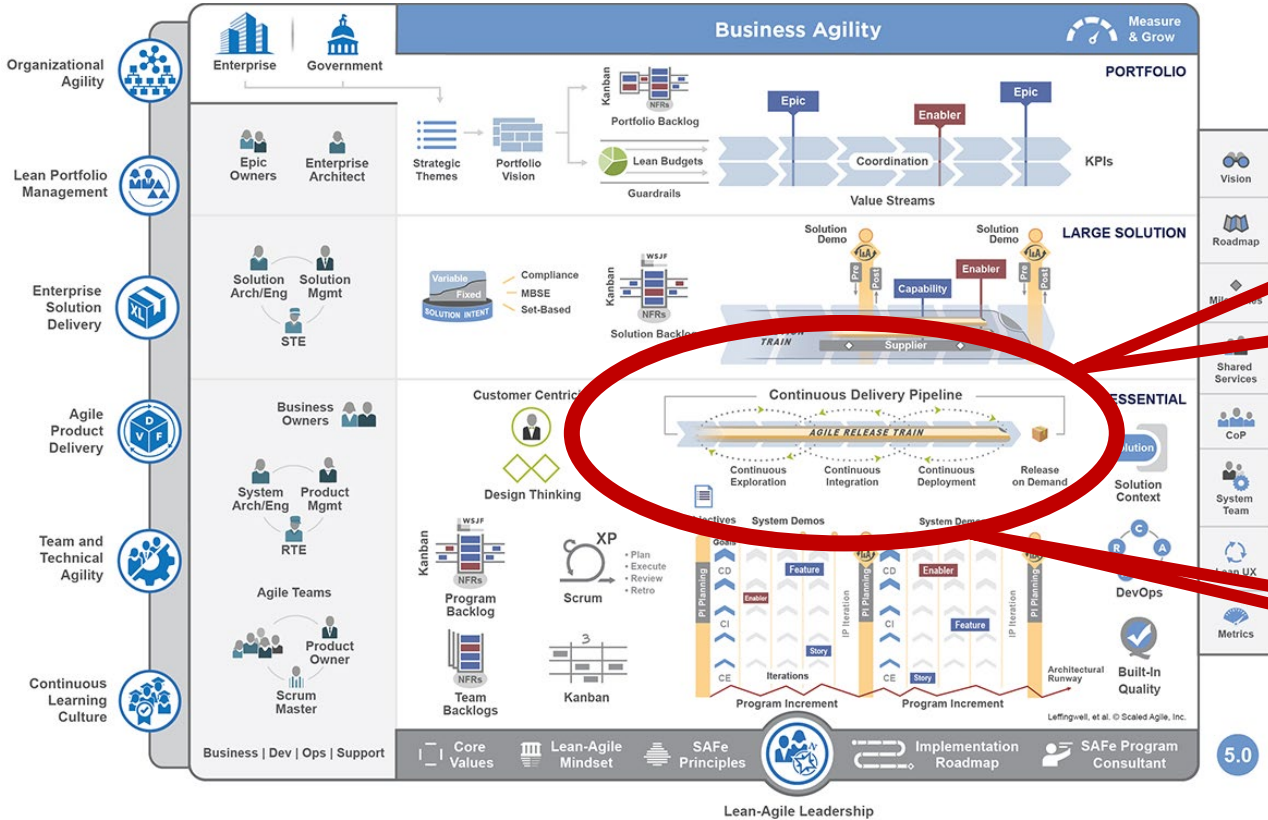
The ART is a cluster of team that delivers a continuous flow of customer value. It has all needed capabilities and is formed to be as independent as possible
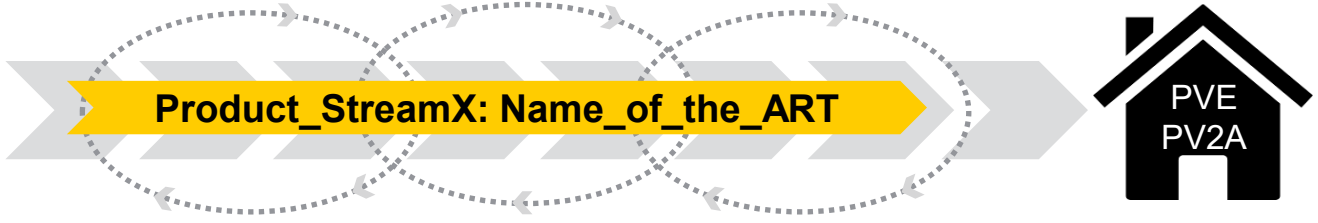
The Agile Release Trains

Aligning 50-125 practitioners to a common mission in a syncronized cadence of 10-12 weeks

ART description template

TEAM_NAME	TEAM_NAME	TEAM_NAME	TEAM_NAME	TEAM_NAME	TEAM_NAME	TEAM_NAME
What do you actually do? PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8

TEAM_NAME	TEAM_NAME	TEAM_NAME	TEAM_NAME	TEAM_NAME	TEAM_NAME	TEAM_NAME
PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8	PO: Name_of_PO ScM: Name_of_ScM 8

PM: Name_of_PM
RTE: Name_of_RTE
Arch: Name_of_Lead_Architect

Product_StreamX: Name_of_the_ART

PVE
PV2A

VISION STATEMENT
Here you write a few sentences about the ART's reason for existence and how it will contribute to our future excellent vehicles.

SCOPE OF THE ART
Here you write a few sentences about the main scope (what you develop) in the ART. You can also mention what is out of scope if you suspect this might be unclear
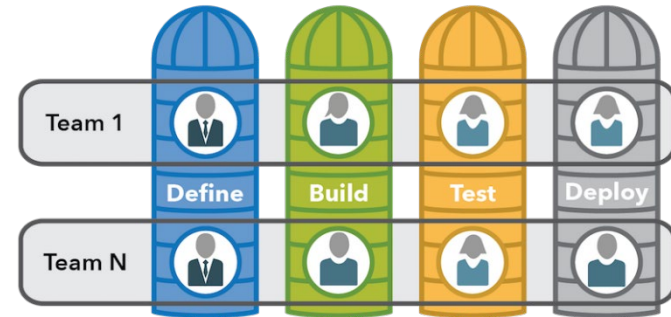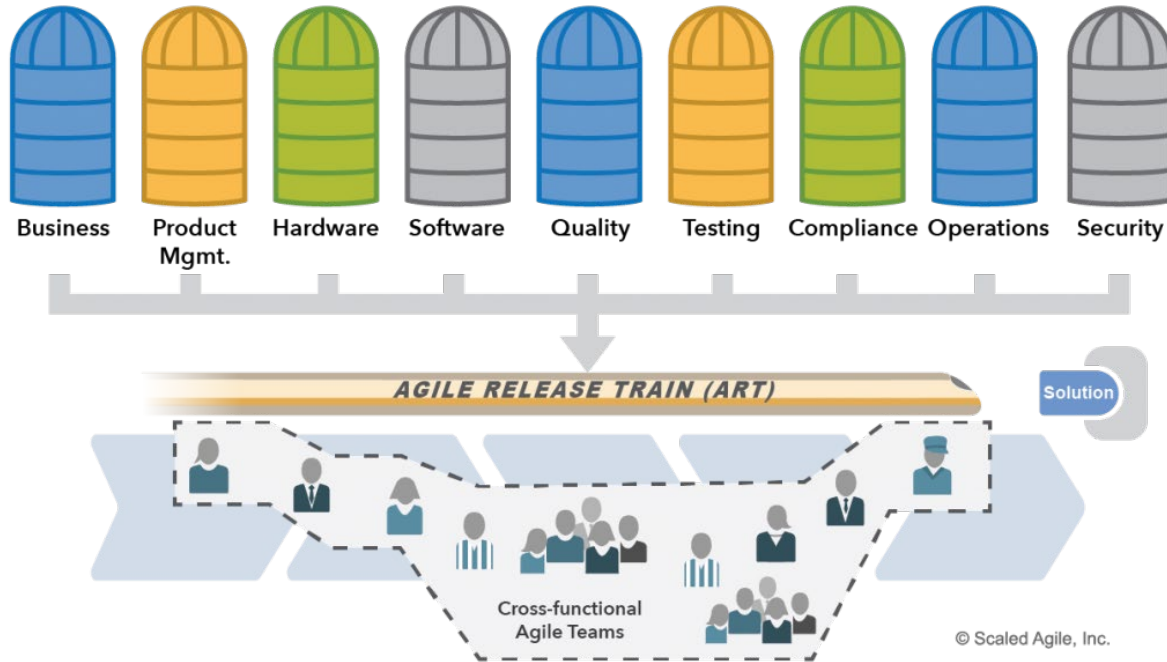
MAIN DEPENDENCIES
Here you write a few sentences about the main dependencies towards key stakeholders (internal as well as external)

SHARED SERVICES
Here you write which shared services or other key roles that contribute heavily to the ART.
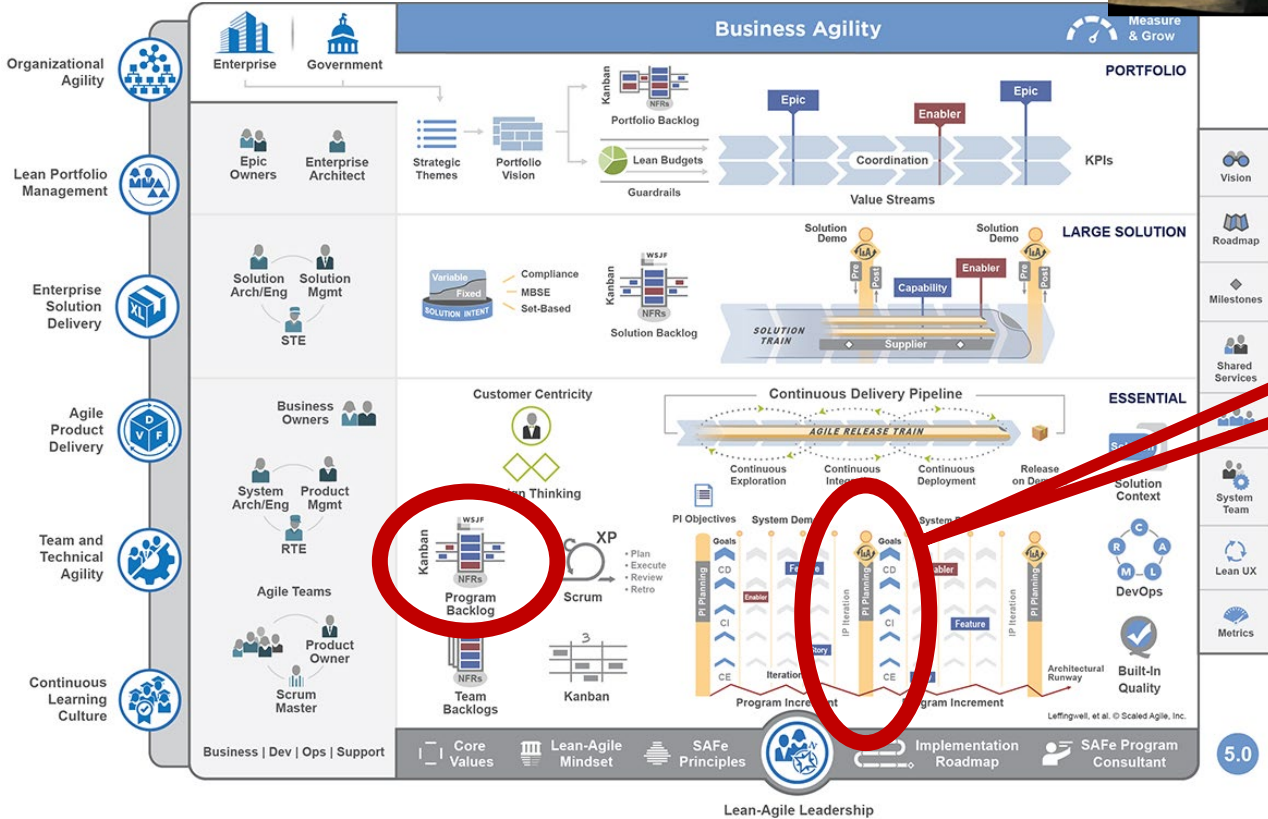
ARTs and teams are fully cross-functional

Business Product Mgmt. Hardware Software Quality Testing Compliance Operations Security

AGILE RELEASE TRAIN (ART)

Solution

Cross-functional Agile Teams

© Scaled Agile, Inc.

Team 1 — Define / Build / Test / Deploy

Team N

© Scaled Agile, Inc.

Program Increment

The PI planning/Big Room Event is a meeting where all stakeholders meet face-to-face to set the high-level plan for all teams in the upcoming increment

The Agile Release Trains

Develop on Cadence.
Release on Demand

Synchronized development cadence
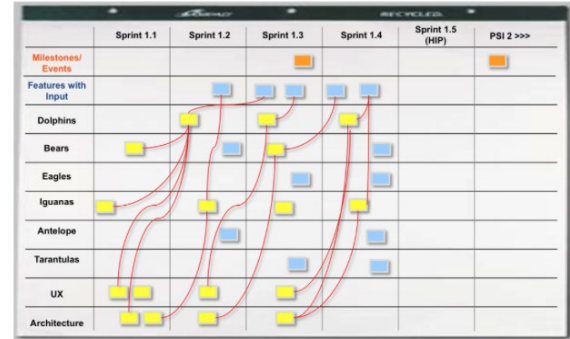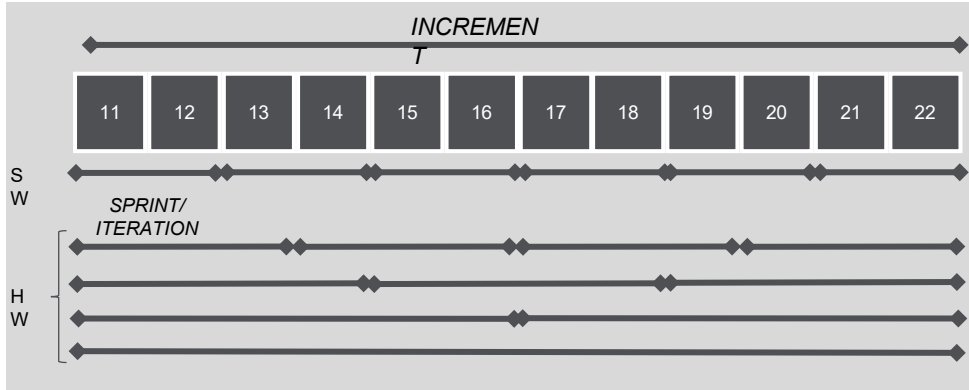
ART lead roles
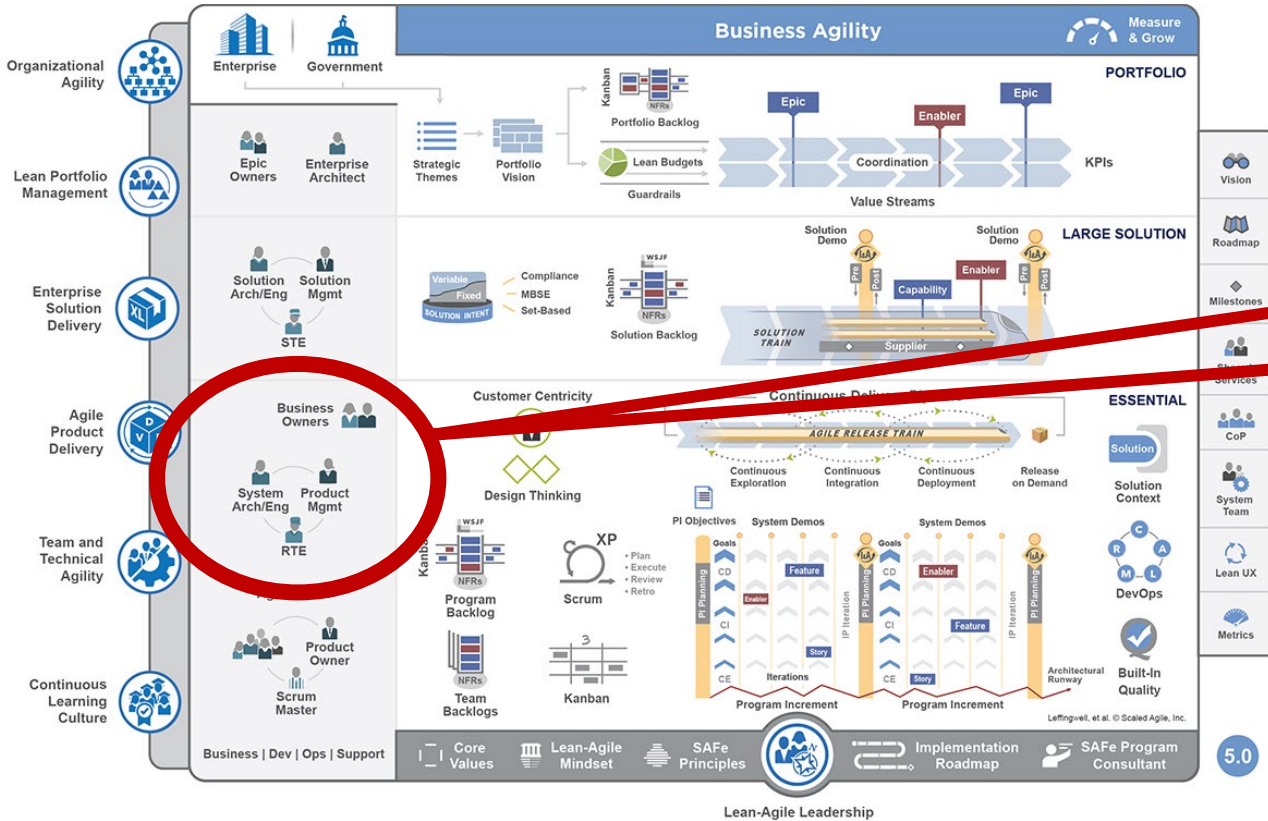
ARTs need roles to facilitate syncronization and continuous flow efficiency

The Agile Release Trains

Product Manager (PM) Role Profile

MY PURPOSE

Maximize value added work by owning and deciding upon priorities in the Program Backlog from a business perspective as well as developing the program Vision and Roadmap.

WHAT DO I DO

- I own the Program backlog
- I work with stakeholders, customers, other Agile Release Trains and the Solution Train to understand needs, split Capabilities and Epics to define and prioritize Features and Program Enablers.
- I am the only person who can approve features as done at the Program Demo. This includes validation that the feature meets acceptance criteria according to the Definition of Done and has the appropriate, persistent acceptance tests.
- I understand and support portfolio artifacts like Budgets, Strategic Themes and Business Cases.
- I collaborate with Solution and System Architects to define both functional and non-functional requirements
- I work with release management to define releases and solution increments.
- I work with System Architect/Engineering to understand and prioritize Enabler work on a program level
- I assess metrics, including evaluation of business value achieved versus plan.
- I take responsibility for product safety, by ensuring planning and fulfillment of safety activities according to the development process and approve my Products for release when sufficient product documentation is available.
- I ensure fulfillment of legal requirements (automotive specific) and certification for my Products.
- I participate in the Pre- and Post-PI Planning to define the inputs, milestones, and high-level objectives.
- I demonstrate contributions of my ART at the Solution Demo
- I build an effective Product Manager/Product Owner team
- I work with Suppliers, making sure the requirements for supplier-delivered capabilities are understood and assisting with the conceptual integration of these concerns.
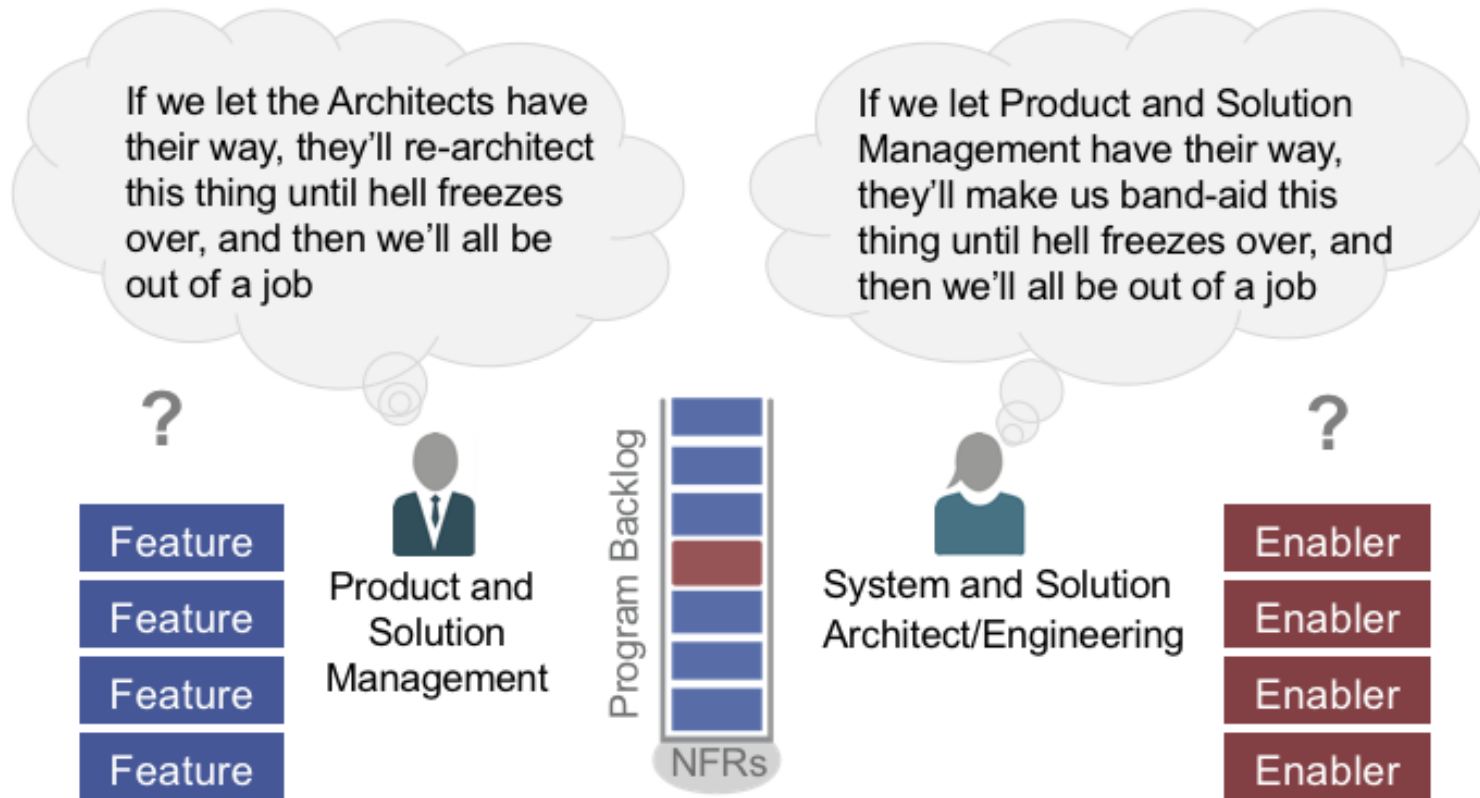
100% PM for one ART
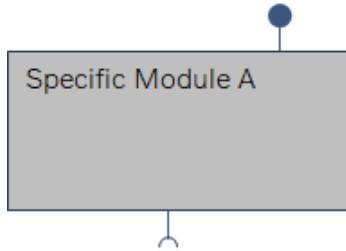(might be more than one)

SUITABLE CANDIDATES

Project Leaders
Managers
Product Owners
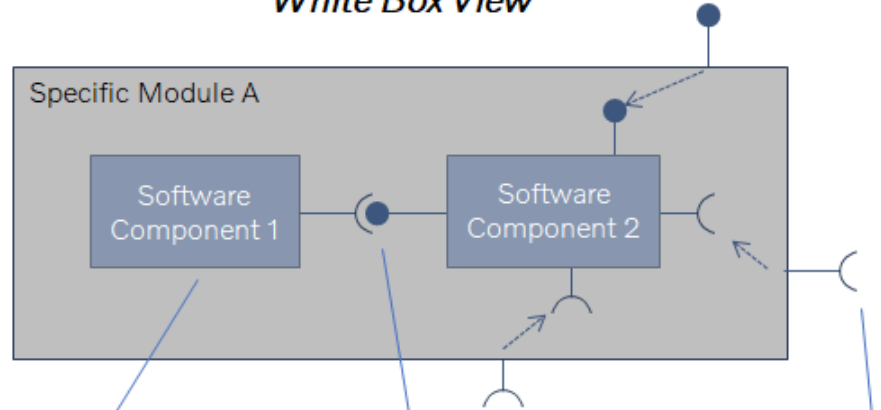...or equivalent skills

How Much Architecture?

If we let the Architects have their way, they'll re-architect this thing until hell freezes over, and then we'll all be out of a job

If we let Product and Solution Management have their way, they'll make us band-aid this thing until hell freezes over, and then we'll all be out of a job

Feature
Feature
Feature
Feature

Product and Solution Management

Program Backlog

NFRs

System and Solution Architect/Engineering

Enabler
Enabler
Enabler
Enabler

MODULES AND INTERFACES

Black Box View

Specific Module A

White Box View

Specific Module A

Software Component 1

Software Component 2

Software interfaces are always realized and used by software components

"Private Interface", not available outside the module

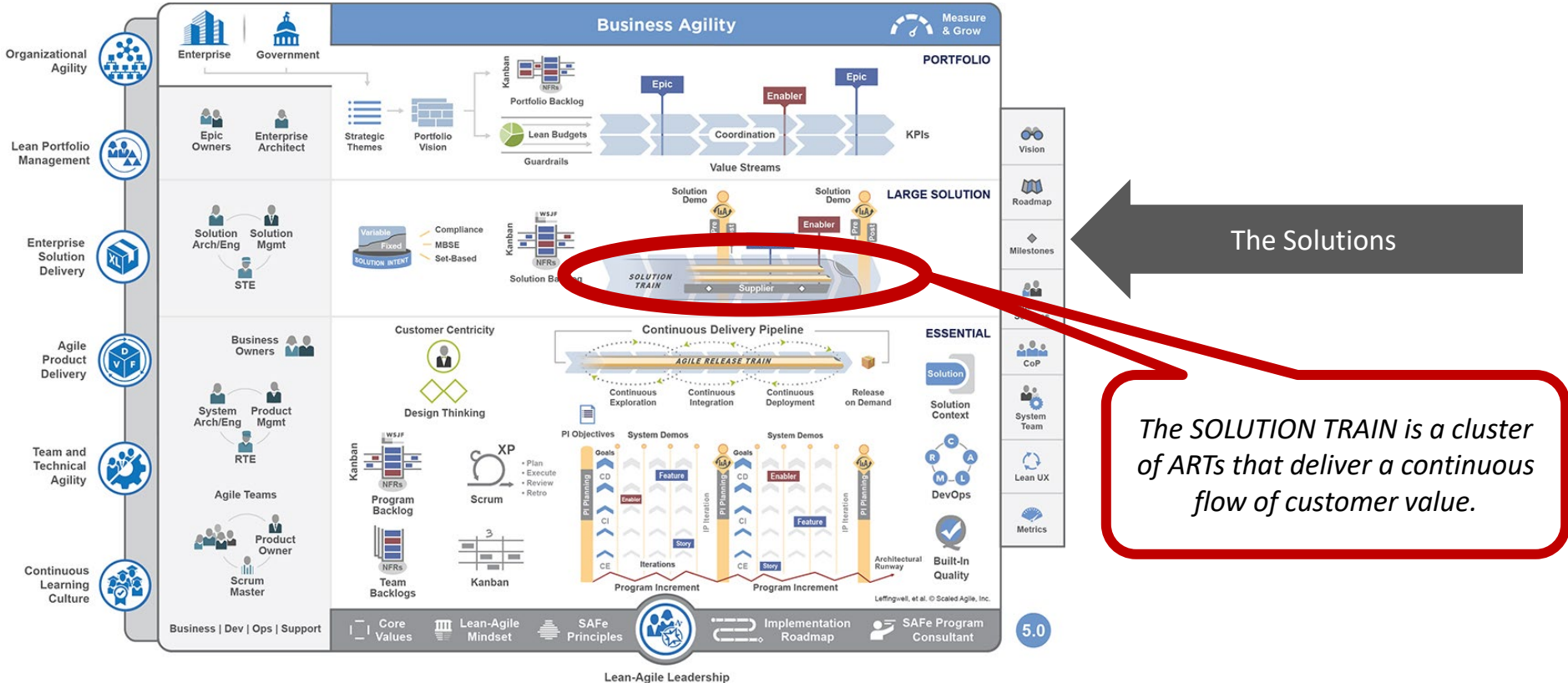*"Module Interface", since available outside the module*
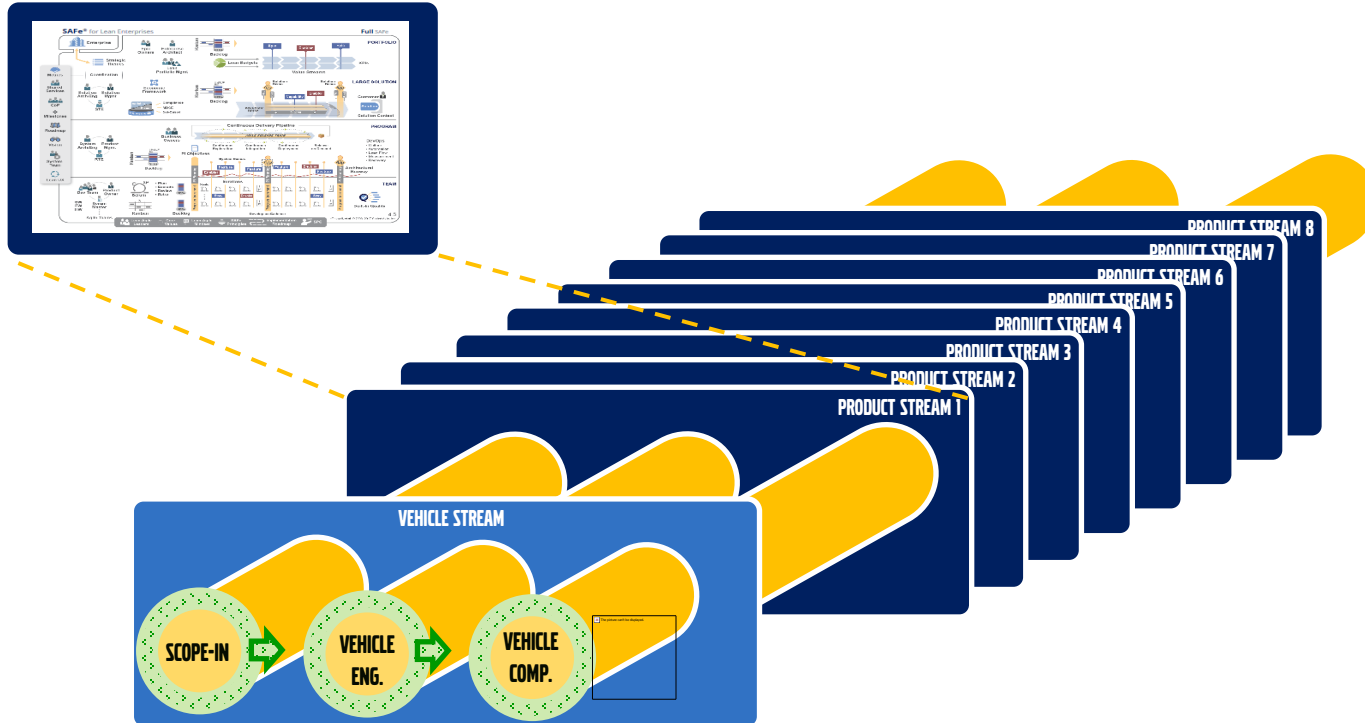
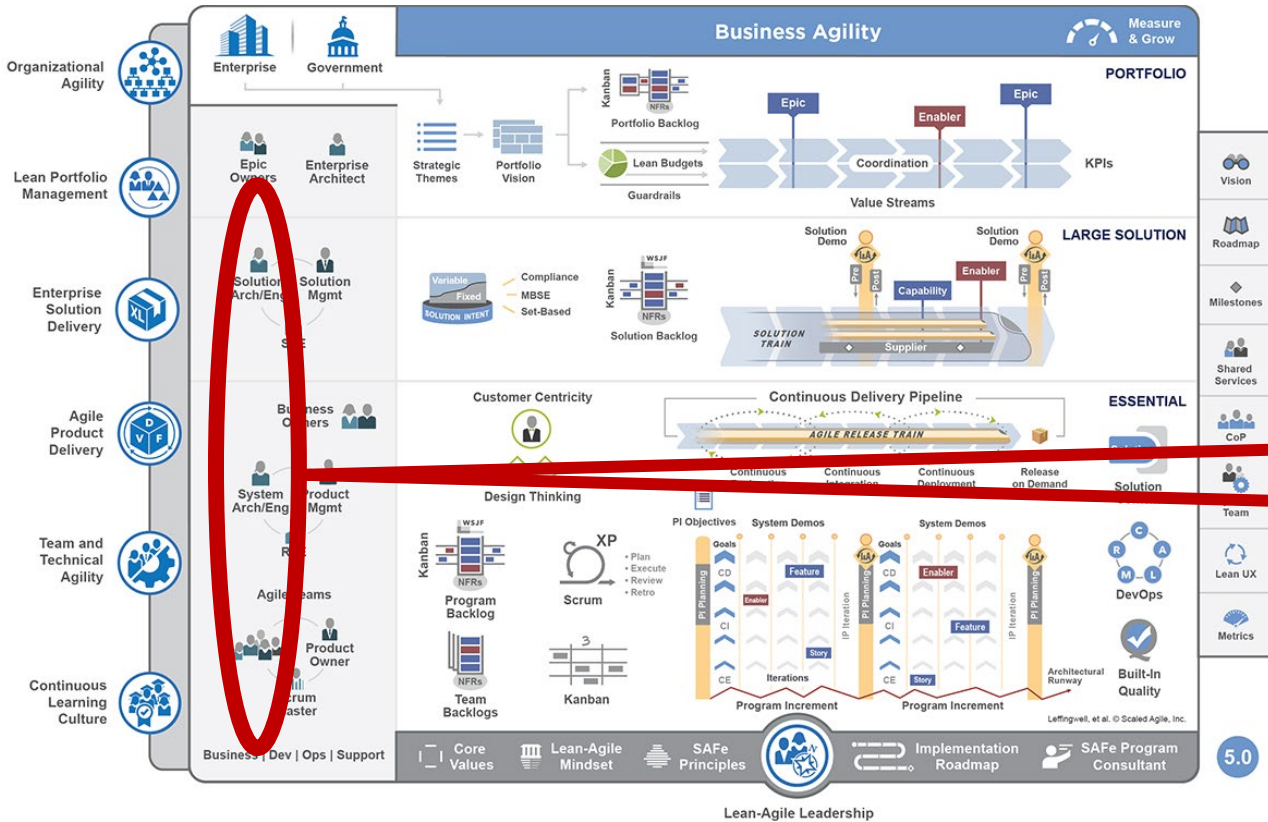# CENTRALIZED ARCHITECTURE

©Volvo Cars

Ethernet
CAN/CAN FD
Lin

The CCU is the same as VCU before, but now with integrated ADPM. + Extended Low Power capabilities

A Zone Controller integrates most (all?) sensors and actuators in a specific zone in the car, and provides gatewaying (if necessary), power distribution and direct I/O control.

UXC

CCU (incl ADPM)

Roof ECU

Tunne

Tail ZC

Left ZC

Left Front Door ECU

Left Rear Door ECU

41

Solution train

The Solutions

The SOLUTION TRAIN is a cluster of ARTs that deliver a continuous flow of customer value.

Cross product stream management

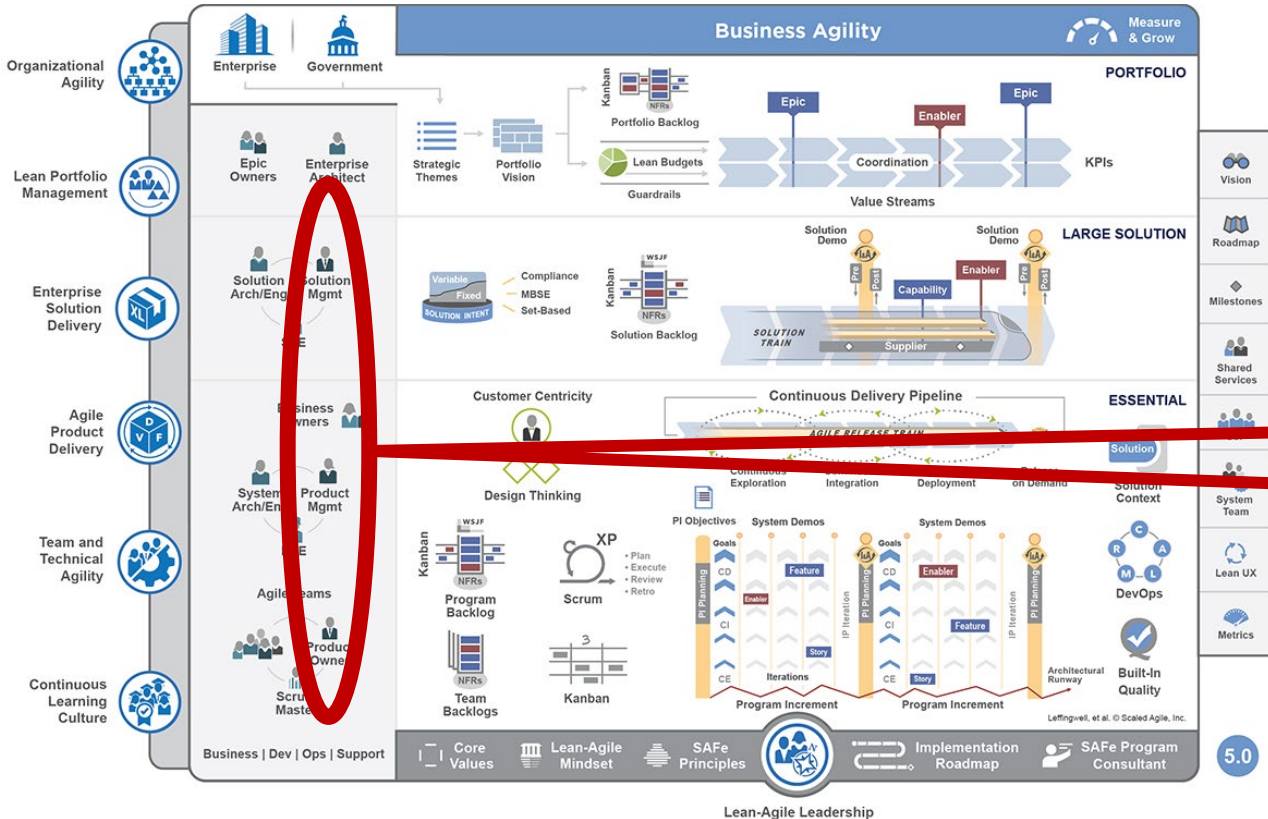# Cross collaboration – Product development

Development teams, System Engineers and Architects collaborate to develop and maintain the product

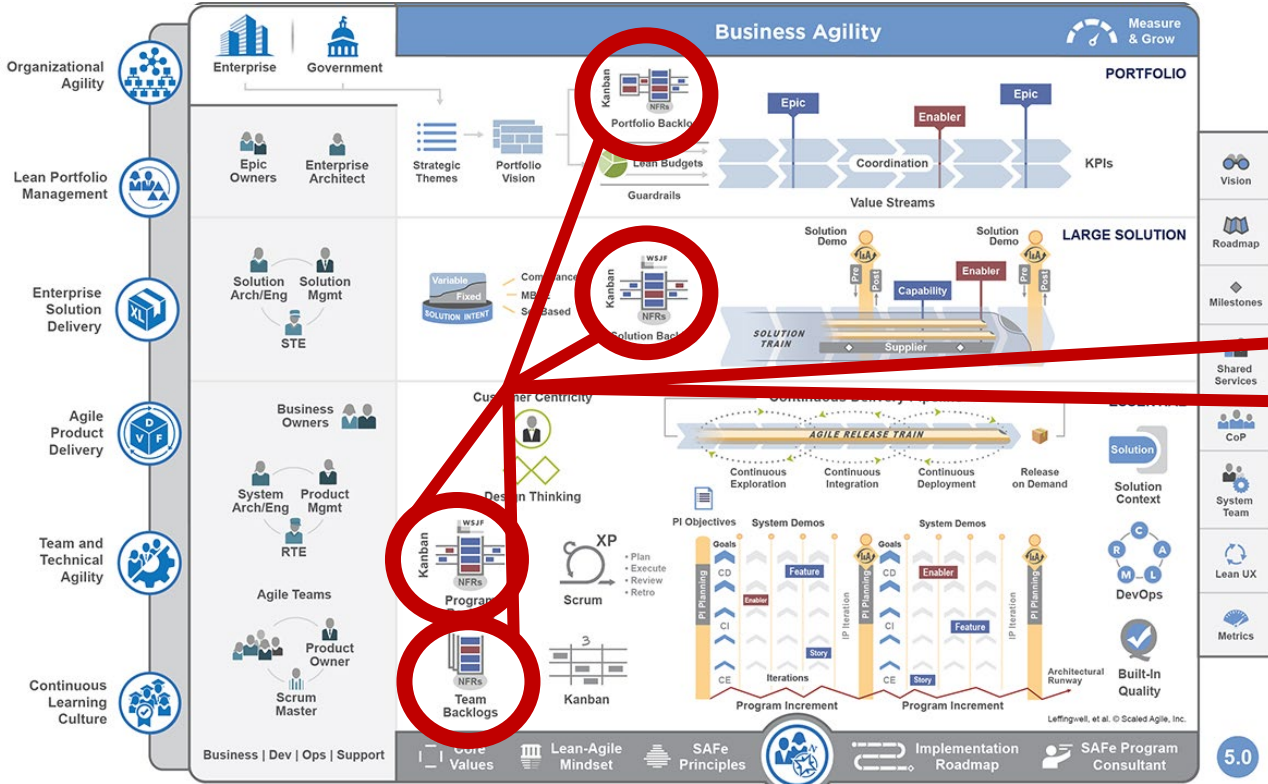# Cross collaboration - Flow and value
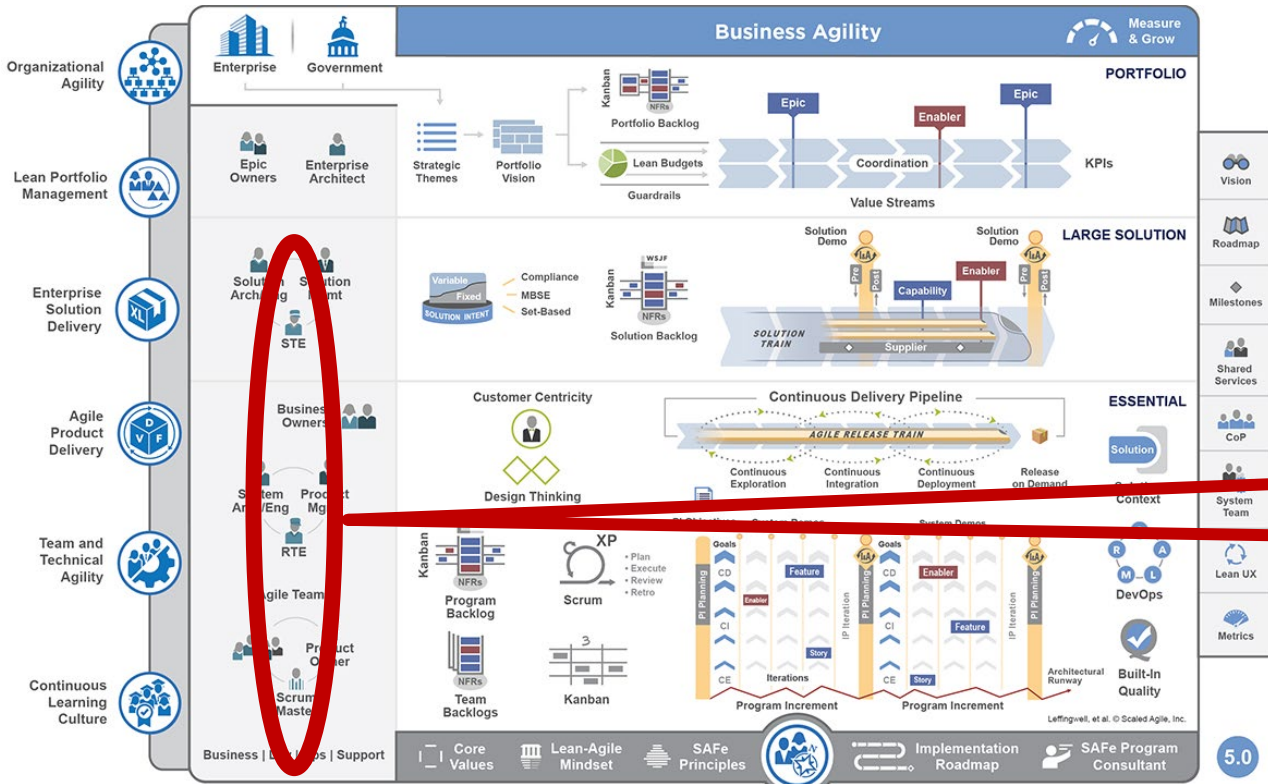
Scrum Masters, RTEs and STEs collaborate to facilitate flow of value cross levels

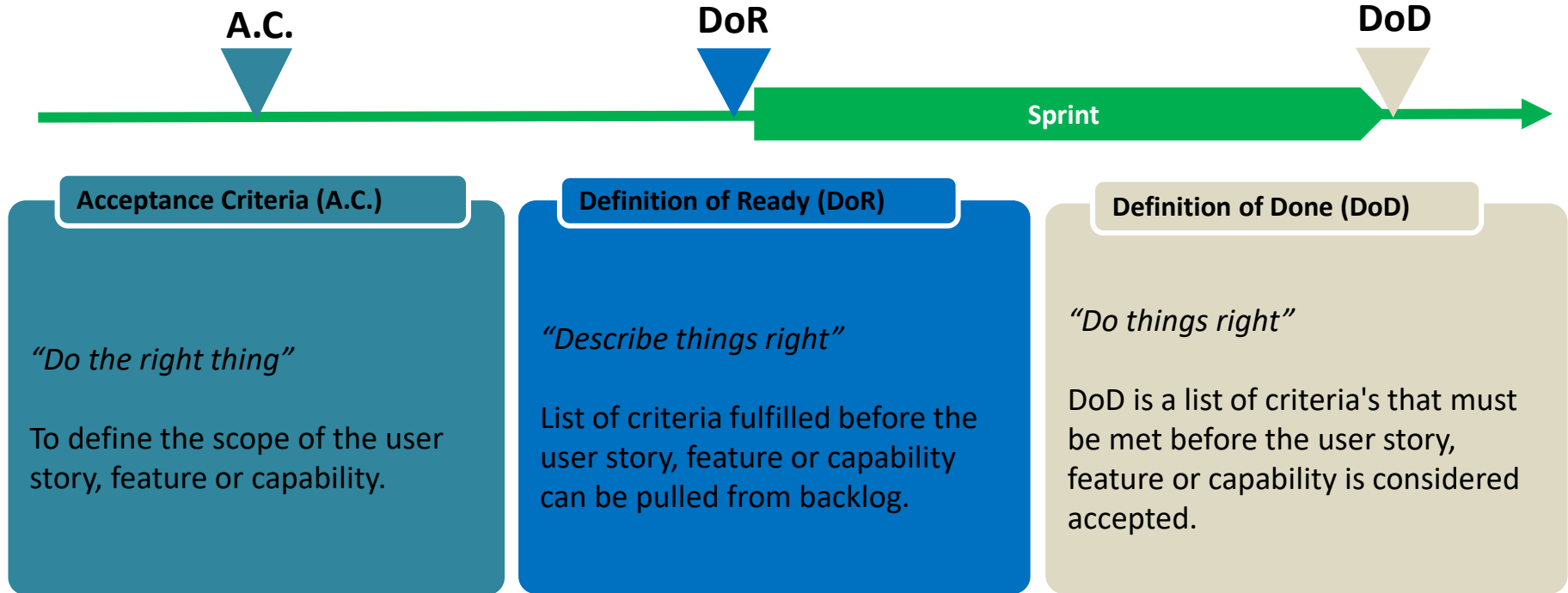# Cross collaboration – Product content

Product Owner, Product Manager and Solution Manager collaborate to assure the right product content cross levels
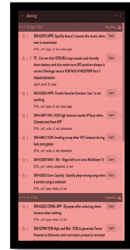
Cross collaboration – Backlog items

Epics on Portfolio (Solution & Program) level
Capabilities on Solution level
Features on Program level
Stories on Team level

Acceptance Criteria, DoR and DoD

A.C.

DoR

DoD

Sprint

Acceptance Criteria (A.C.)

"Do the right thing"

To define the scope of the user story, feature or capability.

Definition of Ready (DoR)

"Describe things right"

List of criteria fulfilled before the user story, feature or capability can be pulled from backlog.

Definition of Done (DoD)

"Do things right"

DoD is a list of criteria's that must be met before the user story, feature or capability is considered accepted.
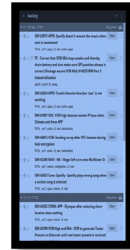
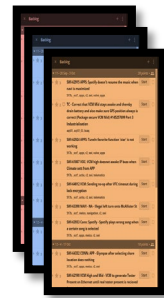# Product backlog vs. Project backlog (push)

Project A Project B Project C

Tasks are pushed to the team from projects.
It is up to the individual to prioritize.

The projects are aware of the over commitment and try to make sure their tasks are prioritized

Capacity allocation for a sustainable development

Development 70%

- The development capacity is divided between the following areas:
  - Industrialization
  - Base product development
  - Operations & Maintenance (where PC is involved)

- The capacity allocated to each area is defined before each PI

- The capacity allocated to each area is defined on PCMT/RDMT/Solution levels

- Top level capacity is balanced between ARTs and teams depending on involvement in prioritized jobs

Base product development

Operations & maintenance

Research and advanced engineering

Improvement

Guard band

Industrialization
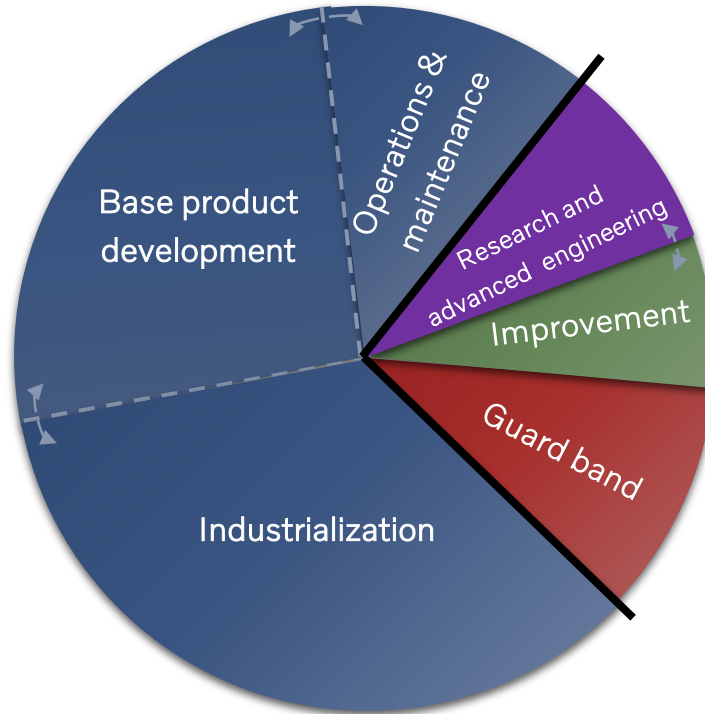
Safe guard 30%

Research and Advanced Engineering
Including innovation

Improvement
Way of working
Flow impediments
Processes, methods and tools

Guard band 15%
Buffer for committed work
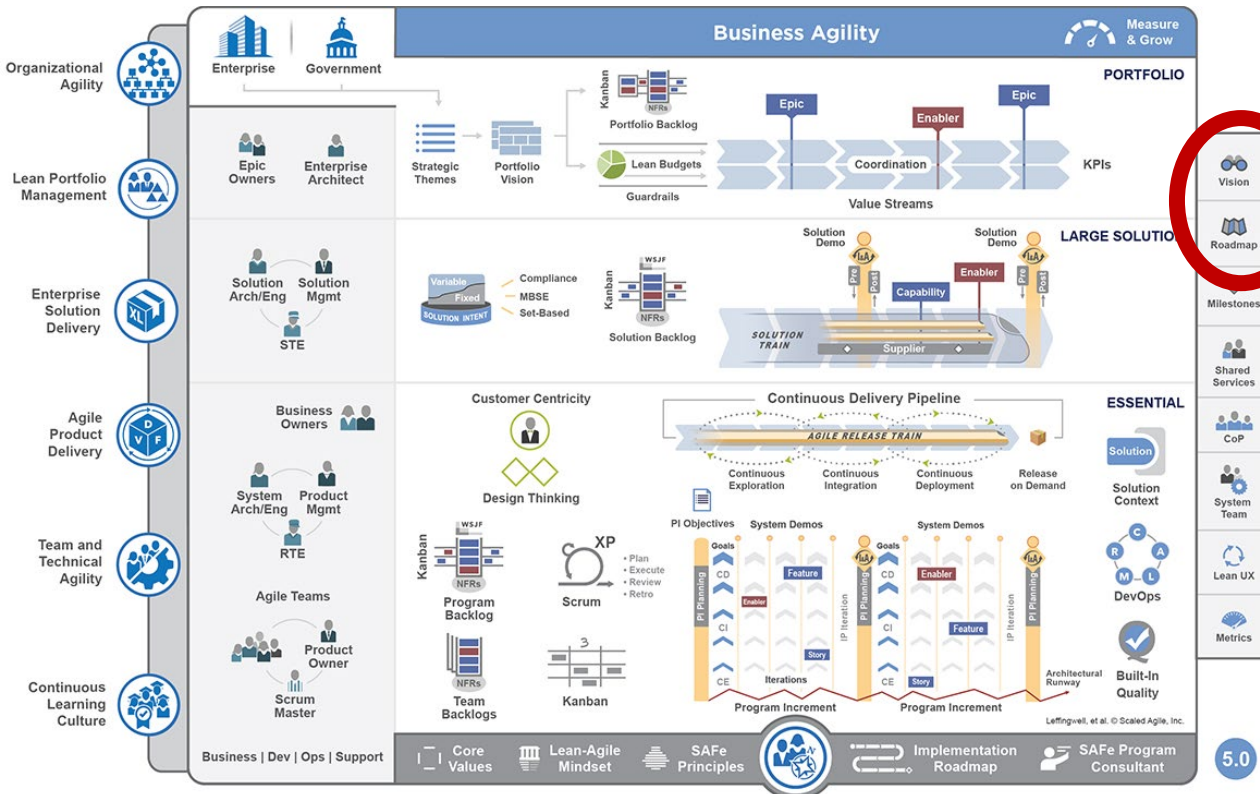Unexpected urgent work
Deliver on stretch items
Line activities

Always safe guard capacity to improve productivity and stay healthy over time

Cross collaboration - Shared Services and System Teams
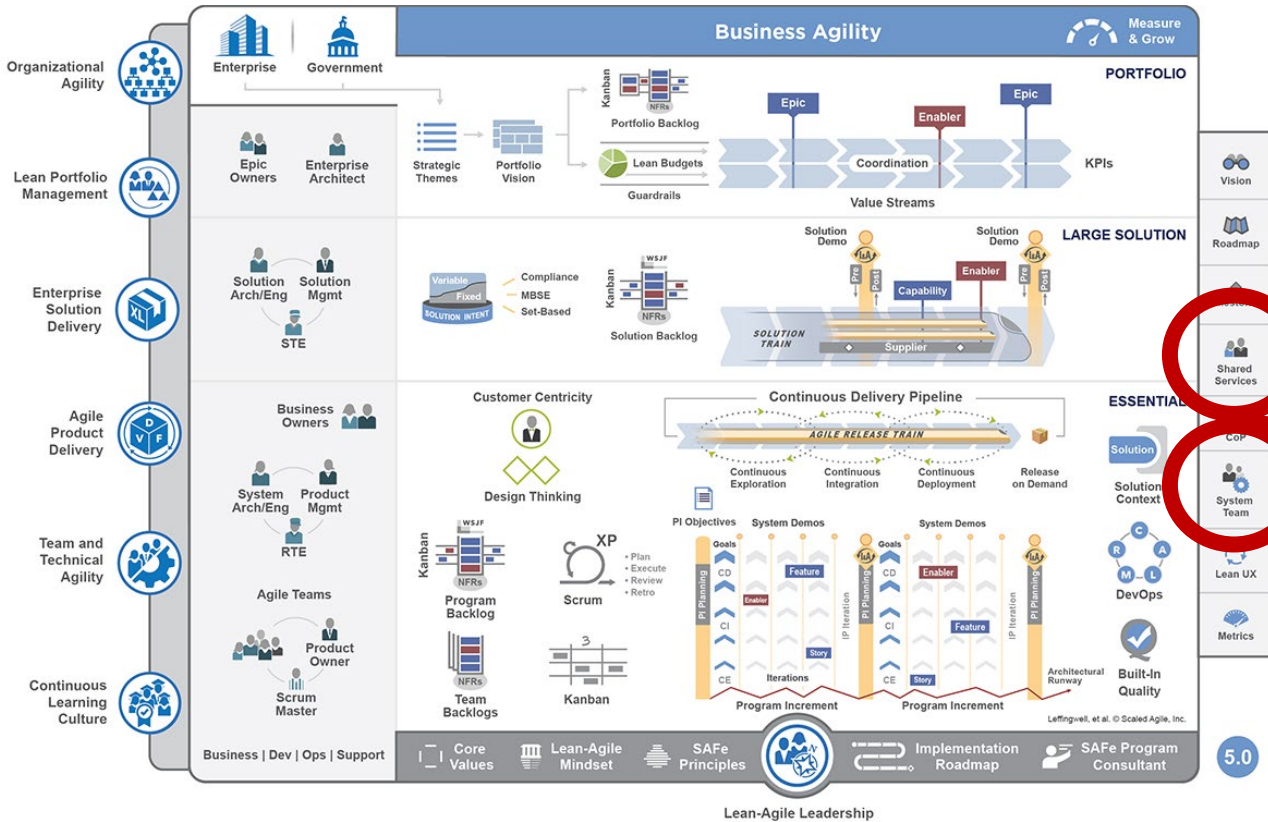
There are a small number of teams and roles supporting the development cross levels and solutions

Roadmap and Vision

The Roadmap is a schedule of events and Milestones that communicate planned Solution deliverables over a planning horizon.

The Vision is a description of the future state of the Solution under development. It reflects Customer and stakeholder needs and Capabilities.

Lessons learned

1. Do not mandate all SAFe roles in the organization.
2. Many other roles are needed, e.g., line (engineering) managers, project leaders, technical experts.
3. Balance between ceremonies and engineering work to assure timely delivery.
4. Be cautions of the fake agile, some teams are not meant for Scrum. React.
5. Acknowledge the difference between SW and HW related to development process and leadership.
6. Employ strong governance of the complete system development to assure quality of the product.
7. One size doesn't fit all.
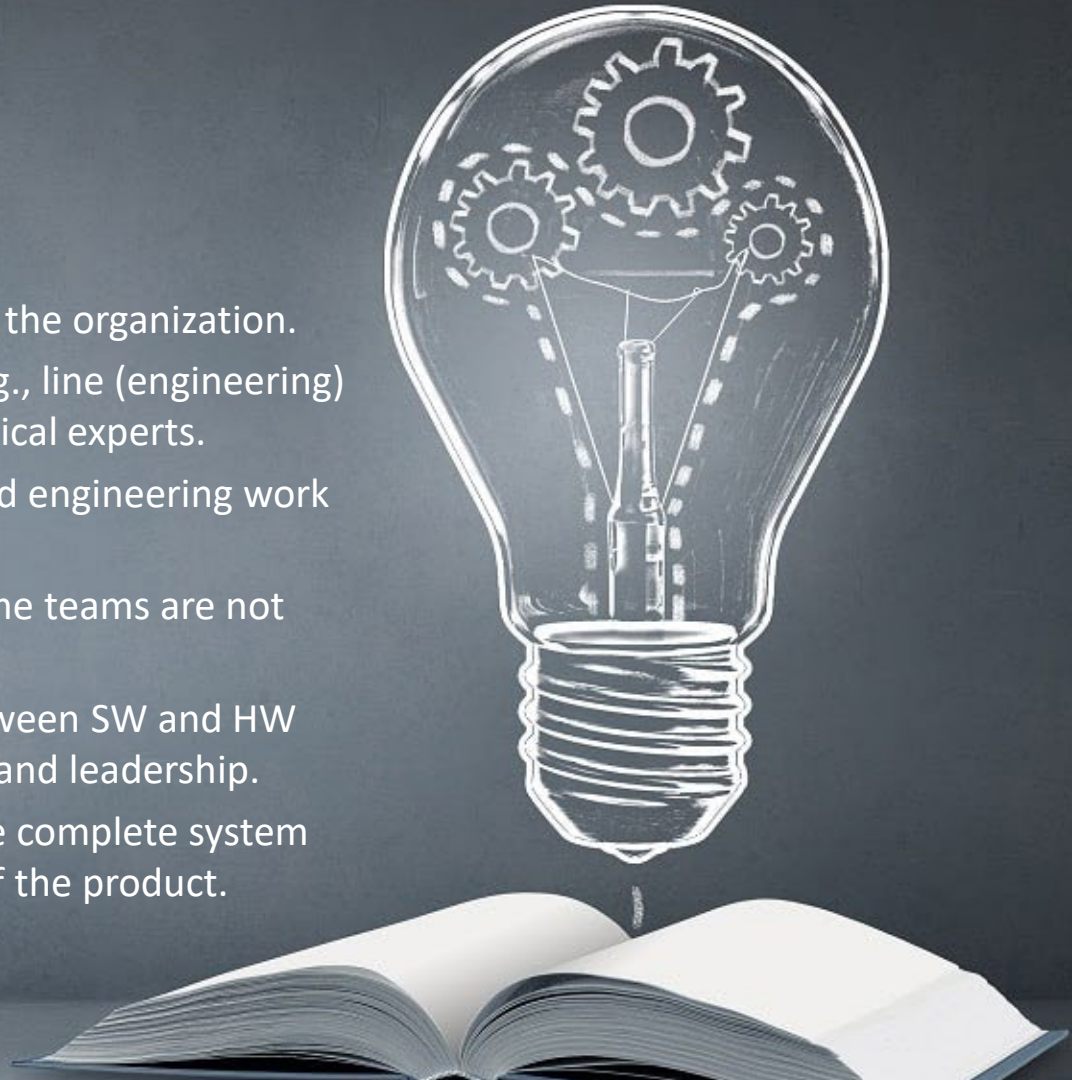
What's in there to stay?

1. Scrum, Kanban, Scrumban, XP software development teams and related roles.
2. Continuous integration and continuous deployment (strong DevOps). Applicable to the development of both software and hardware electronics.
3. Prioritization and alignment – synchronization of the development and deliveries.
4. Data driven decisions and continuous feedback loops.
5. Quite many other agile, lean and SAFe practices that teams themselves find useful.

There is nothing wrong with agile and its principles, it's the mastery of scaling agile in pressured markets that is hard to achieve. Looking at agile as a silver billet for all the problems is a wrong start.

According to Prof. Bosch: link to blog
- BAPO (Business -> Architecture -> Process -> Organization)
- Feedback loops – are we investing into the right thing?
- Experimentation over comprehensive planning

Fist of five