



Leveraging Test and Measurement to Accelerate Digital Twin for Industrial Machinery

Qiao Guo

APAC Principal Field Marketing Manager

Electronics/Energy/Industrial Machinery/Life Sciences

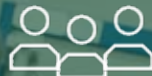




OPERATIONS IN
50+ COUNTRIES

\$1.36

BILLION
IN 2019



35,000+
CUSTOMERS WORLDWIDE



16%
INVESTMENT IN
R&D



以软件为中心的平台提高测
试、测量和控制系统的开发
速度和生产力



NI亚太区总部
上海

NI SOFTWARE-CONNECTED SOLUTIONS

ENABLING INNOVATION AND PRODUCTIVITY ACROSS THE PRODUCT DEVELOPMENT CYCLE

PRODUCT ANALYTICS AND TEST OPERATIONS

SystemLink™

Research

Design and Validation

Production

Deployment and
Maintenance

APPLICATION AND DEVELOPMENT SOFTWARE

LabVIEW TestStand VeriStand C#/.NET Python FlexLogger™ DIAdem ...

MODULAR HARDWARE

PXI CompactDAQ VST CompactRIO USRP ...

SERVICES

Software Services Hardware Services Consulting + Integration Services Education Services NI Partners

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SystemLink™

Research

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Production

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Maintenance

TAILORED, APPLICATION-SPECIFIC SYSTEMS

Semiconductor Test System Electric Vehicle Battery Test System Condition Monitoring ...

SERVICES

Software Services

Hardware Services

Consulting + Integration Services

Education Services

NI Partners



Industry-Leading Hardware to Fit Your Needs

The industry's broadest portfolio of products for automated test and automated measurement is:

- Best-in-class, precise, and accurate, from a trusted provider
- Scalable and flexible to adapt quickly to your evolving test and measurement needs
- Highly configurable and software-connected so you can get your job done in a timely manner



NI深耕中国制造多年

- 提高测试、测量和控制系统的开发速度 and 生产力（物理世界）
- 无缝对接生态圈第三方软件（数字世界）



电力

石油化工

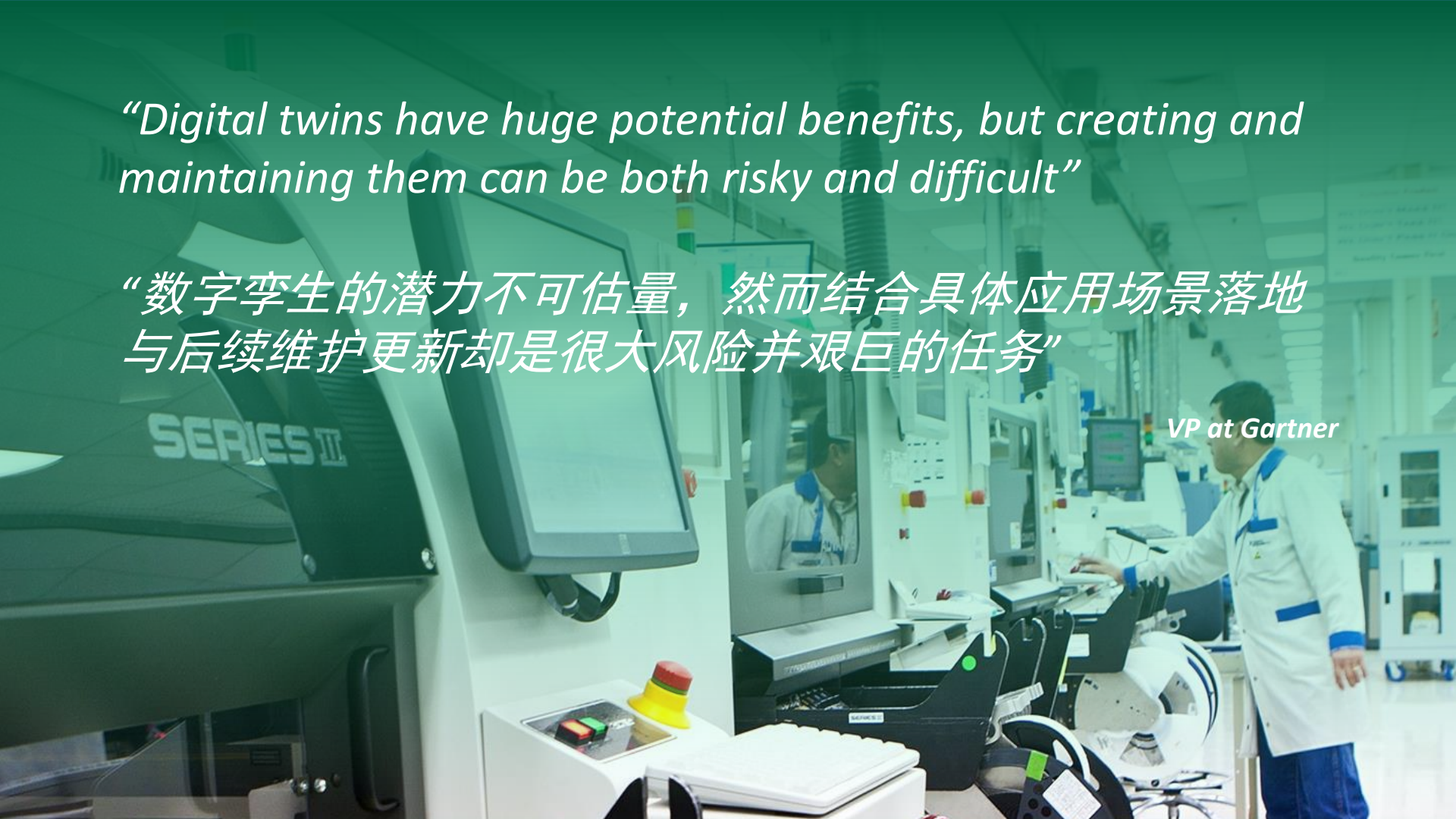
重型装备

钢铁

“Digital twins have huge potential benefits, but creating and maintaining them can be both risky and difficult”

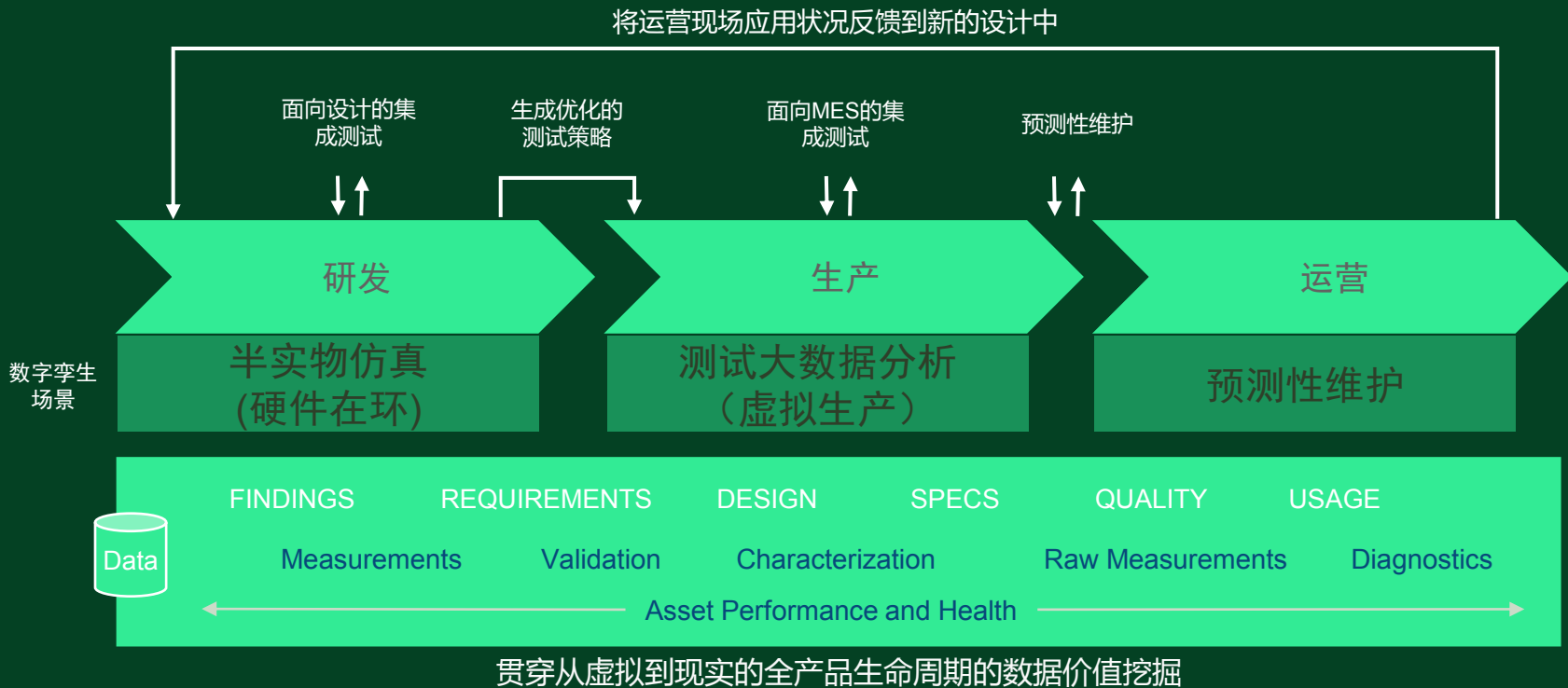
“数字孪生的潜力不可估量，然而结合具体应用场景落地与后续维护更新却是很大风险并艰巨的任务”

VP at Gartner



数字孪生的基石：模型数据(数字)VS 测量数据(物理)

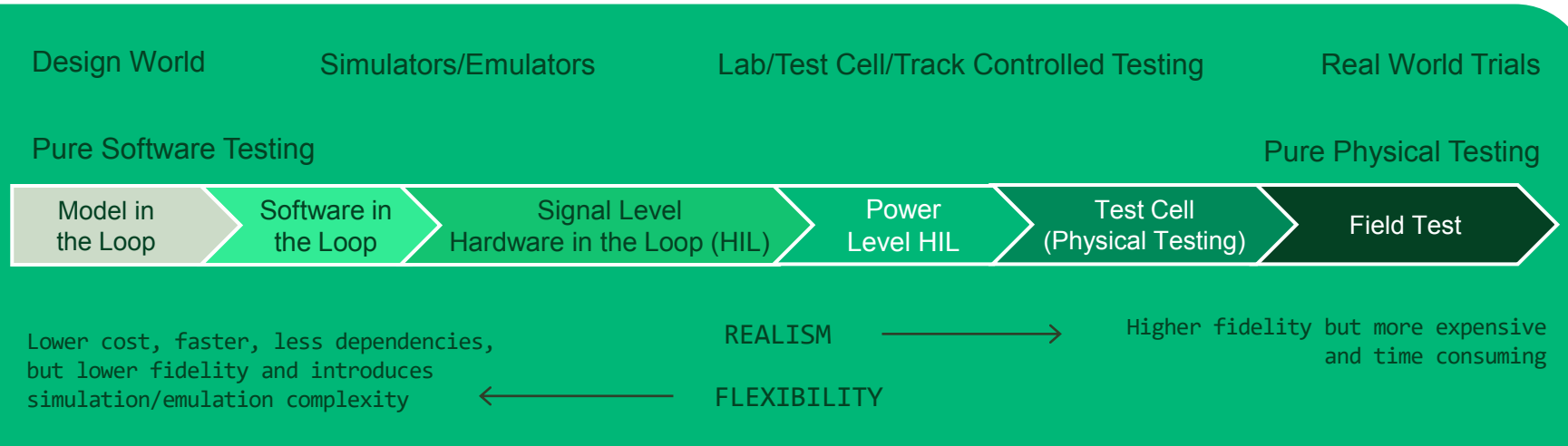
NI：软件定义的自动化测量为数字孪生的物理世界贡献核心价值





数字孪生场景 研发：半实物仿真（硬件在环）

Test Approaches Along the Design Lifecycle



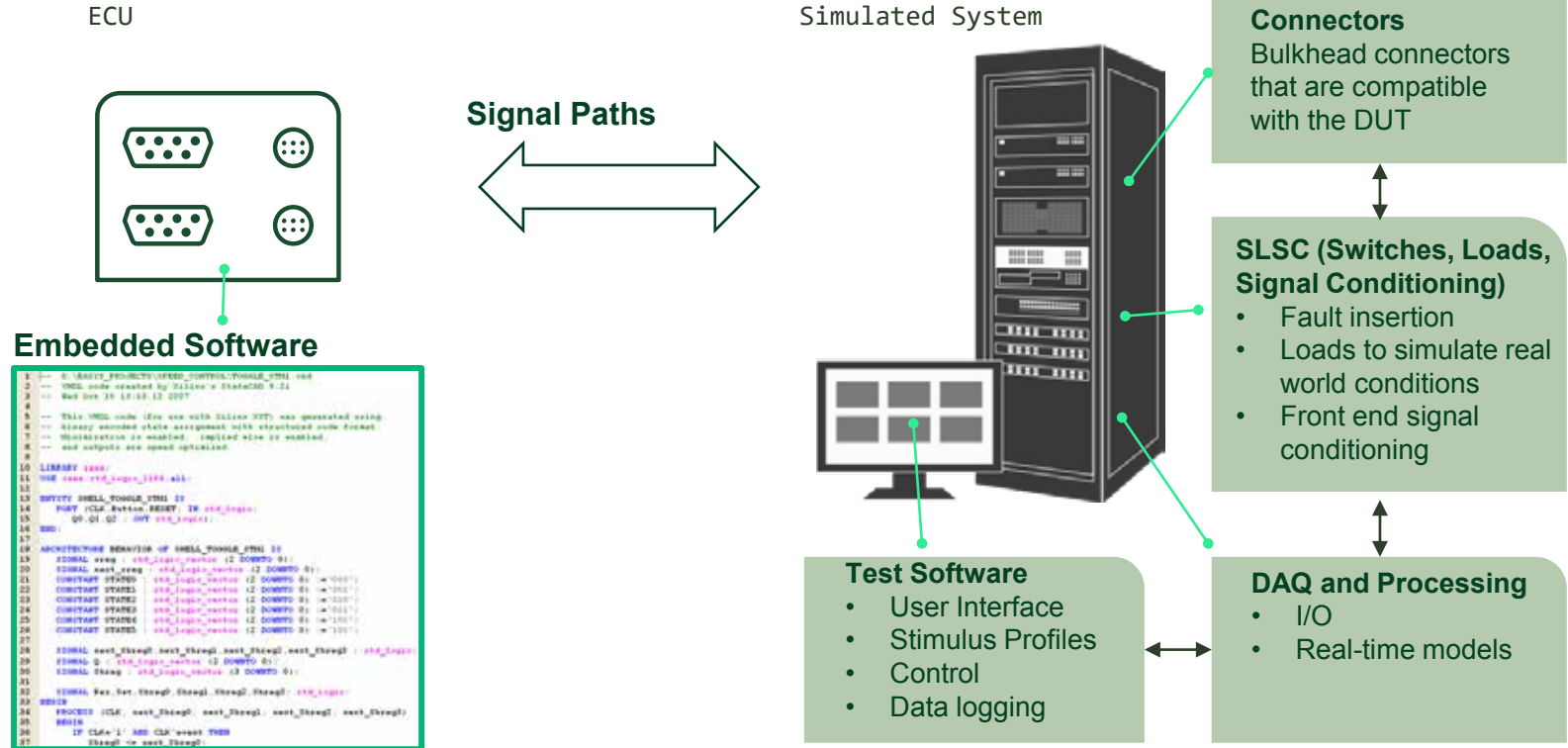
← Goal

Confidently Test Earlier in the Development Cycle

- Increasing ability to choose scenarios
- Flexibility to test different technology
- Less dependence on real system availability
- Accelerate test (faster than real time)

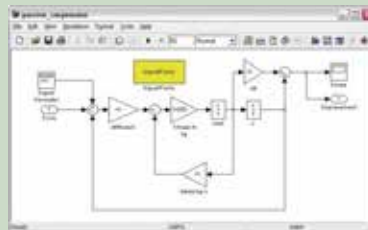
Increasing Cost, Risk, Time to Fix, and Effort

HIL Testing – Virtual Reality for Your DUT



Model Sources

- Existing Model from 3rd party environment (dll)
- Create based on knowledge of the system using modeling environment
- Automatically Generated based on test data (SysID)



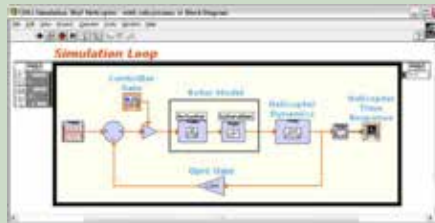
The MathWorks, Inc. Simulink® Software

```

#include "stdio.h"
int main()
{
    float a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q,r,s,t,u,v,w,x,y,z,A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z;
    float x1,x2,x3,x4,x5,x6,x7,x8,x9,x10,x11,x12,x13,x14,x15,x16,x17,x18,x19,x20,x21,x22,x23,x24,x25,x26,x27,x28,x29,x30,x31,x32,x33,x34,x35,x36,x37,x38,x39,x40,x41,x42,x43,x44,x45,x46,x47,x48,x49,x50,x51,x52,x53,x54,x55,x56,x57,x58,x59,x60,x61,x62,x63,x64,x65,x66,x67,x68,x69,x70,x71,x72,x73,x74,x75,x76,x77,x78,x79,x80,x81,x82,x83,x84,x85,x86,x87,x88,x89,x90,x91,x92,x93,x94,x95,x96,x97,x98,x99,x100;
    float x101,x102,x103,x104,x105,x106,x107,x108,x109,x110,x111,x112,x113,x114,x115,x116,x117,x118,x119,x120,x121,x122,x123,x124,x125,x126,x127,x128,x129,x130,x131,x132,x133,x134,x135,x136,x137,x138,x139,x140,x141,x142,x143,x144,x145,x146,x147,x148,x149,x150,x151,x152,x153,x154,x155,x156,x157,x158,x159,x160,x161,x162,x163,x164,x165,x166,x167,x168,x169,x170,x171,x172,x173,x174,x175,x176,x177,x178,x179,x180,x181,x182,x183,x184,x185,x186,x187,x188,x189,x190,x191,x192,x193,x194,x195,x196,x197,x198,x199,x200;
    float x201,x202,x203,x204,x205,x206,x207,x208,x209,x210,x211,x212,x213,x214,x215,x216,x217,x218,x219,x220,x221,x222,x223,x224,x225,x226,x227,x228,x229,x230,x231,x232,x233,x234,x235,x236,x237,x238,x239,x240,x241,x242,x243,x244,x245,x246,x247,x248,x249,x250,x251,x252,x253,x254,x255,x256,x257,x258,x259,x260,x261,x262,x263,x264,x265,x266,x267,x268,x269,x270,x271,x272,x273,x274,x275,x276,x277,x278,x279,x280,x281,x282,x283,x284,x285,x286,x287,x288,x289,x290,x291,x292,x293,x294,x295,x296,x297,x298,x299,x300;
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    float x901,x902,x903,x904,x905,x906,x907,x908,x909,x910,x911,x912,x913,x914,x915,x916,x917,x918,x919,x920,x921,x922,x923,x924,x925,x926,x927,x928,x929,x930,x931,x932,x933,x934,x935,x936,x937,x938,x939,x940,x941,x942,x943,x944,x945,x946,x947,x948,x949,x950,x951,x952,x953,x954,x955,x956,x957,x958,x959,x960,x961,x962,x963,x964,x965,x966,x967,x968,x969,x970,x971,x972,x973,x974,x975,x976,x977,x978,x979,x980,x981,x982,x983,x984,x985,x986,x987,x988,x989,x990,x991,x992,x993,x994,x995,x996,x997,x998,x999,x1000;
}

```

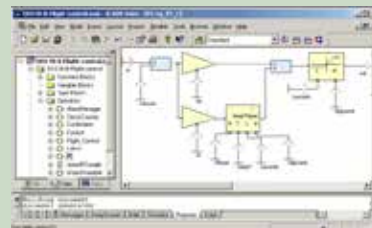
ANSI C



NI LabVIEW



OPAL-RT eHS



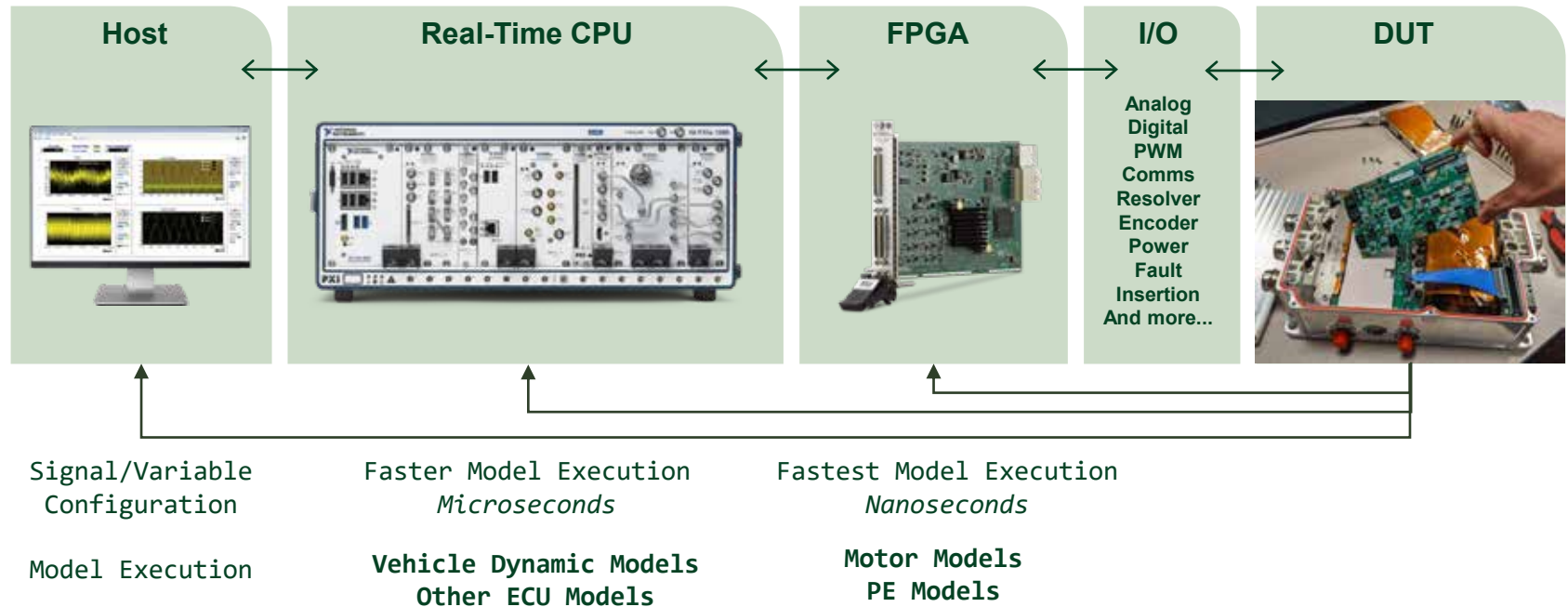
Esterel SCADE



MapleSoft MapleSim

Model Integration in NI Platform

- Synchronized execution across host, real-time processor, and FPGA
- Connectivity to I/O



基于工况模型的超级电容动态测试



超级电容功率密度高，循环性能强，广泛应用于电动汽车能量回收系统，新能源微网，航空航天，舰船等

NI与北京博电联手打造超级电容自动化测试平台

- 功率覆盖 800V/100A（更高可定制）
- 最高精度达到100ppm，稳定性达到20ppm/min
- 支持多种国内外测试标准：GBT34870.1-2017, IEC 62391-2-1, QCT 741-2014
- 集成NI VeriStand支持NEDC/WLTC/CLTC等各种实际工况模型
- 充放电无缝切换，全自动测试（从单人7小时提升至单人15分钟）

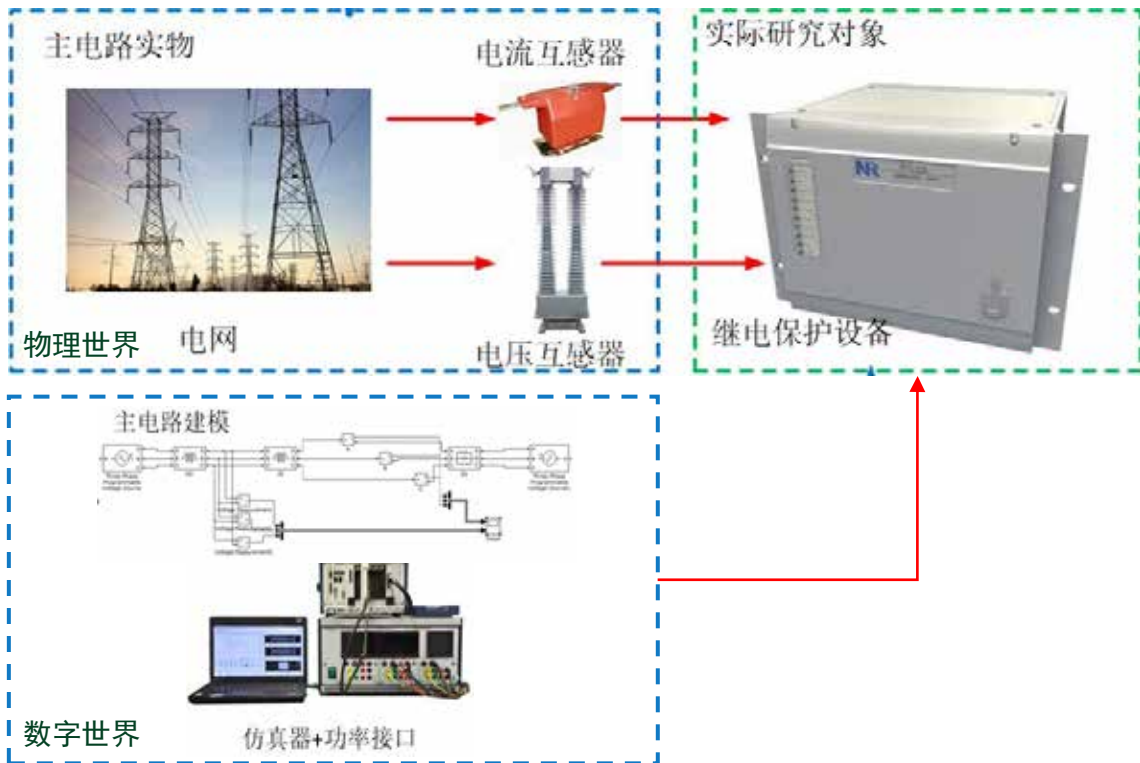


电网一次/二次设备仿真测试



功率级带仿真模型的完整测试系统

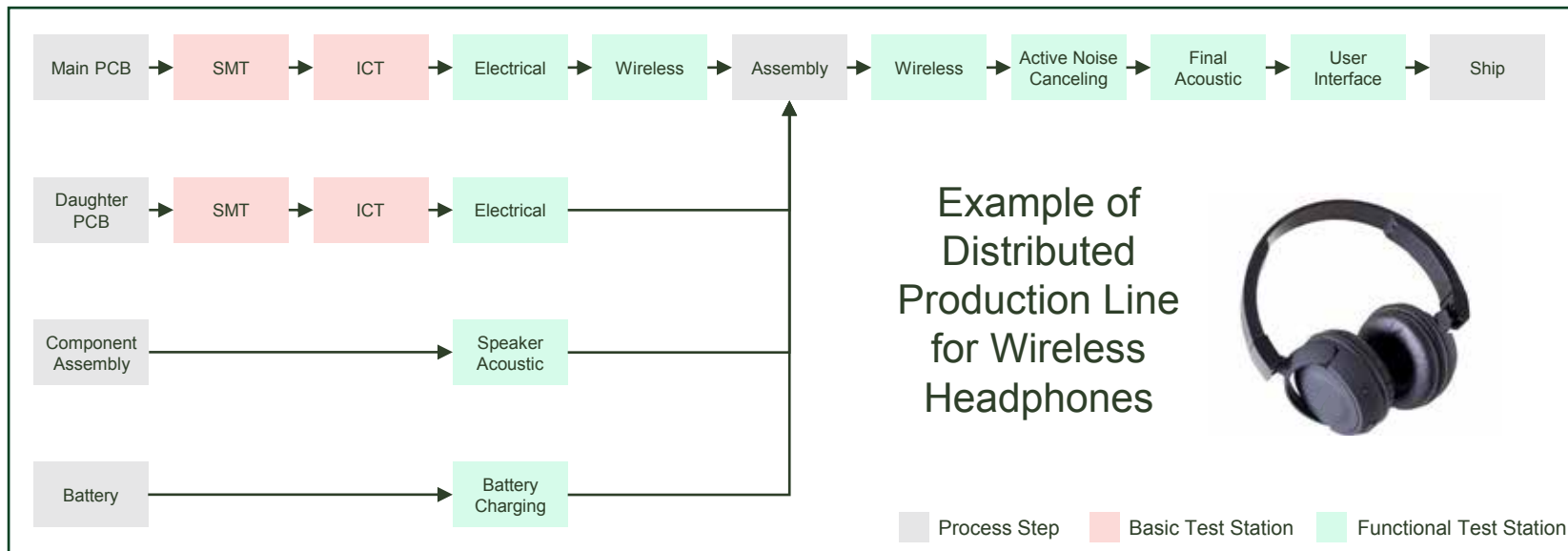
- 电流电压互感器
- 数字化变电站设备
- 继电保护设备
- 电力滤波器





数字孪生场景 生产：制造/测试大数据

消费电子产品产线测试的流程



Common challenges



1 Line down too often affecting throughput

2 Line imbalance affecting efficiency

3 Too many false calls in inspection (SPI, AOI, AXI, etc.)

4 Costly material attrition and scrap

5 Process escapes due to operator overrides

6 Time consuming to root-cause defects/anomalies

Combined NI Enterprise Software Portfolio

NI provides actionable product analytics to **improve product outcomes** and test operations software to **maximize test efficiency**.

O+ Optimal+

PRODUCT LIFECYCLE ANALYTICS



Quality & Reliability

Improve quality and reliability



Supplier Transparency

Trace failure patterns to source



Advanced Analytics

Deploy machine learning (ML) algos



Efficiency Analysis

Streamline manufacturing processes



Data Lifecycle

End-to-end Data Lifecycle Management

NPI Ramp

Accelerate product introduction



ML deployment

Holistic platform for AI/ML lifecycle

Process Data

Machine Data

Test Data

In-Use Data

Repair Data



SystemLink

TEST OPERATIONS MANAGEMENT



Test Station Management

Qualification | Health | Configuration | Utilization



Test Execution Performance

Monitoring | Live KPIs | Process Control



Test Data Management

Ingestion | Search | Transform | Process

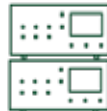


TEST DEVELOPMENT & AUTOMATION



Test Application Design

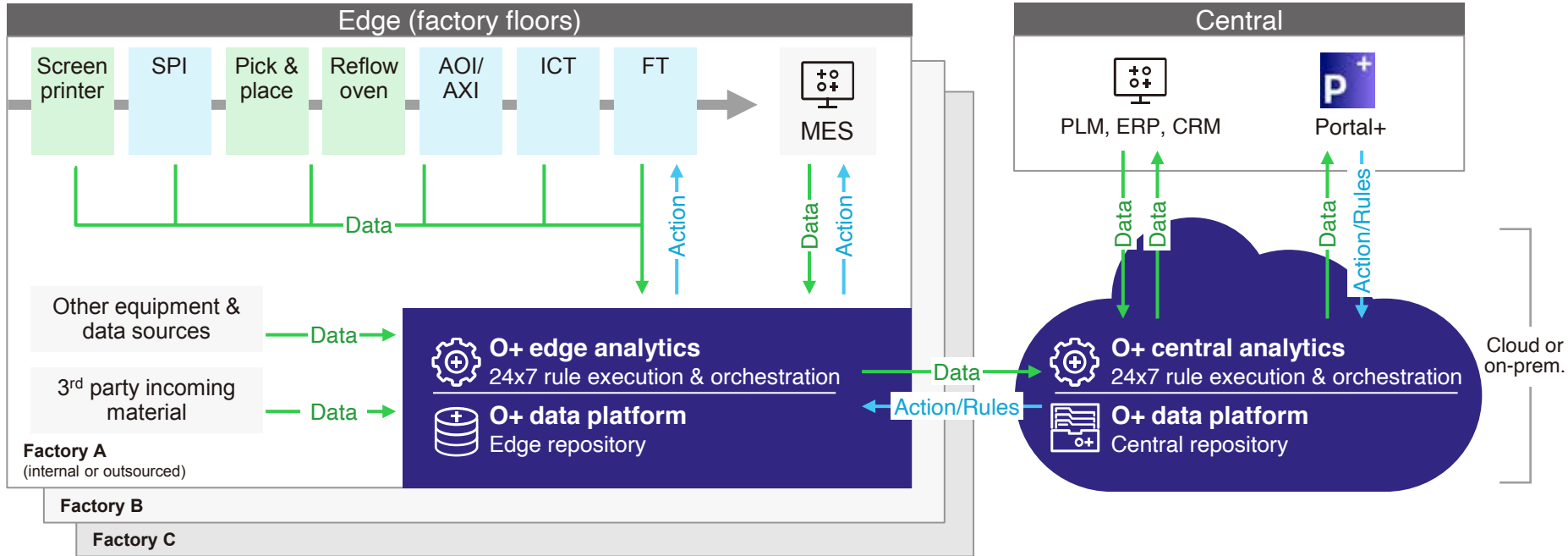
Measurement Science



Hardware Interface

Data Logging

System architecture – SMT example



Actionable insights across all mfg. lines and facilities

Optimal+ SMT solution

1 Simplify factory management

2 Shift Left – early scrap detection

3 Connect data silos from incoming material to end product

4 Early Detection on tool wear

5 Create a holistic product and process view

6 Close the loop with alerts & MES integration



数字孪生场景 运营：预测性维护

Smart, Connected Products (制造企业)



产品为中心

从制造向服务转型:

- 远程监控, 故障诊断
- 设备利用率分析
- 新业务模式

产品差异化/竞争力/增值服务
(开源)

Smart, Connected Operations (运营企业)



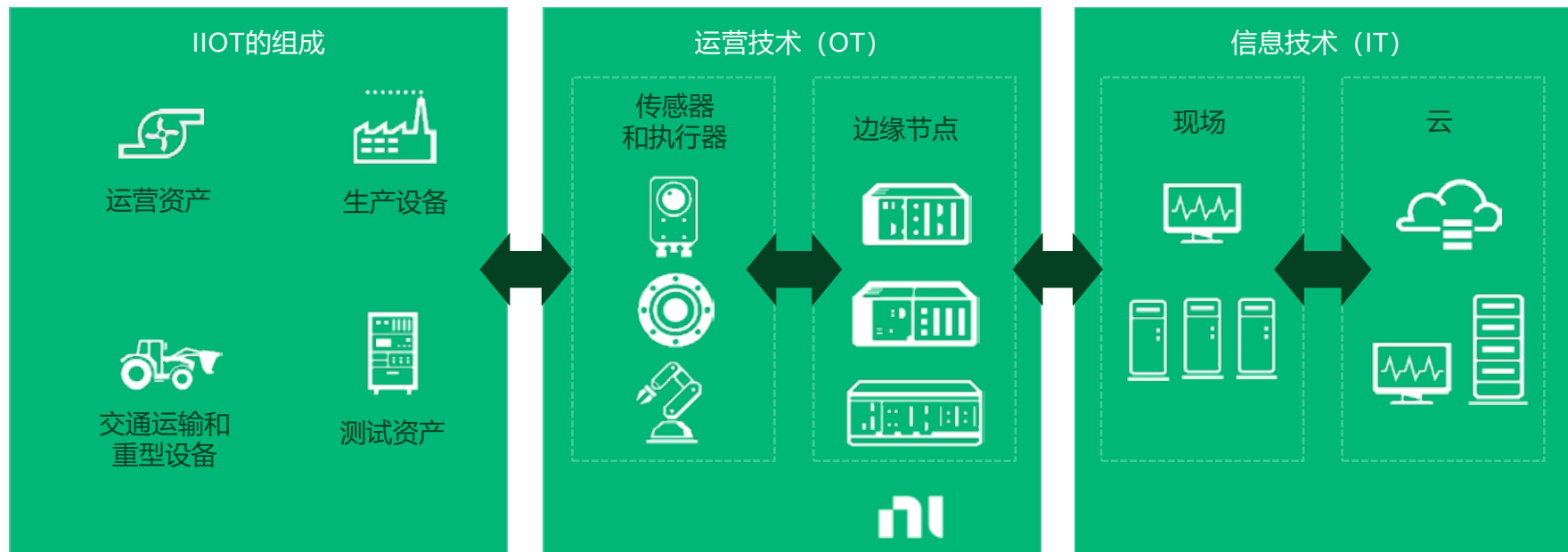
运维为中心

优化关键运营资产:

- 减少非计划停机
- 提升生产产品质量
- 保证产量

降本增效
(节流)

NI 模块化、开放式OT平台快速构建工业预测性维护方案



电机 – 泵在线监测与预测性维护系统



视频链接

借力在线监测系统、增强现实技术，Flowserve轻松实现设备资产管理

恩艾NI知道 3月9日

工业状态监测对于设备维护和故障诊断不可或缺，但是由此产生的大量数据的分析问题给制造企业带来挑战。不过不用担心，NI联合合作伙伴为业界提供了全套的解决方案。尤其是对于NI LabVIEW、CompactRIO和InsightCM在监测领域的应用，有些企业已经运用的炉火纯青。



小编首先为大家奉上全球泵业的领导者Flowserve、专注于提供技术平台和解决方案的全球软件公司PTC、测试测量行业领导者NI联合打造的一个关于泵的在线状态监测的Demo，不要错过哦。

NI 钢铁在线监测与预测性维护方案汇总



钢铁在线监测与预测性维护方案

实时趋势和故障监测

事件通知

群组广播

巡检抄表

噪声比对



公有云



热轧厂在线监测与预测性维护方案

支持主要故障类型：

- 粗轧机/精轧机打滑，扭振，轴间隙冲击，疲劳，断辊，边轧机齿轮箱异常，轧辊振动痕
- 板坯定宽压力机轴间隙冲击，齿轮轴承异常，不同步，耐磨板异常，避震器异常

台湾中钢使用成果：系统安装后**意外停机**时间统计

	2010	2011	2012	2013	2014	2015	2016	2017
清洗线	7.84	12.33	15.25	23.91	0.83	6	4	0
整平线	149.25	54.23	45.57	23.59	10.29	6.76	6.97	0
酸洗线	50.94	10.18	10.58	5.26	0	2.02	5.77	4.71
轧二线	32.3	81.59	3.59	9.44	8	10	7.74	0
调质线	4.29	2.13	4	3.2	0	0	0	2.74
公用线	5	0.21	2.08	0	0	0	0	0
总停机时间 (小时)	249.62	160.67	81.07	65.4	19.12	24.78	24.48	7.45

其他预测性维护设备成功案例

电厂蒸汽/燃气轮机

电厂辅机设备：引风机，交流异步电机，泵，阀

柴油发电机组

化工厂冷冻机，造粒机

往复式/离心式压缩机

冲压机

磨床

切削机

数字孪生的基石：模型数据(数字)VS 测量数据(物理)

NI：软件定义的自动化测量为数字孪生的物理世界贡献核心价值

