

Quality Assurance Involvement Compared to Program Results

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Agenda

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- Next Steps

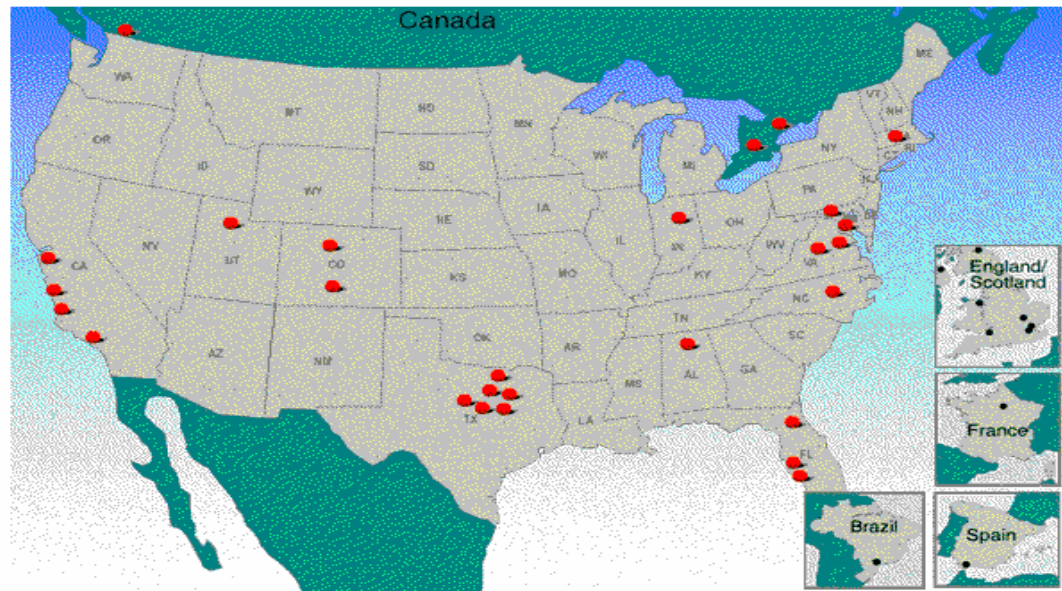
**Quality Assurance Involvement
Compared to Program Results**

Introduction - Raytheon

- Raytheon is an industry leader in defense and government electronics, space, information technology, technical services, and business aviation and special mission aircraft
- Network Centric Systems (NCS) develops and produces mission solutions for networking, command and control, battlespace awareness, and air traffic management
- Space and Airborne Systems (SAS) provides electro-optic/infrared sensors, airborne radars, solid state high energy lasers, precision guidance systems, electronic warfare systems, and space-qualified systems for civil and military applications
- Raytheon-specific data examined for this presentation draws on both NCS and SAS programs executed in North Texas. Data is from software programs

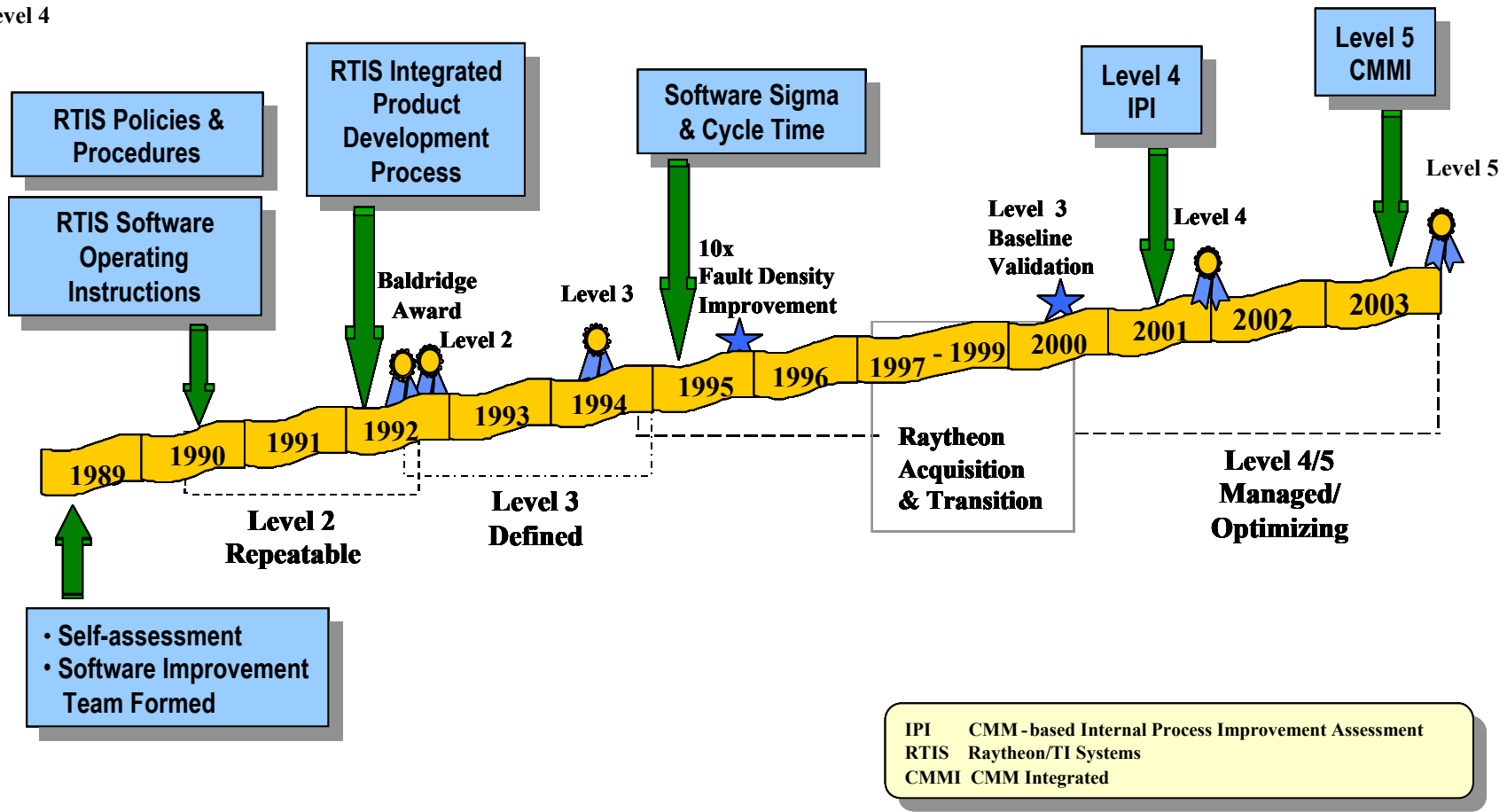
Introduction – Raytheon continued

- For NCS North Texas:
 - 8 QE engineers
 - 145 Software Engineers
 - 30 Programs (including maintenance efforts)



Introduction – Raytheon continued

Level 4



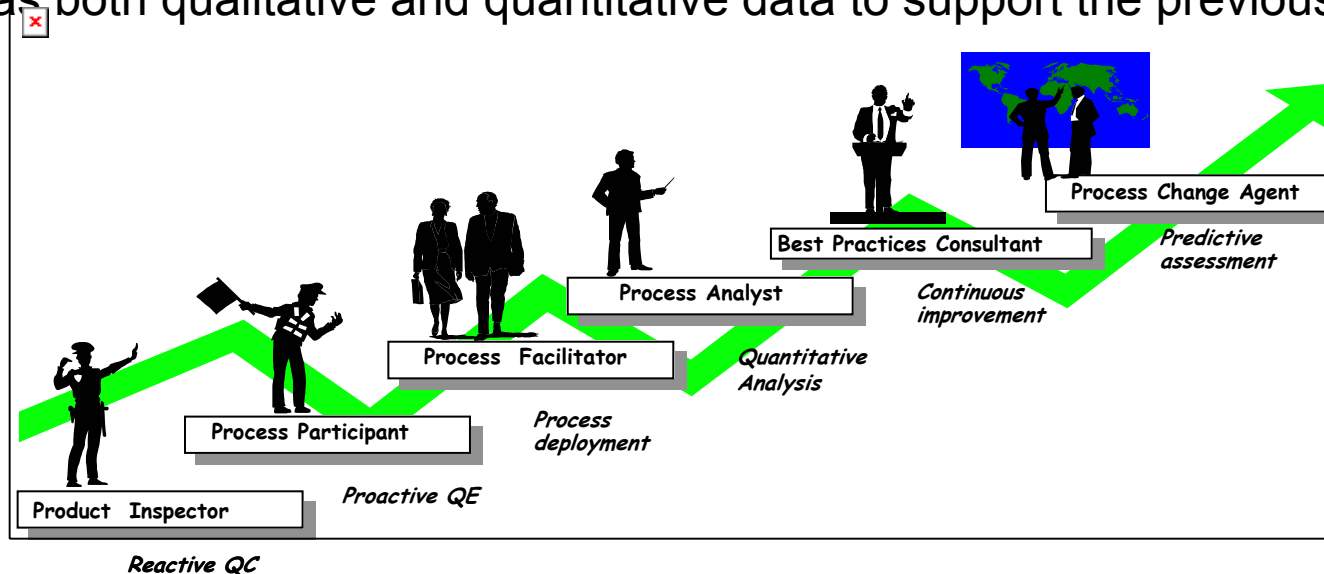
Introduction – The Burning Platform

- Although the CMMI introduces Quality Assurance (QA) at Level 2, and QA is further expanded at higher levels of maturity, QA functions still have to “prove” their worth as QA is often viewed as an “overhead” function



Software Engineering Institute (SEI) Insight

- Quality Assurance is introduced at Level 2 of the Capability Maturity Model Integrated (CMMI)
- Quality activities are in all process areas
- As organizations move up the maturity ladder, there are improvements in program performance
- SEI has both qualitative and quantitative data to support the previous statement



The SEI has collected data which illustrates the correlation between organizational maturity and improved performance

SEI Insight

- Performance results summarized by the Software Engineering Institute, March 4, 2005

Performance Improvement Category	Low	Median	High	Number of Data Points
Cost	4.5%	38%	87%	14
Schedule	20%	50%	90%	14
Productivity	11%	50%	376%	13
Quality	29%	50%	94%	16
Customer Satisfaction	10%	14%	55%	5
Return on Investment	2 : 1	3 : 1	13 : 1	8

Reference: <http://www.sei.cmu.edu/cmml/results.html>

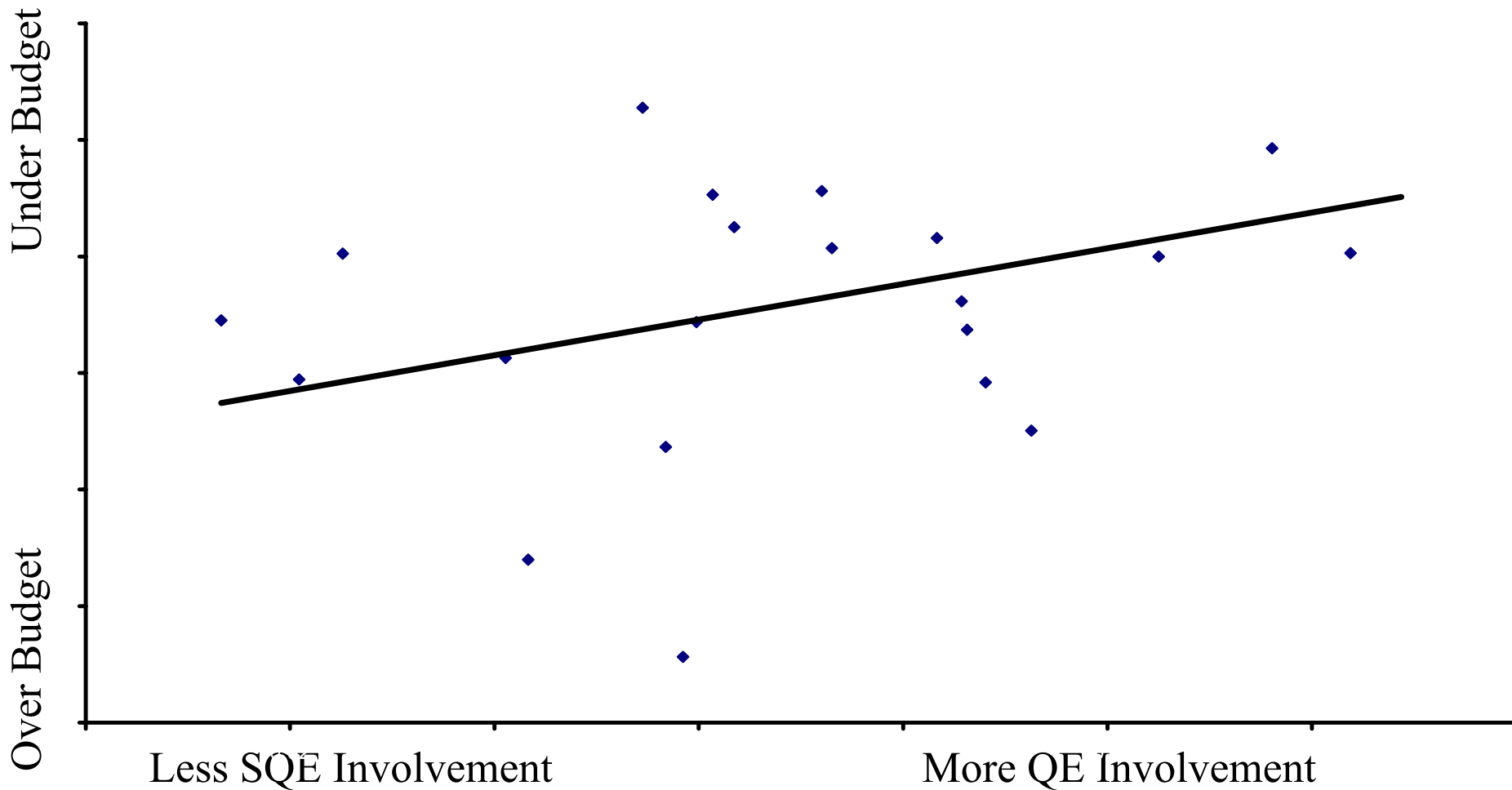
Raytheon North Texas Data – Cost Performance

- QE Involvement is measured as a percentage of the total effort on the program
- Cost Performance Index (CPI) is measured as the ratio of the Budgeted Cost of Work Performed (BCWP) to the Actual Cost of Work Performed (ACWP)

$$\text{CPI} = \frac{\text{BCWP}}{\text{ACWP}}$$



Raytheon North Texas Data – Cost Performance



There is a positive correlation between QE Involvement and Program Cost (measured via CPI)

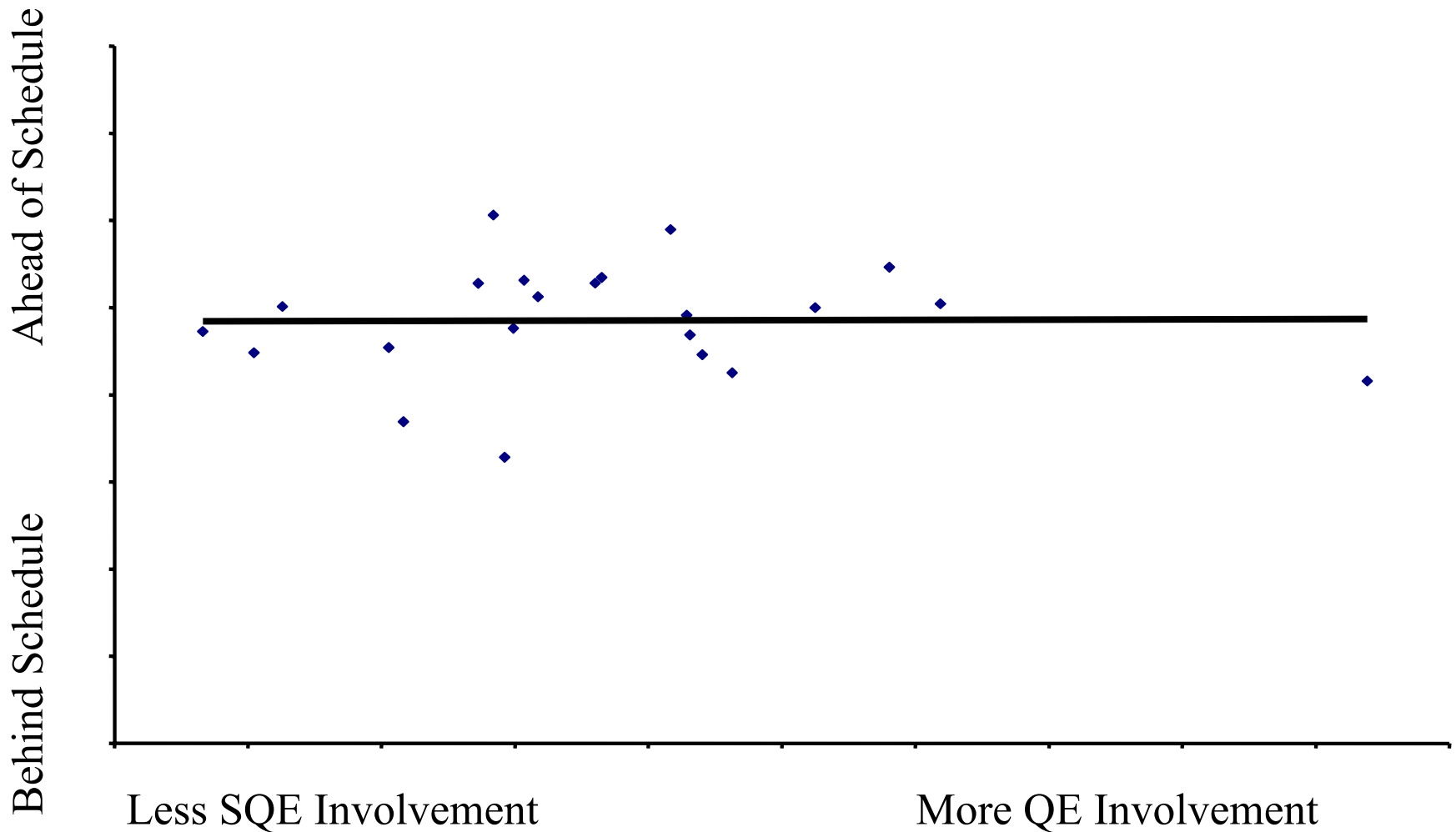
Raytheon North Texas Data – Schedule Performance

- QE Involvement is measured as a percentage of the total effort on the program
- Schedule Performance Index (SPI) is measured as the ratio of the Budgeted Cost of Work Scheduled (BCWS) to the Actual Cost of Work Performed (ACWP)

$$SPI = \frac{BCWS}{ACWP}$$



Raytheon North Texas Data – Schedule Performance

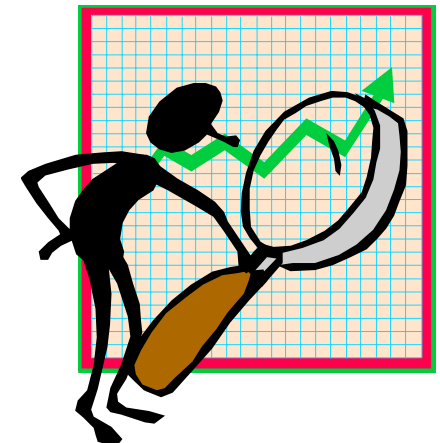


**No apparent correlation between QE Involvement and
Program Schedule (via SPI)**

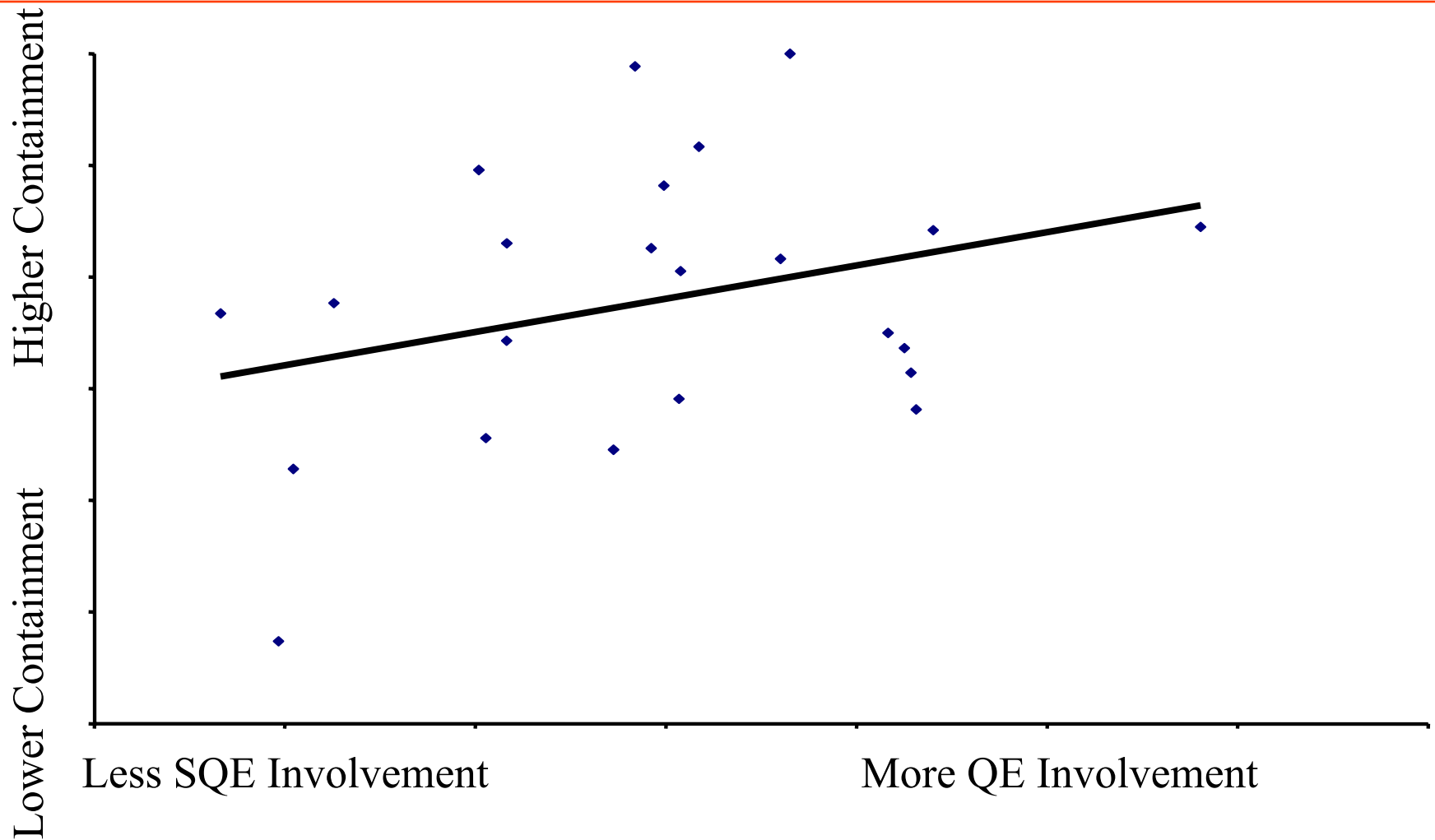
Raytheon North Texas Data – Quality Defect Containment

- QE Involvement is measured as a percentage of the total effort on the program
- Defect Containment (DC) is measured as the ratio of the number of defects which were detected “in phase” versus the total number of defects

$$DC = \frac{\text{In-phase Defects}}{\text{Total Number of Defects}}$$



Raytheon North Texas Data – Quality Defect Containment

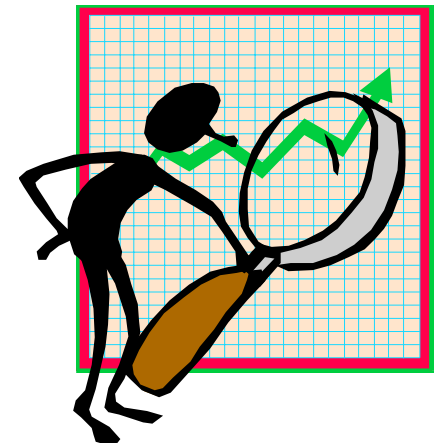


There is a positive correlation between QE involvement and Defect Containment

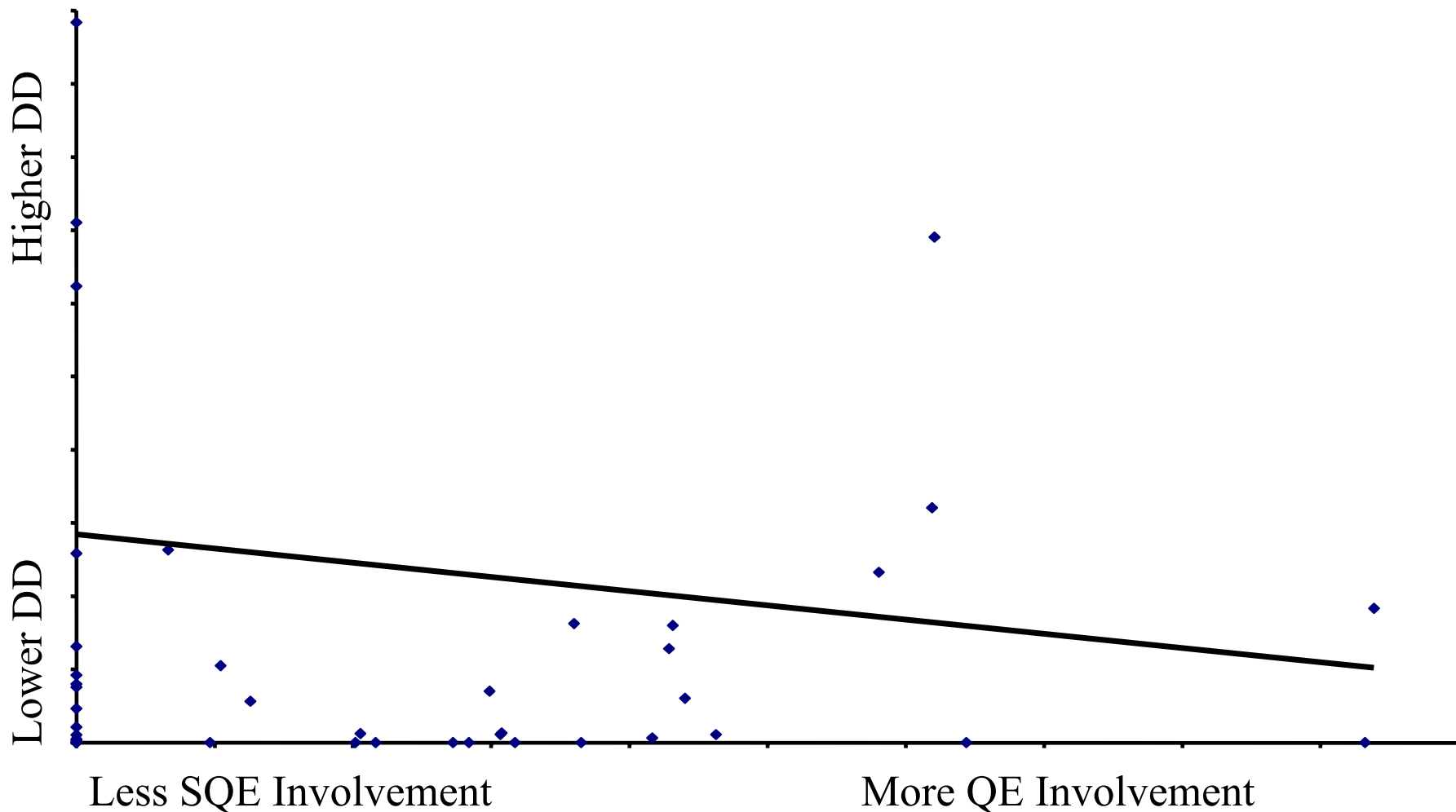
Raytheon North Texas Data – Quality Defect Density

- QE Involvement is measured as a percentage of the total effort on the program
- Defect Density (DD) is measured as the ratio of the number of defects which were detected post delivery versus the size of the product. Note the Equivalent Lines of Code was used to adjust for programs with significant amounts of legacy code

$$DD = \frac{\text{Post Delivery Defects}}{\text{Equivalent Lines of Code}}$$



Raytheon North Texas Data – Quality Defect Density (DD)



There is a negative correlation between QE involvement and Defect Density, which is a good thing!

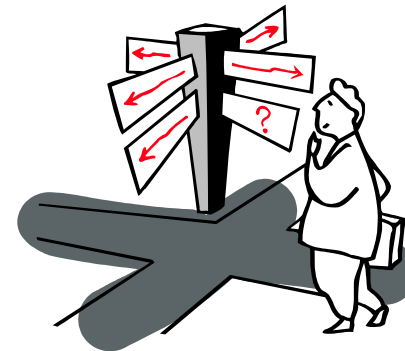
Lessons Learned

- Data, data, data
 - Multiple data repositories
 - The color of money
 - Level of granularity: QE sometimes counted as part of management, planning and control
 - QE may perform expanded role activities (non-traditional QE activities) which are sometimes counted in the QE “bucket”



Other Considerations

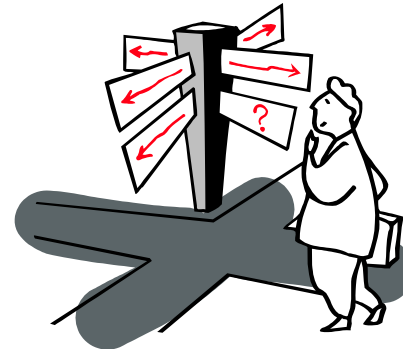
- Execution of QE improved (QE productivity/efficiency)
 - Don't currently have a formal metric for this
 - Process has matured
 - QE staff has had very little attrition
 - Getting more “bang” for the QE buck?



**QE productivity / efficiency is an opportunity
for future analysis**

Other Considerations

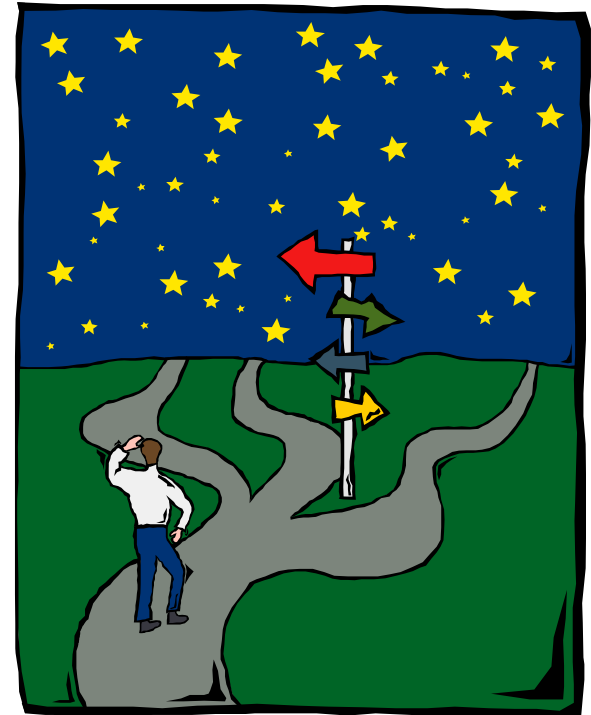
- Customer value of QE involvement
 - Don't currently have a formal metric for this (have customer satisfaction scorecards, but it is not clear if these have the level of granularity required to examine customer perceived value of QE activities)
 - QE involvement required by some contracts
 - QE often has established long-standing relationships with customers
 - Customers request QE participation in various activities



Customer Value of QE Involvement is another relationship to examine

Next Steps

- Continuous Improvement continues...
 - Data repository consolidation
 - NCS is moving towards standardized cost collection system with increased granularity
 - Metrics are being standardized across disciplines: Systems Engineering, Software Engineering, and Hardware Engineering



Although there is evidence that increased QE involvement has a positive impact on program success, there are opportunities for improvement of the data and more analysis in the future!

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Questions

