DYNAMIC POSITIONING CONFERENCE
October 14-15, 2014

RELIABILITY

System Verification Helps Validate Complex Integrated Systems

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ABS

Systems Verification (SV) Helps Validate Complex Integrated Systems

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Houston, Texas
14-15 October 2014

Steve Jobs

"You're looking at it wrong. You're looking at it as a hardware person in a fragmented world. You're looking it as a hardware manufacturer that doesn't really know much about software, who doesn't think about an integrated product, but assumes the software will somehow take care of itself.
*And you assume that the software will somehow just come alive on this product that you're dreaming of, but it won't."*

- Oct. 18, 2010, Earning Conference Call

- Software must be engineered to the specifications which meet the expectations

Introduction

- Software-based systems control nearly all equipment

- As complexity increases, so does the demand for safety

- Challenges within software centered integrated systems

- A well tested system plays an important role in safety and reliability of the asset

- Hardware-in-the-Loop (HIL) testing is a system-level testing of embedded systems

Hardware-in-the-Loop
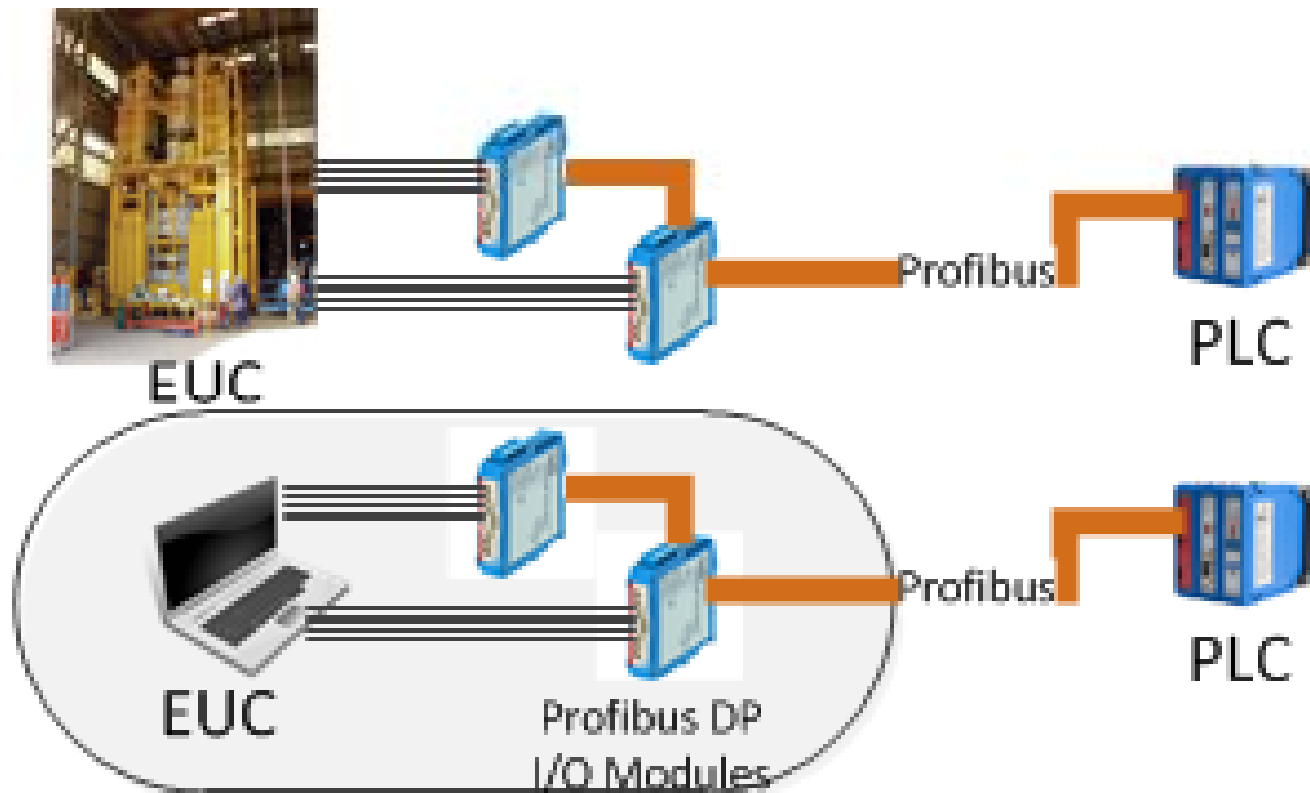
- The PLCs (or SBCs0 controls the equipment on the left)

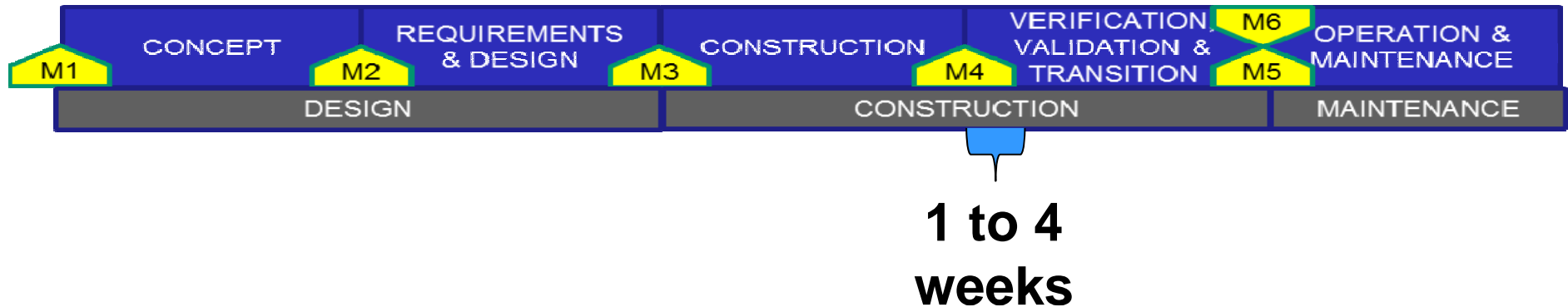- HIL testing simulates the equipment and its I/Os

Hardware-in-the-Loop

- By isolating the control system from its environment, HIL simulation mimics the signals of the I/Os for the system

- This allows for the equipment to be tested under normal, failed, and degraded states of the function without damaging the actual equipment

- Allows for testing at or beyond the limits of the critical or high risk systems

- Provides a safe test environment since the actual equipment is simulated

Software-in-the-Loop

EUC

Profibus

PLC

EUC

Profibus DP
I/O Modules

Profibus

PLC

PLC program running
on emulator
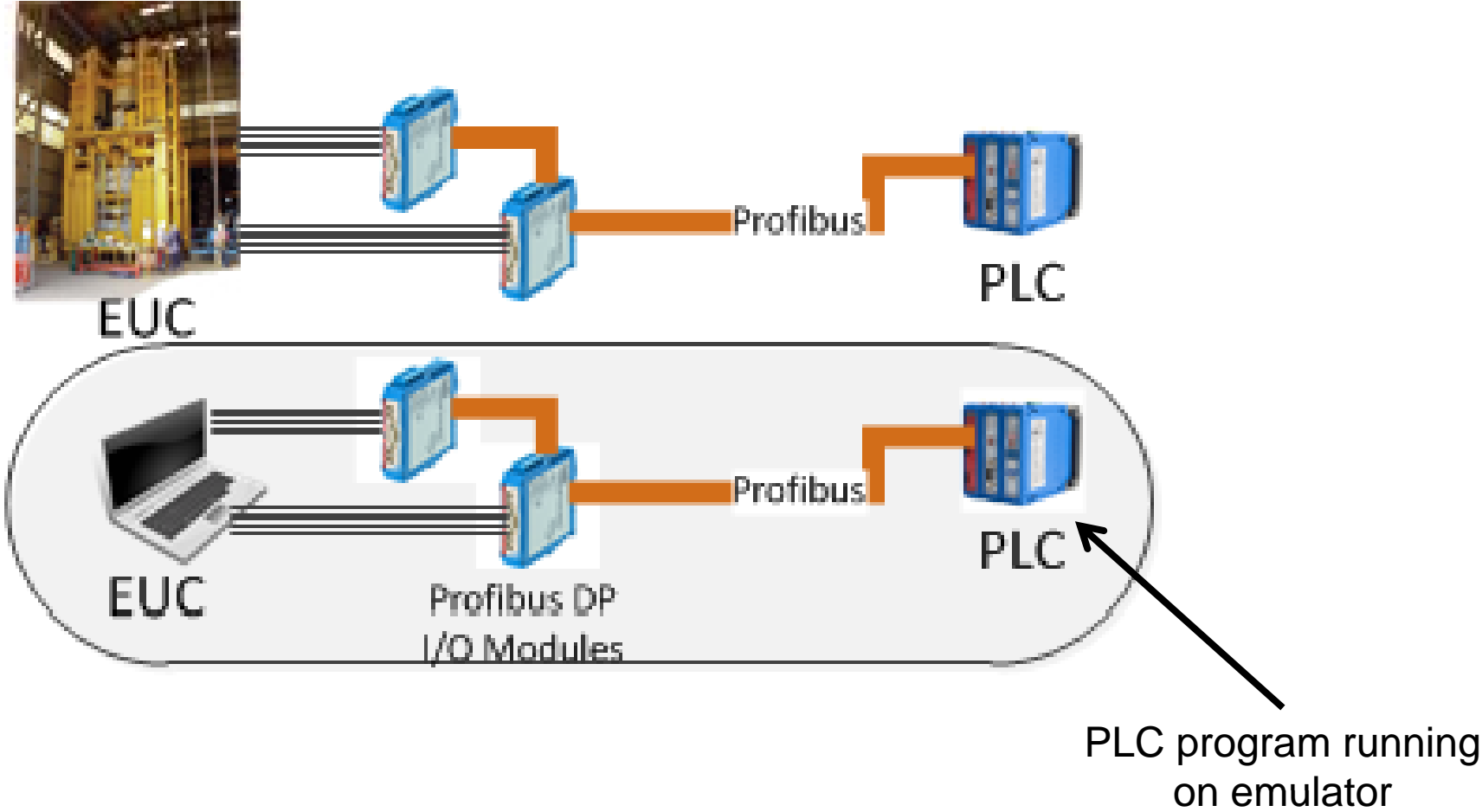
Software Development Life Cycle: SV

1 to 4 weeks

- HIL is a testing method to verify software that can be used as part of the verification phase

- HIL testing, is for a specific version of software

- Demonstrates that the software version 1.1.1 did preform and pass the specific tests detailed in the Verification Plan
  - May not be valid for version # 1.1.2

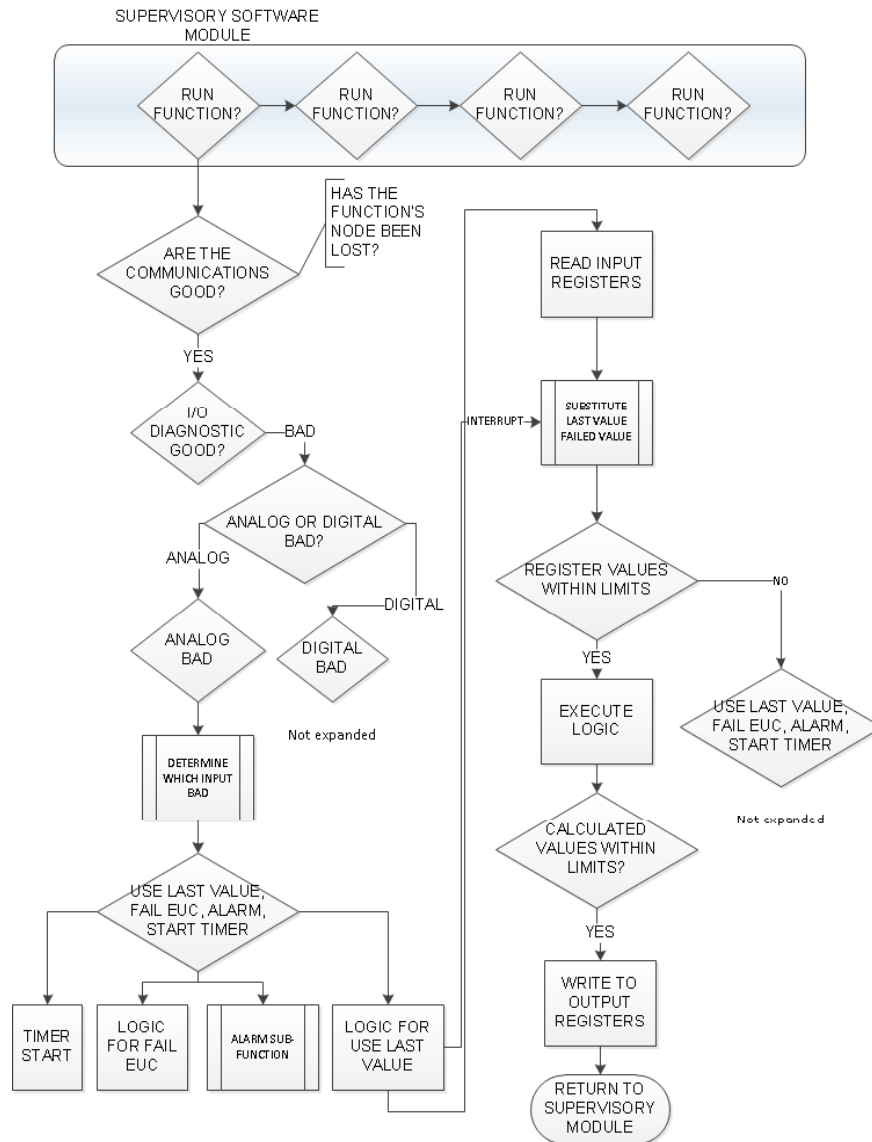- Owner may request HIL testing during the Operation & Maintenance Phase

Code Execution & Verification
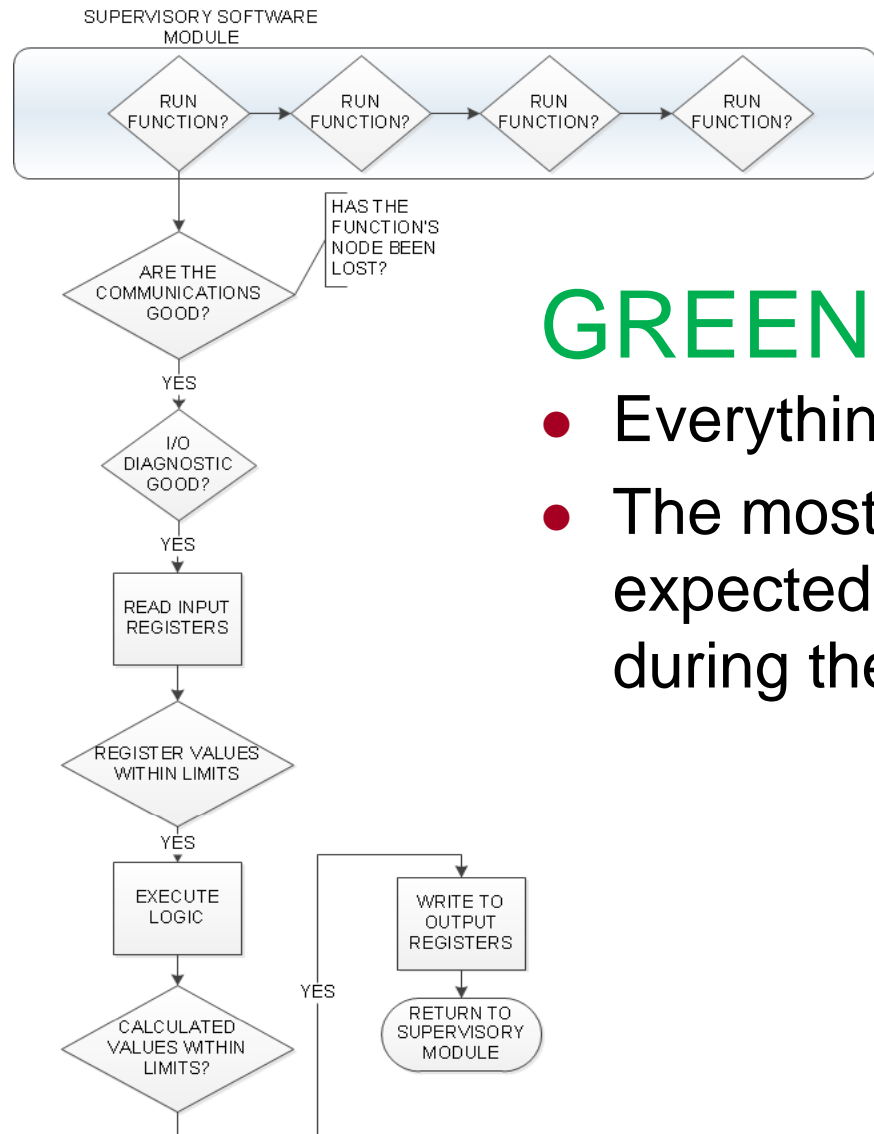
GREEN PATH

- Everything is working
- The most straightforward, expected operational path taken during the verification

Code Execution & Verification

BLUE PATH

- This flow chart follows one of the failure paths executing code that is not executed during normal operation

- The non-operational verification plan for Scenario #1

- There may be many scenarios

System Failures

A problem has been detected and Windows has been shut down to prevent damage to your computer.

The problem seems to be caused by the following file: SPCMDCON.SYS

PAGE_FAULT_IN_NONPAGED_AREA

If this is the first time you've seen this Stop error screen, restart your computer. If this screen appears again, follow these steps:

Check to make sure any new hardware or software is properly installed. If this is a new installation, ask your hardware or software manufacturer for any Windows updates you might need.

If problems continue, disable or remove any newly installed hardware or software. Disable BIOS memory options such as caching or shadowing. If you need to use Safe Mode to remove or disable components, restart your computer, press F8 to select Advanced Startup Options, and then select Safe Mode.

Technical information:

*** STOP: 0x00000050 (0xFD3094C2,0x00000001,0xFBFE7617,0x00000000)

*** SPCMDCON.SYS - Address FBFE7617 base at FBFE5000, DateStamp 3d6dd67c

Application of HIL Testing

- Complex, critical and high risk systems

- In a recently delivered project, HIL testing was utilized for the entire drill floor (32 different systems)

- Safety, environmental and operational risk identification

- HIL testing can be applied while under a tight development schedule

Example of DP Simulation Model
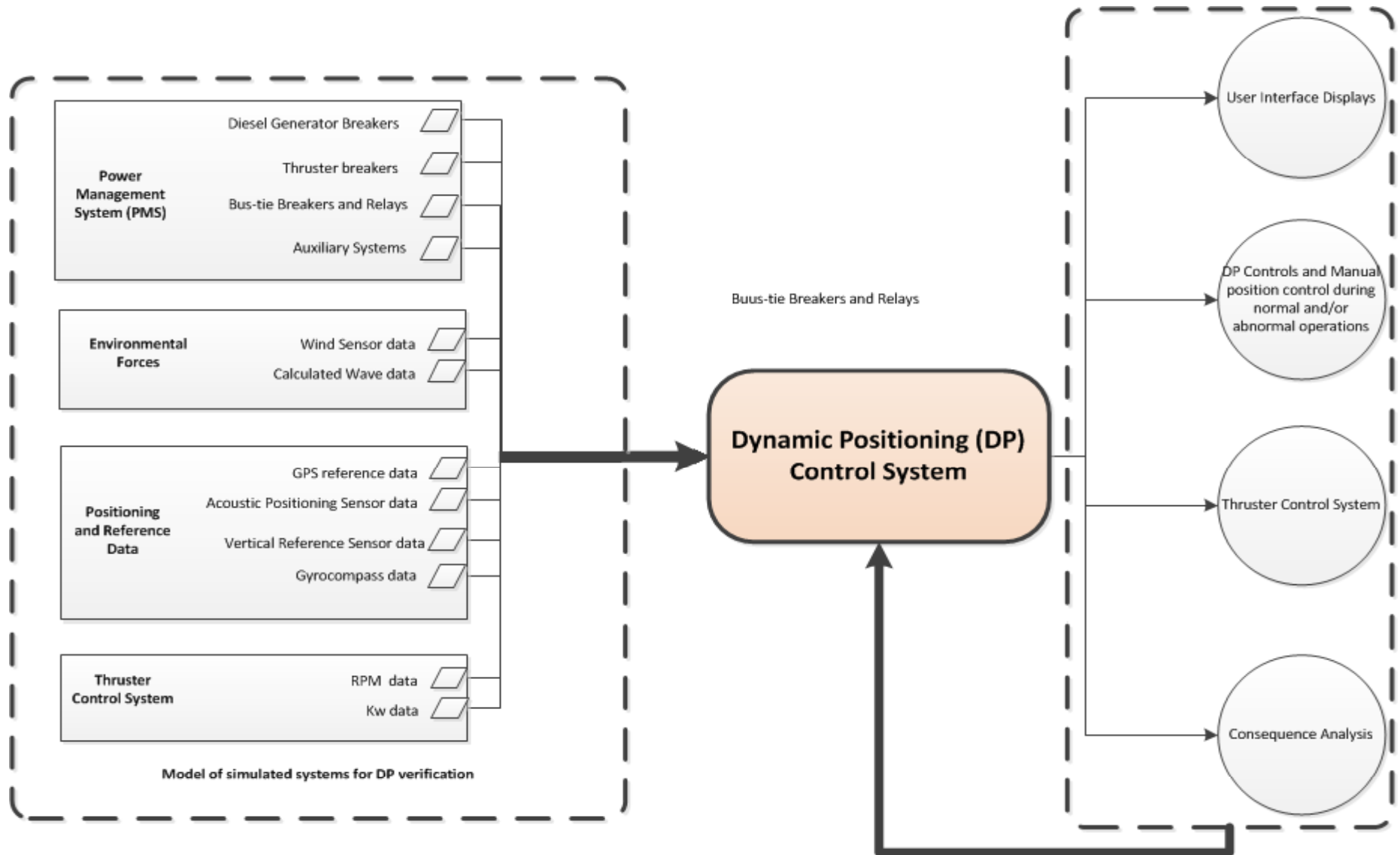
Benefits of HIL Testing

- Open and scalable simulation solutions – to allow the flexible integration of customized simulation models and tools

- HIL testing facilitates the seamless integration of hundreds of software dependent control systems for any offshore asset

- HIL testing can help hardware and control sys-tem manufacturers improve their product designs

- HIL testing is non-intrusive and does not rely upon accessing the computer source code or examining the equipment manufacturer's proprietary software

Benefits of HIL

- Factory Acceptance Testing (FAT)
  - HIL can be performed as part of the FAT to fit the delivery schedule

- Consistent methodology – starting conditions are defined for each test cases
  - Re-usability of models, parameters, measuring data and calculation
  - A known process reduces the risk and increases the robustness in verification
  - HIL is great for personnel training and improving the system knowledge

Benefits of HIL

- Improving safety and the robustness of the functions that are being tested

- Helping the control system provide the expected results every time

- Verification by independent third party

- Evaluation, verification and refinement of critical safety systems
  - Can be conducted without building complex physical test systems, or risking the safety of test personnel

- Facilitates integration during commissioning therefore reducing any delays in the schedule

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