How Senior Managers Perceive the Importance of Calibration

NCSLi Vancouver 2013

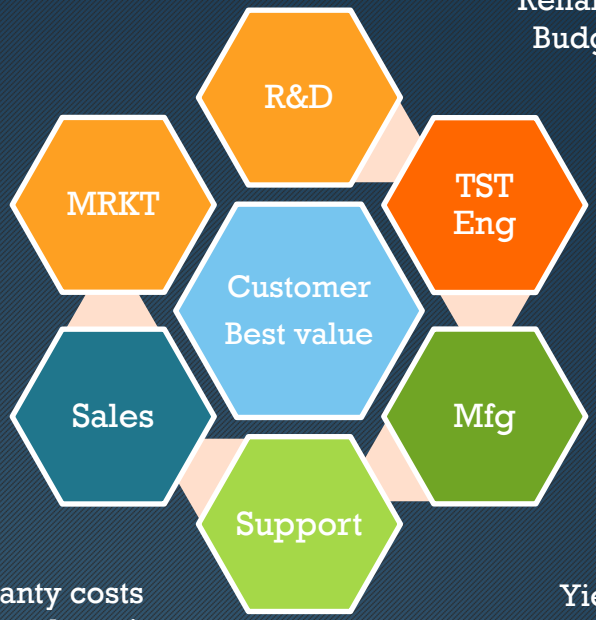
The importance of measurement accuracy and the financial impact it can have on the bottom line

Maximizing top and bottom line by protecting the most valuable assets

What Senior Managers Care About

TTM
Pricing
Competitive differentiators

Innovate products
Schedule
Component 2nd source
Design margins
Reliability
Budgets



Warranty costs
Customer downtime
Customer satisfaction

Yields
Throughput
Quality

- Meeting shareholder expectations
  - Top and bottom lines

Senior Management

Do they care about calibration?

Do they care about the impact a lack of calibration will have on their business?

Equipment uncertainties may never surface as a root cause of missing business objectives.

Calibration is looked upon as a maintenance cost of the equipment. But seldom are linkages made between measurement accuracy and meeting business objectives.

Impact of Metrology On Business Results

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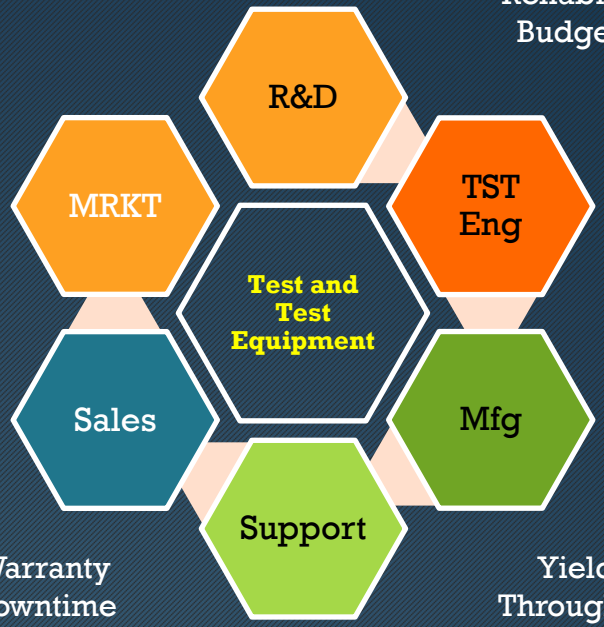


Warranty
Downtime
Customer satisfaction

Yields
Throughput
Quality

Investing in instruments to validate designs and manufacturing processes

Test equipment and associated tests are one of the highest costs to an organization

T&M Investment

- Get the most out of your design cycle. There's a reason why investments are made to obtain the best possible measurement solution.
- Engineering will go through a laborious decision-making process to chose state-of-the-art technology. Go to market quickly with lowest costs and highest value solution.
- Yet, they're not always involved in how their investment are being maintained.

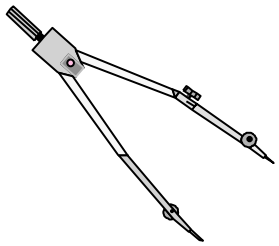
Why Calibrate?

Fact....

- All measurement processes are accompanied by errors and uncertainties and they cannot be eliminated

So....

- Calibration quantifies and controls the errors or uncertainties of the measurement processes to an " acceptable level "



What Is Calibration?

Definitions depend on who you ask. Metrologist, engineering, quality, P&L managers, purchasing…

Is it the measurement of instrument performance of all warranted specifications, for all options, consistently every time?

Or, is the definition of calibration and standards left up to interpretation - whatever is most convenient depending on supplier capabilities and capacity and customer budget?

I trust the supplier, what's the TAT and price?

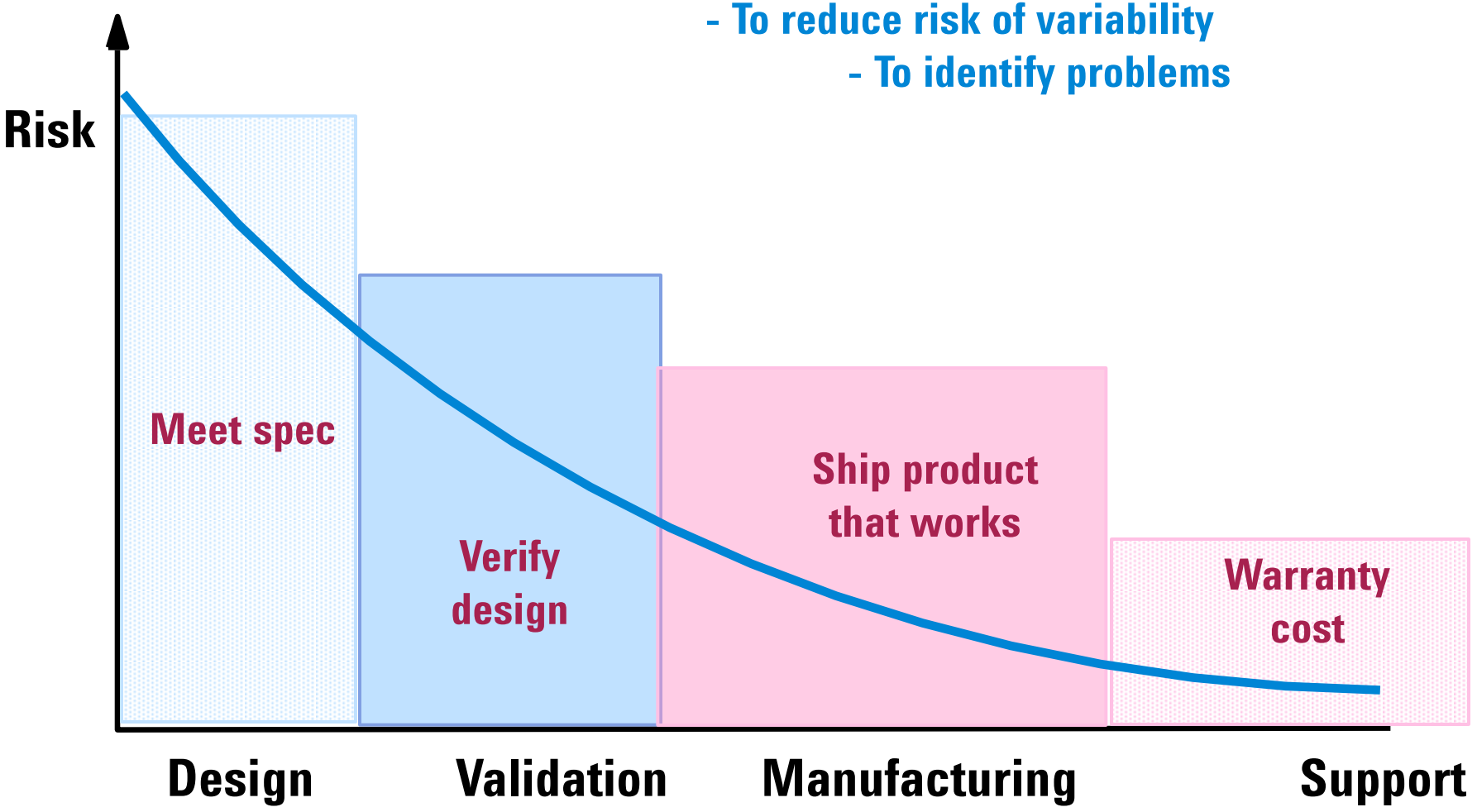
Who manages the risks and assesses the impact?

There are standards to close the loops:

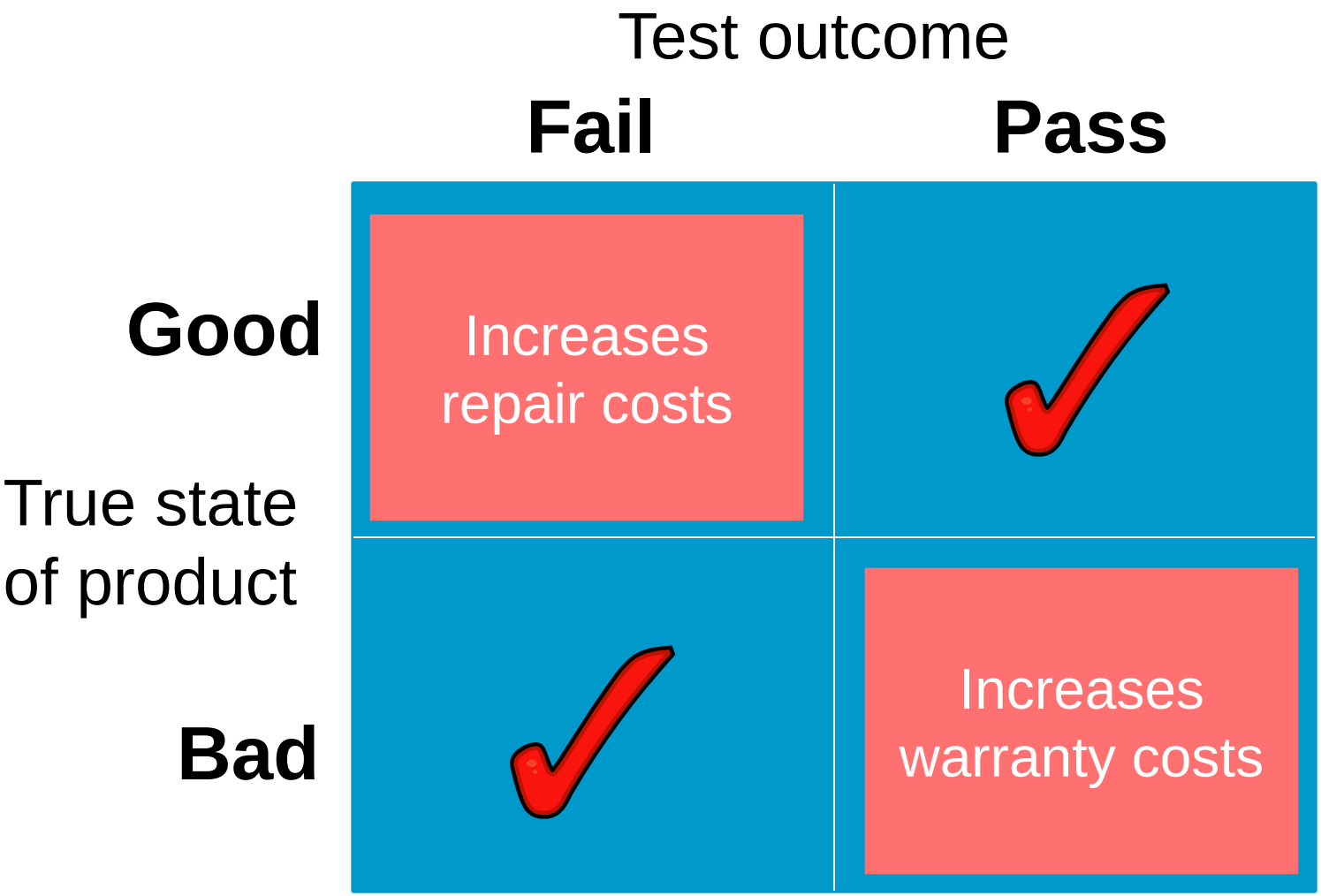
Z540.3

So Why Do We Test…….

- To measure the health of the process
- To reduce risk of variability
- To identify problems



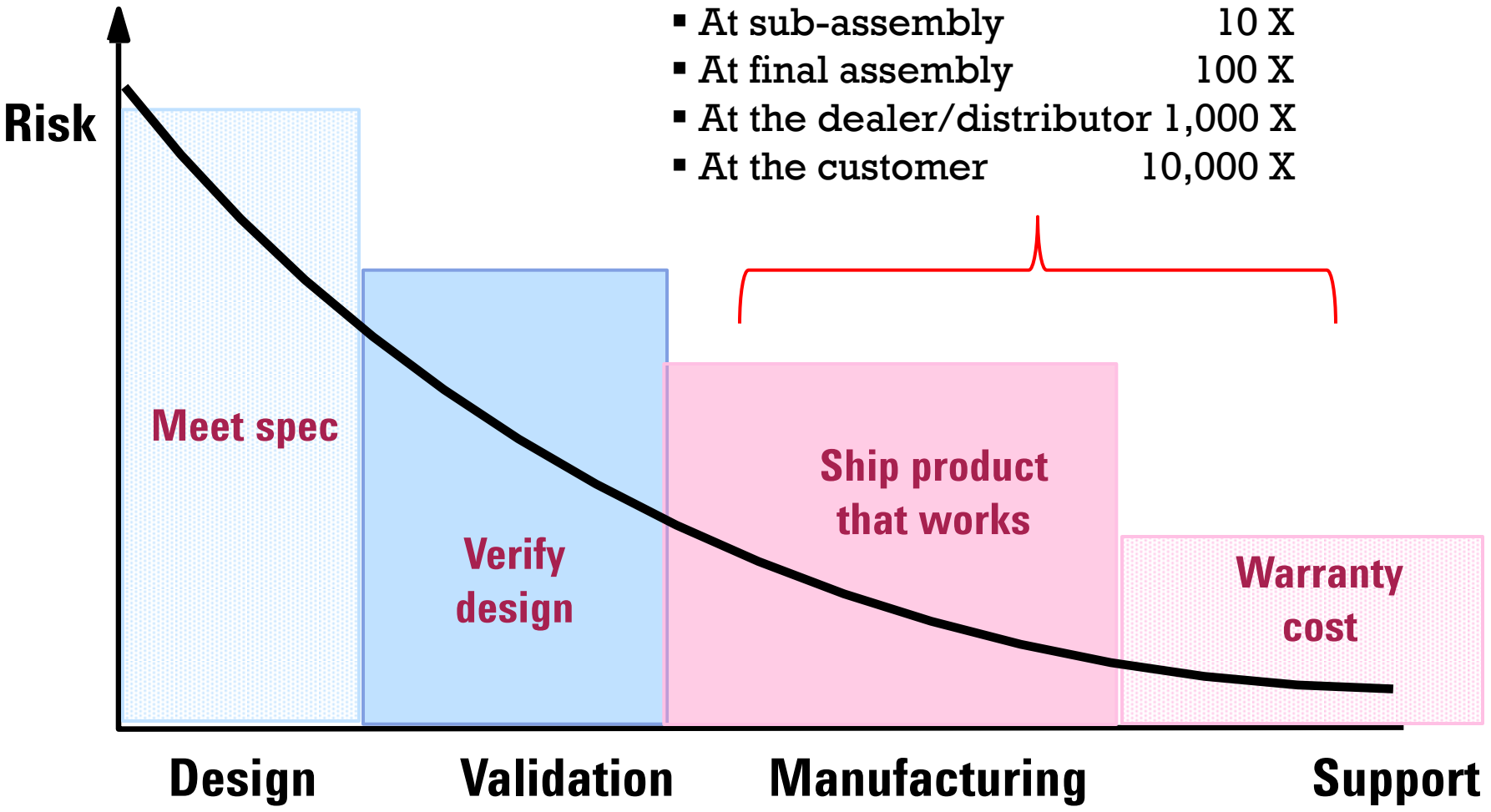
Two Types of Test Errors Increase Testing Costs



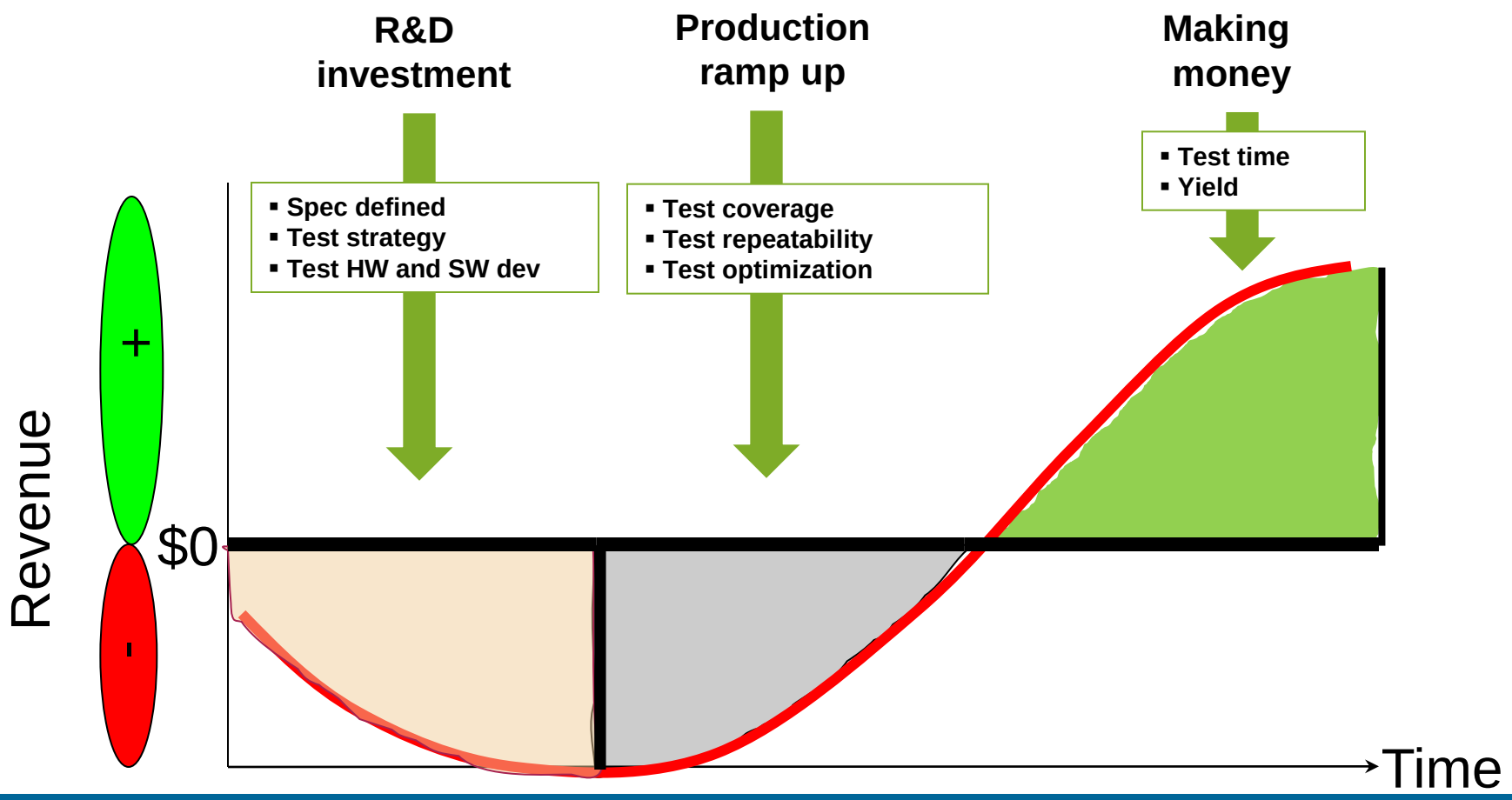
Cost and Delays to Find Repair Defect

False pass and fail

- The part itself X
- At sub-assembly 10 X
- At final assembly 100 X
- At the dealer/distributor 1,000 X
- At the customer 10,000 X



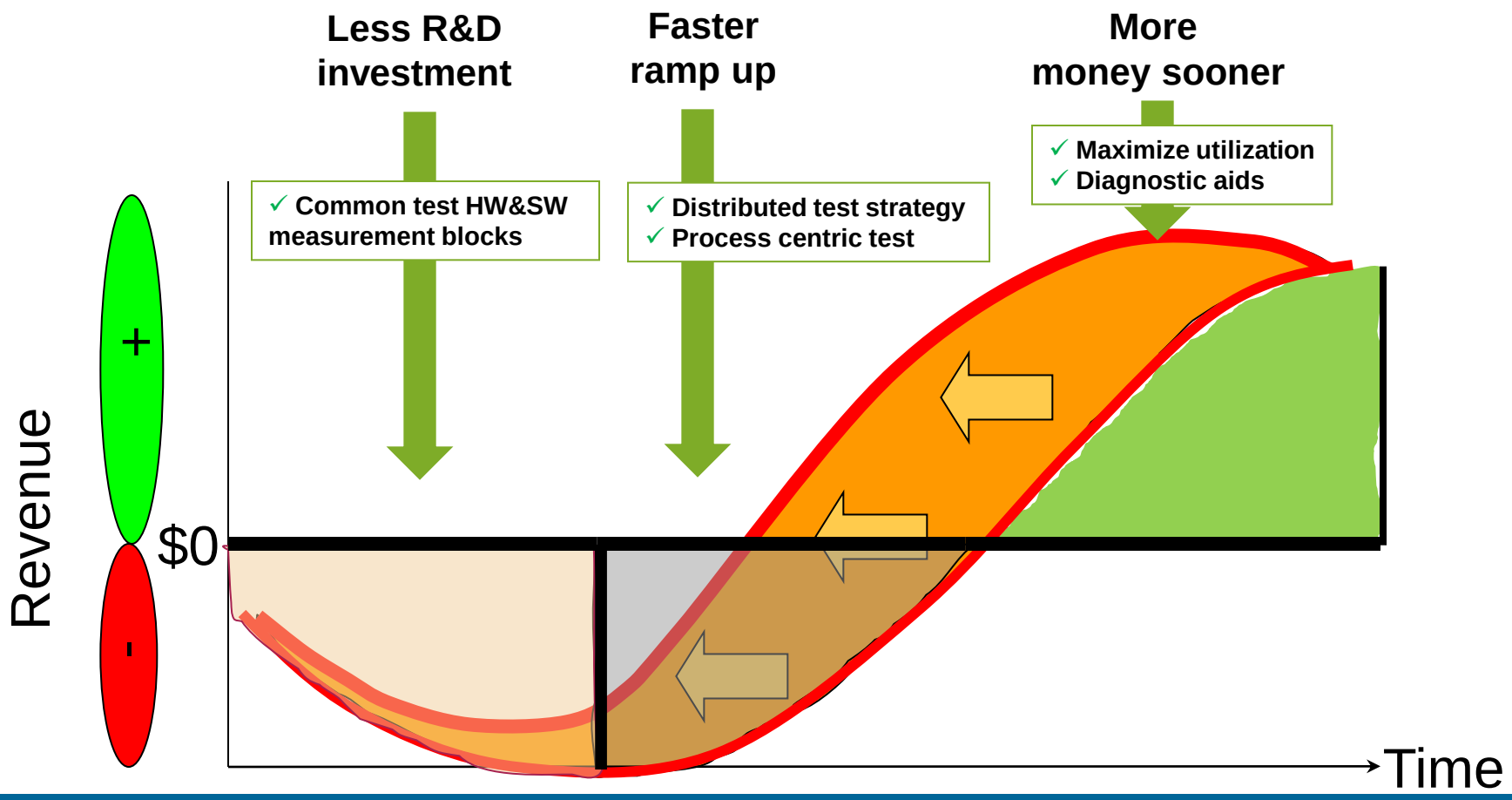
Product Lifecycles in R&D and Production



Senior Managers Care About

Accelerating the product lifecycles in R&D and production

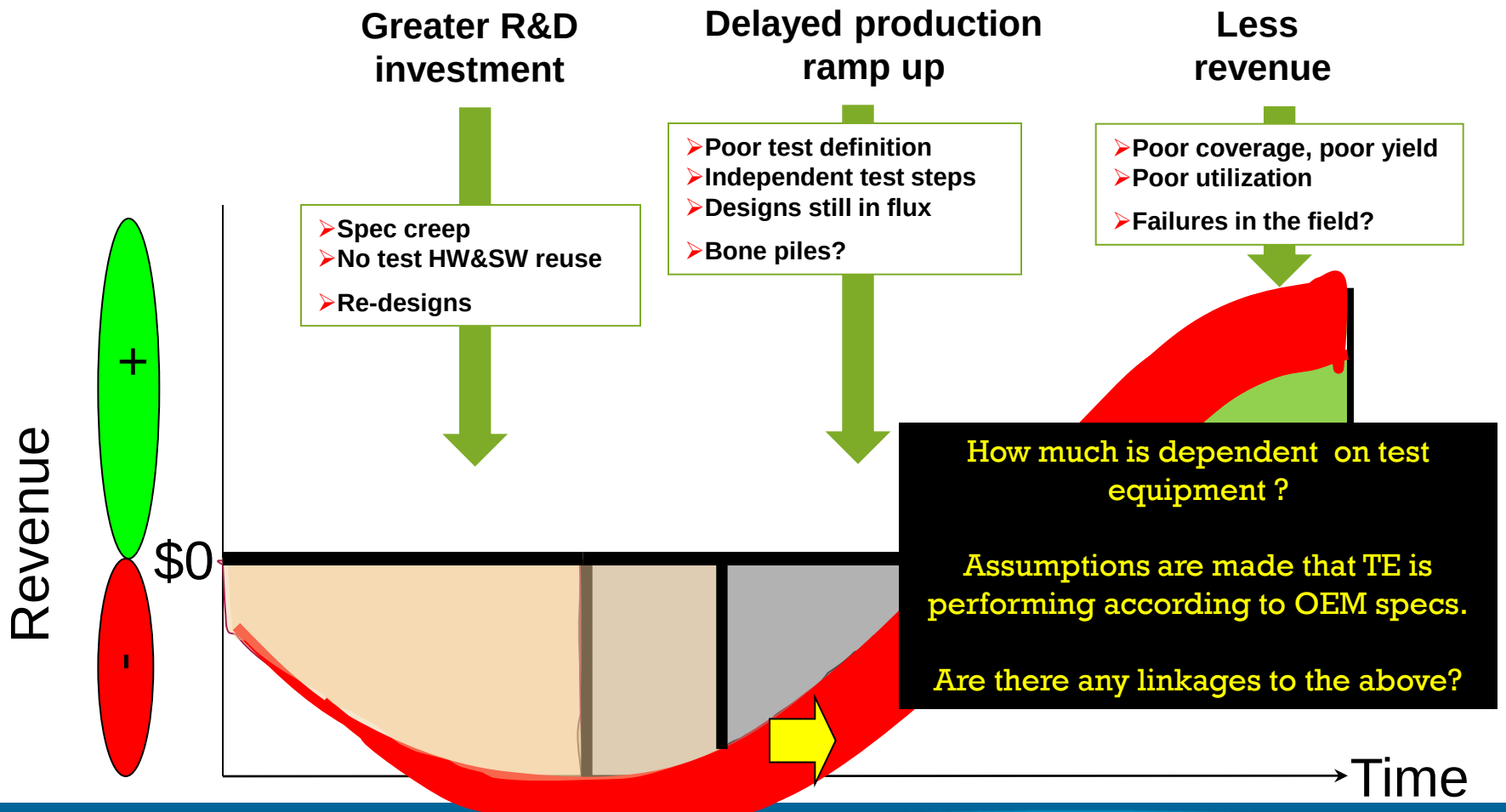
What is the value of a product getting to market faster?



Senior Manager Care About

Product lifecycles and the costs of losing a day

What are the costs of a delayed product to market?



The Potential Cost of Improperly Maintained Equipment – It's All About the Risk

Revenue $

Risks	Costs
TTM delays	Cost of opportunity
Design cycle	Unnecessary design turns, over design, under design
Components	Cost of single sourcing
Design margins	Market share, lower price; competitive differentiators
Bone piles	Productivity in manufacturing
Production delays	Delivery penalties
False pass in mfg; field defects	Warranty costs, field support, customer satisfaction

Margins $

High Risk: Examples

- Food safety
- Nuclear facility
- Aerospace
- Construction safety

Not All Calibrations Are Equal
Price pressures on suppliers

- Are end users getting what they expect and need?
- TAT and price are easy to measure

Are suppliers cutting corners to meet TAT and budgets?

- *Breadth of functions and the number of measurement points*
- *Adequate calibration standards (capital required to keep up with technology)*
- *Automated calibration software complying with OEM specifications*
- *Rigor of quality control*
- *Scope of accreditation/audits*

Price erosion = margin erosion making it difficult for suppliers to invest in new technology to obtain and maintain capabilities

Capex	$100K	Senior mgmt approval required
Calibration	$500-1K	1% of test equipment cost
		20% = $200 savings relative to OEM cal (0.2% of instrument cost)

- Decisions to save $200 can render $100,000 investment to something worth much less – buy lesser product and save much more during the buying process
- Decision not to calibrate or save <1% of cost of equipment on lower quality calibration may affect measurement capabilities and impact business results

Are the R&D and production engineers aware of the risks with regards to how their investment is being looked after? Why take the risk…

Summary

- Business success depends on accuracy and uncertainties throughout the product life cycle.
- Cost of calibration is insignificant relative to cost of asset.
- Impact of inaccuracies on engineering and manufacturing are not always known unless major problems occur.
- Is enough importance (budget/resources) placed on maintenance programs to protect the investment and manage risks?
- Not all calibrations are equal. How much faith do you put into a sticker and a certificate – do you exercise due diligence in selecting suppliers?
- Are the right stakeholders involved in the maintenance process to protect their investments and manage risks?

Do the Senior Managers Care About Calibration?

- Cost savings can be achieved in many other ways while managing risks:
  - Properly managed cal cycles
  - Asset management – increase asset utilization, capex avoidance
  - Education: engineers, technologist and technicians need to be aligned with measurement techniques
  - Rental cost reduction (reduce downtime with better TAT)
  - Increase competencies – repair cost avoidance
  - DFX, lean, common platforms, automation
  - Short-term rentals for peak production periods

Thank You

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(Case A)

$$P(TL)_{FA^+} + P(TL)_{FA^-} \le Risk_{\max}$$

(Case B)

$$\frac{P(TL)_{FA^+} + P(TL)_{FA^-}}{P(TL)_{InTol}} \le Risk_{\max}$$

$$p_m(y - e_{dut}) = \frac{1}{\sqrt{2\pi}\sigma_m} e^{-\frac{(y-e_{dut})^2}{2\sigma_m^2}}$$

$$\sigma_0 = \frac{L}{F^{-1}\left(\frac{1+p}{2}\right)}$$

$$P(y)_{Case\ C} = \frac{P'_{FA^+} + P'_{FA^-}}{P_y}$$

$$P_{InTol} = \iint_{InTol} p_0(e_{dut}) p_m(y - e_{dut}) dA$$

$$P'_{FA^+} = \int_{L}^{\infty} p_0(e_{dut}) p_m(y - e_{dut}) de_{dut}$$

$$P'_{FA^-} = \int_{-\infty}^{-L} p_0(e_{dut}) p_m(y - e_{dut}) de_{dut}$$

$$p(e_{dut}, y) = p_0(e_{dut}) p_m(y - e_{dut}) = \frac{1}{\sqrt{2\pi}\sigma_0} e^{-\frac{(e_{dut})^2}{2\sigma_0^2}} \cdot \frac{1}{\sqrt{2\pi}\sigma_m} e^{-\frac{(y-e_{dut})^2}{2\sigma_m^2}}$$

(Actual equations from Mike Dobbert's NCSLI 2007 paper!)