AFRY X
Real Digital Twin

ACCELERATE YOUR BUSINESS BY SIMULATING ITS NEXT STEPS

AFRY
ÅF PÖYRY

Digital Twin solutions cover a wide range of capabilities

RDT's strength in emulation drives higher precision and quality in all other areas

Visualization

- Advanced visualizations for human centric insights

Simulation

- Provides an approximation of the behaviour of end to end systems or processes

Emulation

- An exact digital replica of the production system behaves and generates data identically to the physical twin

Optimization

- Improve business resiliency through more accurate forecasting and modelling of operational issues and their impact on performance

AFRY
ÅF PÖYRY

Why a smarter factory?

Targets:

- Increase productivity
- Reduce costs
- Assure quality
- Minimize risks

The industry's ability to implement and use new digital technologies will be crucial in today's competitive environment

Adapting digital technology and transforming it into productivity increase and cost reduction

AFRY's own iterative processes, using digital tools, have shown productivity improvements and cost reductions of up to 80%

The roadmap towards a smarter factory

Most companies have too many digitalization initiatives that are not connected – what's the purpose?

Develop a vision to use virtual technologies based on real facilities, real data and real systems
The right tool for maximum value – different parts of the plant have different needs

Be more competitive by:

- Develop processes and working methods that support continuous improvement
- Increase your competence in digitalization
- Introduce the right digital tools that create measurable value and simplify everyday life
- Dismantle unnecessary systems, streamline your data flows

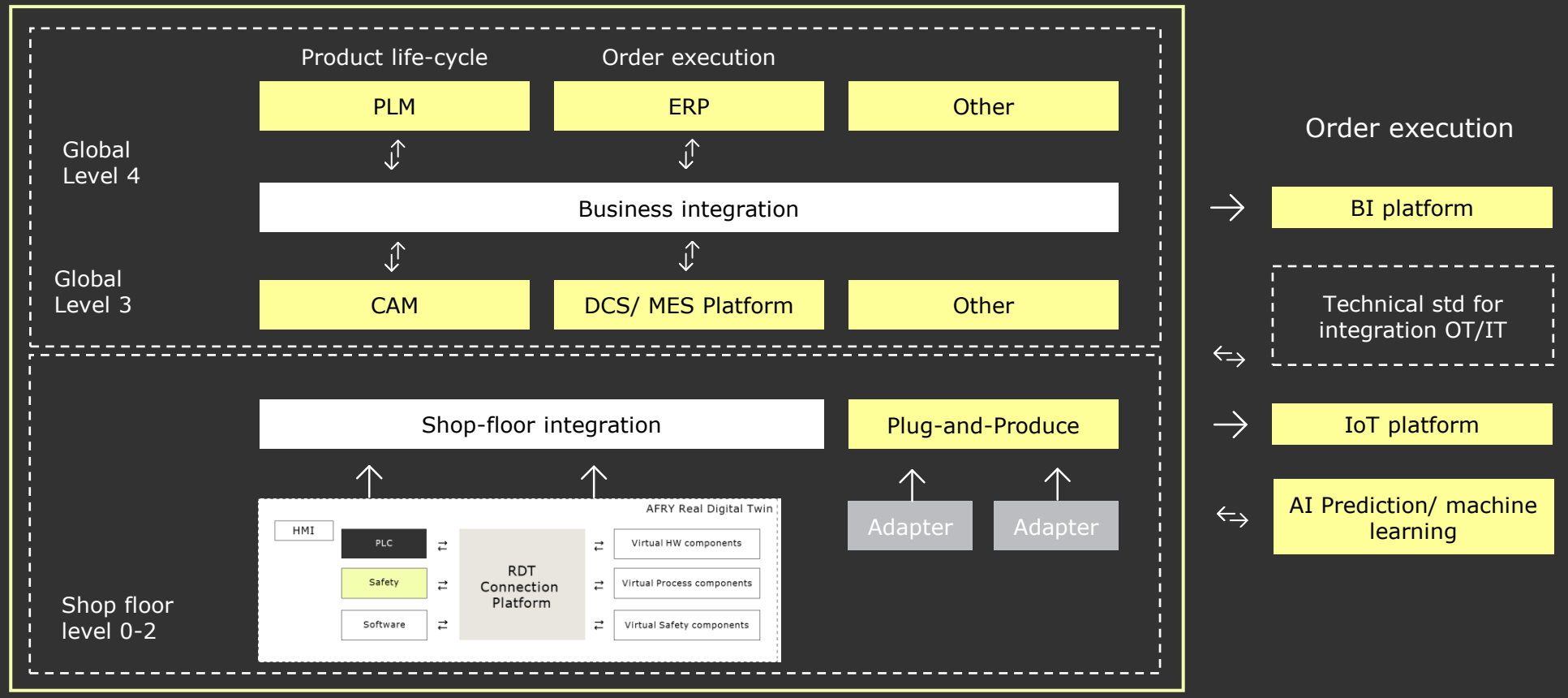
Find the best way forward in the digitalization journey

Connect your production, collect real data and be able to take fact-based decisions

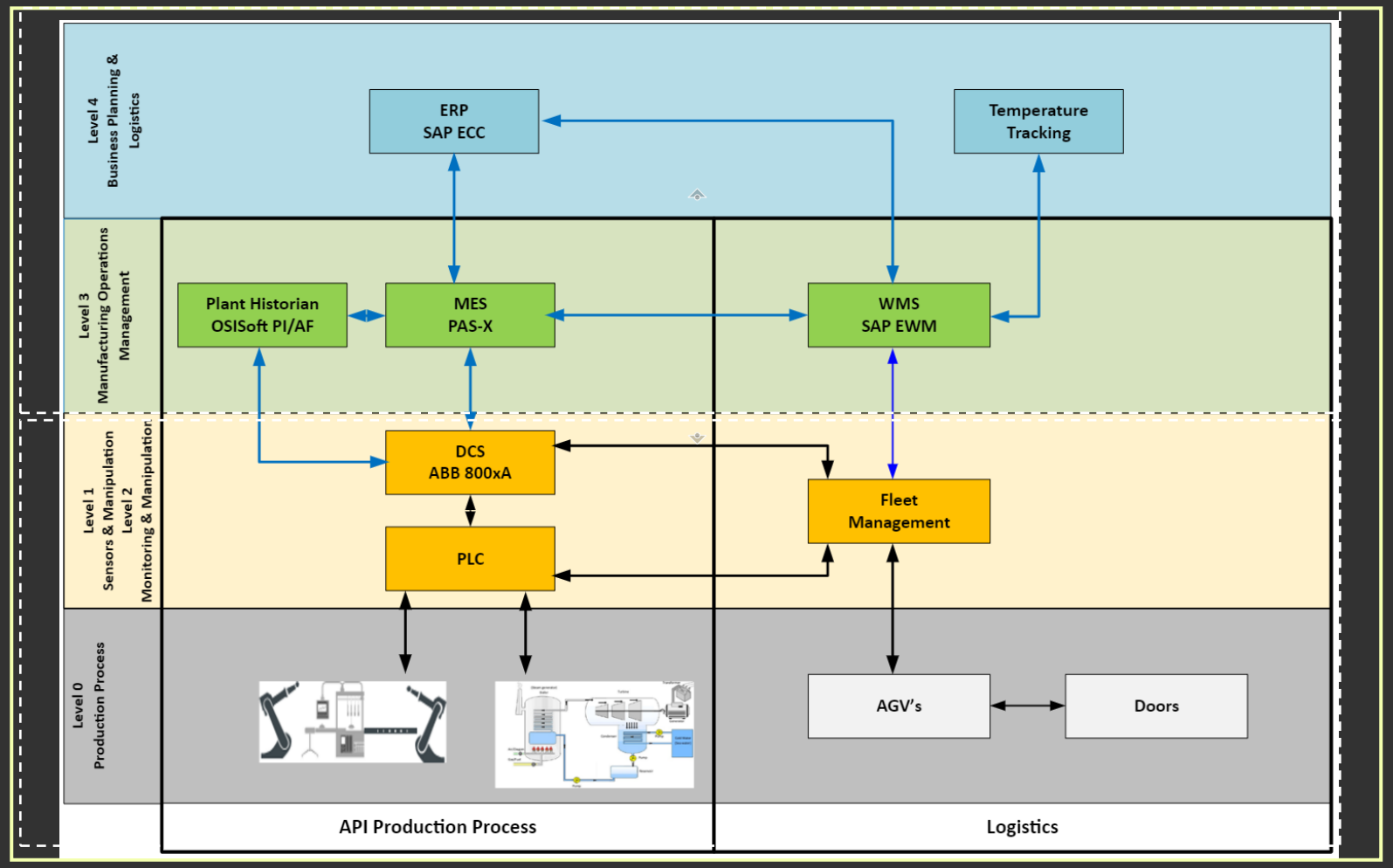
AFRY
ÅF PÖYRY

AFRY X REAL DIGITAL TWIN

The digital thread
- addressing the smart factory



The digital thread - Example



Order execution

→ BI platform

↔ Technical std for integration OT/IT

→ IoT platform

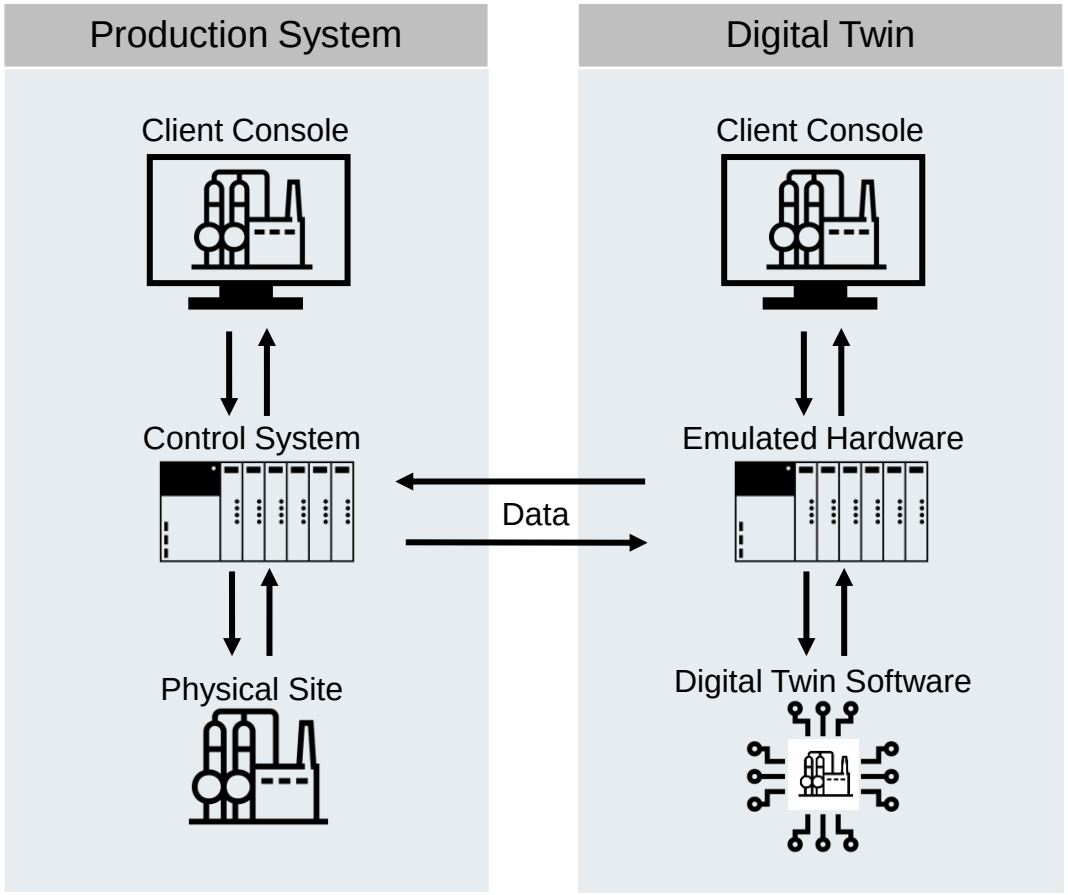
↔ AI Prediction/ machine learning

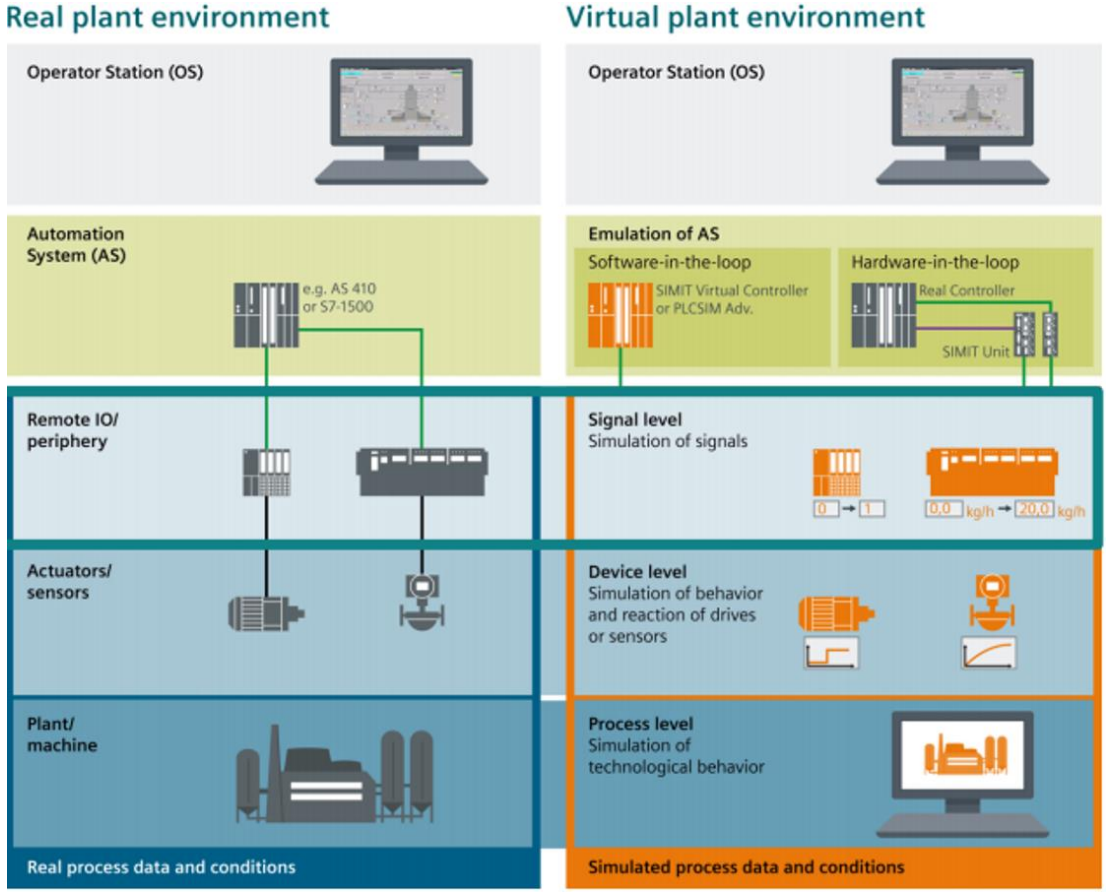
AFRY X
Real Digital Twin

ACCELERATE YOUR BUSINESS BY
USING AFRY REAL DIGITAL TWIN

- TEST BED FOR AUTOMATION
  - Increased quality
- VIRTUAL COMMISSIONING
  - Reduced downtime and shorter ramp-up time
- OPERATOR TRAINING
  - Skill training
- LIFE CYCLE VALUE – OPTIMIZATION (AI ETC.)
  - Efficiency and cost reductions over time

The Process Digital Twin





AFRY X Real Digital Twin

AFRY
ÅF PÖYRY

AFRY X REAL DIGITAL TWIN

Component emulation rather than simulation

SIMULATION

Optimization from **GIVEN** behavior

+ Simplified system test bed
+ Flexible setup
+ Relatively easy

A simulator copies something from the real word into a virtual environment – often to give you an idea about how something works. It simulates the basic behavior but doesn't necessarily abide to all the rules of the real environment that it simulates.

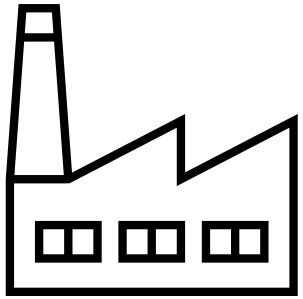
EMULATION

Optimization from **ANY** behavior

+ Advanced system test bed
+ Actual setup
+ Real time interfaces

An emulator, on the other hand, duplicates the equipment as they are. The emulation is efficiently a complete imitation of component behavior – it just operates in a virtual environment instead of the real world. Control system communication 1:1 (virtual:reality)

Connect Simulation & Emulation



Simulation

Factory level

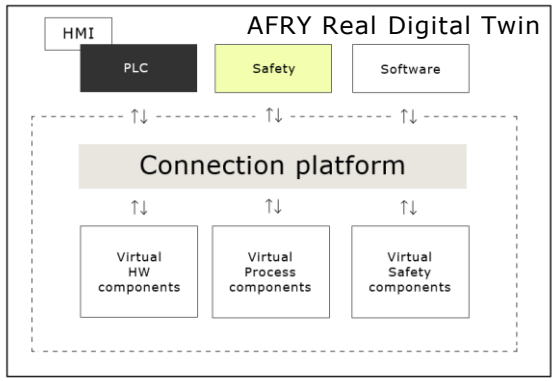
Factory/Simulation [DES]

Line level

Line/Detail Simulation

Emulation

PLC level



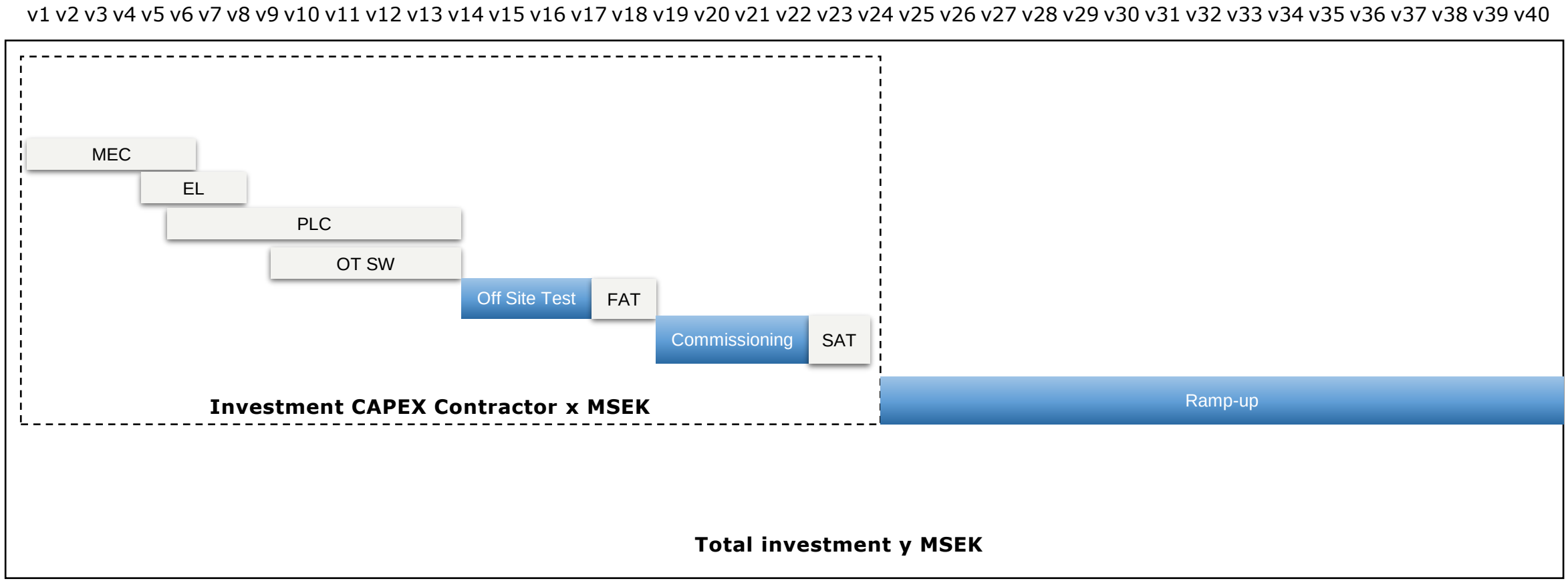
Connection Platform

AI Optimi-zation

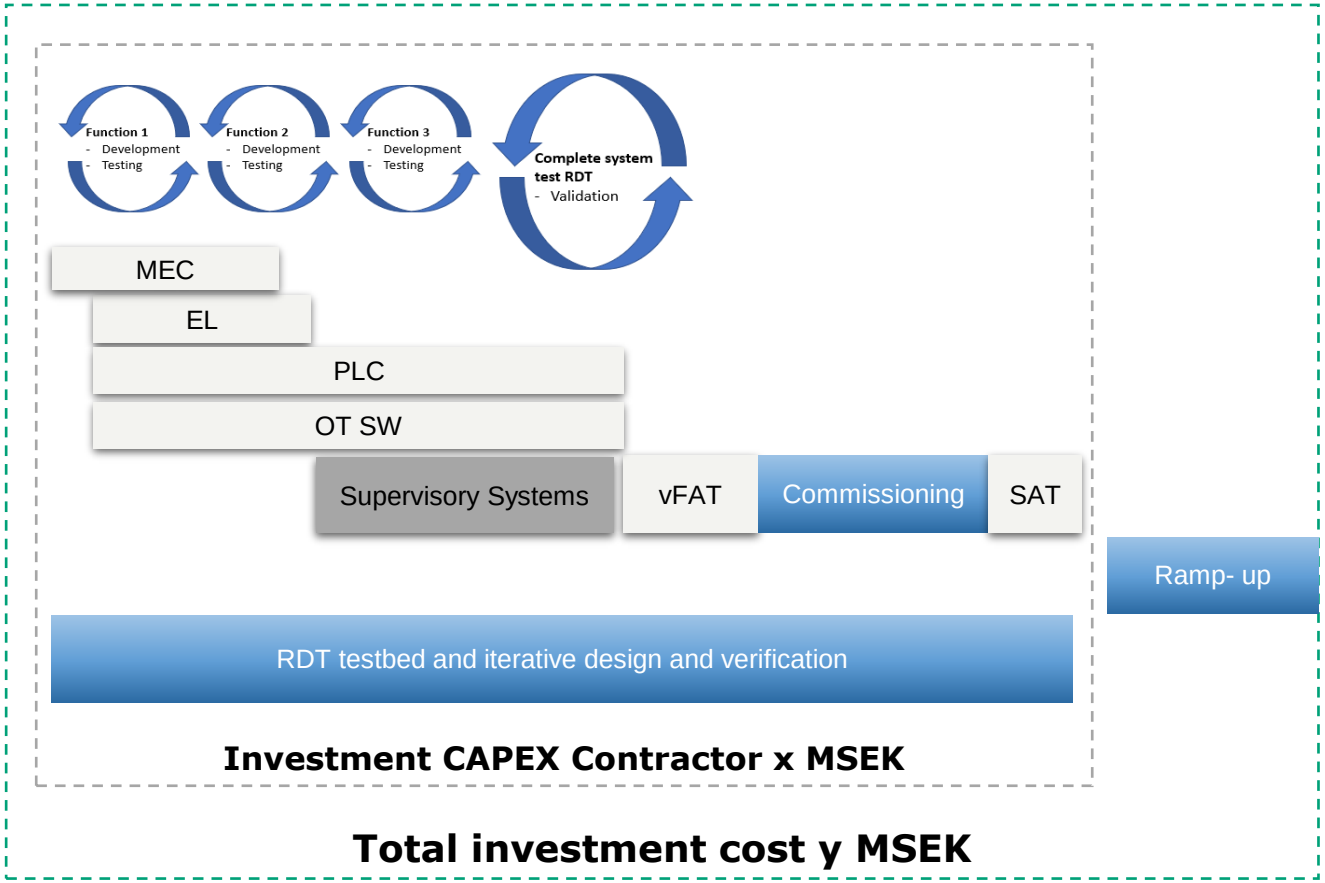
MES/ SCADA

AFRY
ÅF PÖYRY

Todays - project way of working



New agile RDT way of working

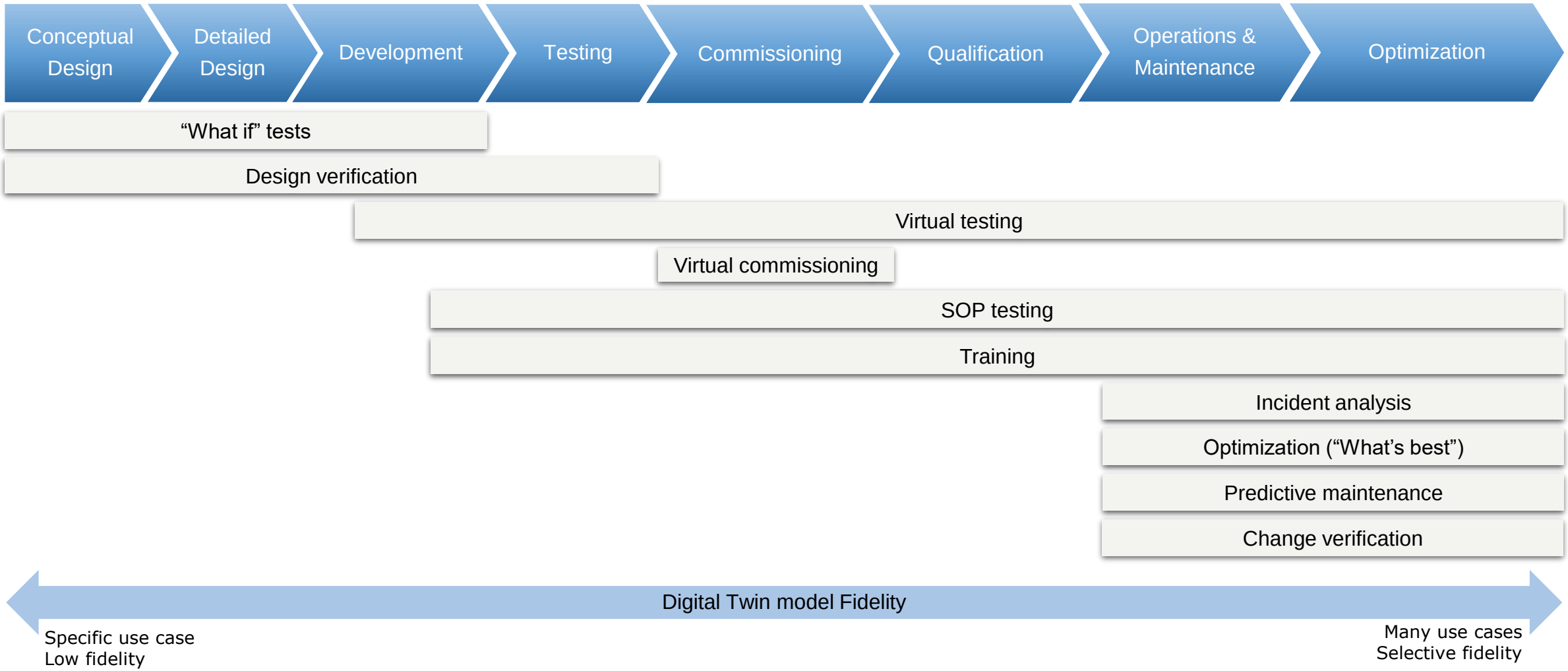


Result

- Reduced total cost
- Better quallity
- Digital Twin

-xx MSek

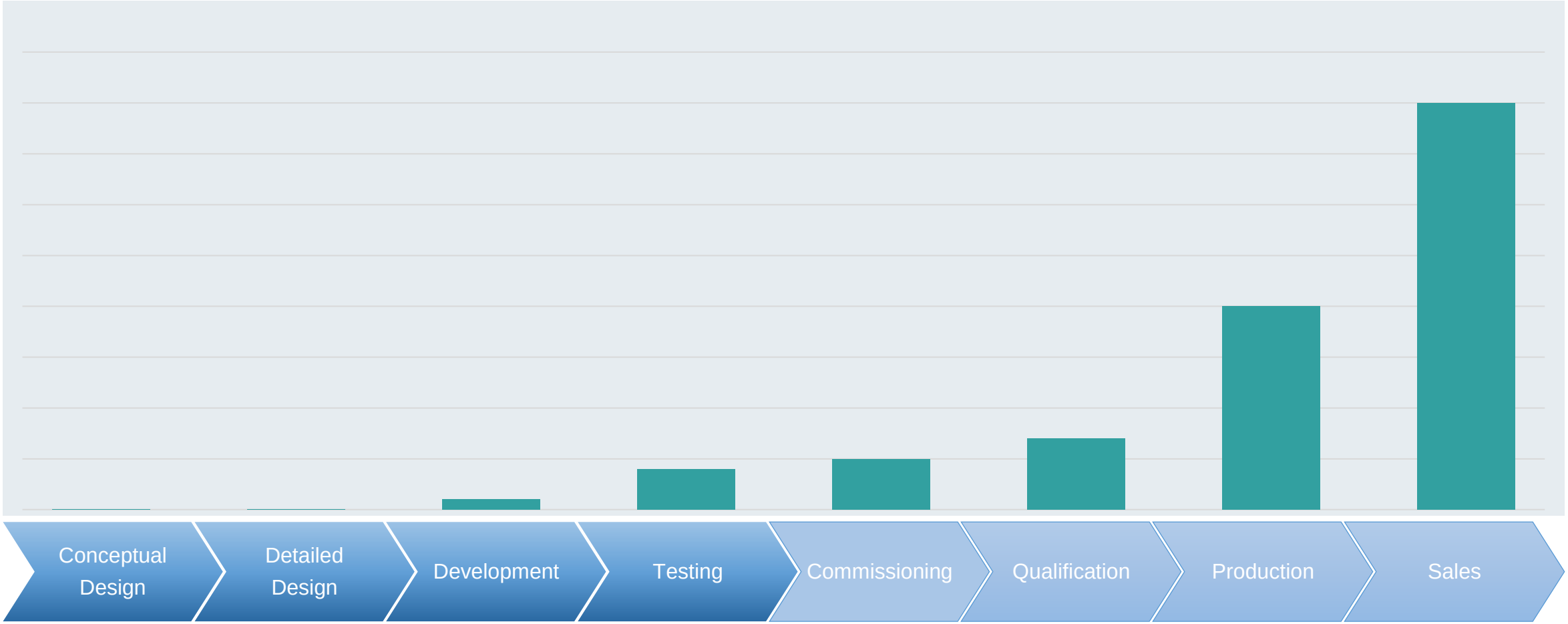
Real Digital Twin in the Life Cycle



AFRY
ÅF PÖYRY

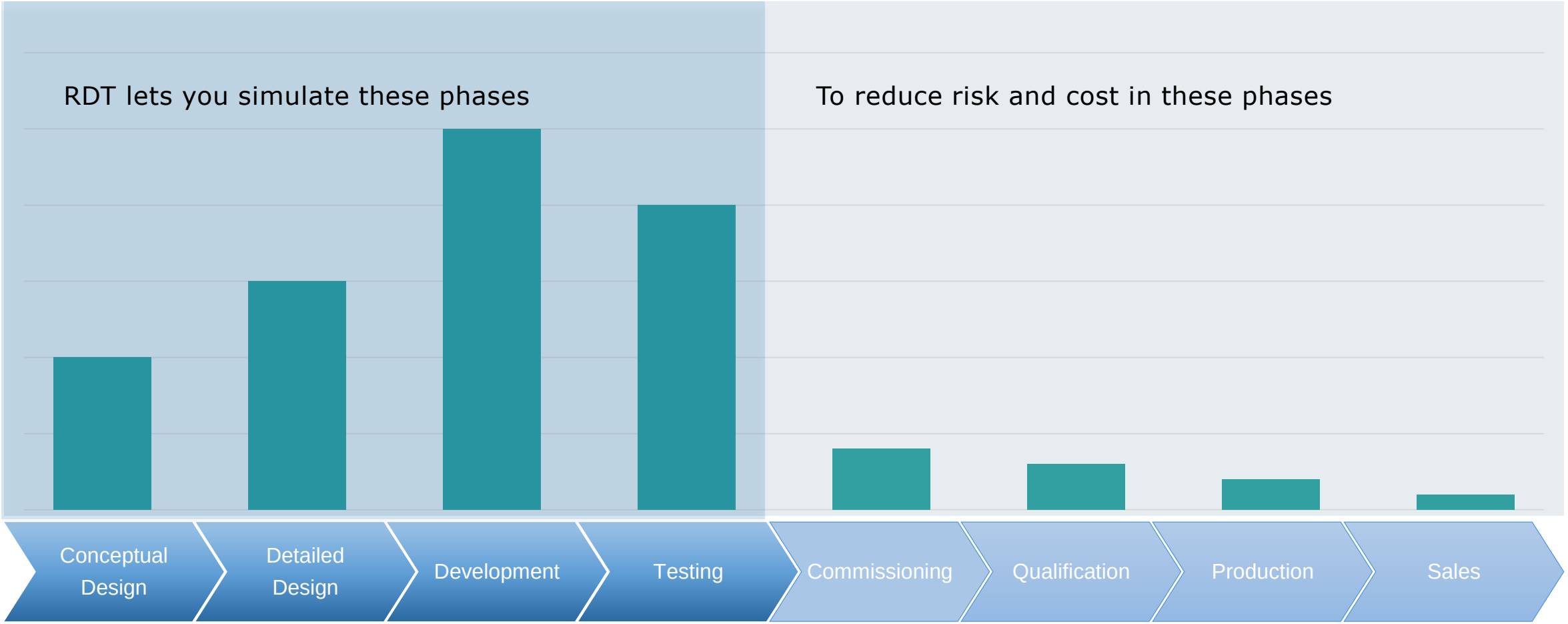
AFRY X REAL DIGITAL TWIN

Cost of Design Changes/ Faults



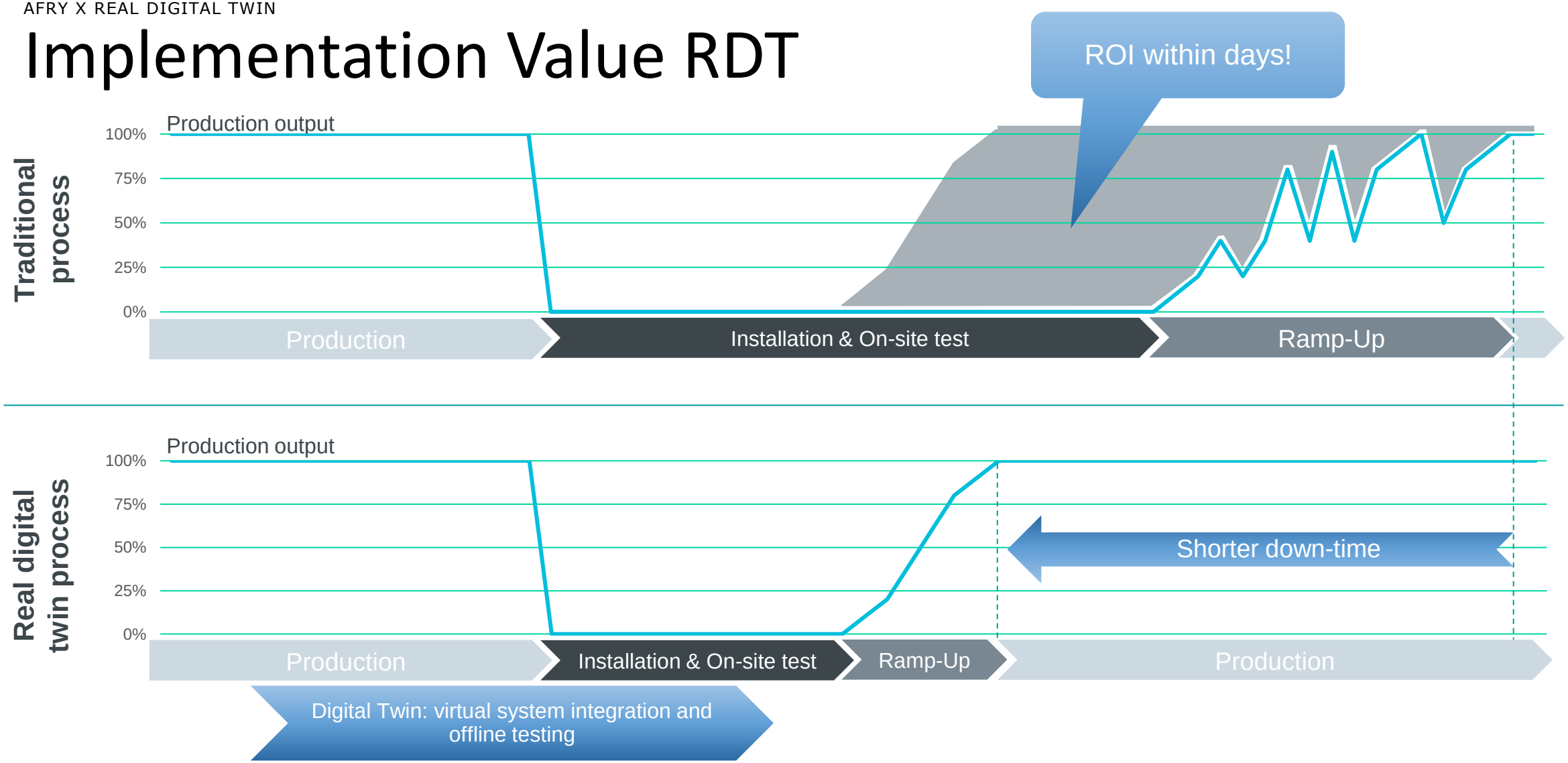
AFRY X REAL DIGITAL TWIN

Fix issues earlier - Fail early - Massive cost reduction



AFRY X REAL DIGITAL TWIN

Implementation Value RDT



The Business Case

Reduced time & cost

- Replace own simplified self-tests with accurate RDT test-bed (sandbox)
- Reduce commissioning and ramp-up time up to 80%
- Reduce overall project development time du to accurate OT test-bed

Minimize risk

- Iterative testing of developed OT systems gives higher code quality
- Unlimited virtual stress tests to improve quality
- Realistic operator training in real OT/IT systems

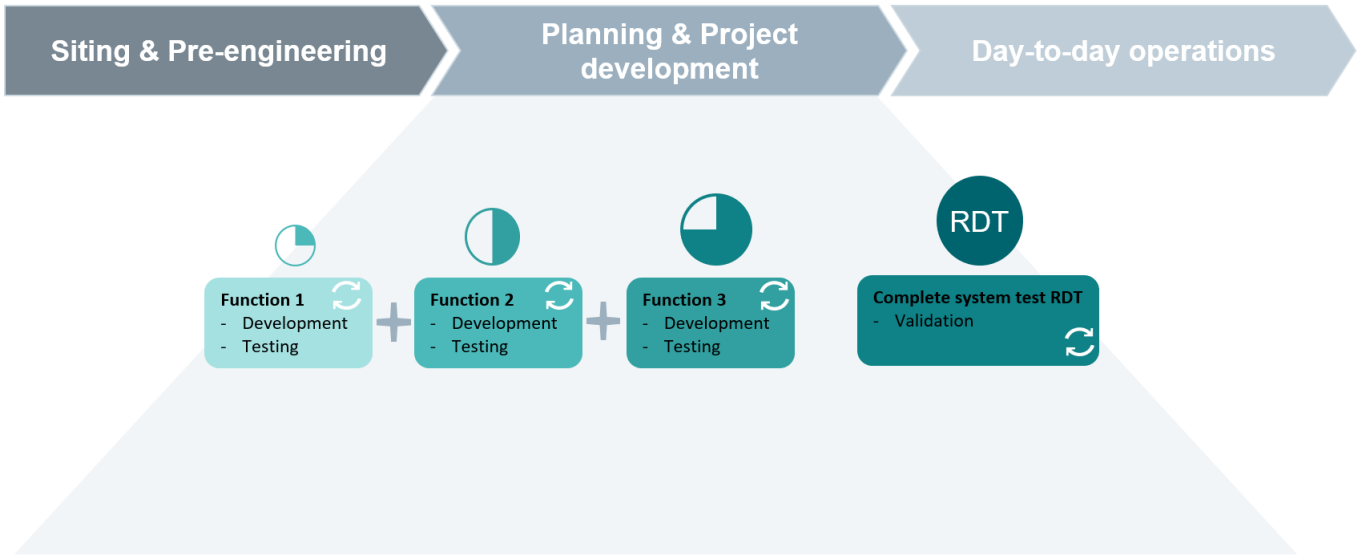
Increase success rate of qualifications

- Use to verify and improve PLC code, find and correct issues that otherwise would not been found before commissioning phase
- Accurate emulated test bed for OT/IT integration (SCADA, MES, IT)
- Commission a control system with higher quality, further stress tested and a faster ramp-up time

Life cycle perspective

- Share knowledge regarding agile WoW and tools to further develop your digitalization
- Test bed for supervisory systems (OSI PI etc.) and AI integration, generating industrial IoT data
- Patching, training, trouble shooting and optimization

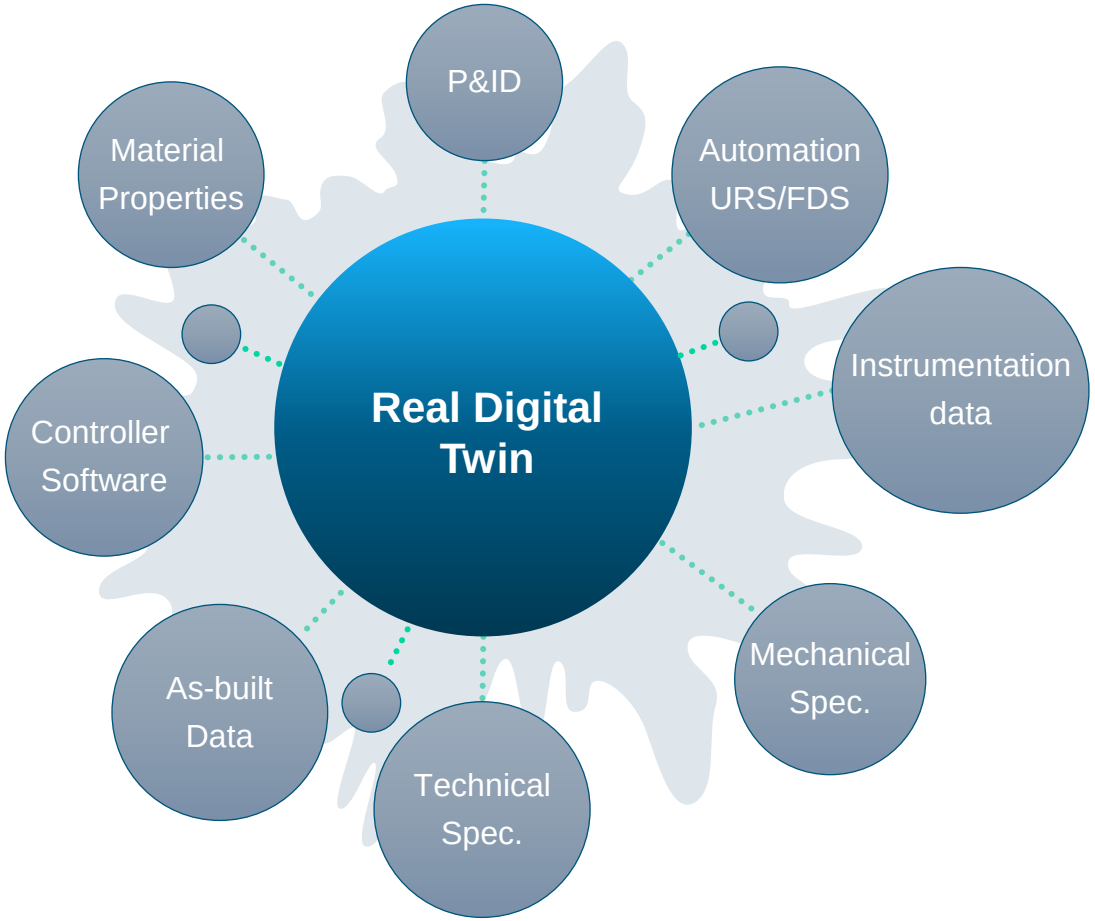
Real Digital Twin – Applicable over complete Asset Lifecycle



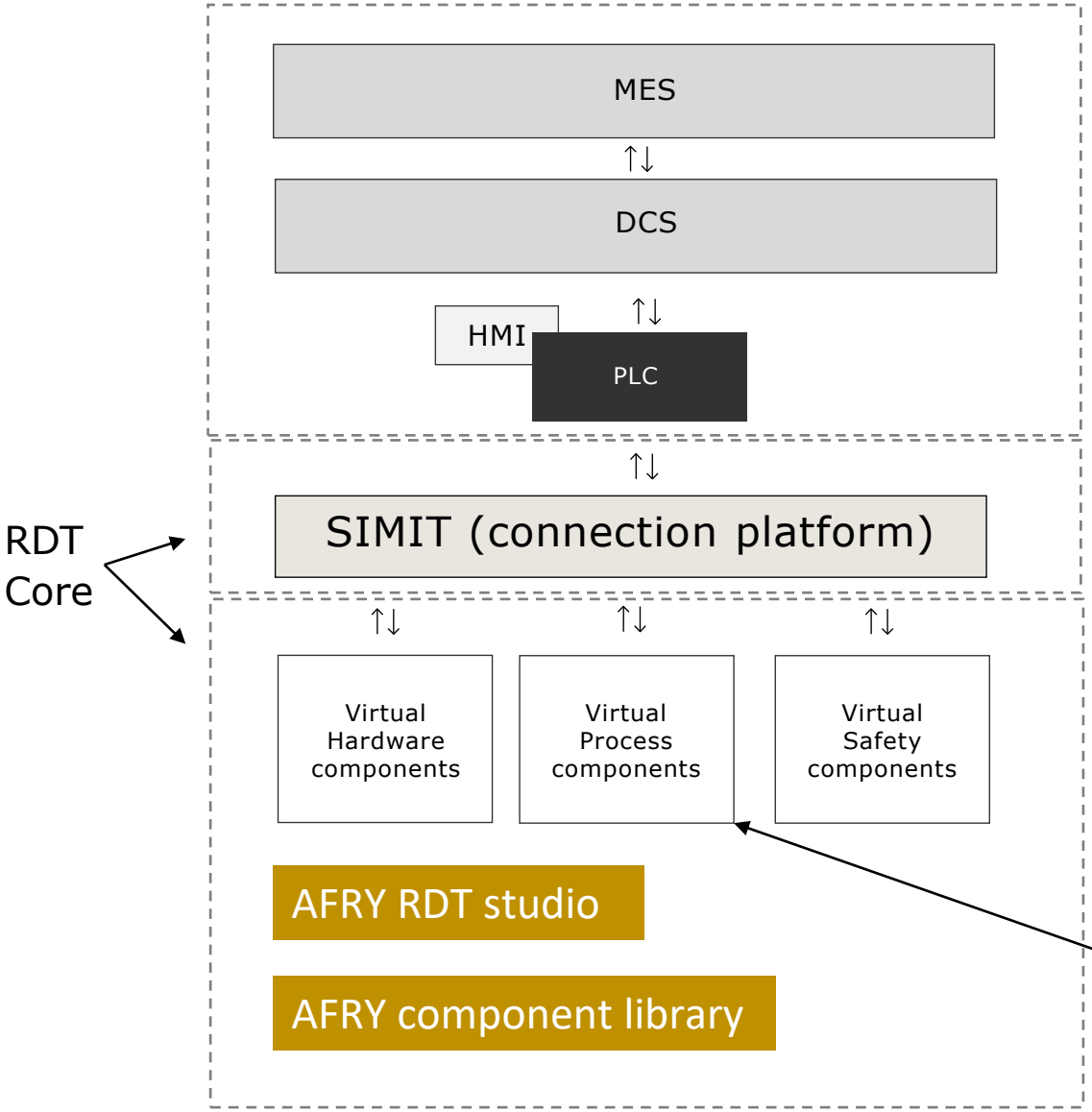
AFRY X REAL DIGITAL TWIN

How it works

Building the Digital Model

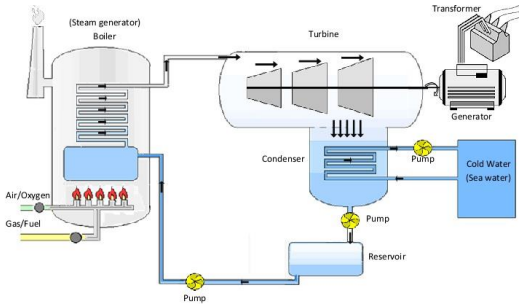


The architecture

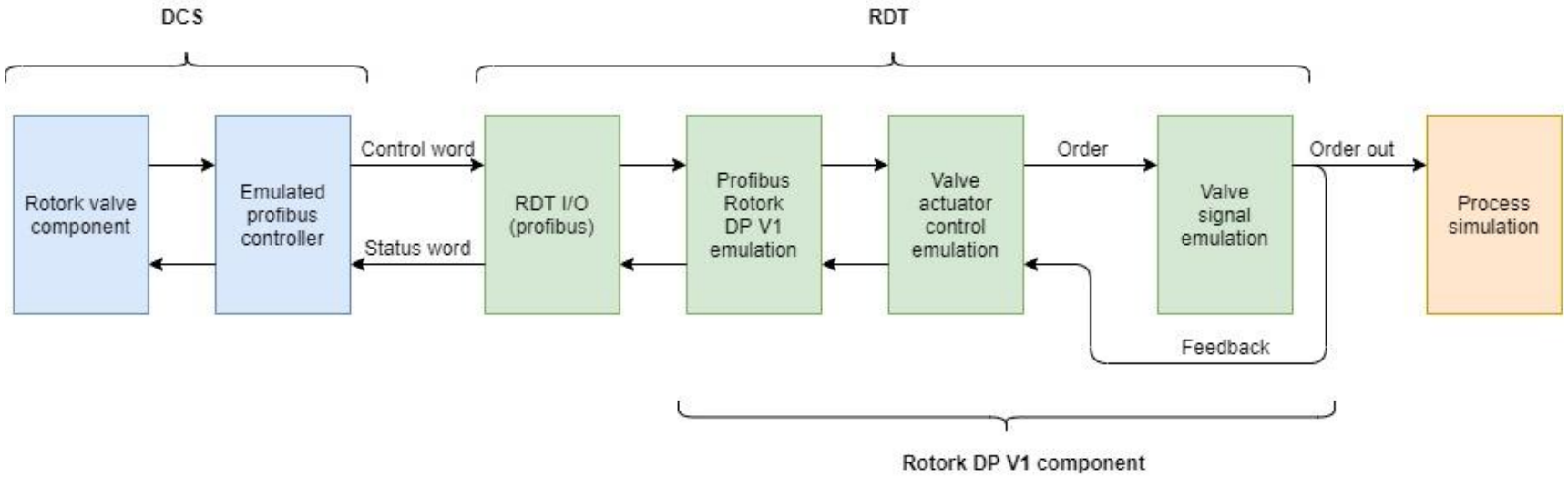


AFRY RDT Studio
- Software products for data washing
- Faceplates & templates
- Tools for generating couplings & signal interface
- Tools for generating the testbed

AFRY RDT Component Library
- AFRY component library
- Behavior models, process step relations



Connecting DCS, RDT and advanced process Simulation



Connecting RDT emulation to advanced process simulation tools creates extensive value and enables new possibilities.

Re-use, Re-connect, Re-scale between different DCS/SCADA systems and process simulations

AFRY
ÅF PÖYRY

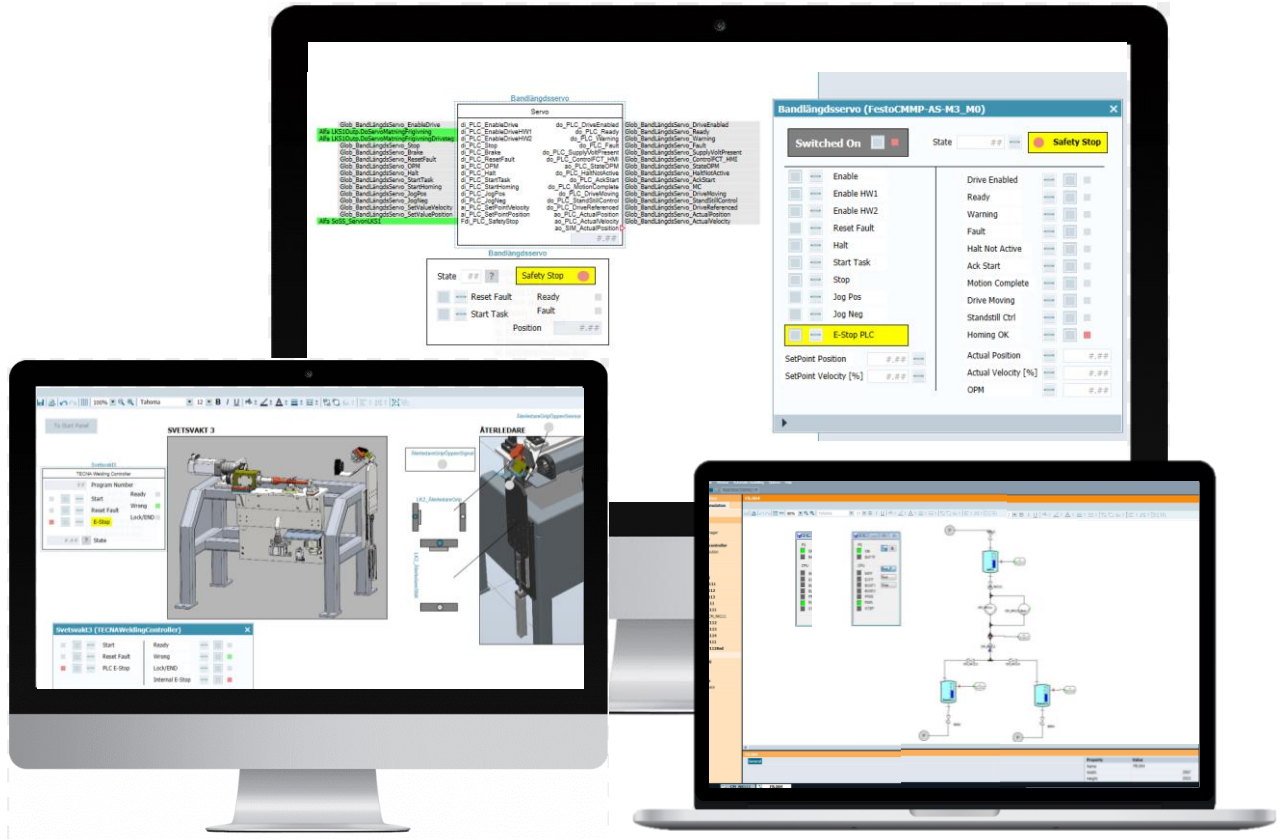
HOW IT WORKS

AFRY’s virtual Hardware library

AFRY has developed a library of hundreds of virtual hardware and process components allowing clients to quickly emulate their physical systems in RDT.

Each virtual component has their I/O connected to the corresponding tag and simulates the signal behavior of the real components.

New components are created as needed and added to the library continually, based on the FMU / FMI standards



FMU – Functional Mockup unit

FMI – Functional Mockup Interface

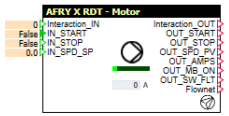
HOW IT WORKS

Structured modular components

AFRY_Motor_Binary

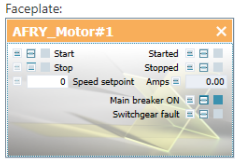
Screenshots

Component:



Link:

Faceplate:



Description

Requirements: SIMIT 10.1
Component for emulating motors, such as pumps, fans etc. Different input configurations is possible which is described below. The component is intended to be used with flownet controlling flownet pumps, fans, compressors etc. The link for the component is also designed for that purpose. Switchgear fault and mainbreaker on are also possible as outputs. Both standard ON/OFF-pumps and pumps controlled by setpoint is possible.

Supplier documentation

PDF documentations:
Manual for motor drive ACS880 from ABB
Manual för RPBA profibus protocol for ACS-drives from ABB

Version

1.0

New component.

Configuration

Parameter

AUTO
Default TRUE
If not true, the component isn´t running.

MaxRampTime_ms
Default 3000
Sets the ramp time from 0-100% RPM and vice versa.

Label
The text that will be shown on the component and link tooltip, most often the name/id of the valve.

max_amps
Default 40.0
Maximum current on motor.

Motor_configuration
- ON and OFF (pulsed/hold) *default*
If IN_START pulses TRUE the motor starts to 100%.
If IN_STOP pulses TRUE the motor stops to 0%.

- ON only (false = OFF)
If IN_START is TRUE the motor starts to 100%.
If IN_START is FALSE the motor stops to 0%.

- ON and OFF with setpoint
If IN_START pulses TRUE the motor starts to selected setpoint on input (IN_SPD_SP).
If IN_STOP pulses TRUE the motor stops to 0%.

- ON only with setpoint
If IN_START is TRUE the motor starts to selected setpoint on input (IN_SPD_SP).
If IN_START is FALSE the motor stops to 0%.

Motor_type
- Motor *default*
Shows motor icon.

- Fan
Shows fan icon.

- Pump
Shows pump icon.

- Compressor
Shows compressor icon.

MB_ON_Default
Default TRUE
Mainbreaker ON start value.

SW_FLT_Default
Default FALSE
Switchgear fault start value.

Signals

Name	Type	Comment
Interaction_IN	Integer input	Interaction IN (see table below)
Interaction_OUT	Integer output	Interaction OUT (see table below)
IN_START	Binary input	Command start
IN_STOP	Binary input	Command stop (if used)
IN_SPD_SP	Analog input	Setpoint (if used)
OUT_START_CLS	Binary output	Indicated start
OUT_STOP_CLS	Binary output	Indicated stop
OUT_SPD_PV	Analog output	Indicated PV (RPM%)
OUT_AMPS	Analog output	Indicated current
OUT_MB_ON	Binary output	Indicated mainbreaker on
OUT_SW_FLT	Binary output	Indicated switchgear fault
Flownet	Analog output	Connect to object in flownet (0-100%)

Interaction parameters IN

Bit	Comment
0	Start motor, same as signal on IN_START (can collide if not used carefully)
1	Stop motor, same as signal on IN_STOP (can collide if not used carefully)
2	Mainbreaker ON, can be used to switch state on OUT_MB_ON
4	Switchgear FAULT, can be used to switch state on OUT_SW_FLT

Interaction parameters OUT

Bit	Comment
0	Motor ON
1	Motor OFF
2	Mainbreaker ON
3	Switchgear FAULT

AFRY
ÅF PÖYRY

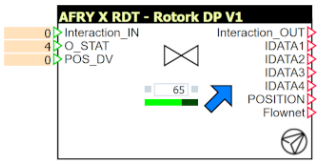
HOW IT WORKS

Structured modular components

AFRY_ROTORK_DP_V1

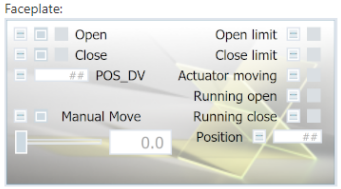
Screenshots

Component:



Link:

Faceplate:



Description

Requirements: SIMIT 10.2
Component for emulating ROTORK-valve with Profibus DP-V1 acyclic messages. Different input configurations is possible which is described below. The component is intended to be used with in flownet simulation interacting with media flow. The link for the component is designed to give a visual feedback for certain operating state. The component issues actuator commands to open, stop, close, preform and EDS operation or move to a set position. It is also possible to manually move the valve after setting "Manual Move" to TRUE.

Version

1.0

New component.

Configuration

Parameter

AUTO
Default TRUE
If not true, the component isn´t running.

MaxMovingTime_ms
Default 10000
Sets the maximum time for a complete sequence from completely closed (0%) to fully open (100%) and vice versa.

Label
The text that will be shown on the component and link tooltip, most often the name/id of the valve.

Signals

Name	Type	Comment
Interaction_IN	Integer input	Interaction IN (see table below)
Interaction_OUT	Integer output	Interaction OUT (see table below)
O_STAT	Integer input	Register containg control commands (see table below)
ACTCON	Internal Register	Register interpreting control commands (see table below)
POS_DV	Integer input	Desired position value to move should be placed in the POS_DV Register (see table below)
IDATA1	Integer output	Dataset relating the status of the actuator (see table below)
IDATA2	Integer output	Dataset relating the status of the valve (see table below)
IDATA3	Integer output	Dataset relating the status of the card connections (Not implememnted)
IDATA4	Integer output	Dataset relating the status of the card conditions (Not implememnted)
POSITION	Analog output	Current position of the valve (0-1000)
Flownet	Analog output	Connect to object in flownet (0-100%)

Interaction parameters IN

Bit	Comment

Interaction parameters OUT

Bit	Comment

POS_DV Register

Name	Value range
Register value	0 to 1000 (0 to3E8)
Position demand	0.0% to 100.0% of valve travel

O_STAT Register

O_STAT Register				
Bit 4-15	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	DO-4	DO-3	DO-2	DO-1

ACTCON Register (Internal interpretation of O_STAT Register?)

ACTCON Register						
Bit 6-15	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Partial Stroke	Positon Enable	ESD	Open	Close	Stop

AFRY
ÅF PÖYRY

References

Some client storys

“By using the advanced twin technology, we can accelerate our work towards a more digital and automated production which is well in line with our Industry 4.0 strategy,” says Mikael Tydén, President of the Operations Division.

“Turn-key projects within AFRY uses AFRY X RDT as a key enabler for successful implementation and quality insurance,” says Michael Mjörnestål, Head of Advanced Manufacturing

“Through this solution, we are strengthening our competitiveness in the global market, while once again demonstrating our commitment to a safe and ergonomic working environment. Like our technology, our production must be at the forefront of what is possible to meet the increased demand for products and solutions that will enable the green energy transition,” said Andreas Berthou, Global Product Group Manager of Hitachi ABB Power Grids’ HVDC & HVDC Service business.

Some client KPI’s

Reduction of commissioning/ramp up time with 50%.

Reduction of commissioning/ramp up time with 80%.

Reduction of commissioning/ramp up time with 80%.


Making Future
AFRY