Virtual Train IRL

Erik Simonson
Daran Smalley

2023-10-10

ALSTOM
• mobility by nature •

Agenda

1. About Alstom and our background
2. How we work today
3. How our journey started
4. Our first Simulink models
5. Our first product
6. Our first project
7. Our first virtual train in real life
8. Conclusion

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About Alstom

Over
22,000
engineers

Over
10,000
patents

Partner to over
300
cities

Over
80,000
employees worldwide

175
nationalities

Over
250
sites

63
countries

As of 31 March 2023

"The role of Alstom is not only to provide rolling stock, services and maintenance but to offer mobility solutions to a world in profound transformation. Alstom is in excellent position to shape tomorrow's mobility: efficient, sustainable and connected!"

Henri Poupart-Lafarge

Alstom Chairman and CEO

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Innovation is key in a complex and dynamic market
Challenges

Climate change	Technological transformation	Population growth and urbanisation	Shortage of natural resources
Passenger expectations	Globalisation	Consciousness and awareness	Cybersecurity

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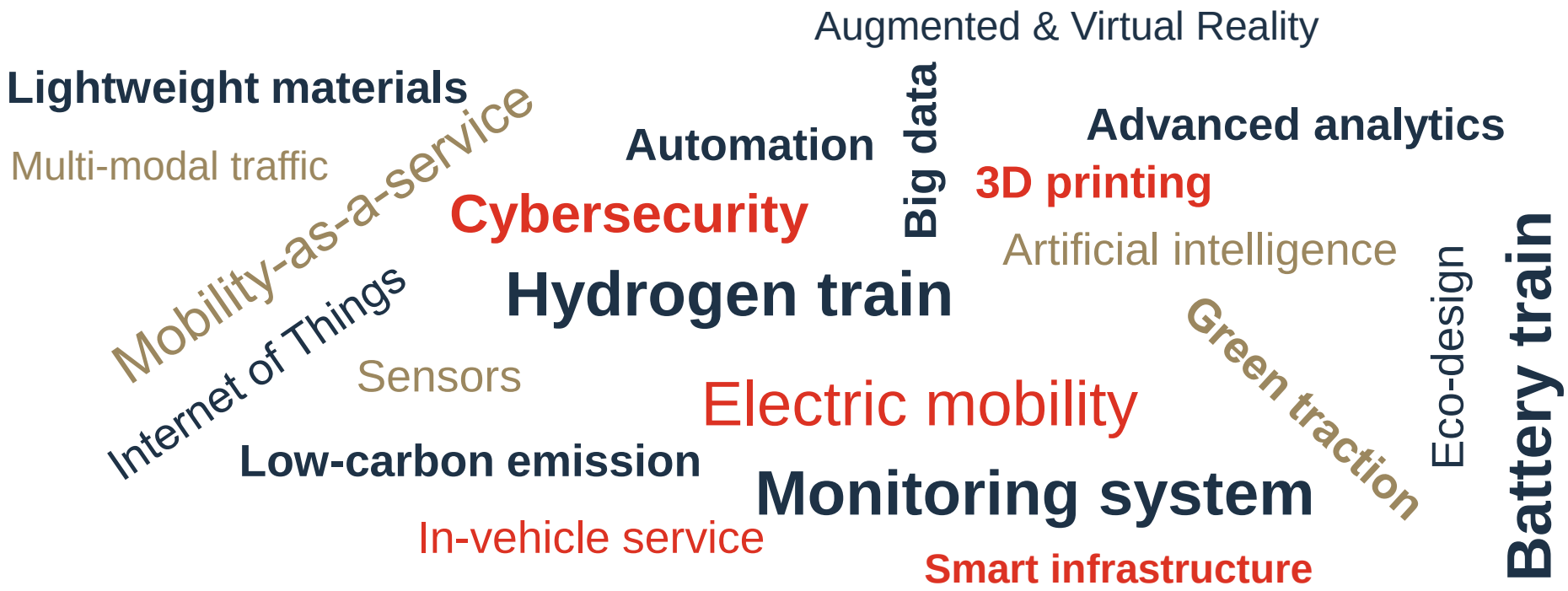
Innovation is key in a complex and dynamic market
Answers



These innovations make rail transport greener, more connected, autonomous, more accessible, safer, reliable, fluid, enhanced, etc

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Alstom Components
We are rolling stock components

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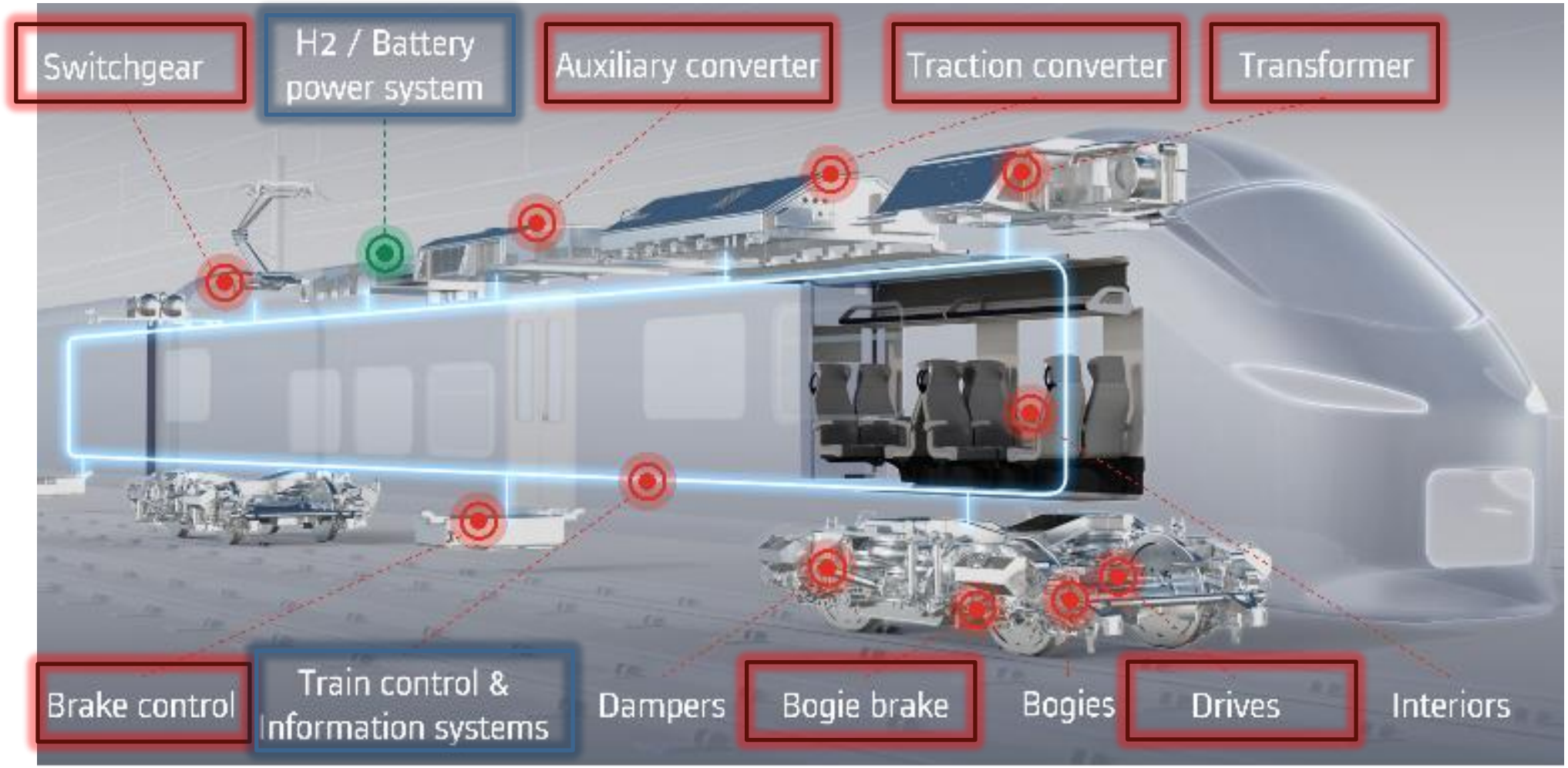
Alstom Components

We are controlling traction and brake systems and interface the train



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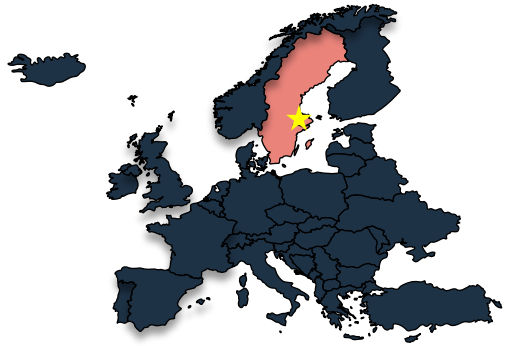
Presenters – Erik Simonson & Daran Smalley

Erik Simonson
Traction Control Site Manager
Västerås, Sweden

~100 control engineers

Current Status: 8 projects (1 with SIL2 certification) totalling 268 trains in passenger traffic with Simulink generated code.

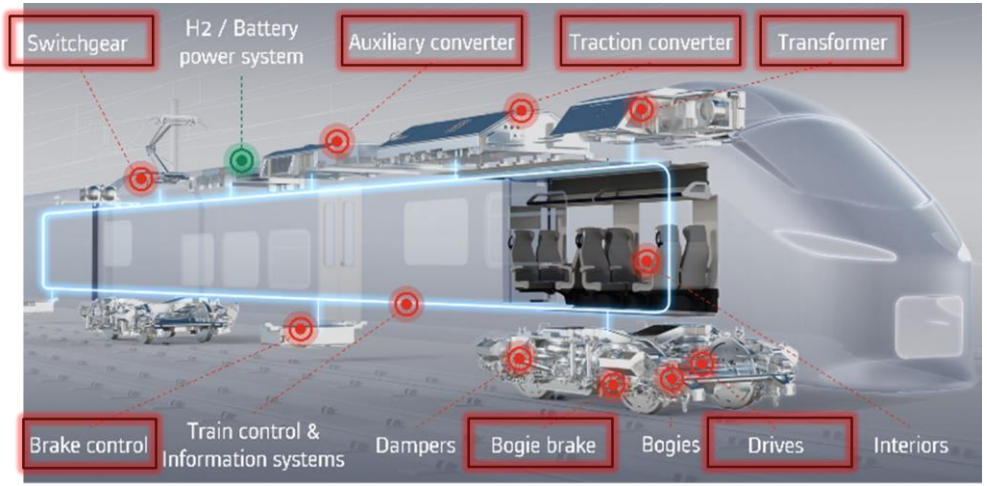
Upcoming MI20 Commuter Train to serve the Paris RER B Line from CDG Airport



Daran Smalley

Brake Subsystem Manager,
Västerås, Sweden

7 years traction control engineer



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The Vision

GROWTH
by offering greater value to customers

INNOVATION
by pioneering smarter and greener mobility solution for all

EFFICIENCY
at scale powered by digital

Early Verification with a Virtual Train

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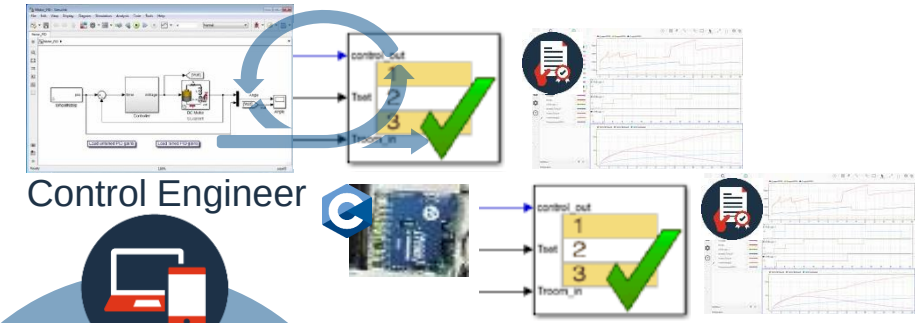
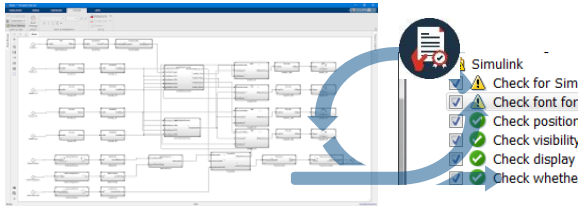
Today



Control Engineer

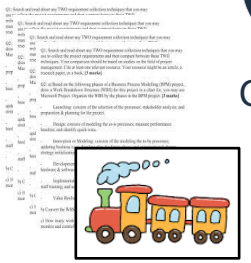
V&V Team

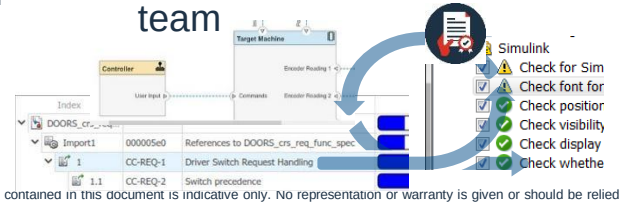


Control Architect

Customer

System team

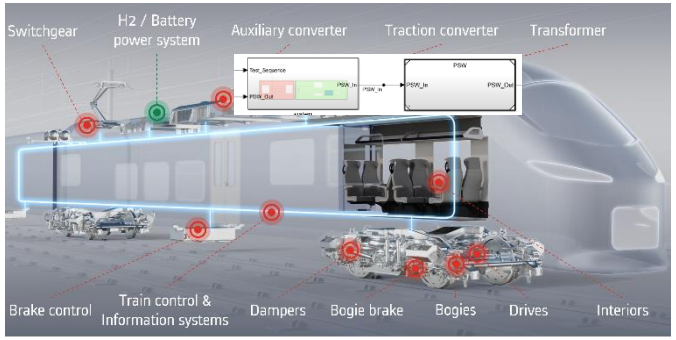




Commissioning

Assessor

Virtual Commissioning



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10 years ago

Google Glass

X(former: Twitter) goes public $26

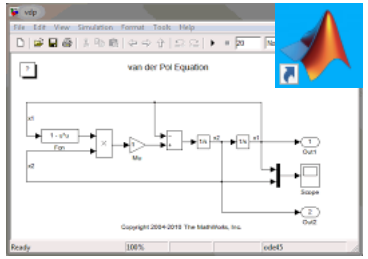
Xbox One

VS

Playstation 4

1131 programming language

VS



Simulink

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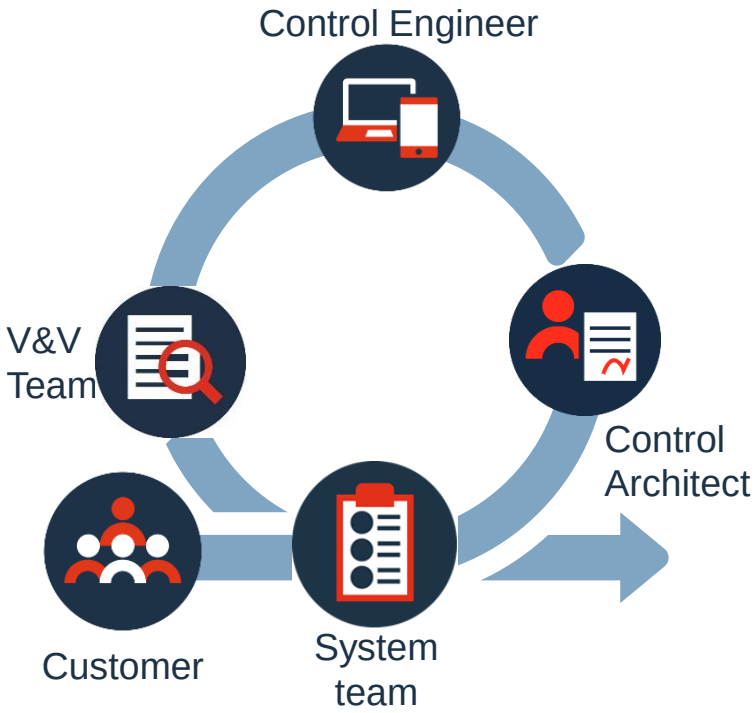
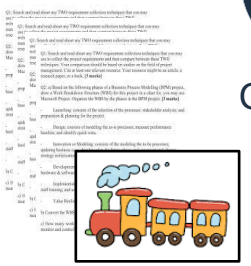
Our legacy process





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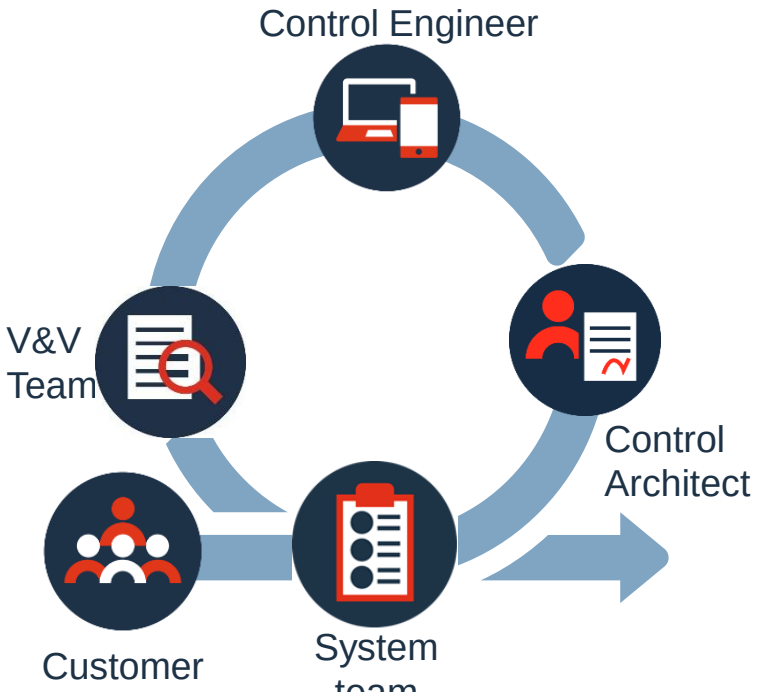

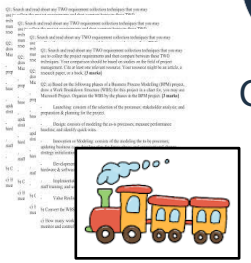

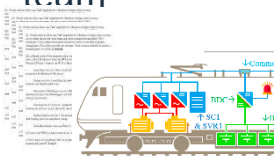

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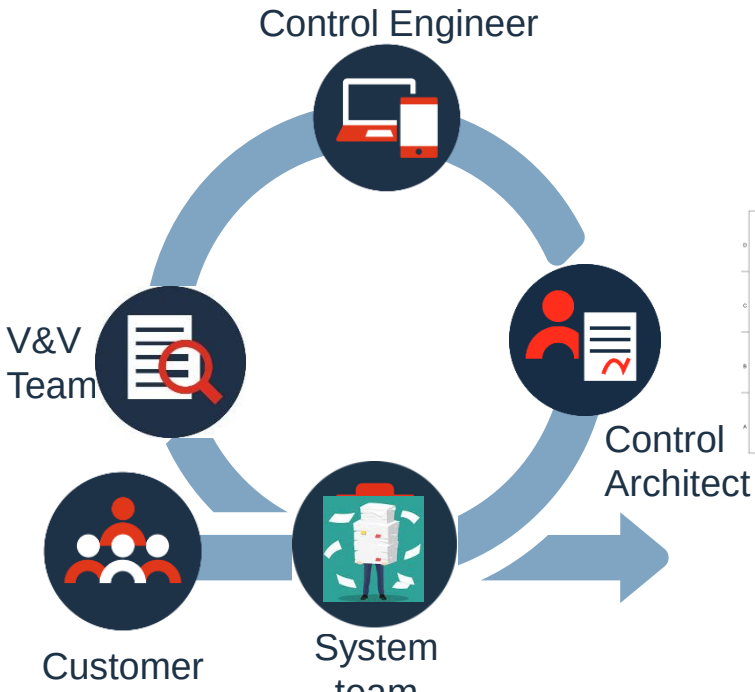

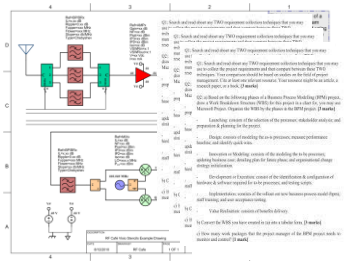

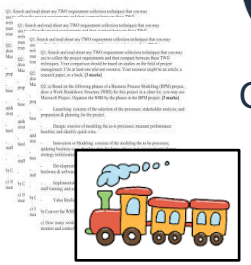

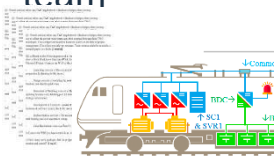

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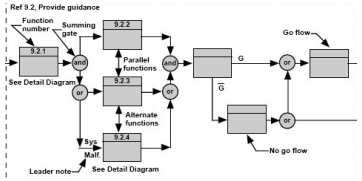
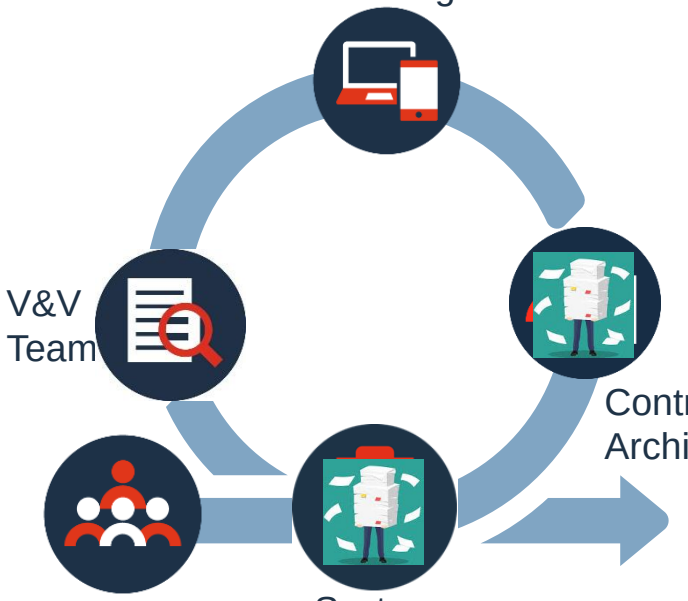
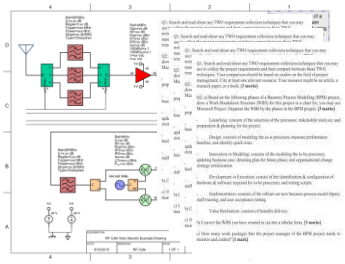


Control Engineer



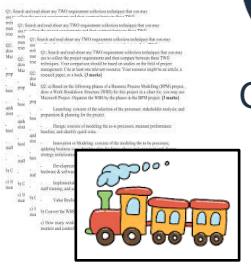
V&V Team

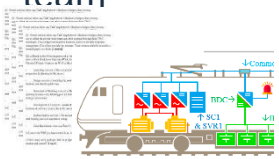
Control Architect



Customer

System team





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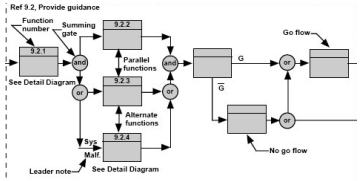
Our legacy process



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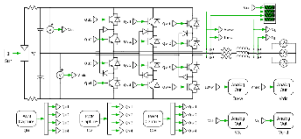
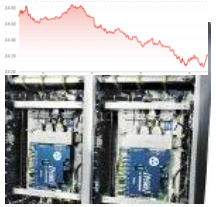
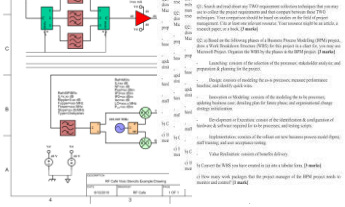




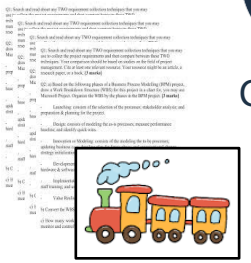
V&V Team

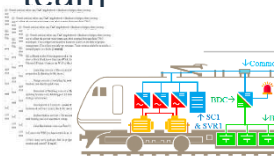


Control Architect

Customer

System team





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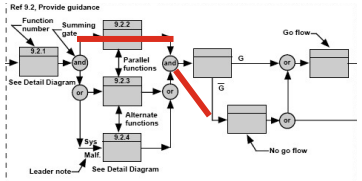
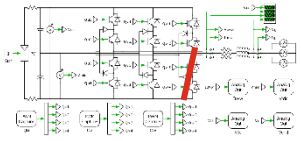
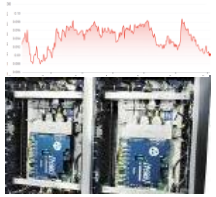
Our legacy process

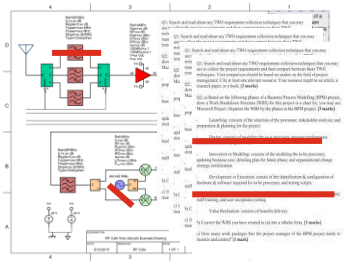


Control Engineer





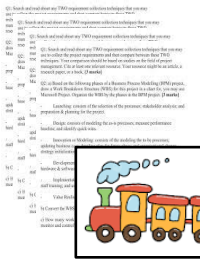
V&V Team

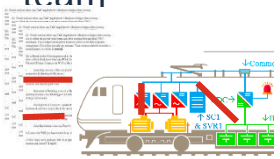


Control Architect

Customer

System team





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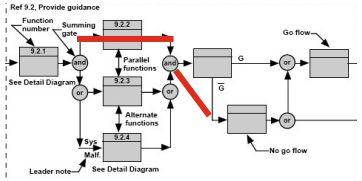
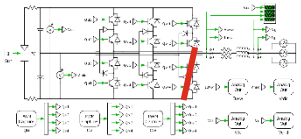
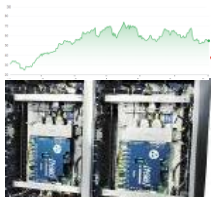
Our legacy process

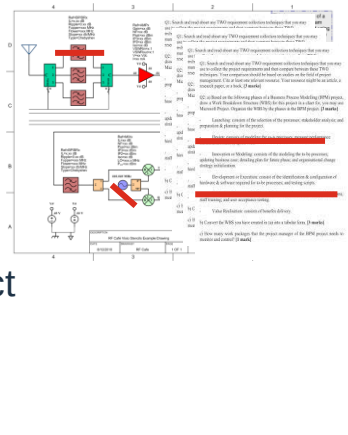


Control Engineer





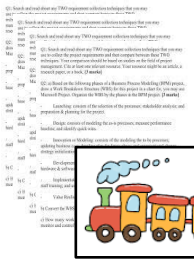
V&V Team

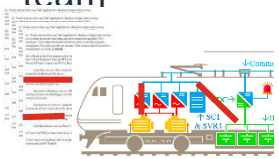


Control Architect

Customer

System team





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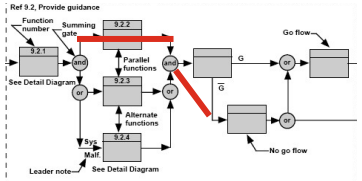
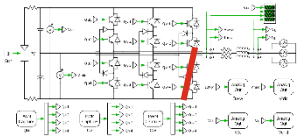
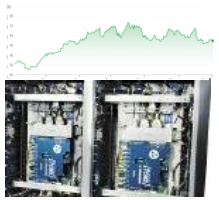
Our legacy process

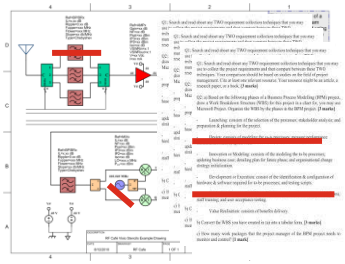


Control Engineer

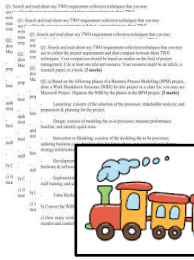




V&V Team

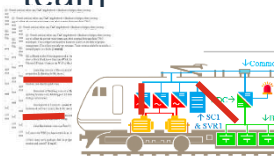


Control Architect

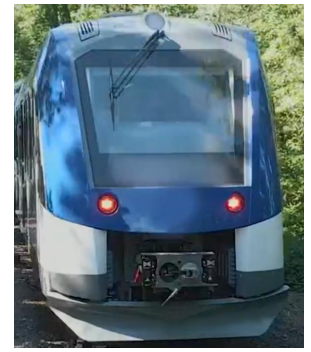


Customer

System team



Commissioning



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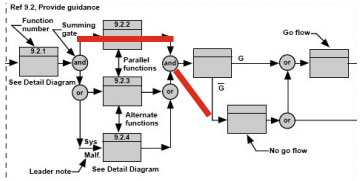
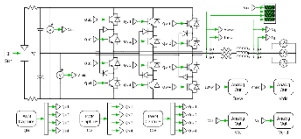
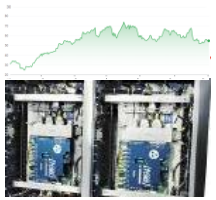
Our legacy process

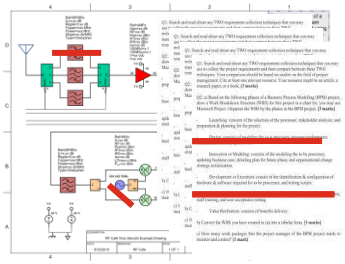


Control Engineer





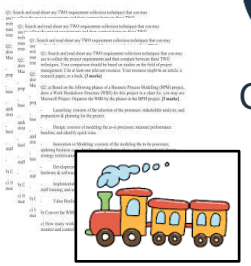
V&V Team

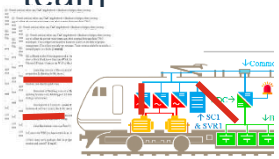


Control Architect

Customer

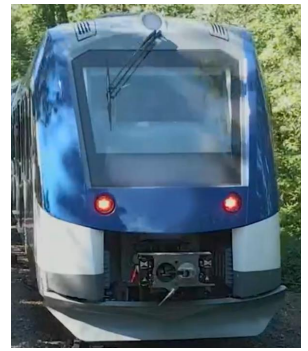
System team





Assessor

Commissioning



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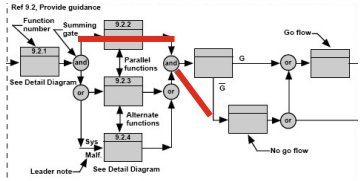
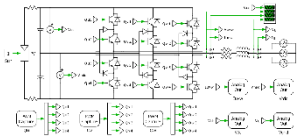
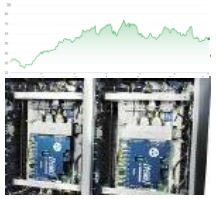
Our legacy process

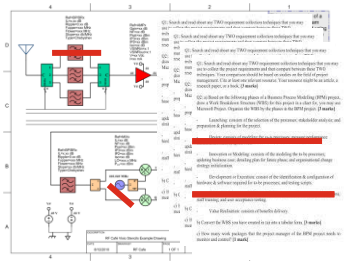


Control Engineer

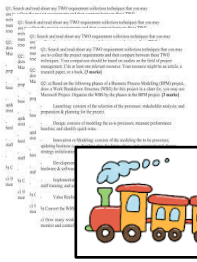




V&V Team

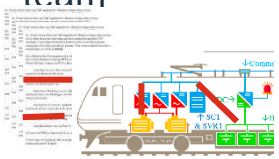


Control Architect



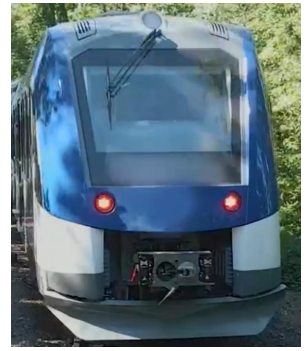
Customer

System team



Assessor

Commissioning



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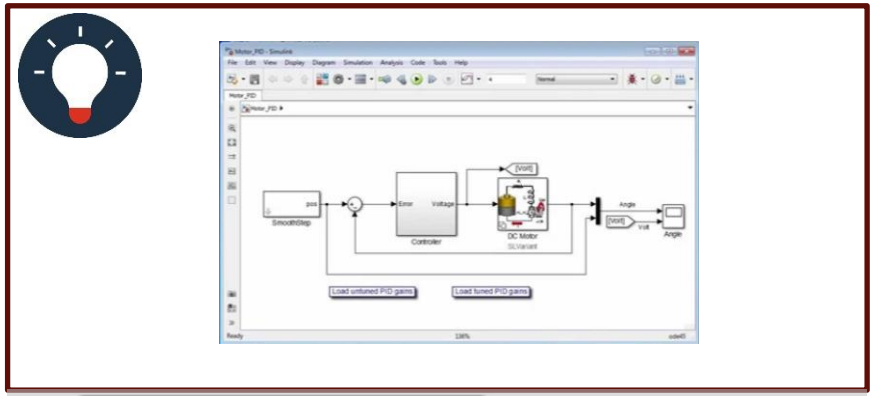
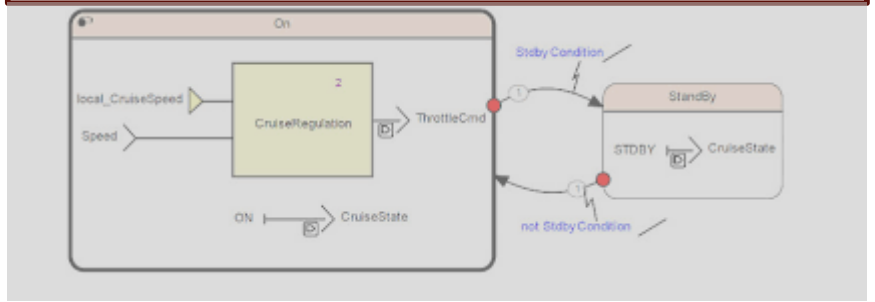
Initial Startup

"Bottom-up solution to a problem not yet identified"

OLD WAY

NEW WAY





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Where to go now?

When do we have time to change?

Can we test on computer?

Can Simulink generate optimised code?

Is it cheaper?

Can we trust the model?

Can Simulink work with our Alstom Tools?

Is it safe?

Changing to Simulink sounds good BUT…

Resistance argumentation include

- Yes, but we are so special……
- Yes, but it is too expensive to change
- Yes, but……..

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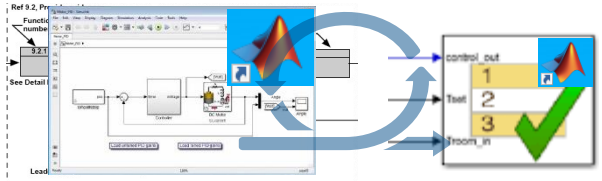
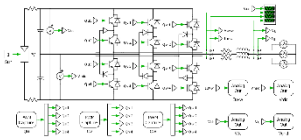
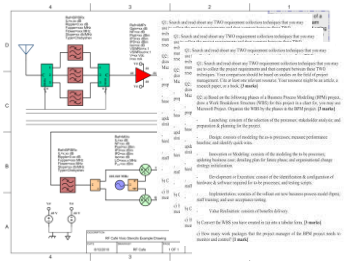
Our first Simulink models



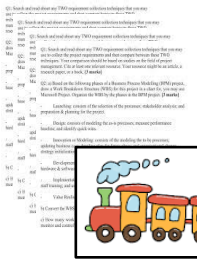
Control Engineer



V&V Team

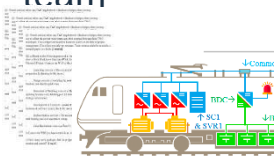


Control Architect



Customer

System team



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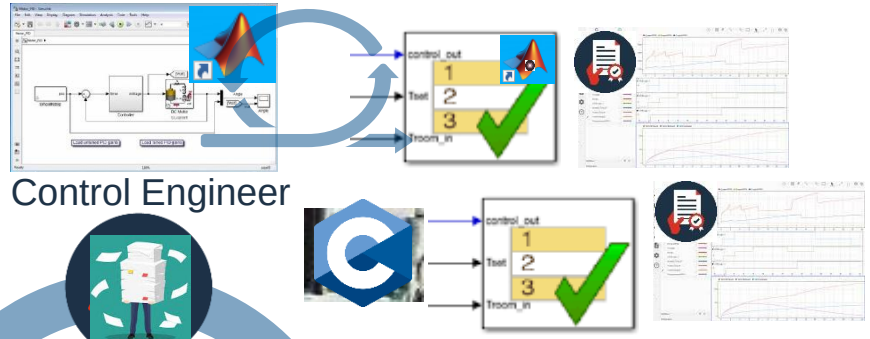
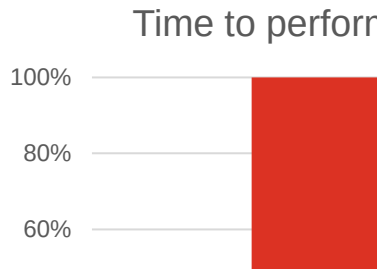
Our first Simulink models

KPI	+/-	Description
Time	↘	-87% Time to iterate tests
Cost	↘	No manual Implementation Simulink toolbox cost





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Where to go next?

Do we have time to change?

Should we focus on larger scope with an even better business case or stay within control domain?

Complex customer problem, out of scope, with large risks -- we really want to avoid it.

Should we develop a product with what we now believe in? which product? Financing?

Again – **is it safe?**

Can Simulink work with our Alstom Tools?

Yes, but……..

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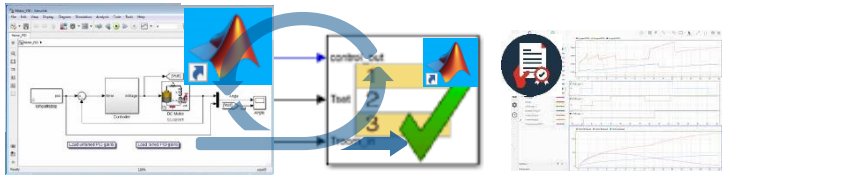
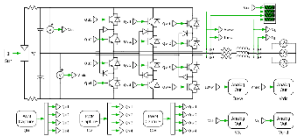
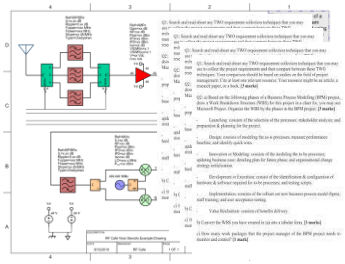
Our first product



Control Engineer



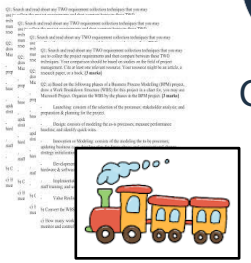
V&V Team

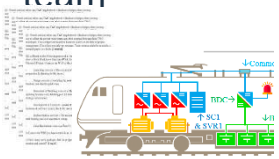


Control Architect

Customer

System team





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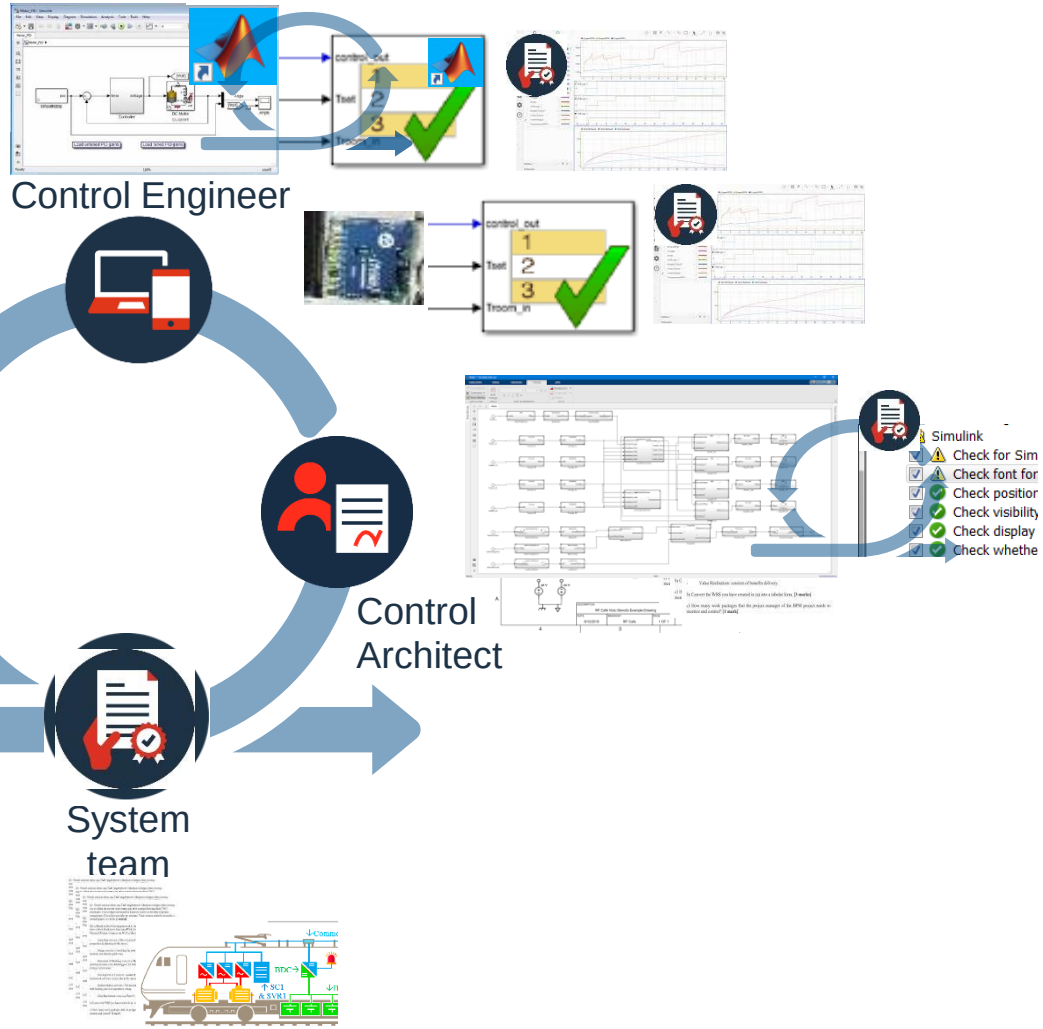

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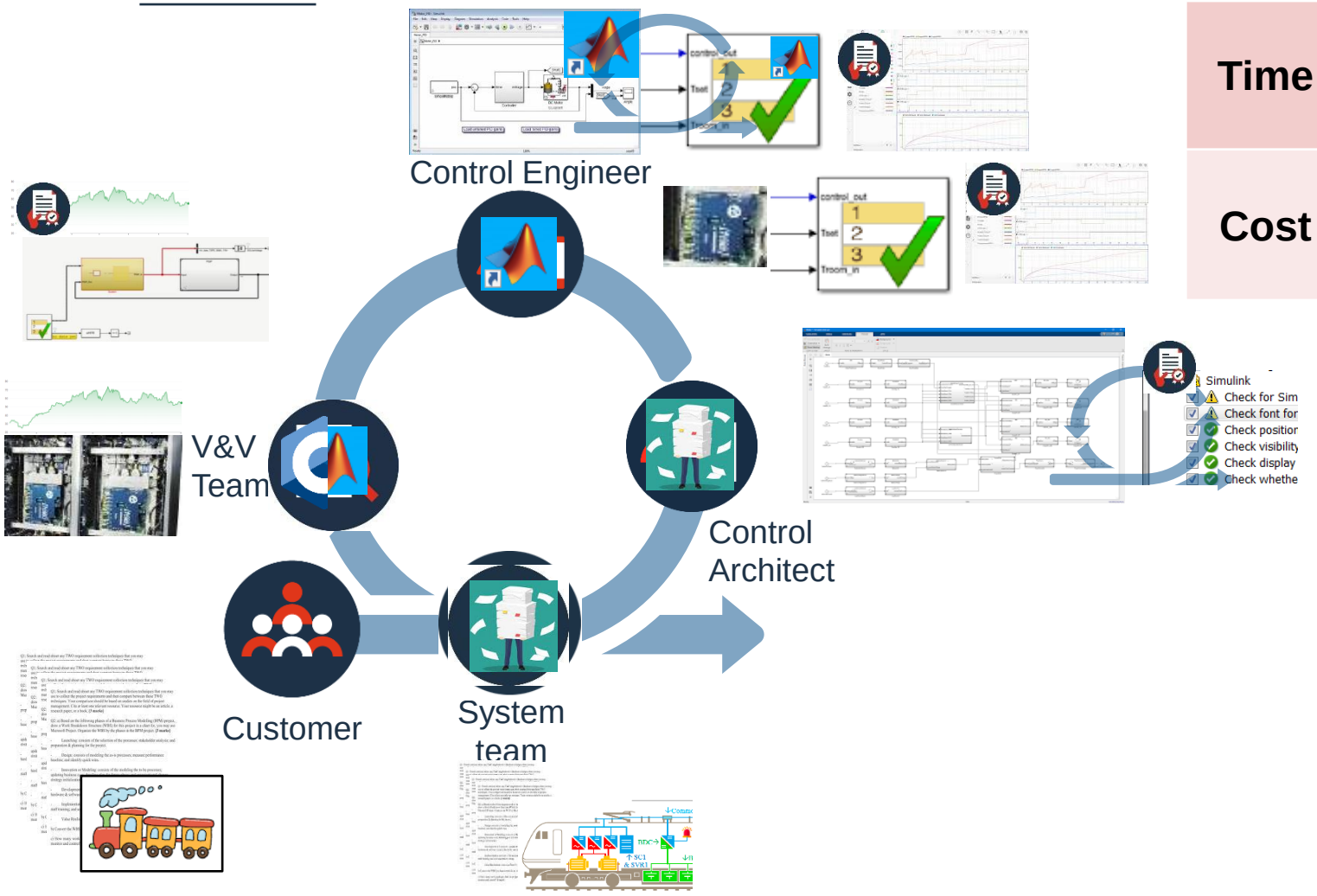
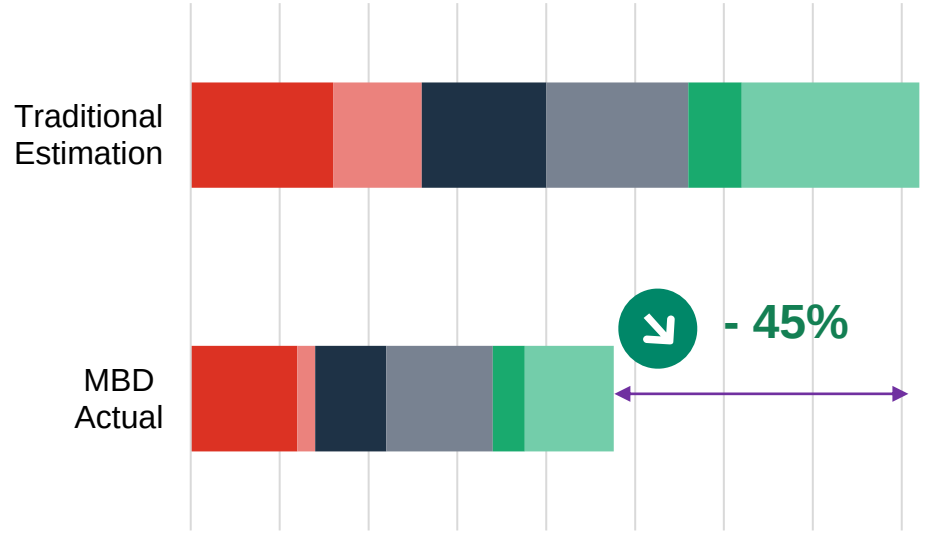
Our first product

KPI	+/-	Description
Time	↘	Reduce software development time Reduce train commissioning time
Cost	↘	Reduce test hardware & train tests Reduce customer & engineer time Simulink toolbox cost





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Where to go next?

Do we have time to change?

Shall we introduce the new product into a project sometime?

Can we re-use models?

Shall we generate more artefacts from the model?

Can we debug on target?

Is it safe? We really need an answer…..

Amount of resistance is lower, but the remaining is more stubborn than earlier.

Shall we increase automation even more?

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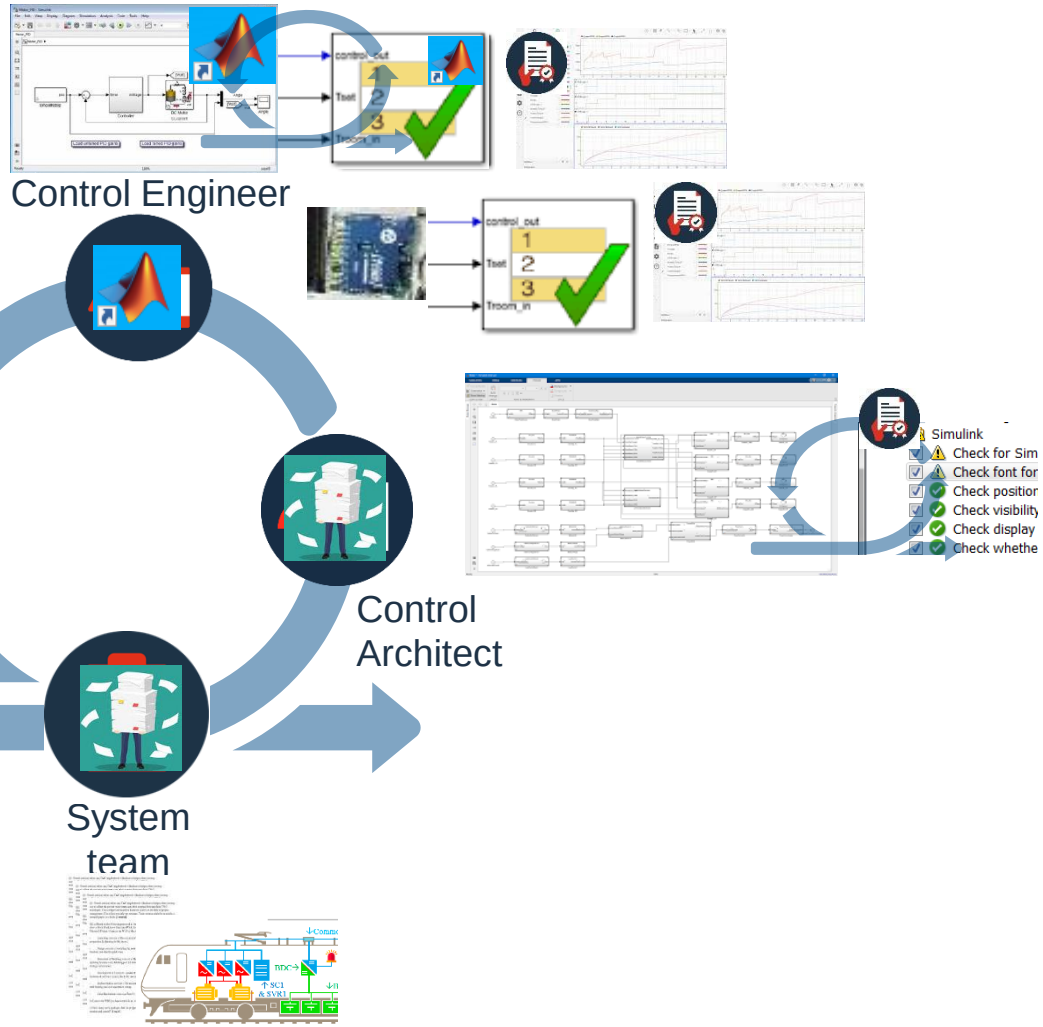
Our first project



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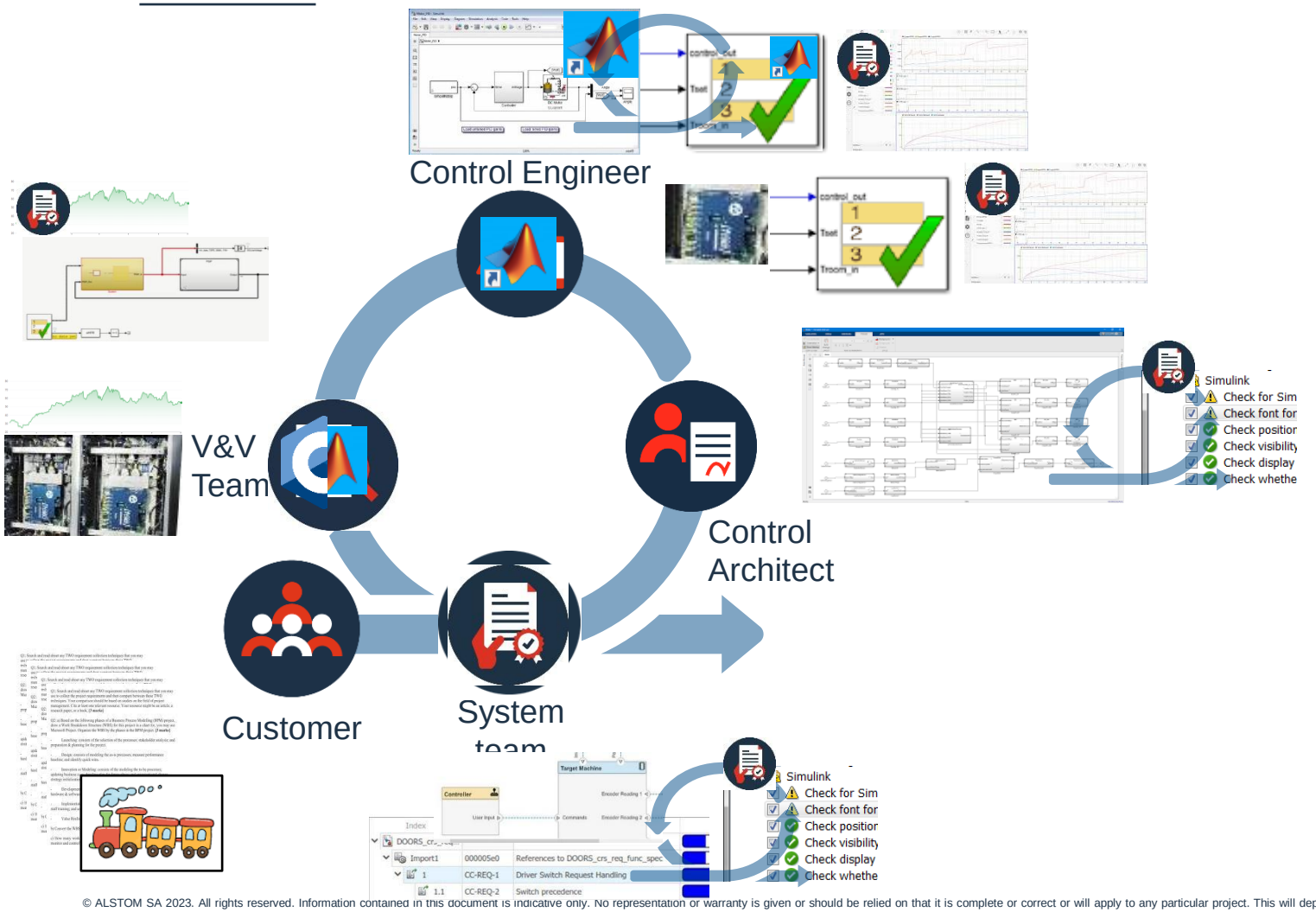

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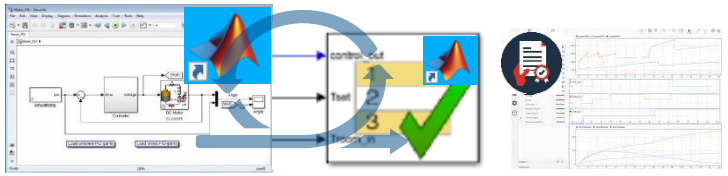
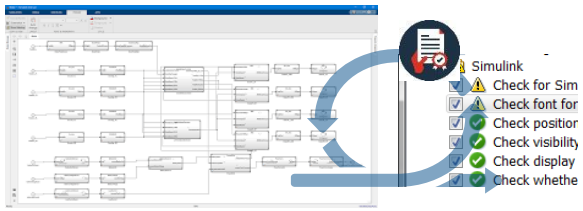


Control Engineer

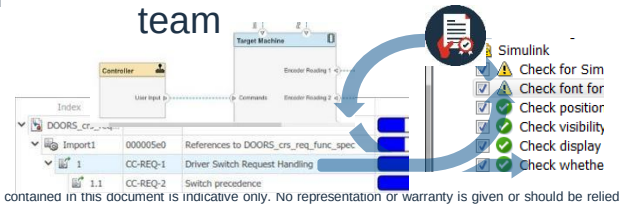


V&V Team

Control Architect

Customer

System team



Commissioning

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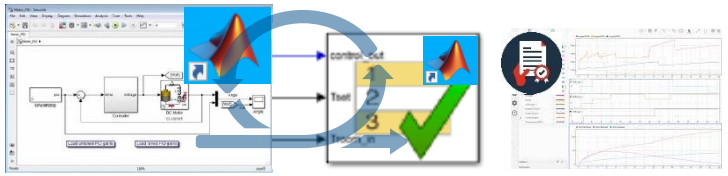
Our first project



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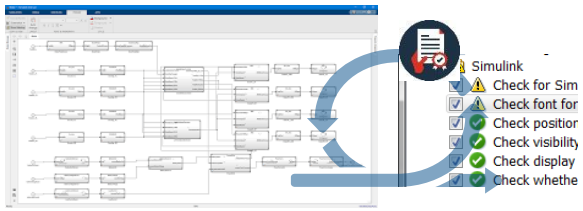

V&V Team

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Customer

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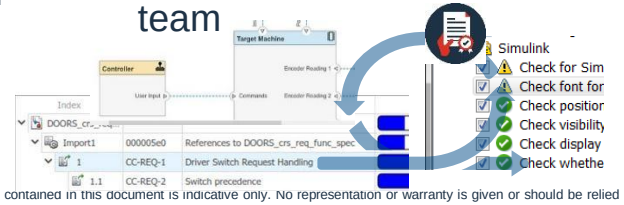

EN 50128
EN 50657

Assessor

Commissioning

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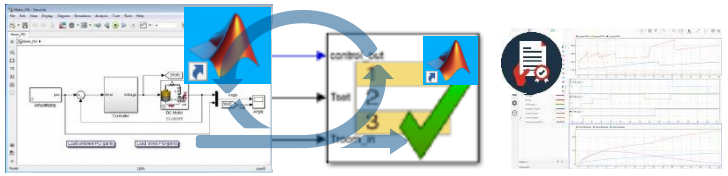

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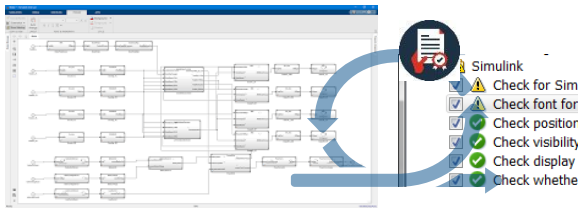
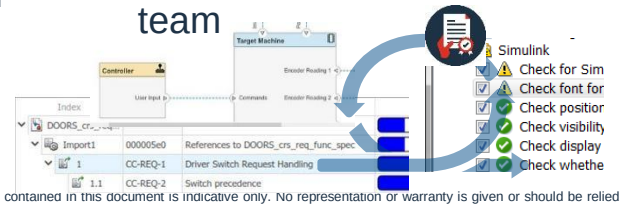


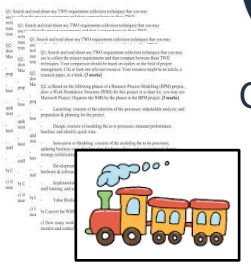
V&V Team

Control Architect

Customer

System team





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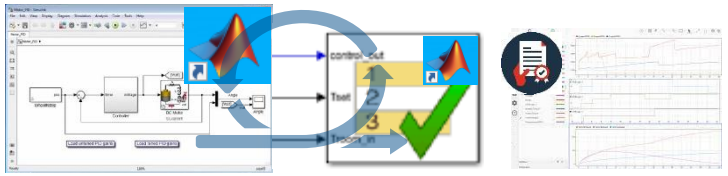

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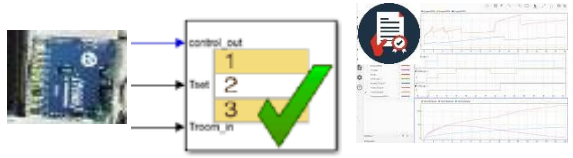
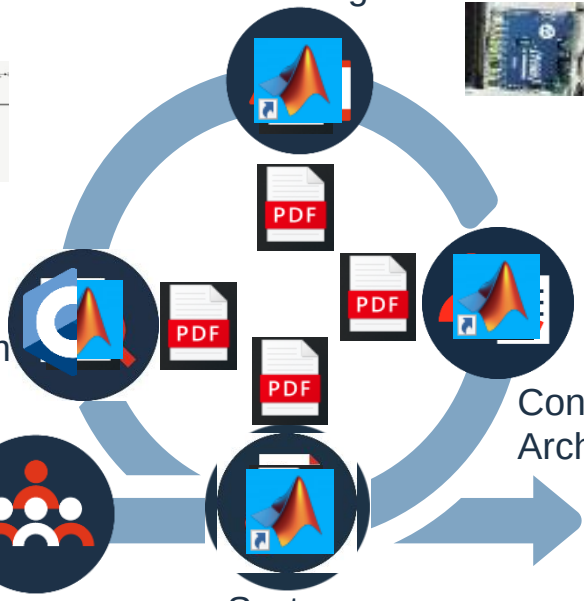


V&V Team



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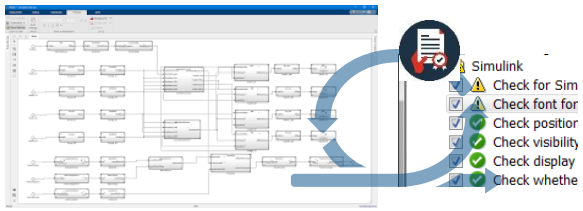
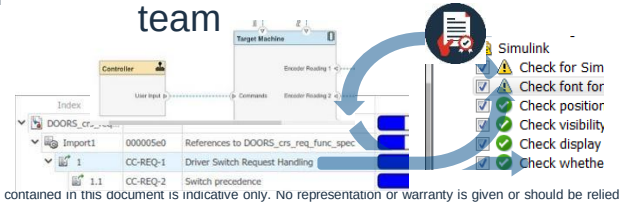
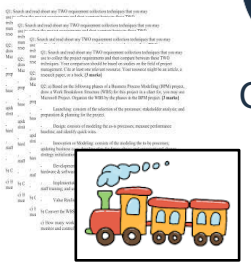


Customer

System team





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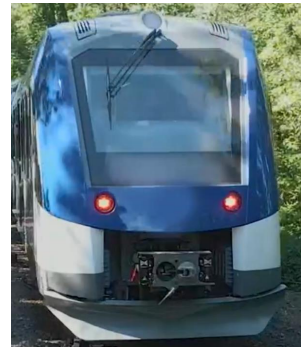
Assessor

Commissioning



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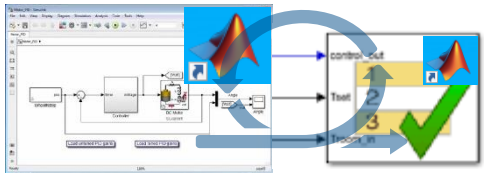
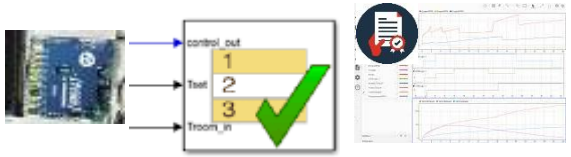
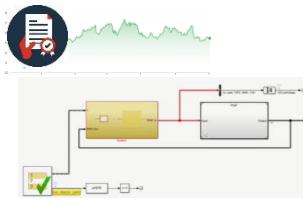
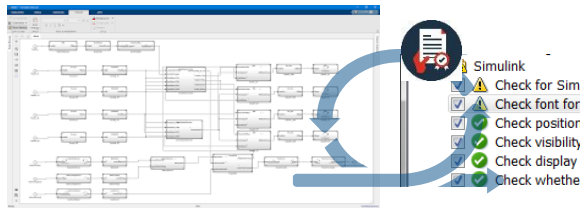
Our first project

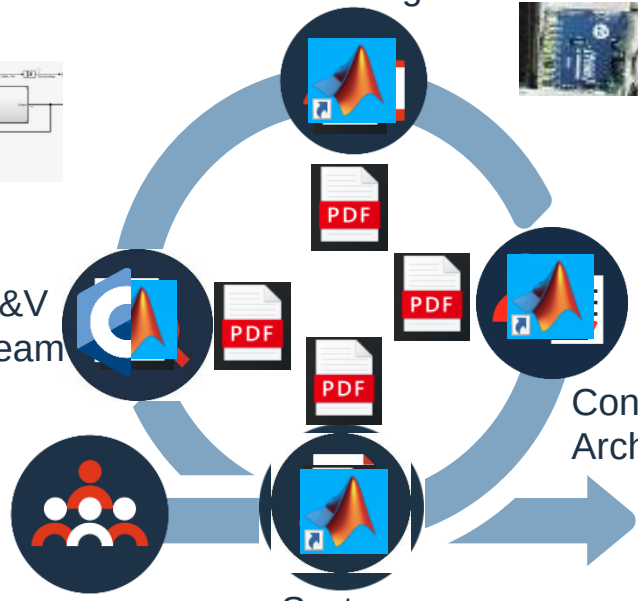
KPI	+/-	Description
Time	↘	Create system architecture faster Generated documents faster 50-80% re-use
Cost	↘	Reduce engineers time Simulink toolbox cost

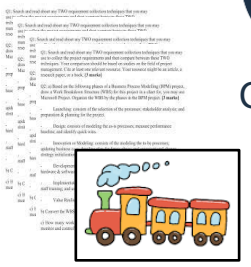


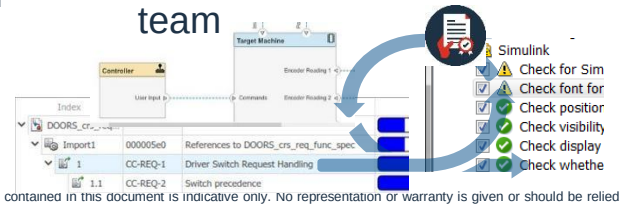












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So, now what?

- Shall we go wider?
- Hardware modelling
- Can we re-use models on train level?

- We shall probably update the process….
- Pursue the virtual train?
- Is there a budget?
- Are they willing to change?

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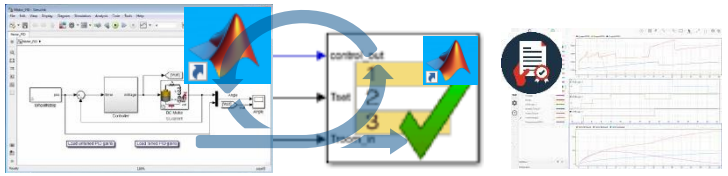
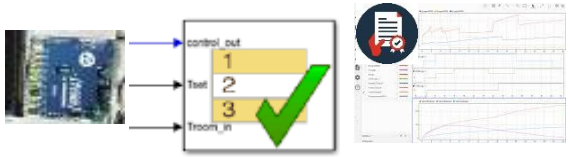
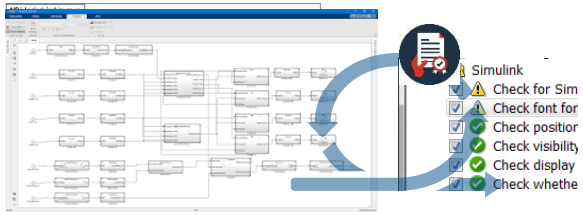
Our first semi-virtual train



Control Engineer



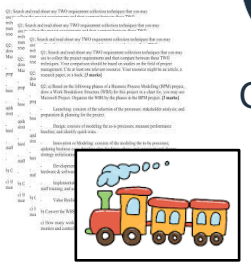


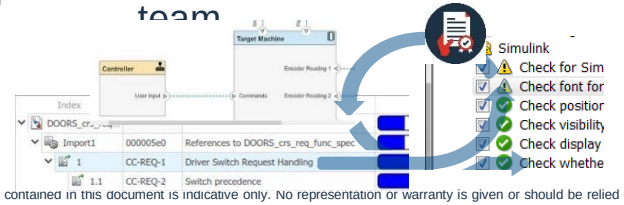
V&V Team

Control Architect

Customer

System team





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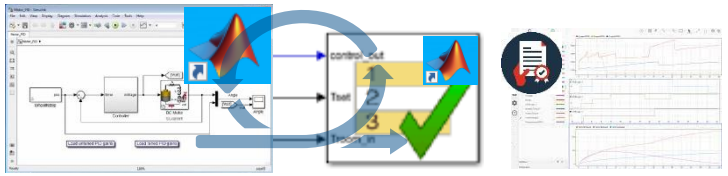

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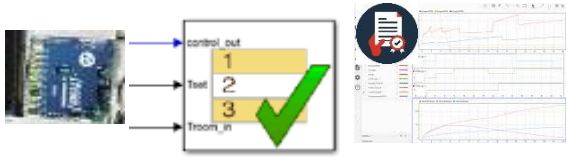
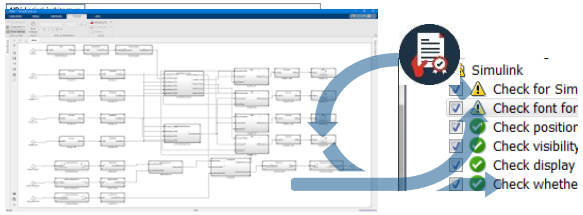


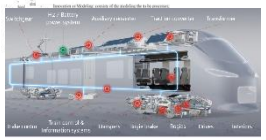


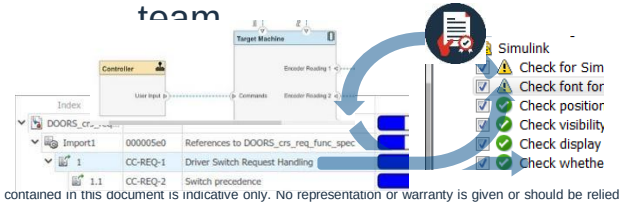
V&V Team

Control Architect

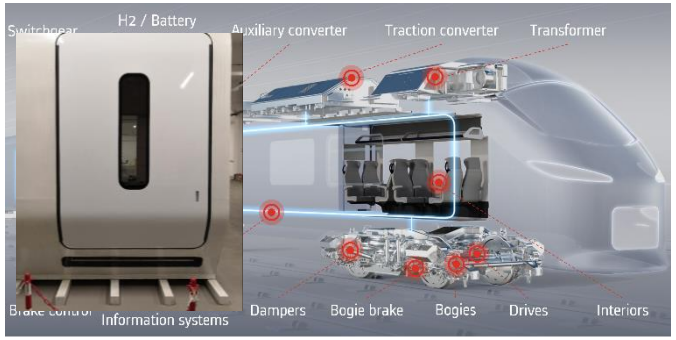
Train Lab

System team





Virtual Train engineer



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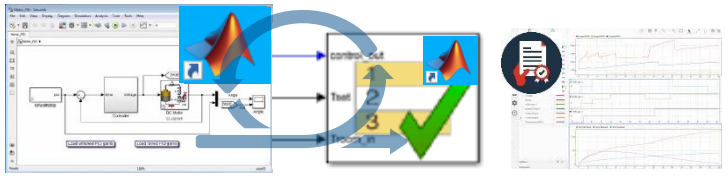
Our first semi-virtual train

KPI	+/-	Description
Time	↘	~50% time reduction re-using models
Cost	↘	50-70% cost reduction using same tool Simulink toolbox cost



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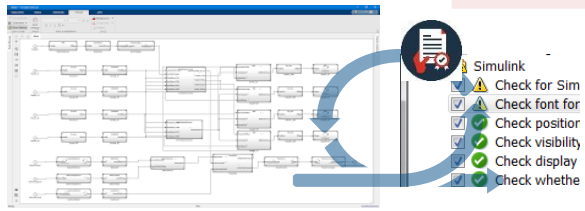
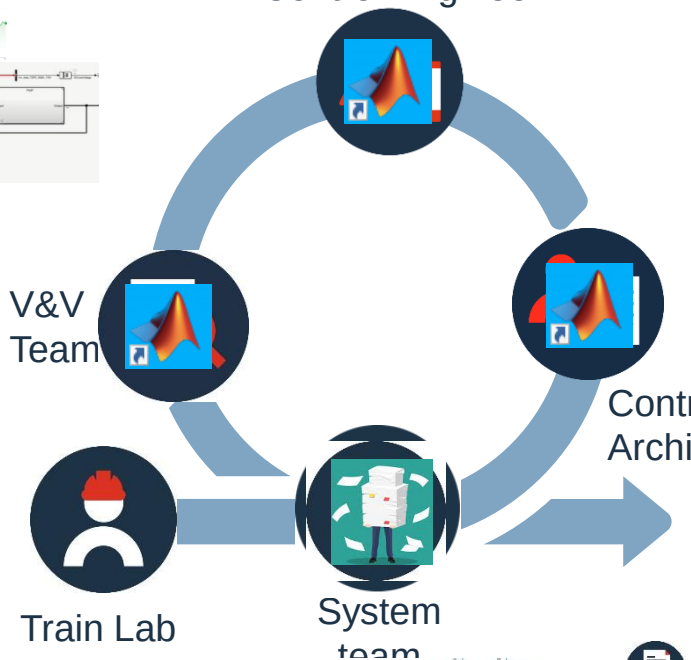
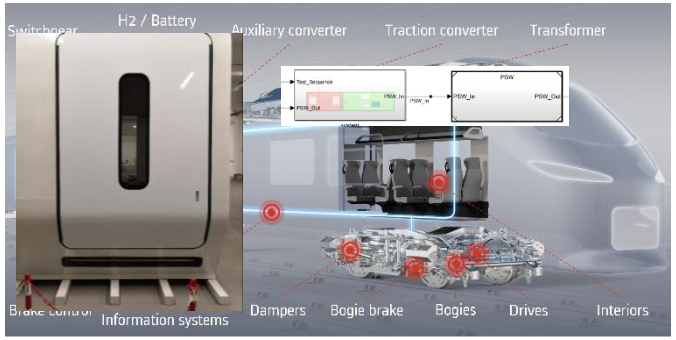
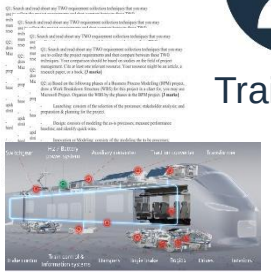


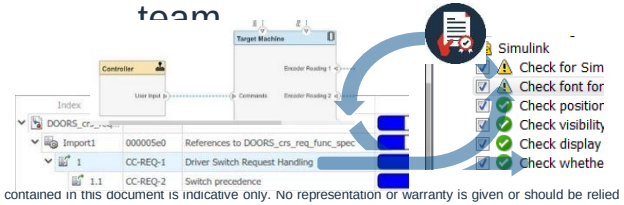


Train Lab

Virtual Train Engineer







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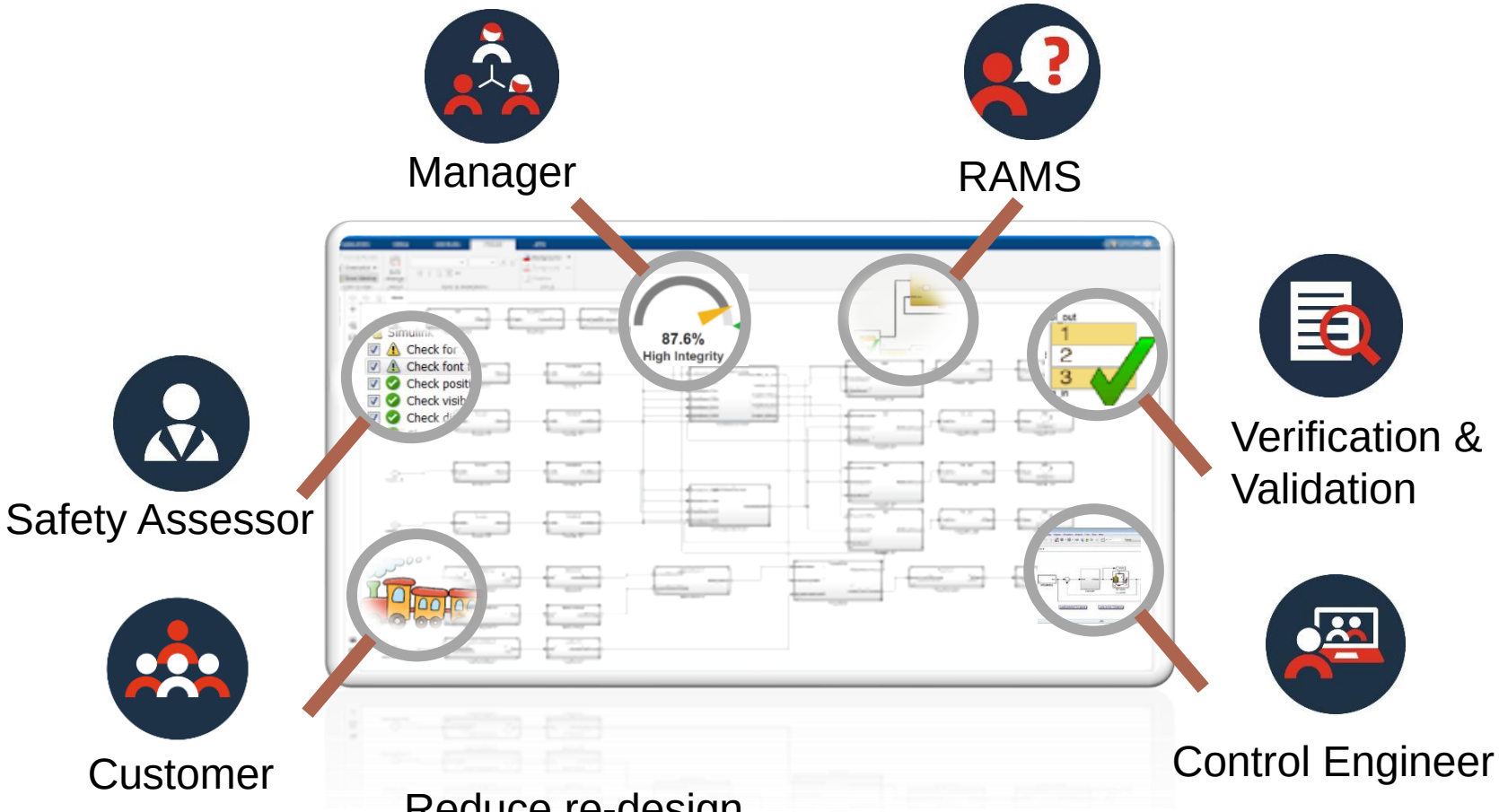
The Vision



Reduce re-design
Eliminate error prone implementation
→ Faster innovation to meet the market

Model Centric – The model is the truth

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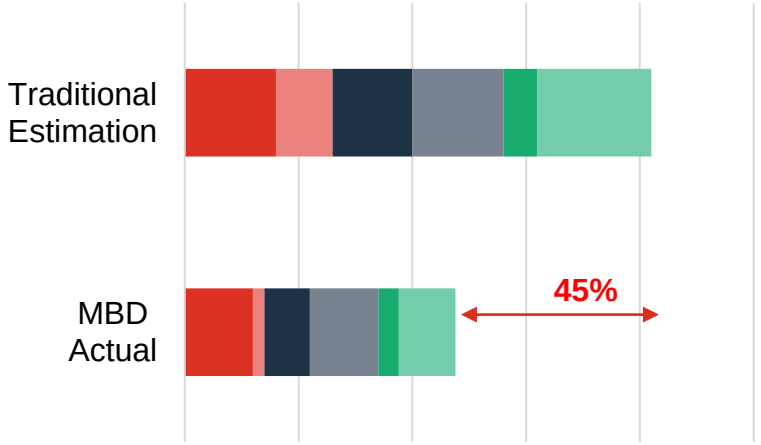
Conclusion



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