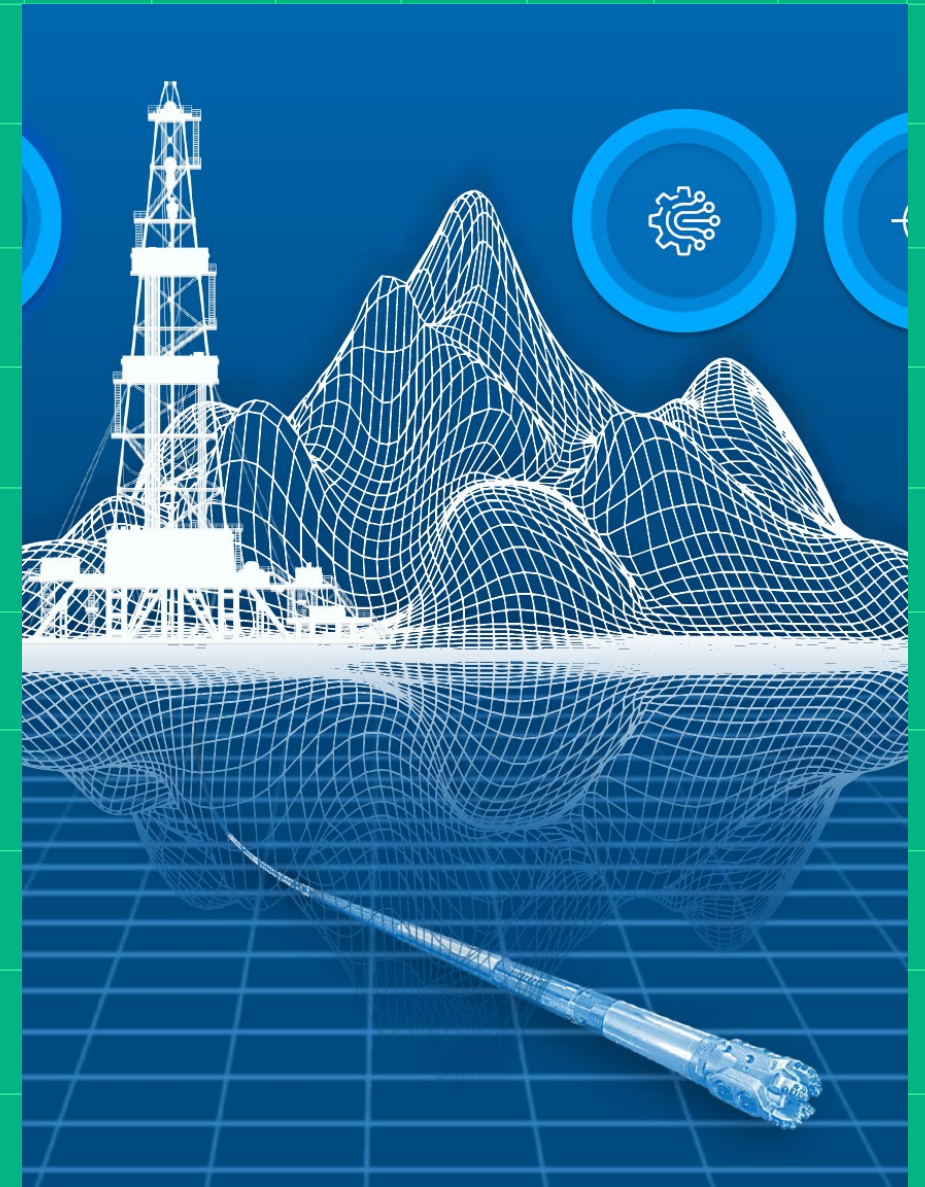


Modernizing Embedded Software Design, Test & Validation

Solomon Idinyang

Luc Argentier



What we do



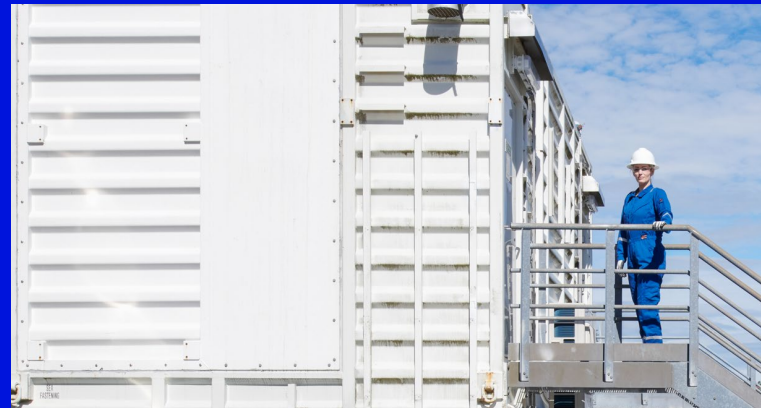
Decarbonizing industry

Working together to abate emissions



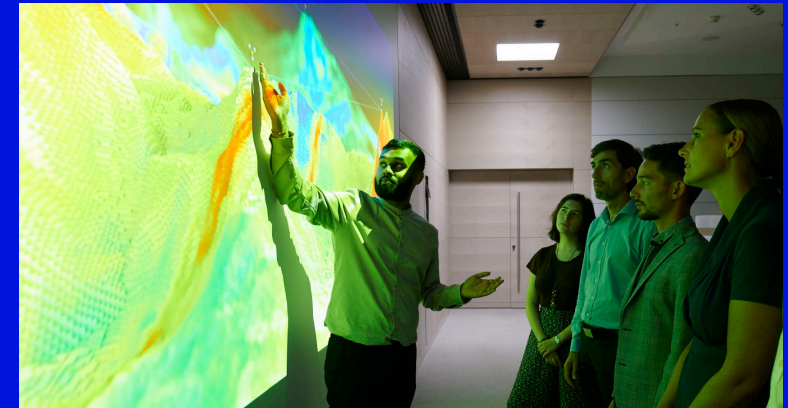
Innovating in oil and gas

Improving performance
in the oil and gas industry



Scaling new energy systems

Accelerating the transition
to clean energy



Delivering digital at scale

Accelerating time to value



SLB Drilling

Safety



High Temp



High Pressure



Innovation



SLB Business Context



**Market
Variability**



**Product
Complexity**



**Time to
Market**



SLB Business Context



**Market
Variability**



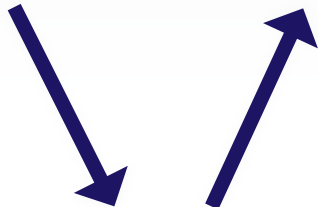
**Product
Complexity**



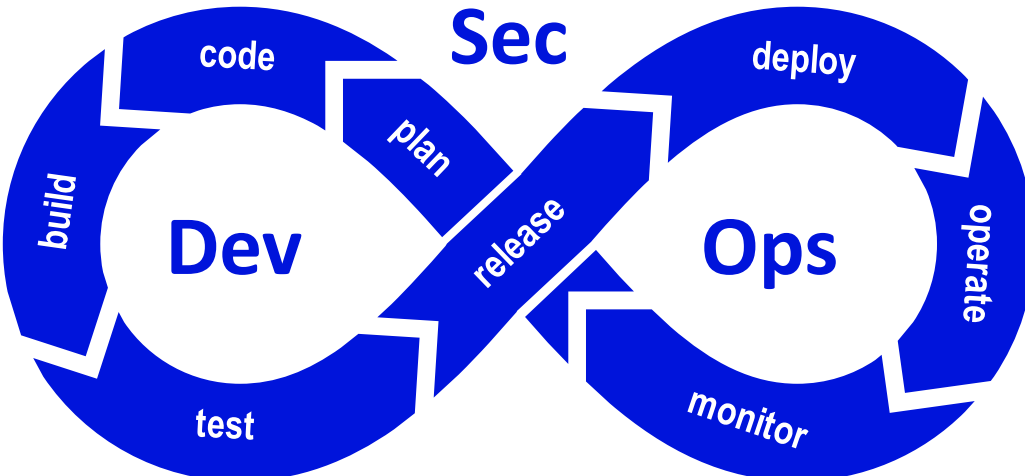
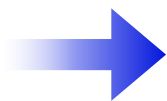
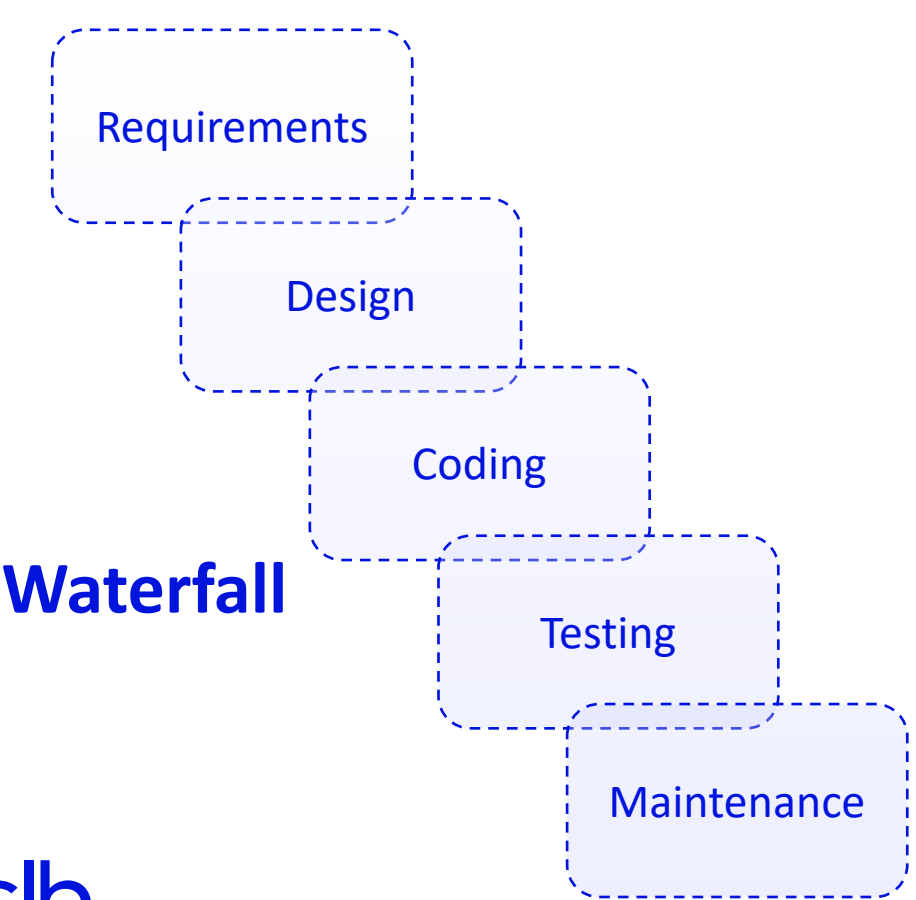
**Time to
Market**

ENG

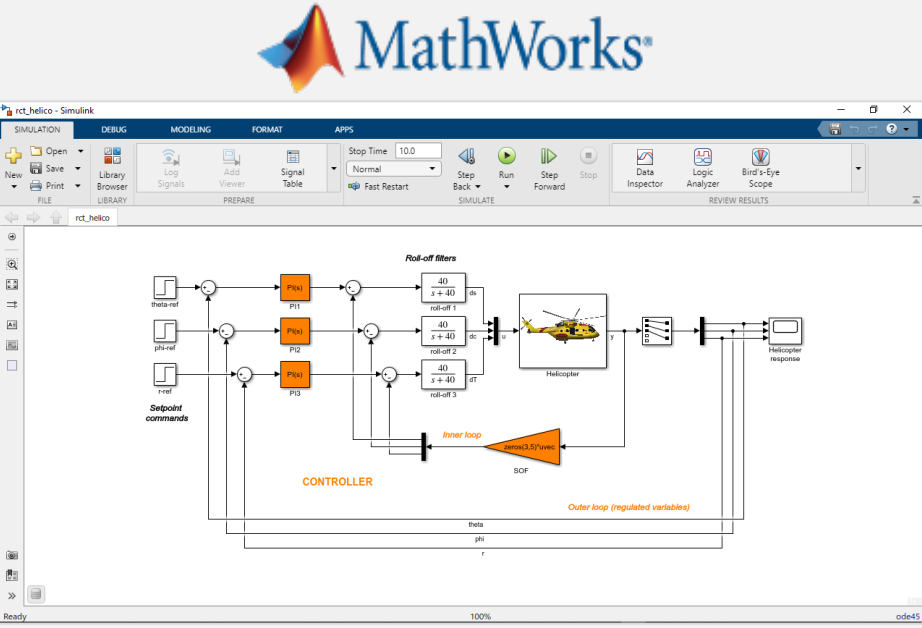
UPDATES



Modernizing Our Processes

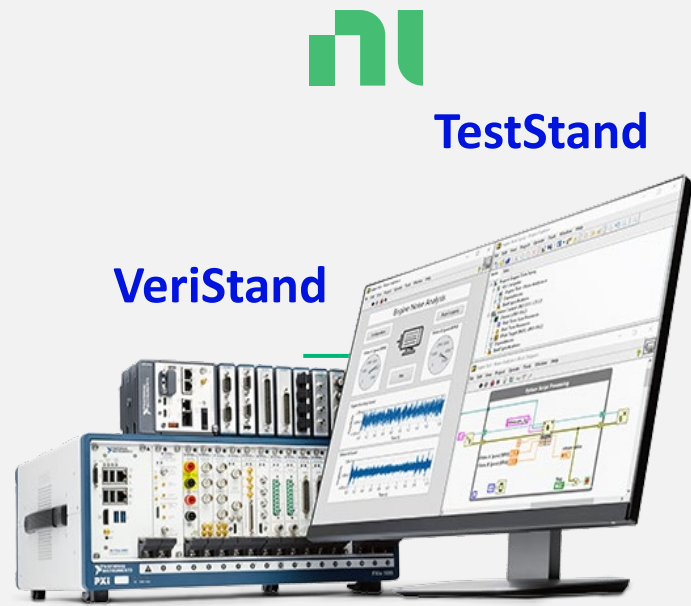


Embedded Software Modernization Infrastructure



The screenshot displays the MathWorks Simulink environment. The main workspace shows a control system model for a helicopter. It includes a 'CONTROLLER' block with an 'Inner loop' and an 'Outer loop (regulated variables)'. The model consists of several blocks: 'Setpoint commands' (theta-ref, phi-ref, rref), three PI controllers (P1, P2, P3), 'Roll-off filters' (roll-off 1, 2, 3), a 'Helicopter' plant block, and a 'SOF' (Step Function) block. The interface includes a menu bar (SIMULATION, DEBUG, MODELING, FORMAT, APPS), a toolbar with simulation controls (Stop, Run, Step Forward, Step Back, Fast Restart), and a status bar at the bottom indicating 'Ready' and '100%' completion.

Simulink



The photograph shows a PXI (PCI eXtensible Instrument) test system. A monitor in the foreground displays the TestStand software interface, which is used for test execution and data collection. The TestStand interface shows a test sequence diagram and various data plots. The PXI system itself is a rack-mounted hardware unit with multiple slots for modules. The VeriStand software is also mentioned in the context of the infrastructure.

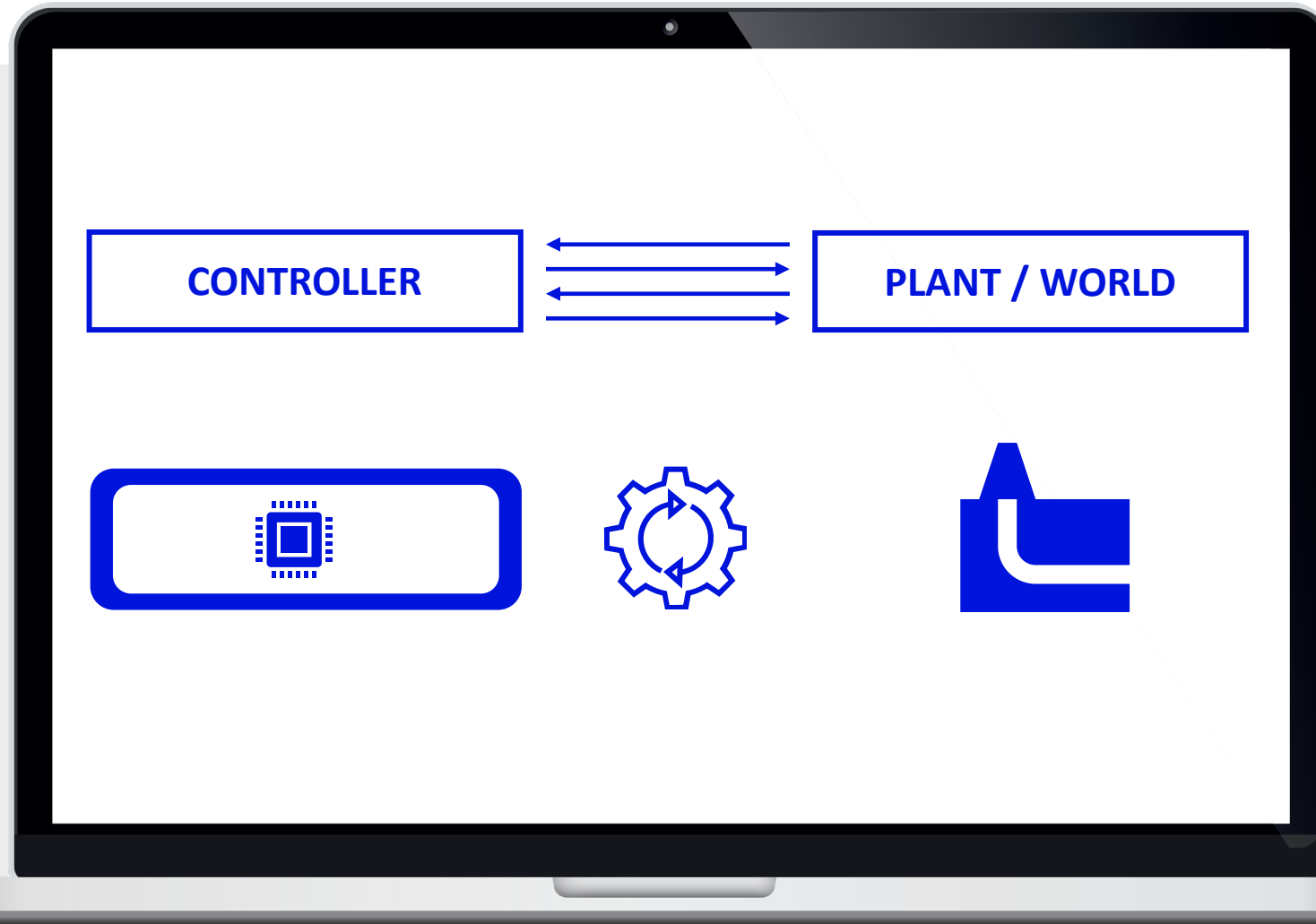
TestStand

VeriStand

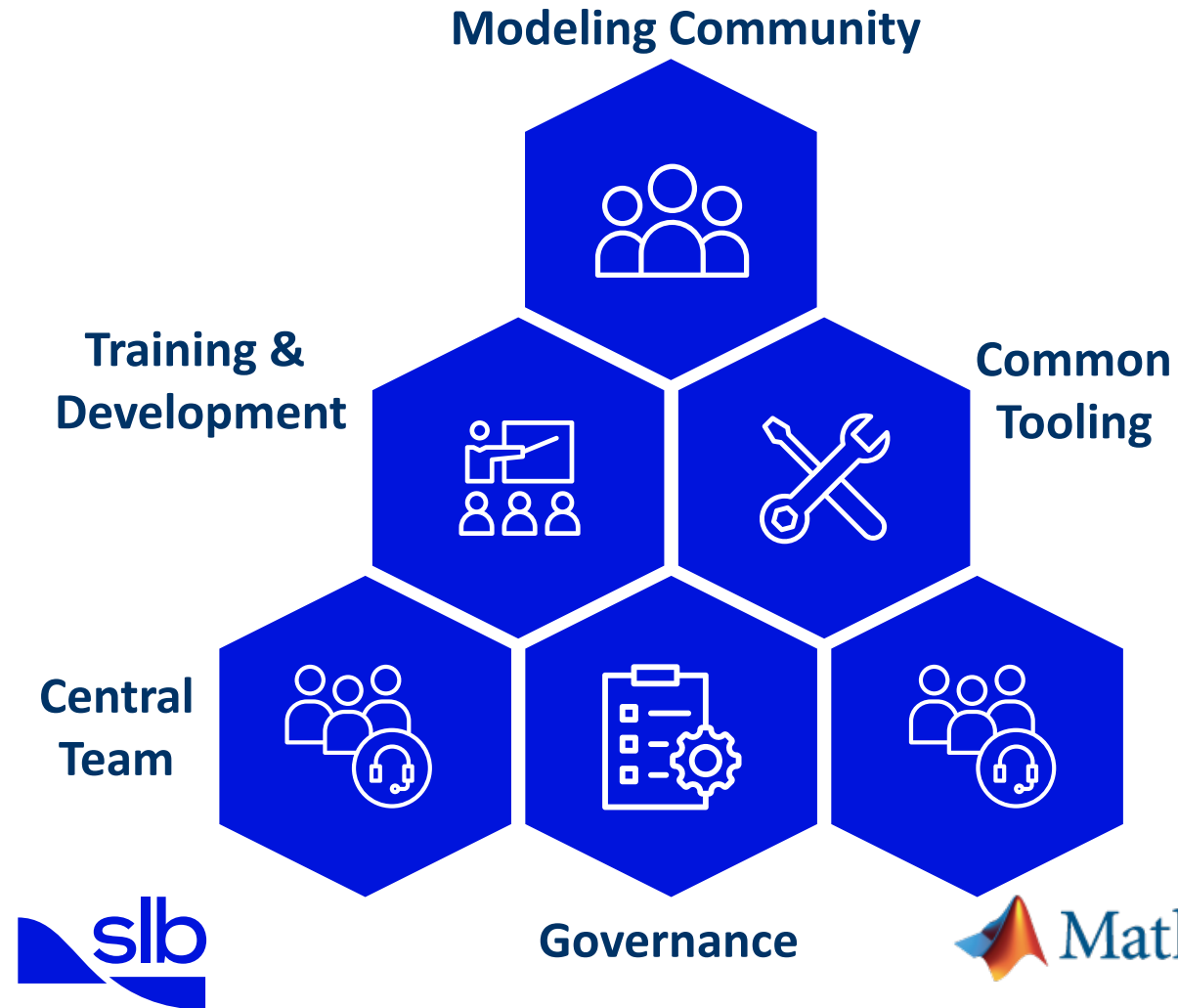
Standardized Test Infrastructure



Behavioral Modelling



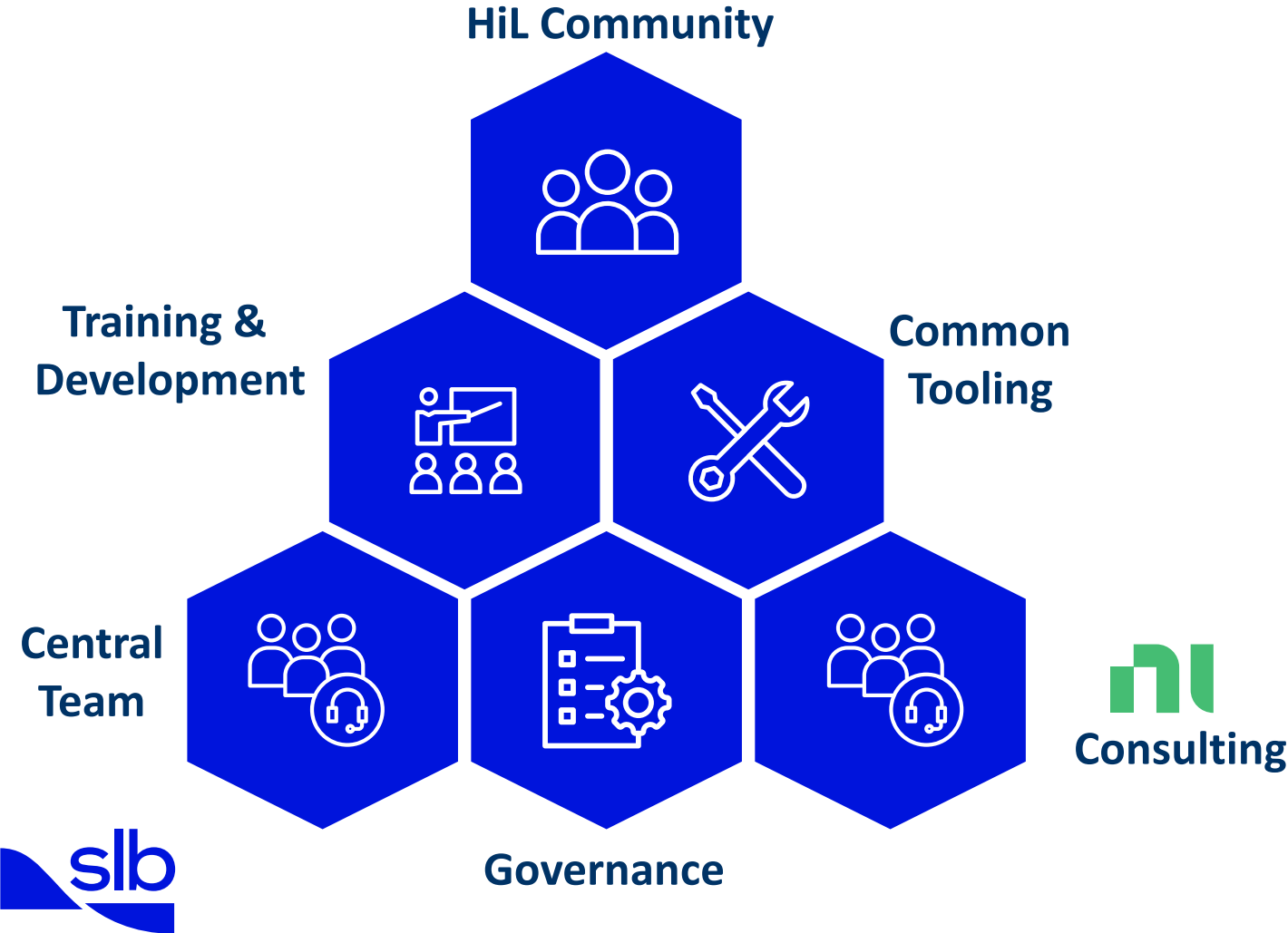
XiL Modeling



Central Library



Modernizing HiL

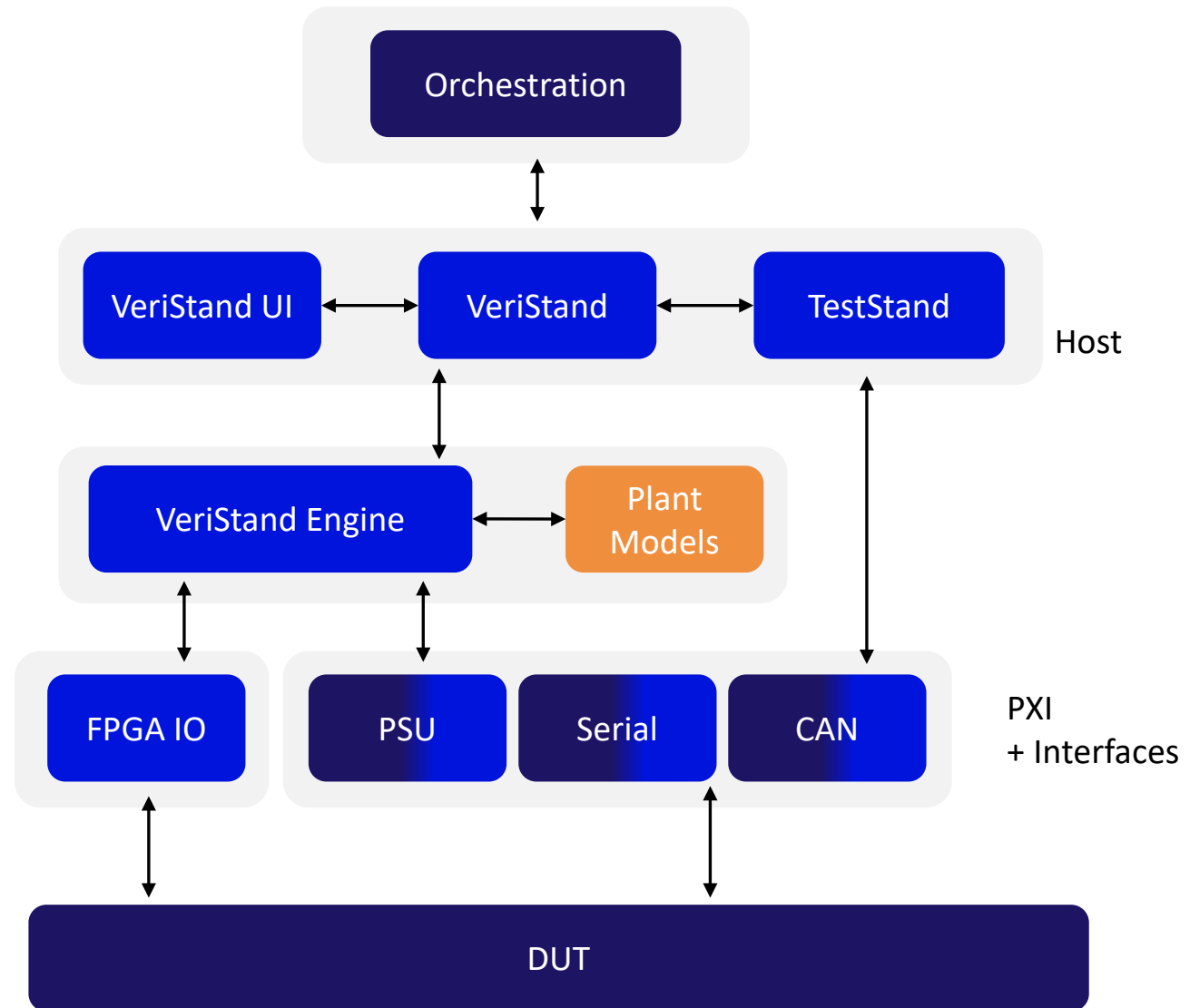


Common Architecture



Standardized HiL Architecture

- PXI with Linux RT
- VeriStand
- TestStand



Training... For Re-use

**MathWorks
Modeler**

**Simulink/
Simscape**

NI Basic

**Basic
VeriStand and
TestStand**

NI Expert

**Advanced
LabView,
VeriStand and
TestStand**



Example – PowerDrive, Rotary Steering Tool

Existing Fleet

- Rapid response
- Prevent failures in operation

New Projects

- Left shift testing
- Enable innovation
- Increase business confidence



PowerDrive Orbit RSS



Autonomous Drilling

Ability for steerable systems to autonomously steer minimizes intervention from surface

Near Bit 6-axis continuous inclination & azimuth

DOWNHOLE AUTOMATION

RSS

ABSS

Vertical Section

Build

Tangent

Drop

Tangent

Build

Horizontal

Auto Vertical

Auto Inclination

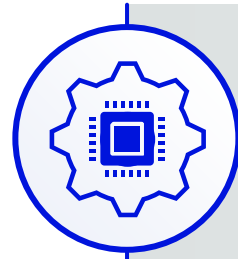
Auto Tangent

Auto Curve

The diagram illustrates an autonomous drilling system. At the top left, a 3D wireframe model of a surface drilling rig is shown. A blue line representing the wellbore path extends from the rig down into the earth. The path is divided into several sections: a purple 'Vertical Section', an orange 'Build' section, a blue 'Tangent' section, an orange 'Drop' section, another blue 'Tangent' section, an orange 'Build' section, and finally a blue 'Horizontal' section. To the right of the wellbore path, four circular icons represent different automation capabilities: 'Auto Vertical' (purple), 'Auto Inclination' (blue), 'Auto Tangent' (orange), and 'Auto Curve' (orange). At the bottom left, two circular icons labeled 'RSS' and 'ABSS' show different drill bit designs. A central circular icon with a gear and signal waves is labeled 'DOWNHOLE AUTOMATION'. Text on the right states 'Ability for steerable systems to autonomously steer minimizes intervention from surface' and 'Near Bit 6-axis continuous inclination & azimuth'.



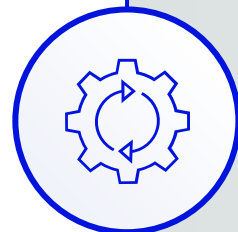
Conclusions



Adoption of Continuous Integration with automated testing



Reducing release cycle duration through SecDevOps and adoption of XiL



Standardization of tools, best practices and knowledge is key



Creating a community around modeling and XiL implementation with the support of a central team

Thank you

