Danfoss Drives
The Digital Drive – FMI Customer Models

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Agenda
The Digital Drive – FMI Customer Models

- About Danfoss Drives

- The Digital Drive Use Case

- Automated Digital Drive Generation & Usage

- Key Takeaways and Q & A

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THIS IS WHERE THE TRANSFORMATION STARTS

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27,000
Employees

100+
Countries with sales

71
Factory sites

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Danfoss Drives

One of three business segments of Danfoss

R&D Centers in e.g.

- Gråsten/DK
- Vaasa/FI
- Loves Park/US

What is a drive?

- Variable frequency converter
- Machine side control (variable motor speed)
- Grid side control (active front end)

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Danfoss Drives Simulation Journey

✓ Imagine being able to predict performance and lifetime.

✓ Imagine testing every corner of your idea without having to lift a finger, travelling anywhere or spending prototypes.

✓ Imagine being in a true collaborative environment, where experts discuss and develop together, explore possibilities and find solutions together across companies.

Danfoss simulation and modelling competences are available to you, to achieve just that.

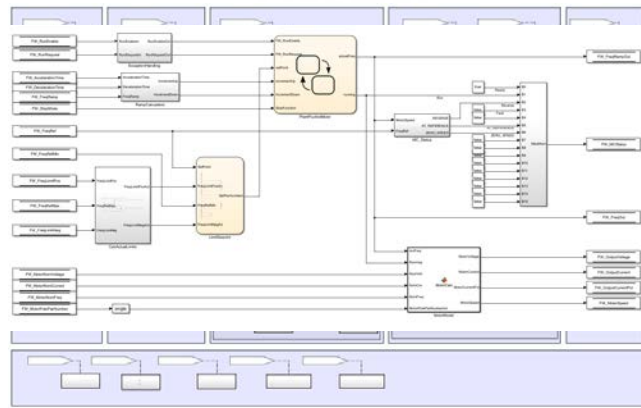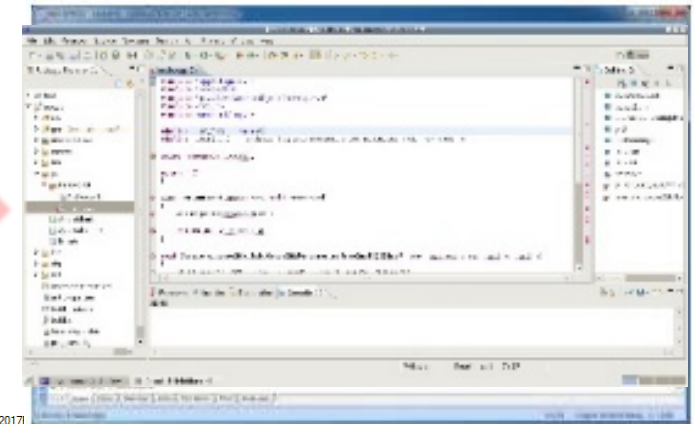| >1000	>300	>50	x 2	>40
Engineers use Modeling & Simulation in their daily work.	Practitioners constantly share best practice in Danfoss Modeling & Simulation community.	Virtual test benches, used Globally for testing and development in Drives.	Faster turnaround time for new software in Drives.	Engineers use Model Based Design for developing software every day in Drives.

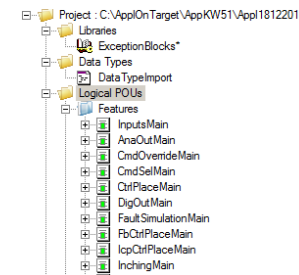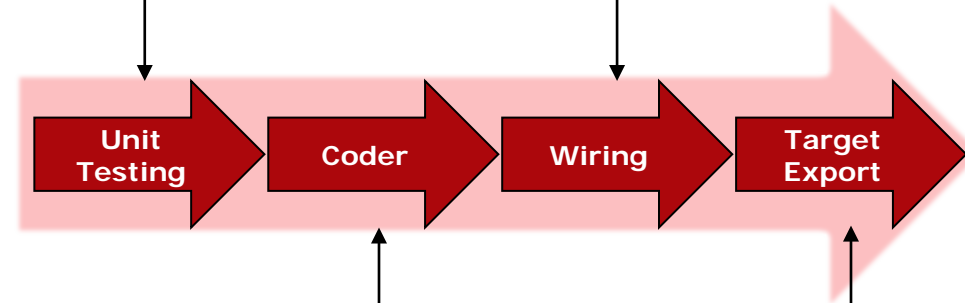## Work smarter – not harder

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Danfoss Drives Model-Based Design Toolchain

Application model
SapplicatFW model
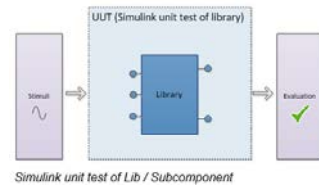
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The Digital Drive Use Case

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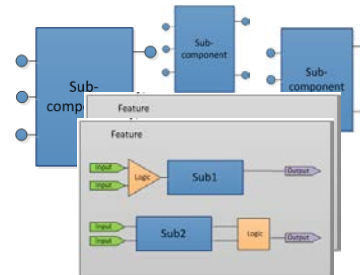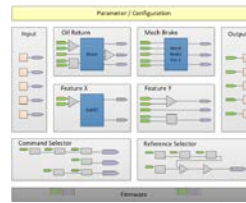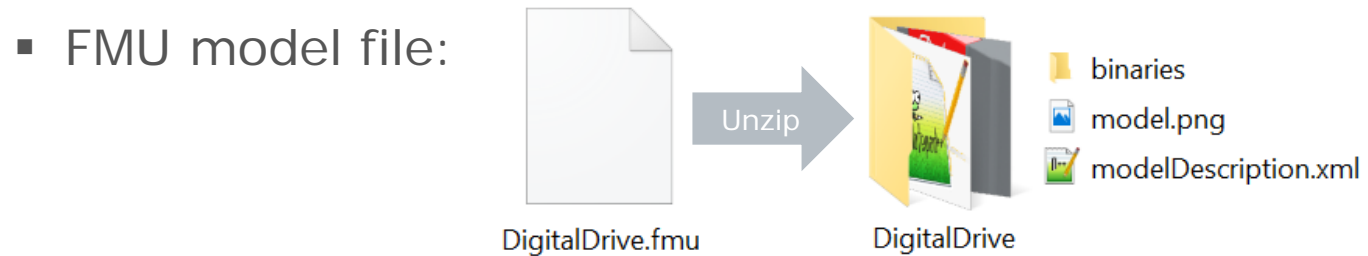
The Digital Drive Use Case

Growing demand for (software) behavioral models from several customers of new product platform drives

Different models needed dependent on customers use case:

Customer	A	B	C
Simulation usecase	System simulation, ramping & fieldbus	Grid simulation, harmonics & power	System simulation, motion functions
Product scope	Industry Products & small FW plant model	Firmware Product & HW plant model	Motion Product
Simulation tool	Simulink	PSCAD	SIMIT

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The Digital Drive Use Case – Functional Mockup Interface

- Tool independent standard for model exchange and co-simulation of dynamic models – Supported by more than 150 simulation tools

- FMU model file:

- Use of FMUs by import function blocks in many tools

- Limitations:
  - double, int32 and bool data types only on interface
  - Platform dependency, e.g. 64bit Windows
  - …

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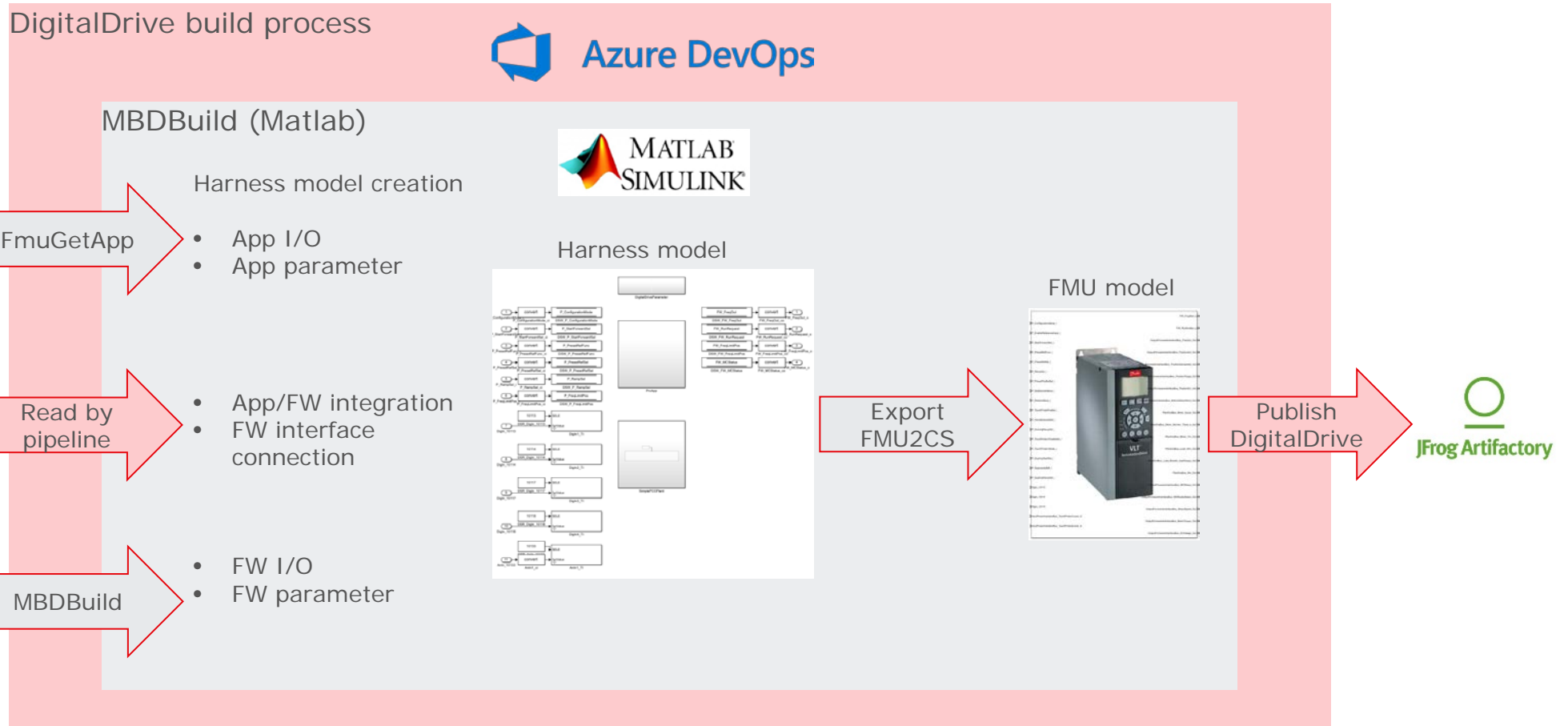# The Digital Drive Use Case – Goals & Specification

Goals:

- Enable customers to perform End-to-End simulations to increase their innovation capacity and reducing risks in complex systems
- Deliver Digital Drive in seconds for customers to learn and test the drive before buying
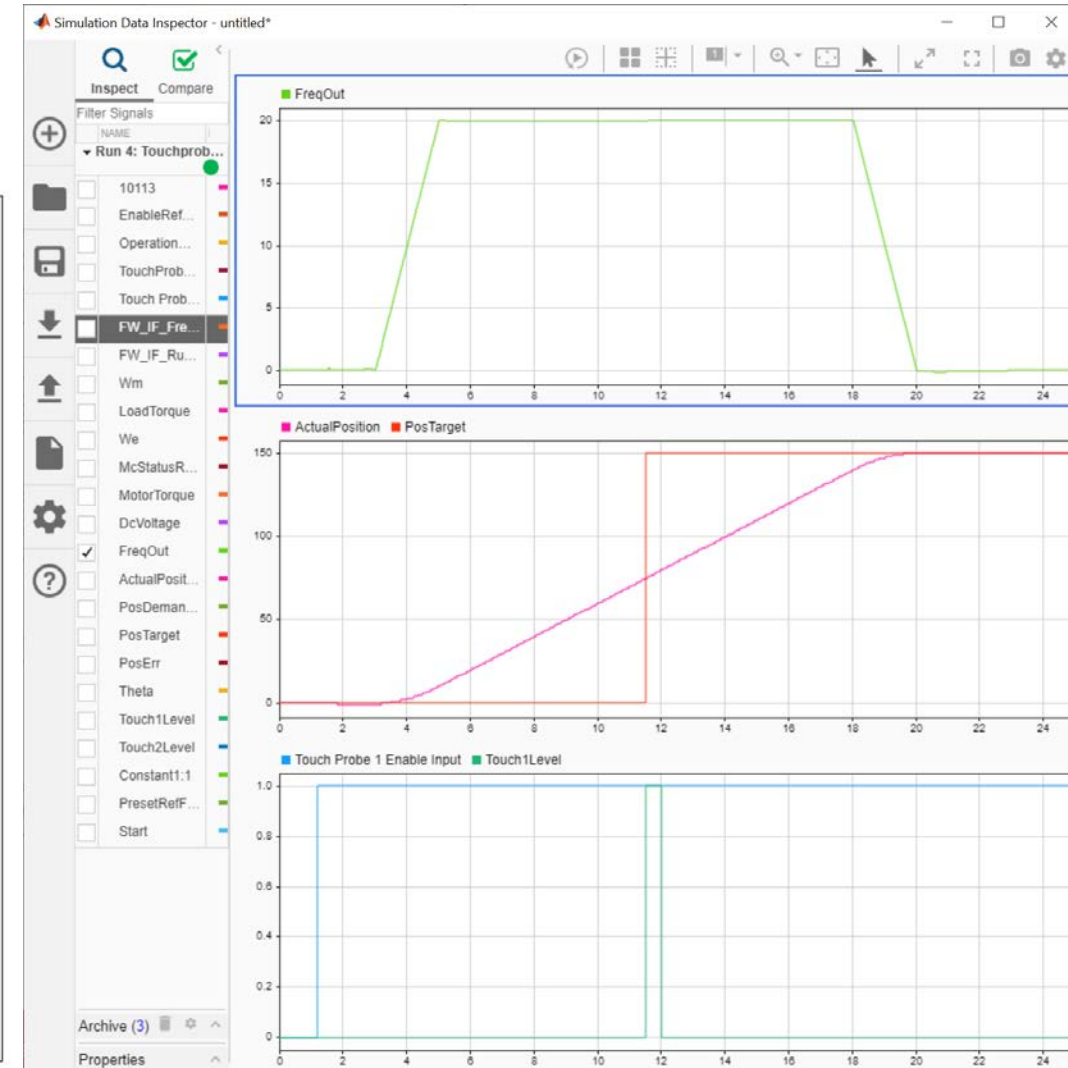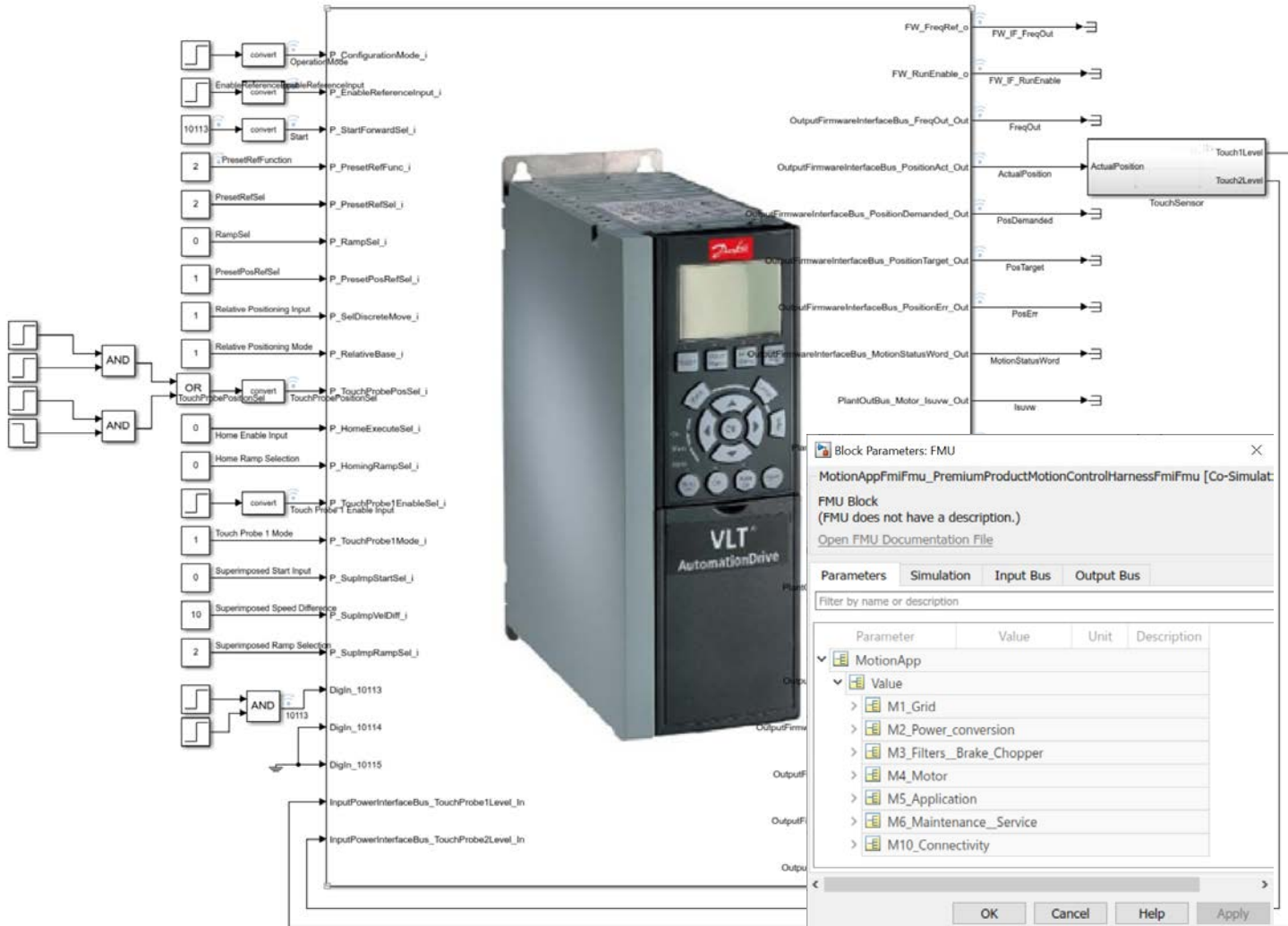
Specification:

- I/O definition
- Parametrization
- Models with different amount of details
- Automation of model creation
- Protection of intellectual property

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Automated Digital Drive Generation & Usage

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Automated Digital Drive generation

DigitalDrive build process

Azure DevOps

MBDBuild (Matlab)

Harness model creation

MATLAB SIMULINK

- App I/O
- App parameter

FmuGetApp

Application model

Config file

Read by pipeline

- App/FW integration
- FW interface connection

Harness model

FMU model

Export FMU2CS

Publish DigitalDrive

JFrog Artifactory

Control FW model

MBDBuild

- FW I/O
- FW parameter

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Danfoss

Digital Drive usage in MATLAB/Simulink

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Key Takeaways
The Digital Drive – FMI Customer Models

- Danfoss Drives is looking forward to provide product models to customers

- Customer models are created fully automatic from Model-Based Design control models which leads to a high level of fidelity

- Automatic generation utilizes MATLAB/Simulink FMU export function in order to achieve compatibility with many different simulation environments

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