



# Virtual Commissioning with Simulink

## Part 2: Virtual Commissioning

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*“Harnessing technology is central to making  
insert your field here safer and more efficient”*

Gary Goldberg, President and Chief Executive Officer, Newmont  
Mining Corporation, USA

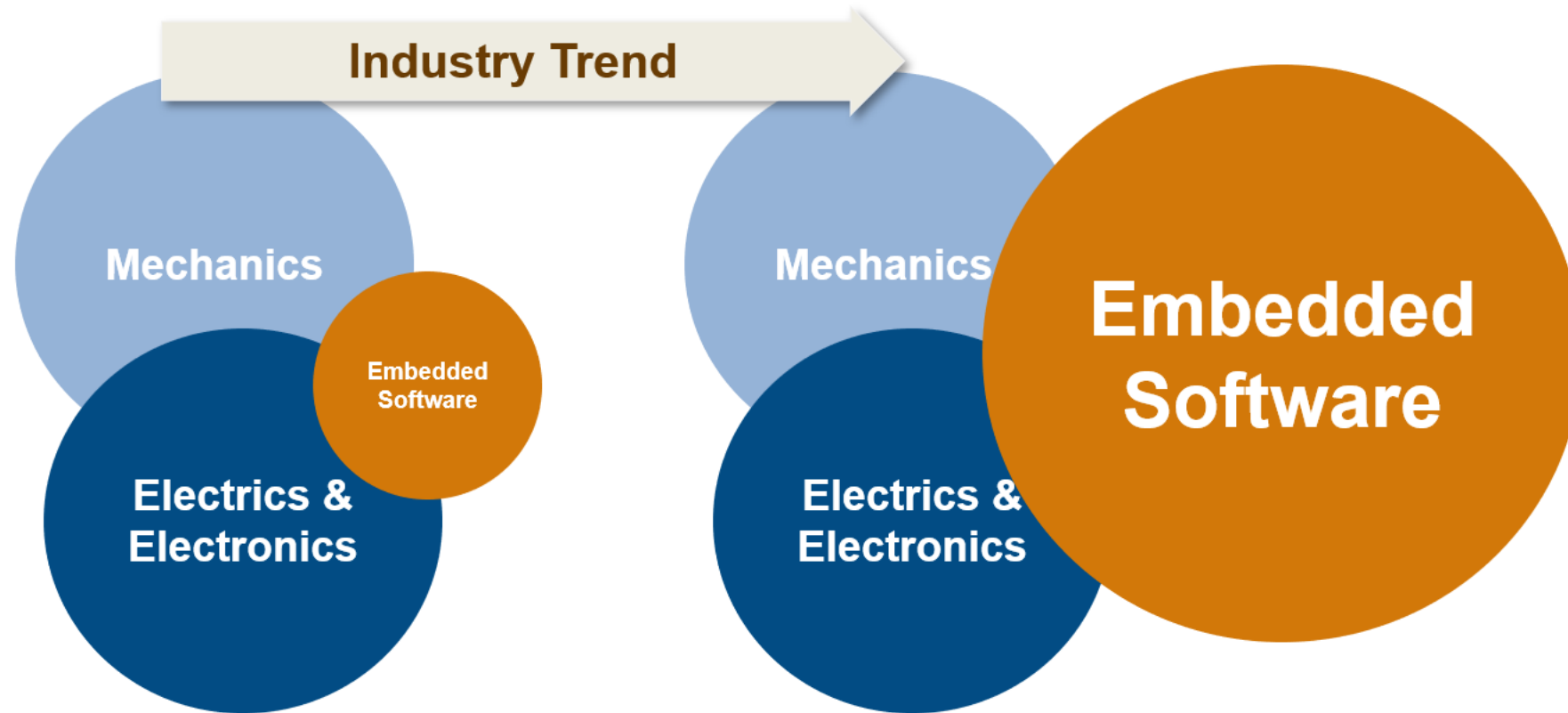


Source:

[Digital Transformation Initiative, Mining and Metals Industry  
\[2017, World Economic Forum in collaboration with Accenture\]](#)

Analytics techniques applied to big data and the use of new sensors can strengthen process control and boost plants' hourly profit by optimizing process parameters used to balance yield, throughput, recovery, and material costs. For example, yield, energy, and throughput (YET) analytics alone can improve EBITDA by 2 to 3 percentage points (reducing manufacturing costs by 3 to 5 percent, and leading to significant debottlenecking opportunities).

All industries experience a trend to increasingly complex systems

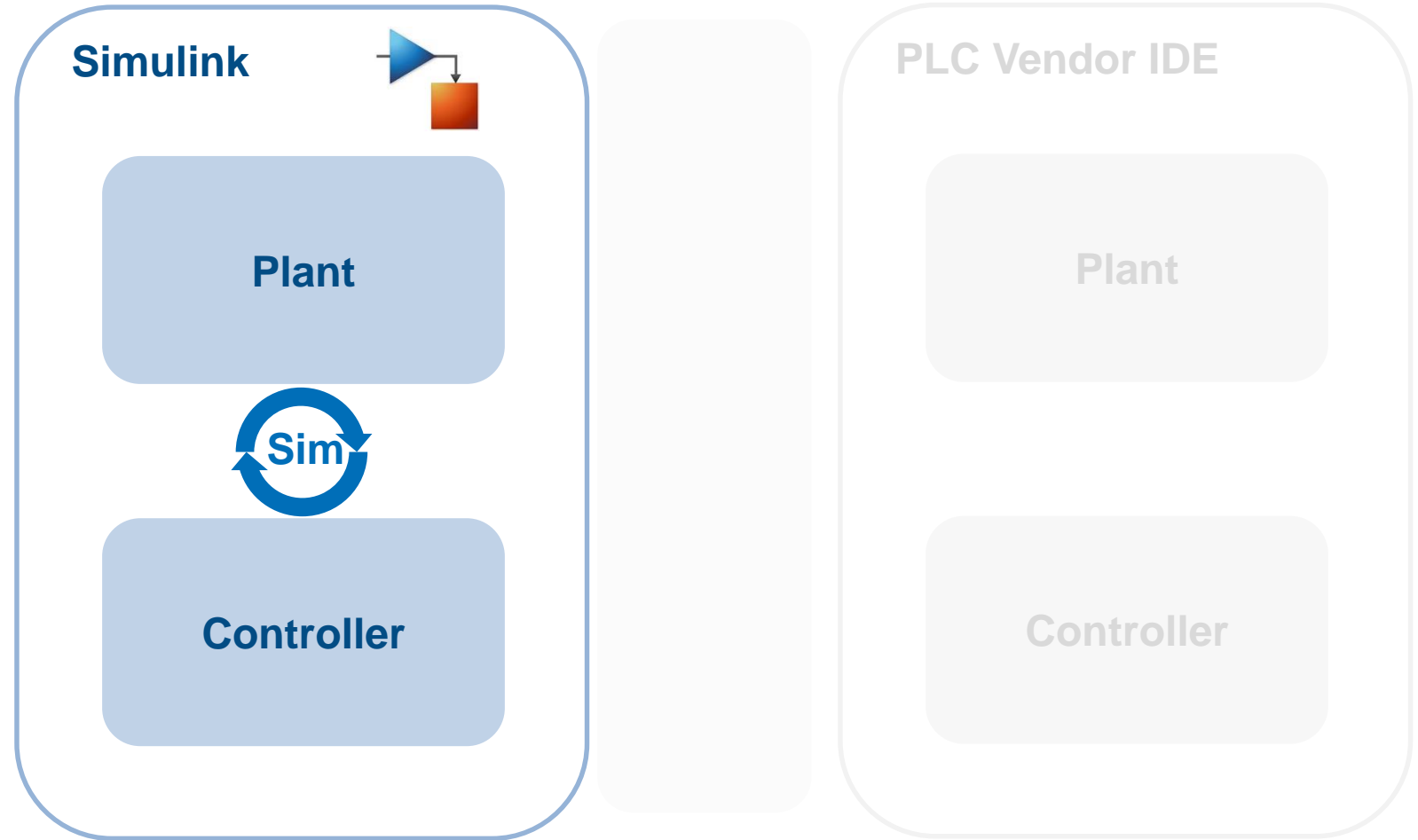


Trying new technology on the physical system can be expensive and sometimes impossible



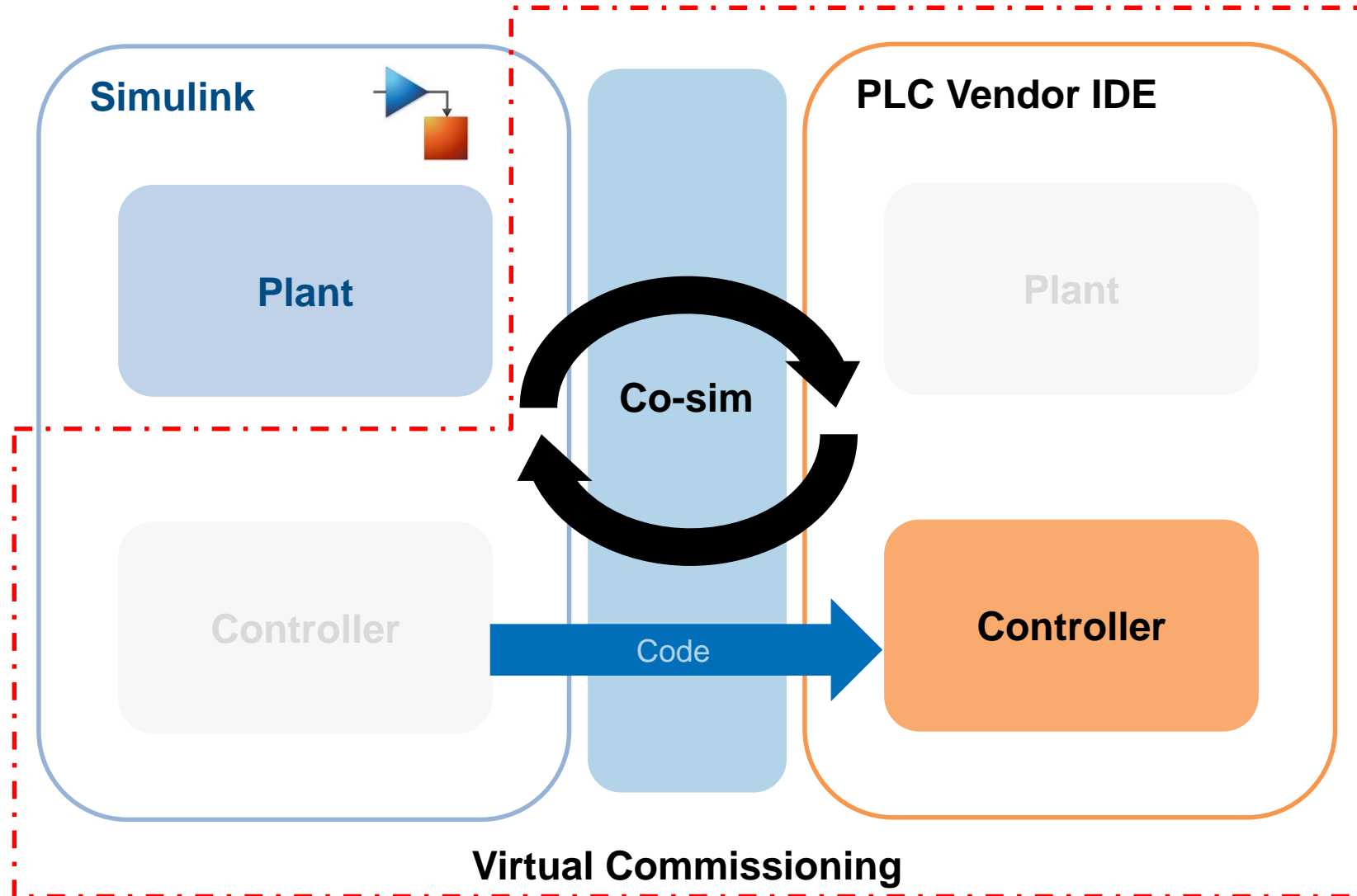
# Using a virtual system (model) for design is your first step

- ✓ Simulation



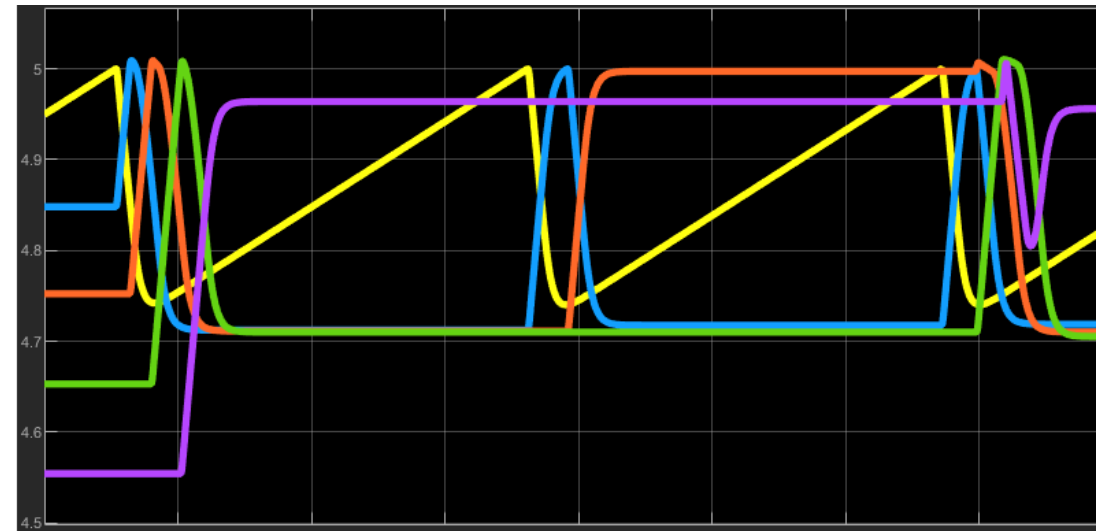
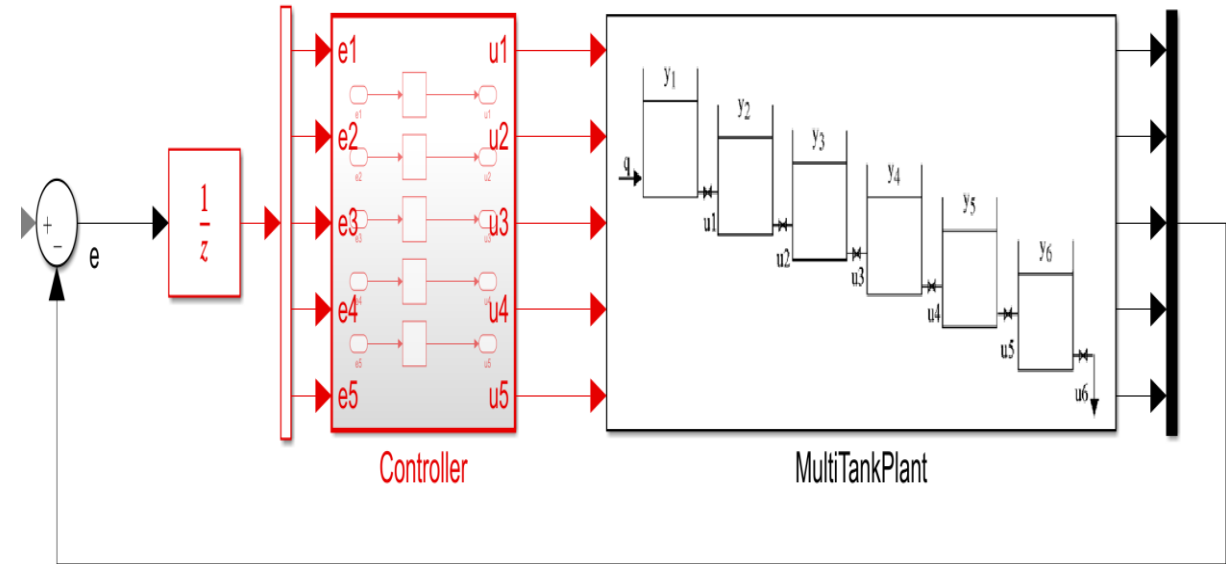
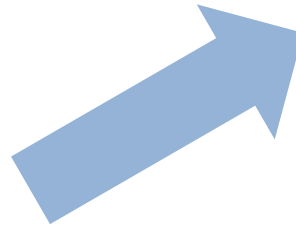
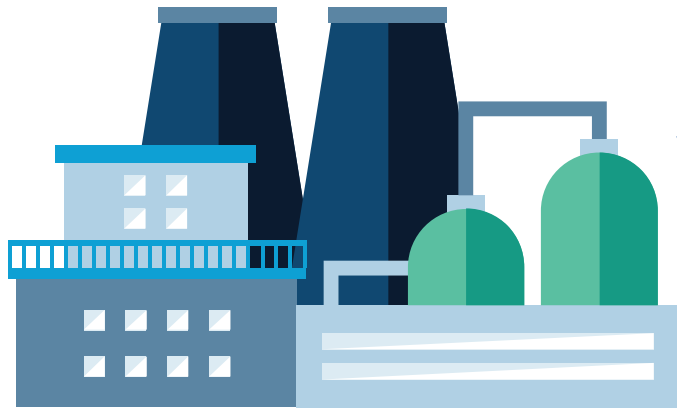
# Integrating your model with real system is the second step

- ✓ Simulation
- Code Generation
- Virtual Commissioning



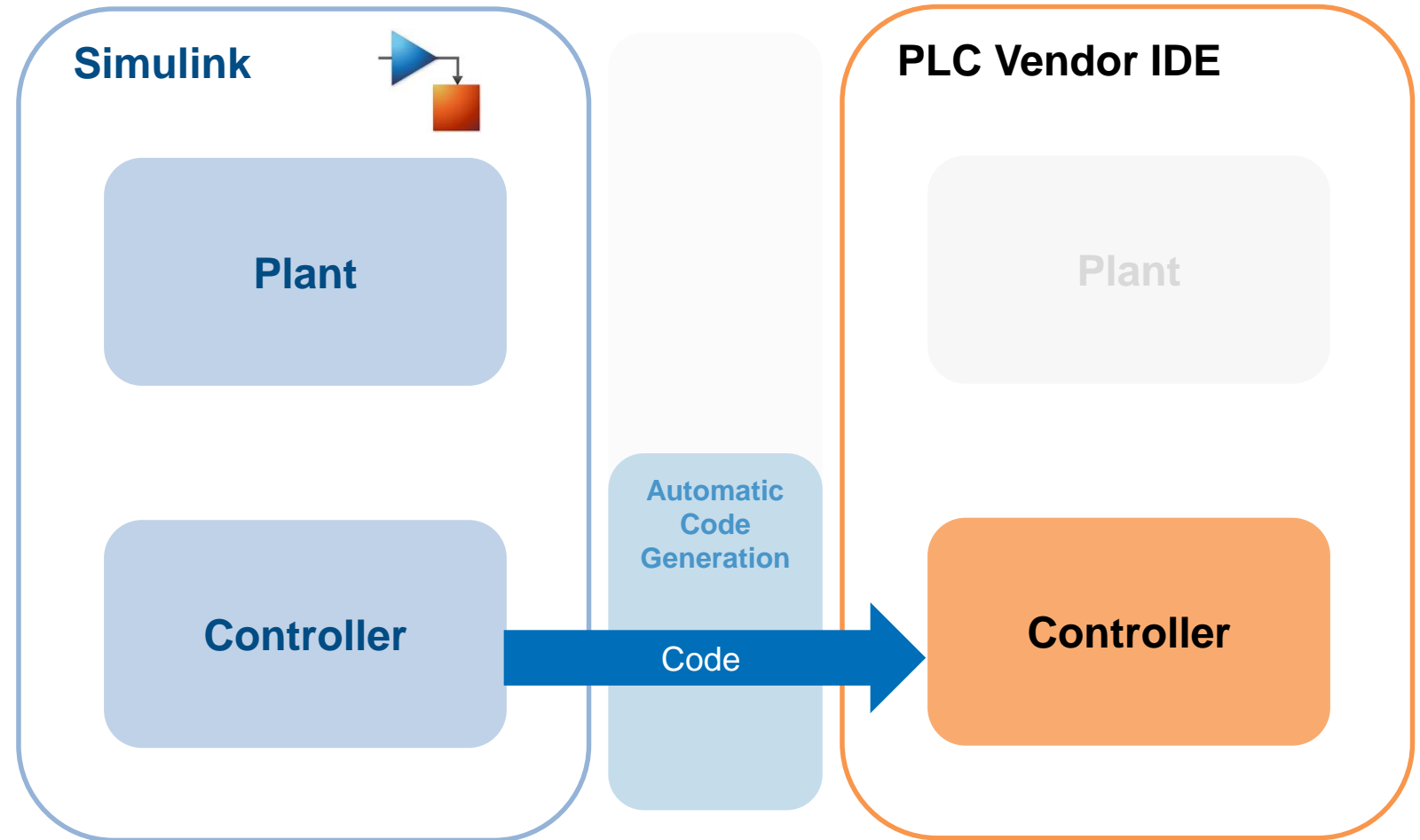


# 'Virtual commissioning' tests your new algorithm with a virtual plant

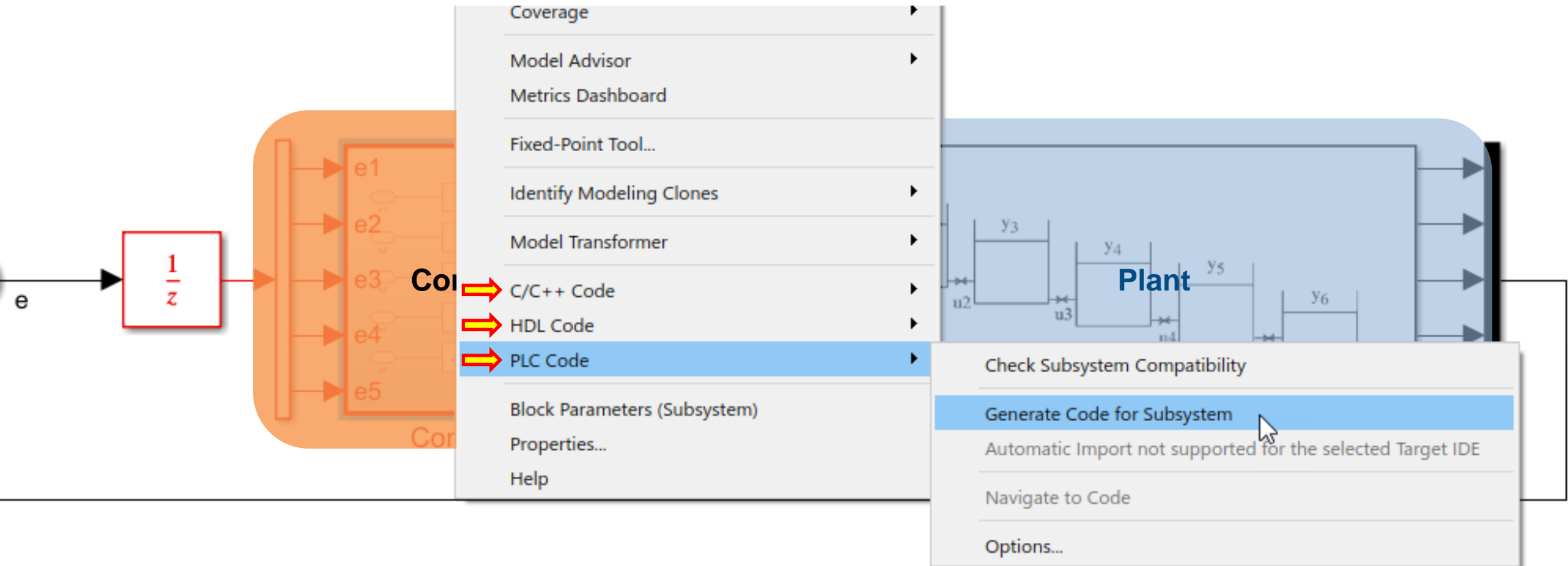


# Automatically transfer your algorithm to your controls platform

- ✓ Simulation
- Code Generation



# Code Generation is simple, fast and reliable



# Generated code is traceable back to your design

The screenshot displays the Simulink environment for a multiTankPID\_plc model. The main workspace shows a block diagram with a  $\frac{1}{z}$  block and a Controller block containing five parallel paths (e1-u1 to e5-u5). The Diagnostic Viewer window is open, showing a warning about back-inherited sample times and a successful PLC code generation report. The report includes the following text:

```

Component: Simulink | Category: Block warning
Source 'multiTankPID_plc/level2SPI' specifies that its sample time (-1) is back-inherited. You should explicitly specify the sample time of sources. You can disable this diagnostic by setting the 'Source block specifies -1 sample time' diagnostic to 'none' in the Sample Time group on the Diagnostics pane of the Configuration Parameters dialog box.

Component: Simulink | Category: Block warning
Creating PLC Code Generation Check Report multiTankPID_plc_report.html
PLC check for 'multiTankPID_plc' complete with 0 errors, 320 warnings, and 0 messages.

Component: PLC Coder | Category: PLC Coder
Datatypes that are unsupported for current target IDE have been found. Please check report multiTankPID_plc_report.html. Data type conversion and precision loss may happen in the generated code.

Component: PLC Coder | Category: PLC Coder warning
Component: PLC Coder | Category: PLC Coder
Component: PLC Coder | Category: PLC Coder
### Emit PLC code to file.
### Creating PLC code generation report multiTankPID_plc_codegen_rpt.html.
### PLC code generation successful for 'multiTankPID_plc/Controller'.
### Generated files:
plcsrc\multiTankPID_plc\multiTankPID_plc.scl
Component: PLC Coder | Category: PLC Coder

```

The Traceability Report and Code Metrics Report sections are also visible, with the generated file multiTankPID\_plc.scl highlighted. The bottom right of the image shows the generated C code for the controller, including saturation and summing logic:

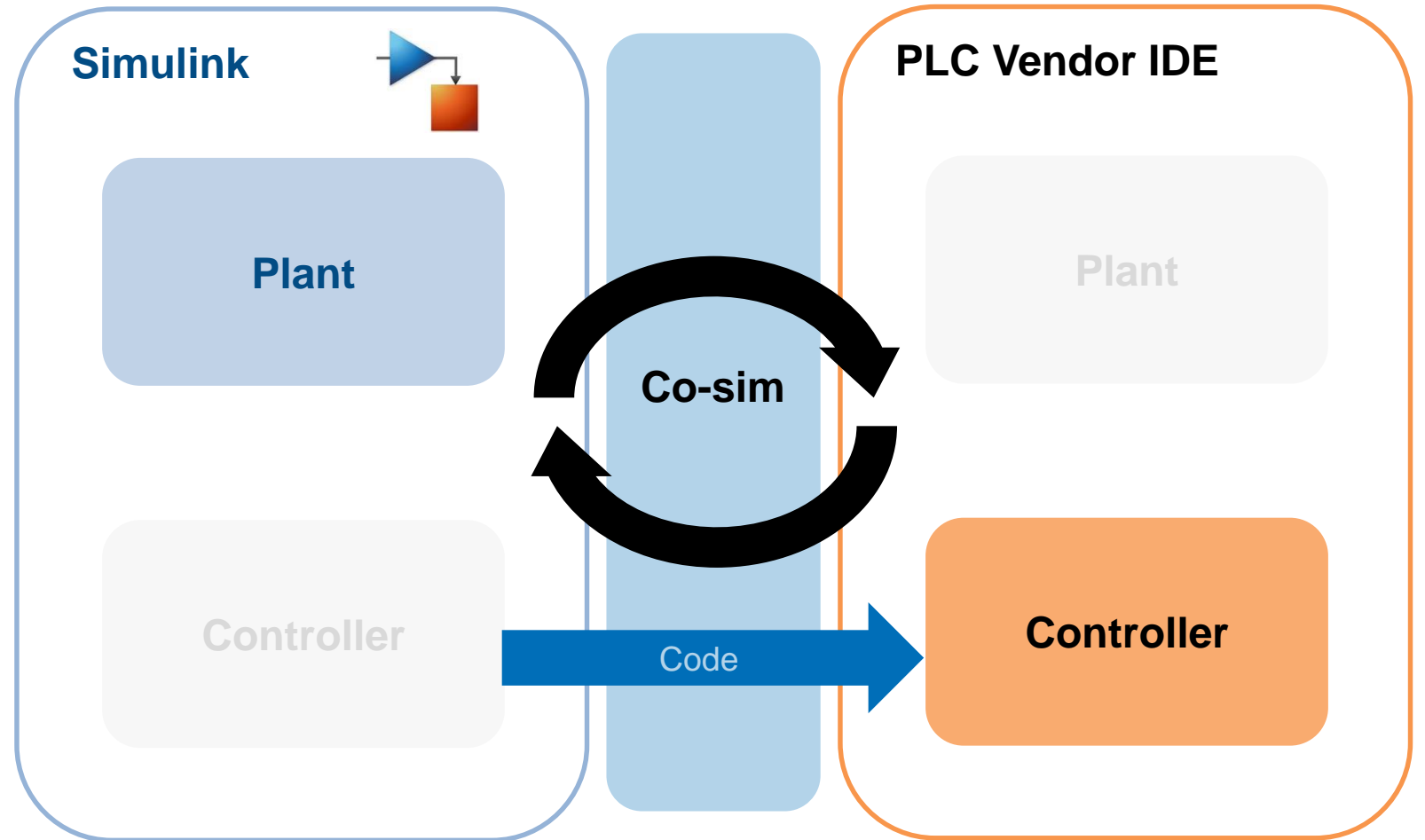
```

71     u1 := 0.0;
72     END_IF;
73     (* End of Saturate: '<S45>/Saturation' *)
74
75     (* Sum: '<S95>/Sum' incorporates:
76      * DiscreteIntegrator: '<S86>/Integrator'
77      * Gain: '<S91>/Proportional Gain' *)
78     u2 := (-5.2447291529139548 * e2) + Integrator_DSTATE_p;
79     (* Saturate: '<S93>/Saturation' *)
80     IF u2 >= 0.3 THEN
81         (* Output: '<Root>/u2' *)
82         u2 := 0.3;
83     ELSIF u2 <= 0.0 THEN
84         (* Output: '<Root>/u2' *)
85         u2 := 0.0;
86     END_IF;
87     (* End of Saturate: '<S93>/Saturation' *)
88
89     (* Sum: '<S143>/Sum' incorporates:
90      * DiscreteIntegrator: '<S134>/Integrator'
91      * Gain: '<S139>/Proportional Gain' *)
92     u3 := (-4.32994523979992 * e3) + Integrator_DSTATE_n;
93     (* Saturate: '<S141>/Saturation' *)
94     IF u3 >= 0.3 THEN
95         (* Output: '<Root>/u3' *)
96         u3 := 0.3;
97     ELSIF u3 <= 0.0 THEN
98         (* Output: '<Root>/u3' *)
99         u3 := 0.0;
100    END_IF;
101    (* End of Saturate: '<S141>/Saturation' *)
102
103    (* Sum: '<S191>/Sum' incorporates:
104     * DiscreteIntegrator: '<S182>/Integrator'
105     * Gain: '<S187>/Proportional Gain' *)
106    u4 := (-4.5605211846083487 * e4) + Integrator_DSTATE_a;
107    (* Saturate: '<S189>/Saturation' *)
108    IF u4 >= 0.3 THEN
109        (* Output: '<Root>/u4' *)

```

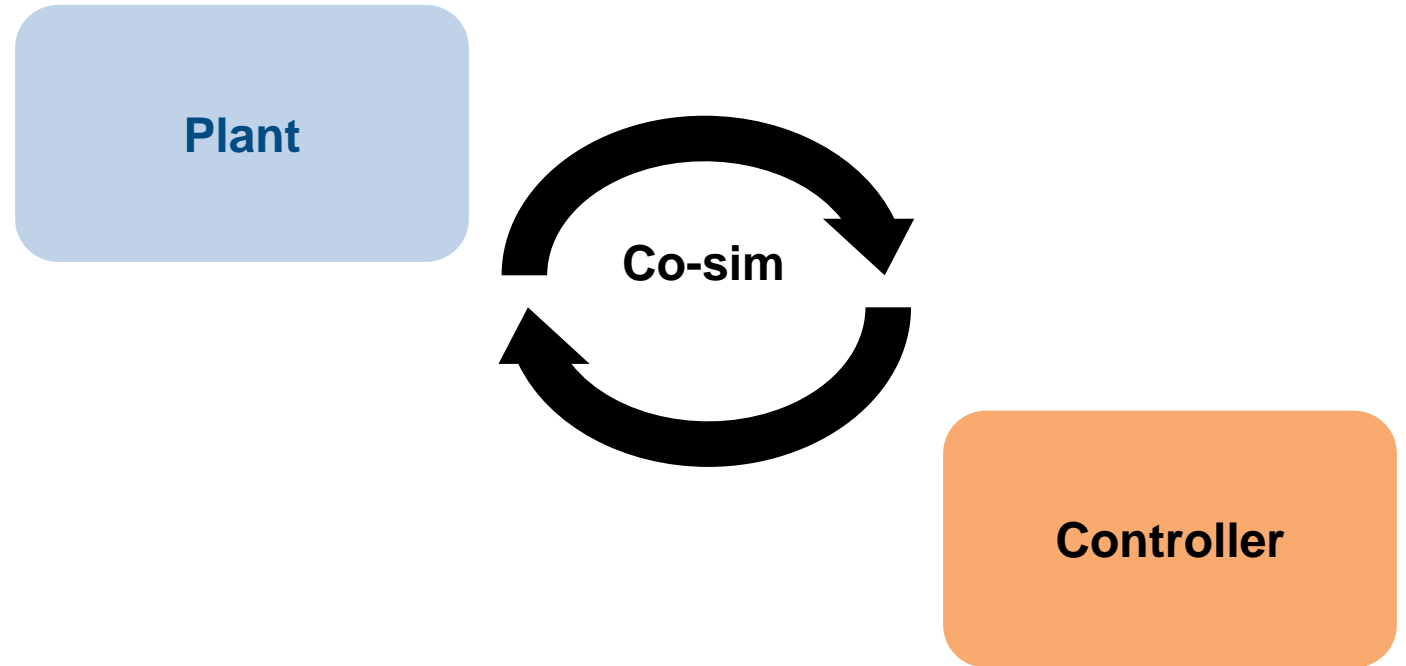
# Simulate your production algorithm with a virtual plant

- ✓ Simulation
- ✓ Code Generation
- Virtual Commissioning

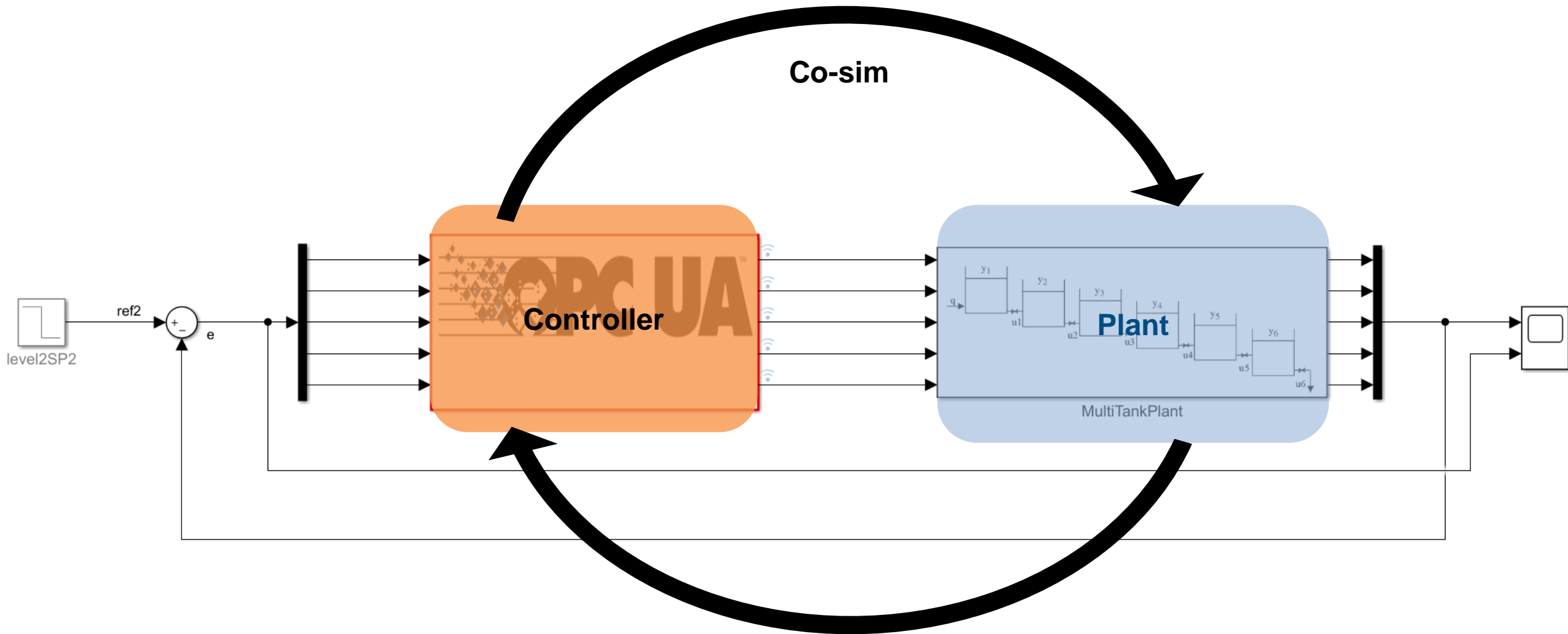


# Simulate your production algorithm with a virtual plant

- ✓ Simulation
- ✓ Code Generation
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# Virtual Commissioning looks just like a regular simulation

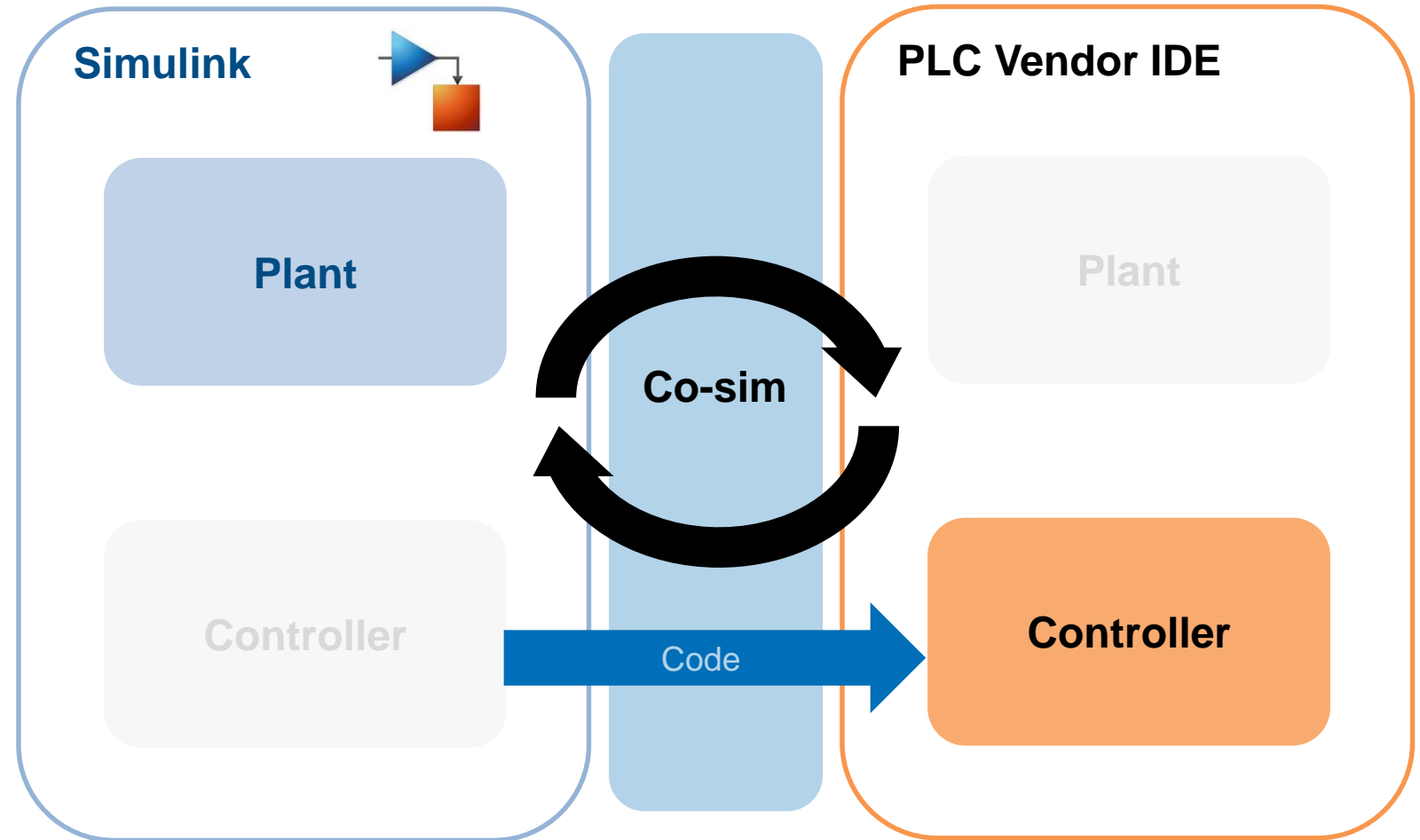


Let's see this in action



## We just saw a Simulink plant model co-simulating with a PLC

- ✓ Simulation
- ✓ Code Generation
- ✓ Virtual Commissioning



## When you use virtual commissioning you can also ...



Deploy optimal algorithms to production automatically



Explore new plant designs with real control systems without affecting production



Leverage any platform  
(e.g. PLC vendors, FPGA, GPU, Cloud, Embedded ...)



Reuse the virtual plant as a training simulator

# Baker Hughes Improves Precision of Oil and Gas Drilling Equipment

## Challenge

Improve the quality and precision of directional measurement algorithms for oil and gas drilling equipment

## Solution

Use  
meas  
prod

Res

- E
- F
- F

**Expensive field tests minimized.** “A single field test can cost more than \$100,000, and even at that cost does not replicate the complex scenarios our customers encounter,” says Hoehn. “Simulations and HIL tests with Model-Based Design enabled us to simulate realistic conditions and conduct fewer field tests.”

Hardware (PLC) In the Loop  
= Virtual Commissioning



teerable System

expertise and  
bedded Coder  
our resources  
m design and

- Ingolf Wassermann, Baker Hughes

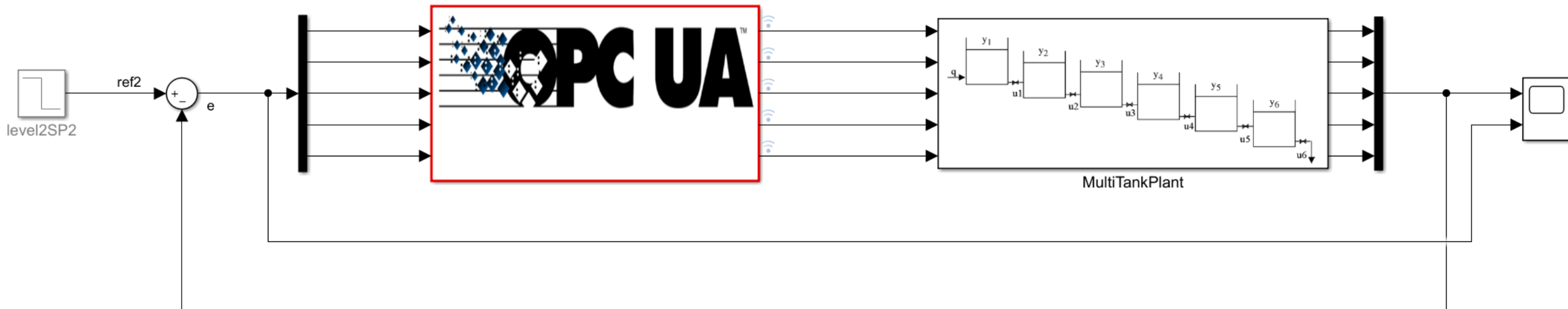
# Leverage Virtual Commissioning with Simulink to



**Reduce risk of costly downtime** by testing integration of new algorithms virtually first



**Save time** by rapidly iterating your design in a virtual environment



# Save time and money by using Simulink models for your design



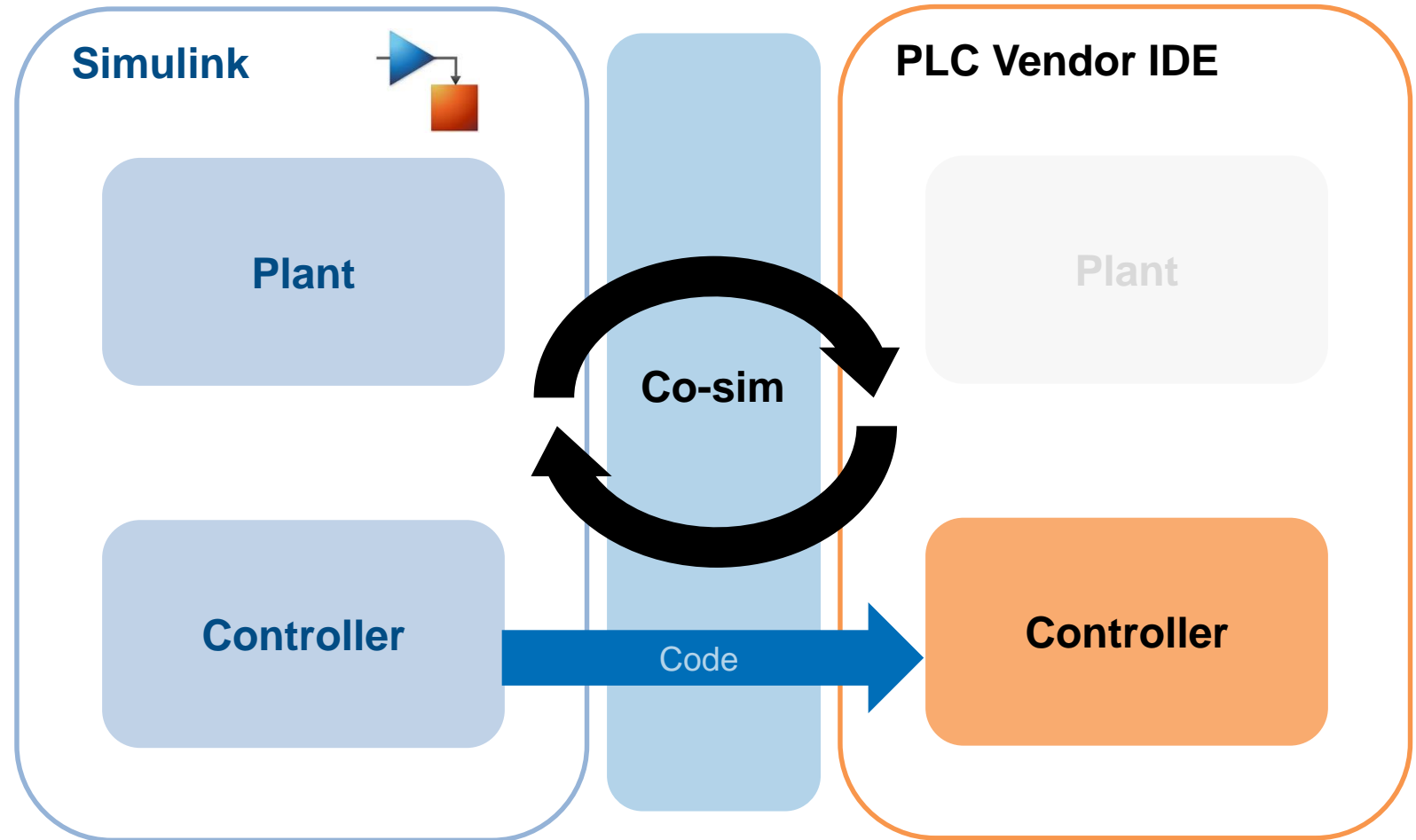
**Reduce risk of costly downtime** by testing your algorithms in simulation first, and then by validating the integration of new algorithms virtually



**Improve** performance of your increasingly complex system



**Save time** by rapidly iterating your design in a virtual environment



# Where to go from here



## Attend upcoming webinars

- [MATLAB and Simulink for Mining Webinar Series](#)

## Additional resources on our website

- [Virtual Commissioning White Paper](#)
- [Virtual Commissioning with Simulink](#)
- [Mining Webinar – Part 1: Design with Simulation](#)



## Contact us for guided evaluation

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