Create Business Impact with LabVIEW

Understanding the True Cost of Test

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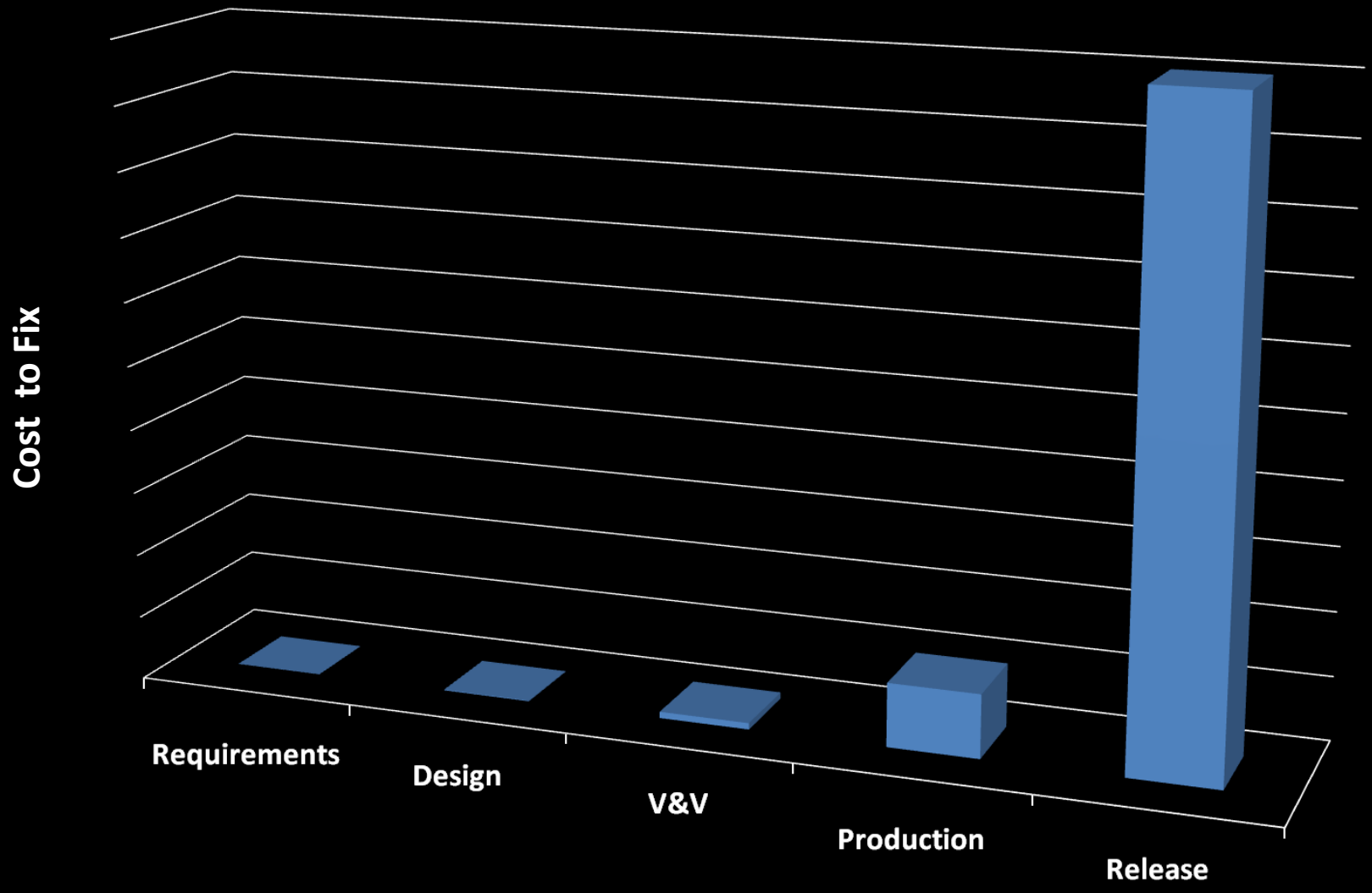
Why do we Care?

Test saves Money



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5 Things CEOs Care About

- Cash Flow
- Margin
- Strength of Assets
- Growth
- Customer Loyalty

Where do test costs show up on your financial statements?

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What if you could reduce COGS by 2%?

- COGS for company X is $800M
- How much is 2%?
  - $16M
- What could they do with $16M?
  - Reduce prices, fuel growth
  - Invest in R&D, create more products, fuel growth
  - Invest in quality initiatives, customer loyalty
- What could your organization do?

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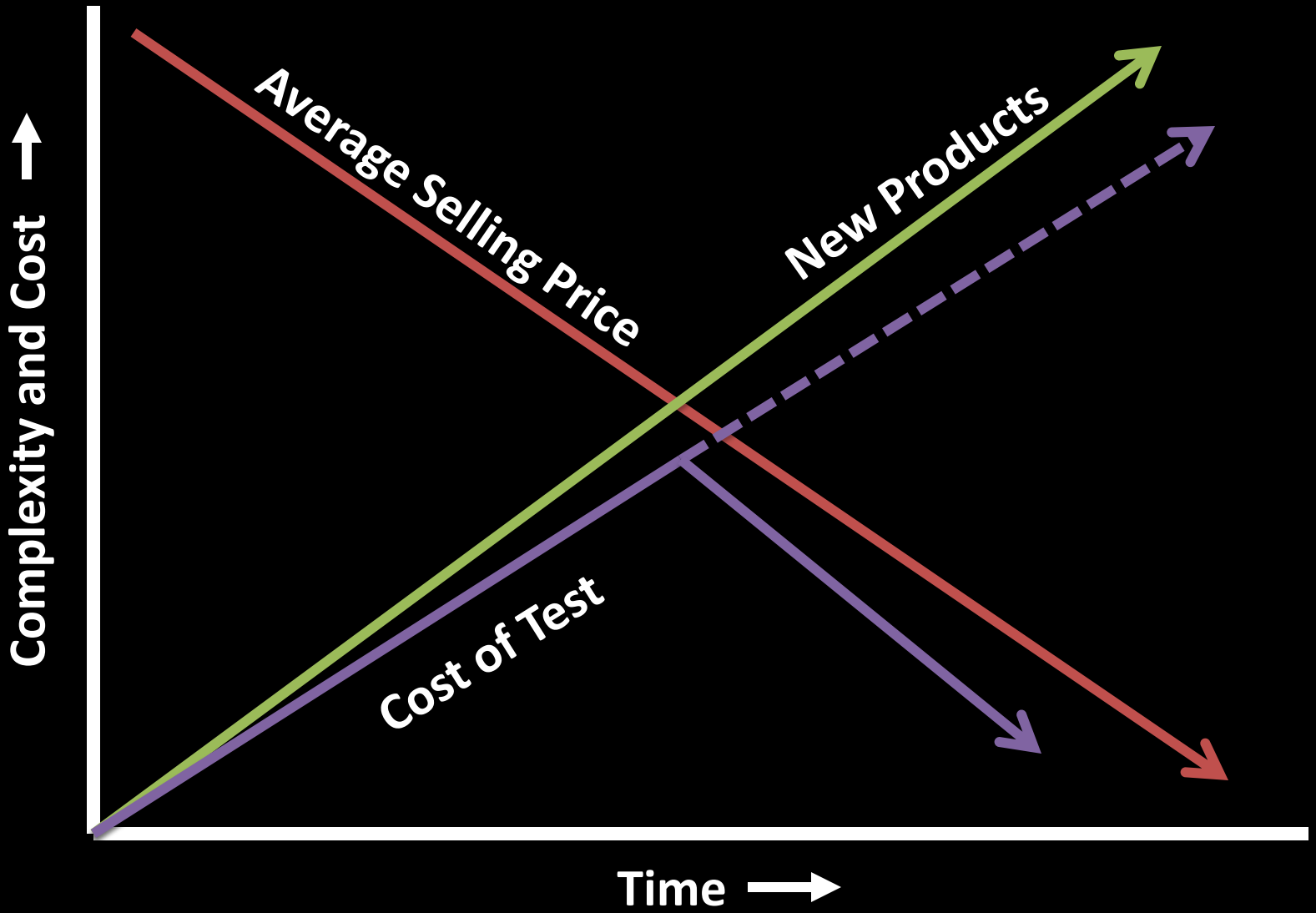

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What is The Cost of Test?

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Cost of Test ≠

True Cost of Test

Production test capital expense reduction

Number of square feet per tester

Avg. Hrs./person spent on planning effort

Number of current testers/needed testers

Software cost per Tester

Total Test Project Savings

Cost per Test Engineer

Test Engineering Development Engineers

Total Test System Savings (annual)

Investment needed in spares/inventory per each tester

Operator cost/person

Years spent on the project

Capital Equipment Cost per Tester

Number of Development Systems

Spares/Inventory Cost Reduction

# of Maintenance people/test

Payback Period

Manufacturing Floor Space Cost Reduction

Maintenance cost/person

Calibration cost per tester

Number of developers sent to training classes

Per copy price of Development System

Reduction in Cost of Test /Product

Costs of internal training and documentation effort for standard

Operational cost Reduction

# of operators/test

New /Old Tester Throughput Improvement

% Time dedicated

Calibration Cost Reduction

Cost per square foot

Software development cost

Volume of product produced annually tested

Life of the project (years)

Volume of product produced tested annually through new testers

Cross-functional Planning team Test Engineers

Cost of product training/person

Operator & Maintenance Cost

Average ROI Test Project

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Total Test Cost

=

Upfront Development Cost

+

Deployment Cost

+

Operational Cost

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Upfront Development Cost

- Strategy development effort
- Development tools cost
- Development training cost
- Development effort
- Internal Training

Development Example

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Development Tools Cost

- 10 copies of test development software
- $10,000 copy

Total Development tools cost

10 * $10,000 = $100,000

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Development Effort

- # of Engineers = 10
- Engineer Cost = $100,000
- Years spent on project = 2
- % of Engineers time on project = 75%

Cost per Engineer

$100,000 * 2 *.75 = $150,000

Total Development Cost

$150,000 * 10 = $1,500,000

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Development Example

Tools Cost	=	$100,000
Development Cost	=	$1,500,000
Total Cost	=	$1,600,000

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Lawrence Livermore National Labs

Developed automated maintenance process for world's most energetic laser array at the National Ignition Facility using NI LabVIEW and PXI

- LabVIEW increased productivity by 3X over Java and C++
- Developed complex application consisting of over 1,000 VIs
- Applied software engineering practices to ensure quality

An overhead view of one of the main laser chambers

"The value in using the graphical dataflow language is the speed in which a team can deliver a robust solution while still using proper software engineering practices.

- Glenn Larkin, LLNL

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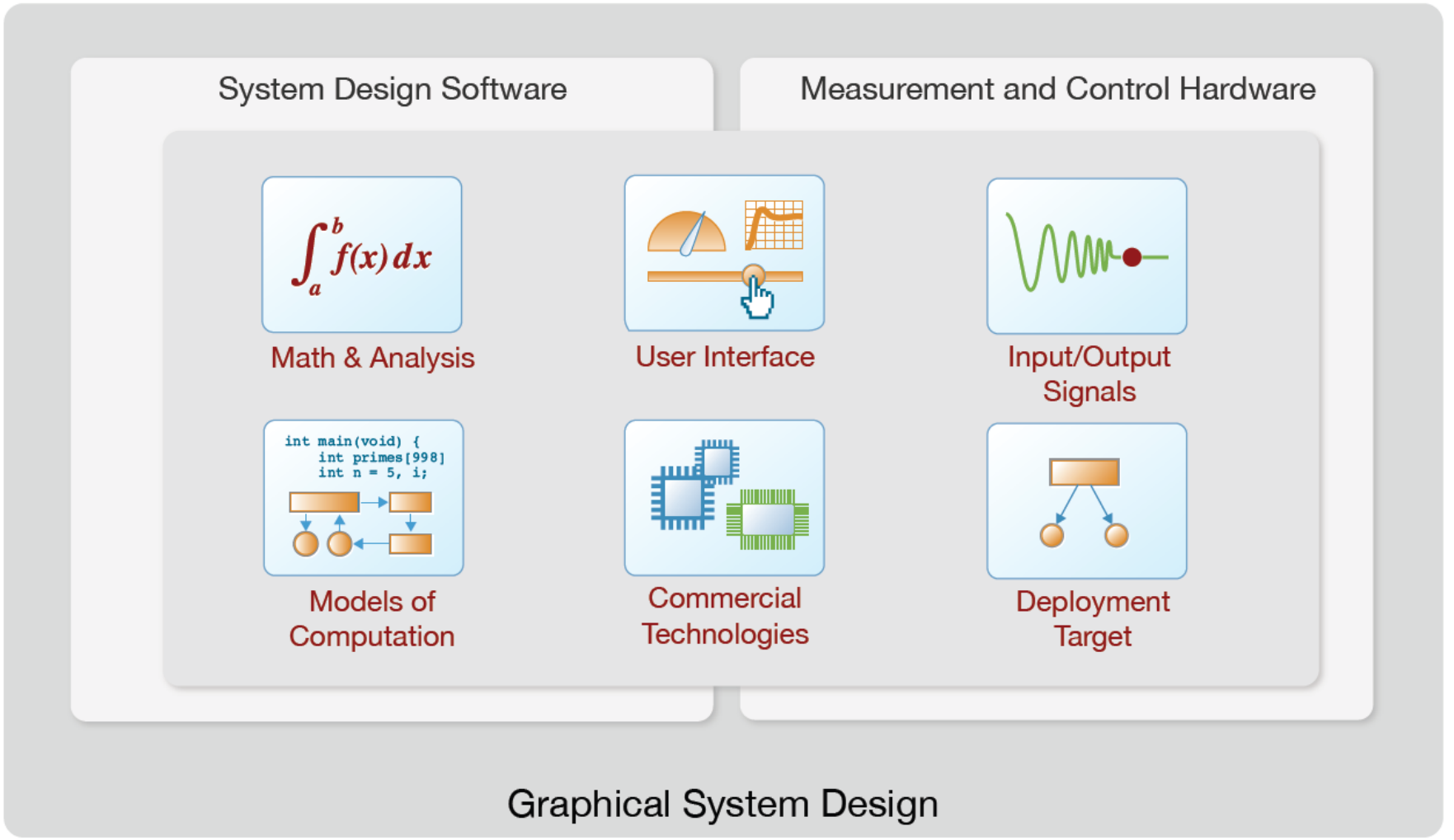

Graphical System Design is an **approach**
that **integrates** software and hardware
to combine the **six elements** of measurement and control systems

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Graphical System Design

- The primary benefits of Graphical System Design are tight integration of software and hardware resulting in increased productivity.

- Leveraging Graphical System Design-enabled tools allows scientists and engineers to focus on discovering and innovating rather than learning and managing disparate tool chains.

- Productivity gains are realized by giving smaller teams of scientists and engineers the ability to create what previously only larger teams of dedicated tools experts were able to do.

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Jet Plume Testing | AFRL

Embedded Monitoring

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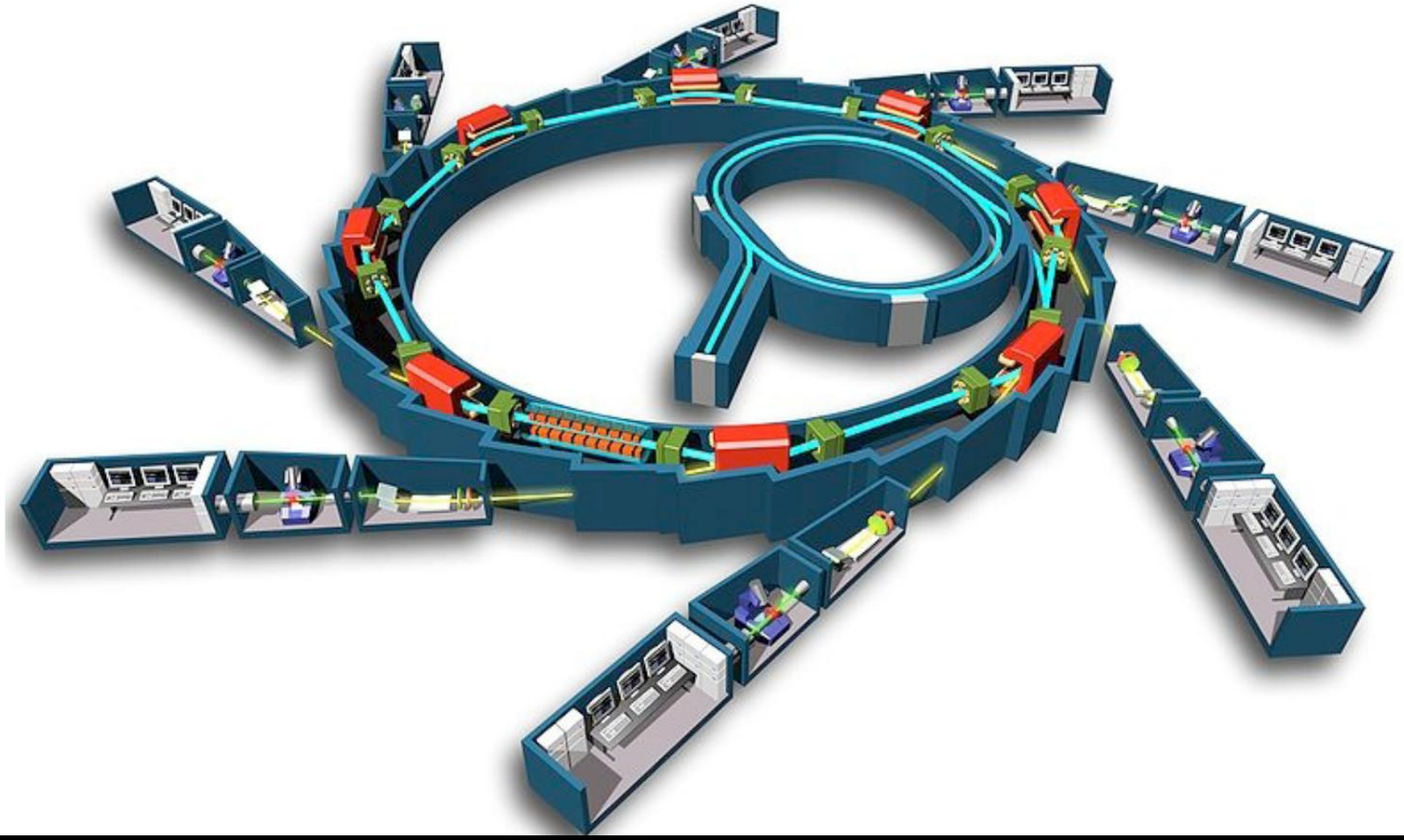

ISIS Proton Synchrotron

Advanced Data Acquisition

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Ford Motor Company

Fuel Cell Engine Control

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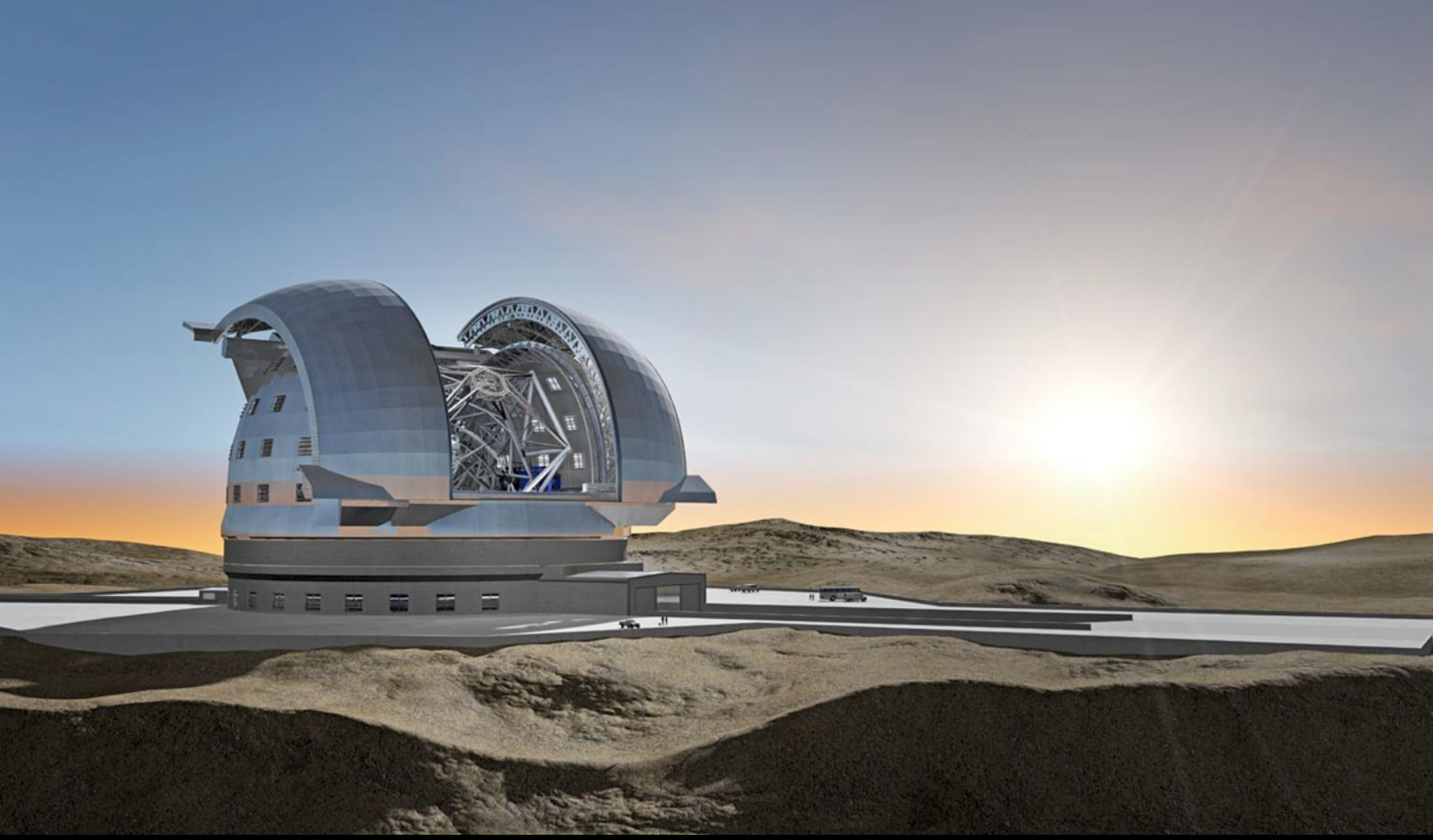

ESO E-ELT

Advanced Control

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Analog Devices

Semiconductor Test

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Reducing Development Costs Through Training

170 percent return on investment on training all Lexmark engineers in LabVIEW

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Sample Project Impact

- Project profile:
  - 6 month project with a 3 year life
  - 1 engineer, 70% of time spent on project
  - Annual cost of an engineer: 80,000 Euros

Total Phase Costs	Without NI Training	With NI Training
Expected total labor cost of project - learning phase	2,462	4,589
Expected total labor cost of project - development phase	56,000	42,000
Expected total labor cost of project - maintenance phase	12,000	6,840
TOTAL PROJECT LABOR COST	**70,462**	**53,429**
TOTAL PROJECT LABOR COST SAVINGS with NI training		**17,032**
TRAINING ROI		**371%**

Details at ni.com/training

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Deployment Test cost

- Test capital equipment cost
- Deployed test software cost

Deployment Example

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Test Throughput Matters

Must Test 20 Devices

- Tester A
  - $100,000
  - 2 DUTs at a time
- Total cost to test
  = (20 / 2) * $100,000
  = $1,000,000

- Tester B
  - $200,000
  - 5 DUTs at a time
- Total cost to test
  = (20 / 5) * $200,000
  = $800,000

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Example: Auto-schedule Parallel Test

HARRIS

"The original test station sequentially tested each handheld radio produced. The new test system, on the other hand, is **capable of testing up to eight radios** in about the **same time required by the previous system to test two radios**."

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Operational Test Cost

- Operator personnel cost
- Maintenance personnel cost
- Spares cost
- Floor space cost

Operational Example

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Variable Operational Costs

- # of Testers = 10
- Annual Operator Cost = $50,000
- Annual Technician Cost = $60,000
- Technician time required = %50
- Floor space cost = $50/ft^2
- Square ft per tester = 10

Variable Cost per Tester

$50,000 + $60,000 * 0.5 + 10 *$50 = $80,500

Total Variable Cost

$80,500 * 10 = $805,000

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Reduces MEMS Test Costs

	PXI Tester	Reduction	Previous ATE
Cost	$40K USD	11X	$450K+ USD
Footprint	18 by 24 by 7 in	15X	98 by 66 by 74 in
Weight	60 lbs	66X	4,000 lbs
Facility	600 W	16X	10KW

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Reduces MEMS Test Costs

- Reduced Footprint
  - Can wheel system around on a cart
- Lower Weight
  - Lower shipping costs, keep local spares
- Decreased Power Usage
  - Use standard power plugs

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Costs are Interrelated

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Interrelated cost examples

- More developer training -> lower development times
- Smaller test equipment -> less floor space
- Built-from scratch test executive -> reduced SW licenses
- COTS test executive -> reduced development time
- Developing a parallel test architecture -> Improved Production throughput

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Test Cost VS Opportunity Cost

- Time to Market
  - First to market equals $$$
  - Invest in development tools to reduce time
- Production Throughput
  - Implement Parallel Testing
  - Invest in more capable test systems
- Global Standardization
  - Larger strategy development investment

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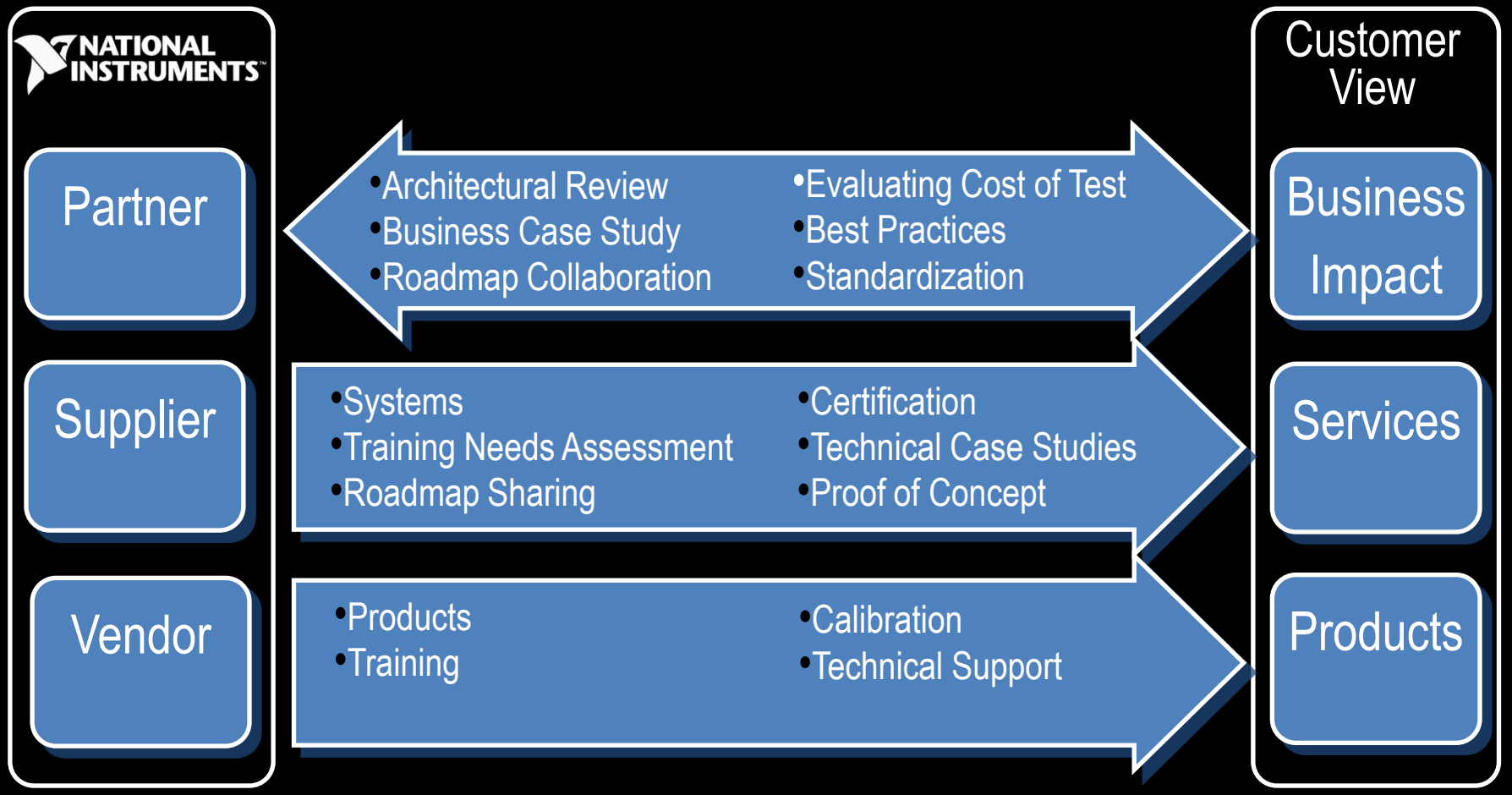
National Instruments Evolution



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