How to Sell CMMI to Your CEO in His Own Language

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A Few Questions

- How many of you have tried to convince your “C” level executives on the merits of the CMMI Model and haven’t made any headway?
- How many of you keep thinking there is a communication problem, if only…. I can make myself heard?
- How many of you have approached your CEO regarding process improvement efforts from a technical perspective?

Session Objectives

- Review the language of engineering and engineering processes
- Learn the language of the CEO
- Translate the engineering language to CEO's language
- Learn how process improvement efforts can be sold in business context – an example

Language of Engineering

Life Cycle (waterfall, iterative, spiral, v-model)

Requirements development

Configuration management

Solution development

Integration

Interfaces

Testing (unit, component, system, …ability, performance, etc.)

Builds

Bug fixes

Release

Language of CMMI Framework

Process institutilization

Project instantiation

Maturity level

Capability level

DAR process

Causal analysis

Monitor and control

Criteria

Relevant stakeholders

Language of CEOs

- Revenue
- Expense – selling, administrative, engineering, etc.
- Gross margins
- Net income
- Earnings Before Interest, Taxes Depreciation and Amortization (EBITDA)
- Operating profit
- Cost reduction
- Revenue growth
- Return On Investment (ROI)
- Strategy
- Productivity
- Competition

Typical Customer Survey/Feedback Results

- Quality of our products are very low
- They may be reconsidering purchasing another product from us
- They find numerous bugs
- They feel as if they are our testing group
- Our products are always late
- Our products are not meeting their needs

State of Engineering Organization

- Long hours for engineers
- Fighting the same old battles again and again
- Attrition is high - Losing many talented people
- Too many bugs
- Cannot get a product released as expected
- Rework, rework, rework – not enough time to do it right, but plenty of time to do it over!
- Heroes, heroes, heroes

Solution 1

We are going to adapt CMMI to create engineering processes; we are going to institutionalize them and mature the organization.

We will put everything under configuration management.

We will fix all bugs before we release a product.

It will take a long time; but it will be worth it at the end.

What do you think the reaction of your CEO will be?

- What is this CMMI thing?
- How long did you say it will take?
- How much did you say it will cost?

Solution 2

- We find out our SW engineering costs in real $s by conducting a **cost analysis against the industry benchmarks**, based on the results we work to reduce the biggest cost areas.

- We find out the state of our **engineering practices as compared to the industry best practices** (CMMI Model) and then adapt them to fix our problems based on where we can impact the highest costs.

Strategy

A business approach to process improvement based on the language of the CEO:

Step 1: Financial Cost Analysis of engineering quality

Step 2: Gap Analysis of engineering practices against the industry best practices (CMMI)

Step 3: Correlation between steps 1 and 2

Step 4: Recommended Areas of Improvement for the best ROI.

Example: Company A – Situation Analysis

- Company A, Engineering Organization is developing a Next Generation System (NGS) that incorporates hardware and software elements.
- Software defect rates in previous products were high.
- To develop and deliver a high quality product, Company A has engaged in several process improvements, including Design for Six Sigma (DFSS) House of Quality (HOQ).
- To meet the timing requirements, impact, and budget constraints, a "QuickLook" assessment was performed – to determine **highest value, engineering practice improvement opportunities** and setting baselines.
- Effort will focus on 3 key areas: Project management, engineering and support areas across 5 engineering subsystem teams over a 1-week timeframe and include a Cost of Quality analysis.

Underlying Quality Premises

- The earlier quality can be driven into a product, the less costly it will be to deliver and support the product.
- Average software projects spend 50% or more of their budgets fixing quality problems introduced earlier in the software engineering life cycle.
- High cost of poor quality robs organizations of the ability to deliver more features and functionality to the market.
- The underlying premise of process improvement is:
  - *“The quality of a product is largely determined by the quality of the process that is used to develop and maintain it.”*

Based on TQM (Total Quality Management) principles as taught by Shewhart, Juran, Deming and Humphrey

Cost of Quality Analysis

Cost of Quality Analysis Objectives

- Quantify in "$"s poor quality costs
- Identify major opportunities for poor quality to reduce cost
- Identify opportunities for reducing customer dissatisfaction
- Identify threats to product salability
- Expand budgetary and cost controls
- Stimulate improvement through publication
- Improve ability to deliver more to the business/market
- Reduce the functionality gap versus the competition
- Provide executives with tangible reasons to invest in software engineering improvement

Cost of Quality (CoQ) Concept

- Developed by J.M. Juran and applied successfully by companies like Toyota Motor Corporation to achieve competitive advantages through the development of better quality products
- CoQ represents *all costs associated with poor quality*

Source: Juran's Quality Handbook

Example – Company A, Engineering Org. Cost of Quality Results Summary

• Total Organizational 3-Month Costs:	$3, 648,000	100%
• Software Development Costs	$1,060,000	29%
• Quality Costs	$2,588,000	71%
• Prevention Costs	$200,000	5%
• Appraisal Costs	$181,000	5%
• Internal Rework Costs	$725,000	20%
• External Rework Costs	$1,482,000	41%

Yearly Organizational Cost Savings Opportunity $3,094,000 30%

Based on Company A SW Eng. budget of $10M/year reducing CoQ to 40%

- Company A, SW Development Quality of Data Low/Average

Example – Company A, Engineering Cost of Quality Results

Development Costs = 29%

Costs incurred to directly develop the product, or interim work products that lead to a product. Does not include any reviews, testing, or rework

Examples:

- Capturing/Documenting Requirements
- Architecting the system
- Designing the system
- Writing and unit testing code
- Managing the project
- Creating user documentation
- Creating installation guides

Example – Company A, Engineering Cost of Quality Results

Prevention Costs = 5%

Costs incurred to keep failure and appraisal costs to a minimum

Examples:

- Quality planning
- Software quality assurance
- Software configuration management
- Supplier capability assessments
- Quality training
- Software reuse
- Requirements reviews
- Design reviews
- Code reviews
- SCM tools
- External process assessments
- Process improvement efforts

Example – Company A, Engineering Cost of Quality Results

Appraisal Cost = 5%

Costs incurred to determine the degree of conformance to quality requirements

Examples:

- Purchased software testing
- Defect reporting/tracking
- Test automation software
- First iteration integration testing
- First iteration system testing
- User acceptance testing

Example – Company A, Engineering Cost of Quality Results

Internal Failure costs = 20%

Costs associated with defects that are found prior to transfer of the software to the customer

Examples:

- Design corrective action
- Design re-reviews
- Purchased software corrective action
- Purchased software re-test
- Defect reporting/tracking
- Defect fixing
- 2nd and subsequent integration testing iterations
- 2nd and subsequent system testing iterations

Example – Company A, Engineering Cost of Quality Results

External Failure Costs = 41%

Costs associated with defects that are found after the software is shipped to the customer

Examples:

- Next release defect rework (maintenance)
- “Re-engineering”
- Technical support personnel
- Software returns
- Lawsuits
- Contract penalties
- Lost customers
- Lower marketplace perception
- Loss of pricing power
- Lost sales

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Step 2: Gap Analysis of Engineering Practices Against the Industry Best Practices

CMMI Based Gap Assessment

Engineering Process Improvement Premise

- Capability Maturity Model Integration (CMMI®) incorporates systems and software engineering industry best practices that are widely recognized to deliver quality systems.
- In performing the "QuickLook" Company A process assessment, the CMMI will be used as the reference model.

Example – Company A, "QuickLook" Engineering Processes Assessment

Process Areas selected for "QuickLook":

- Engineering:
  - Requirements Development
  - Requirements Management
  - Product Integration
  - Verification
- Project Management:
  - Project Planning
  - Project Monitoring and Control
- Support:
  - Configuration Management
  - Measurement and Analysis

Example – Company A, "QuickLook" Engineering Processes Assessment Results

Capability Level	Process Area
1	Requirements Development (9 practices satisfied out of 12; 3 not rated)
0	Project Planning (6 practices satisfied out of 14)
0	Project Monitoring & Control (4 practices satisfied out of 10)
0	Requirements Management (3 practices satisfied out of 5)
1	Product Integration (9 practices satisfied out of 9)
0	Verification (4 practices satisfied out of 8)
0	Configuration Management (5 practices satisfied out of 7)
0	Measurement and Analysis (0 practices satisfied out of 8)

Example – Company A, "QuickLook" Engineering Processes Assessment Results

CMMI Generic Goals and Practices Summary

Rating	Generic Goal/Generic Practice Description
NS	GG 2 – Institutionalize a Managed Process
NS	GG 2.1 – Establish an Organizational Policy
NS	GG 2.2 – Plan the Process
NS	GG 2.3 – Provide Resources
S	GG 2.4 – Assign Responsibility
NS	GG 2.5 – Train People
NS	GG 2.6 – Manage Configurations
NS	GG 2.7 – Identify and Involve Relevant Stakeholders
S	GG 2.8 – Monitor and Control the Process
NS	GG 2.9 – Objectively Evaluate Adherence
NS	GG 2.10 – Review Status with Higher Level Management

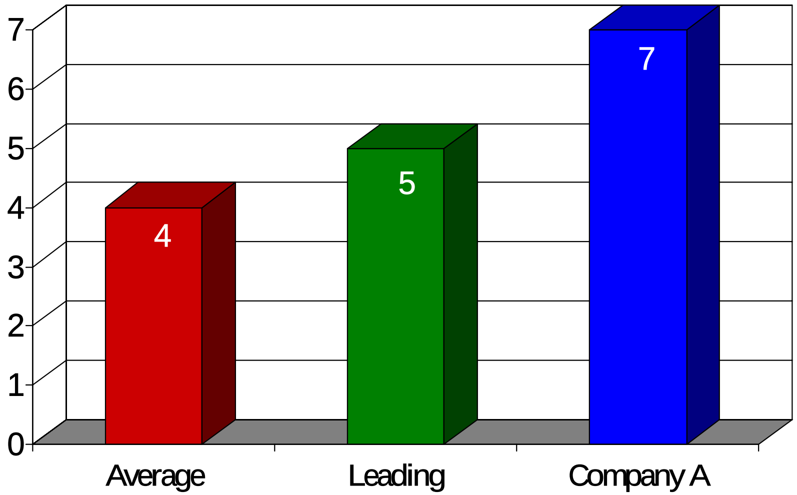
■ S = Satisfied ■ NS = Not Satisfied

Step 3: Correlation Between Cost of Quality and Gap Analysis of Engineering Practices Against CMMI

Correlation of Two Assessments

Example – Company A, Correction of Engineering Costs and Process Gaps

Requirements Effort % Benchmarks

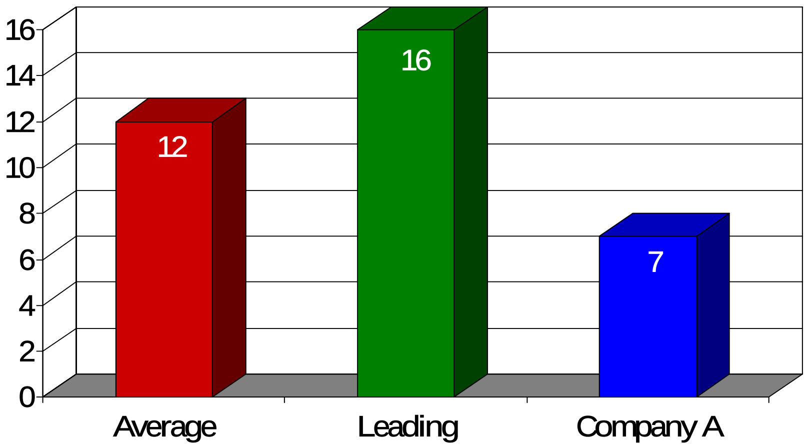


"Quick Look" Engineering Process Assessment Results

Capability Level	Process Area
1	Requirements Development (9 out of 12 practices satisfied; 3 not rated)
0	Requirements Management (3 out of 5 practices satisfied)

Example – Company A, Correction of Engineering Costs and Process Gaps

Design Effort % Benchmarks



"Quick Look" Engineering Process Assessment

Capability Level	Process Area
1	Product Integration (9 out of 9 practices satisfied)

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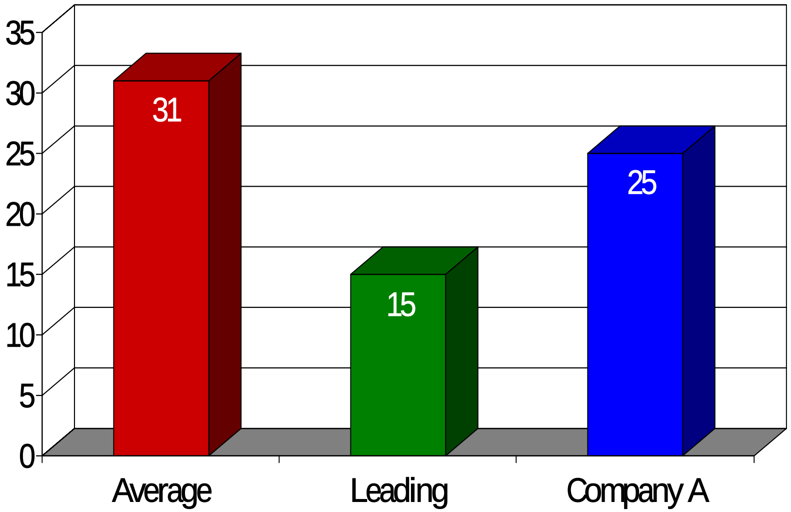
Example – Company A, Correction of Engineering Costs and Process Gaps

Testing Effort % Benchmarks



"Quick Look" Engineering Process Assessment Results

Capability Level	Process Area
0	Verification (4 out of 8 practices satisfied)

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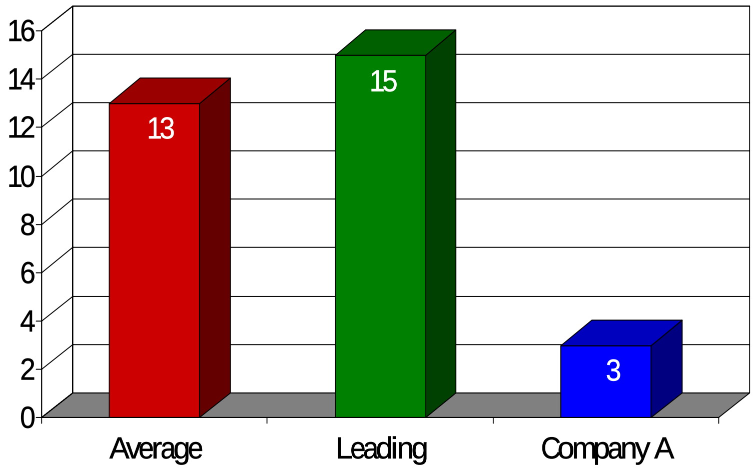
Example – Company A, Correction of Engineering Costs and Process Gaps

Project Management Effort % Benchmarks



"Quick Look" Engineering Process Assessment

Capability Level	Process Area
0	Project Planning (6 out of 14 practices satisfied)
0	Project Monitoring & Control (4 out of 10 practices satisfied)

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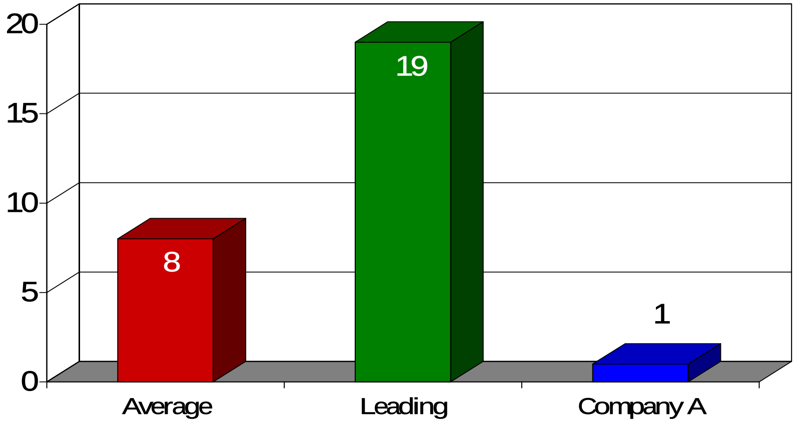
Example – Company A, Correction of Engineering Costs and Process Gaps

SQA % Benchmarks



"Quick Look" Engineering Process Assessment

Capability Level	Process Area
1	Configuration Management (5 practices out of 7)

Risks and Recommendations

Example – Company A, Recommended Areas of Improvement for the Highest ROI

Major Areas of Risk – 1:

- Most widely-recognized software experts view project management as a critical capability in delivering quality software. Project planning and project monitoring and control is weak in Company A SW organization. (CoQ PM cost allocation confirms this observation.)
- Effective measurement and analysis (M&A) is almost non-existent. Without M&A it is very difficult to gain insight into the software development processes, products, and projects, and take corrective actions when necessary.

Example – Company A, Recommended Areas of Improvement for the Highest ROI

Major Areas of Risk – 2:

- Verification activities at the component and sub-assembly level need to be better planned and implemented. Unit and integration tests must be tied back to the requirements allocated to the software components.

Example – Company A, Recommended Areas of Improvement for the Highest ROI

Overall Recommendations – 1:

- Take steps to apply a level of discipline and rigor to software engineering project management in-line with the DFSS and systems engineering improvements already installed
  - Thoroughly plan the software activities and deliverables as related to the system requirements allocated to software
  - Properly schedule the software projects – do not allow "un-tethered" activities to remain off schedules
  - Plan and implement a measurement and analysis capability that addresses process, product, and project dimensions

Example – Company A, Recommended Areas of Improvement for the Highest ROI

Overall Recommendations – 2:

- Institute more formal software work product inspections and track results.
- Continue to apply the successful DFSS and systems engineering techniques to drive systems requirements to the software components where verification can take place against those requirements.

Questions and/or Comments?

Appendix

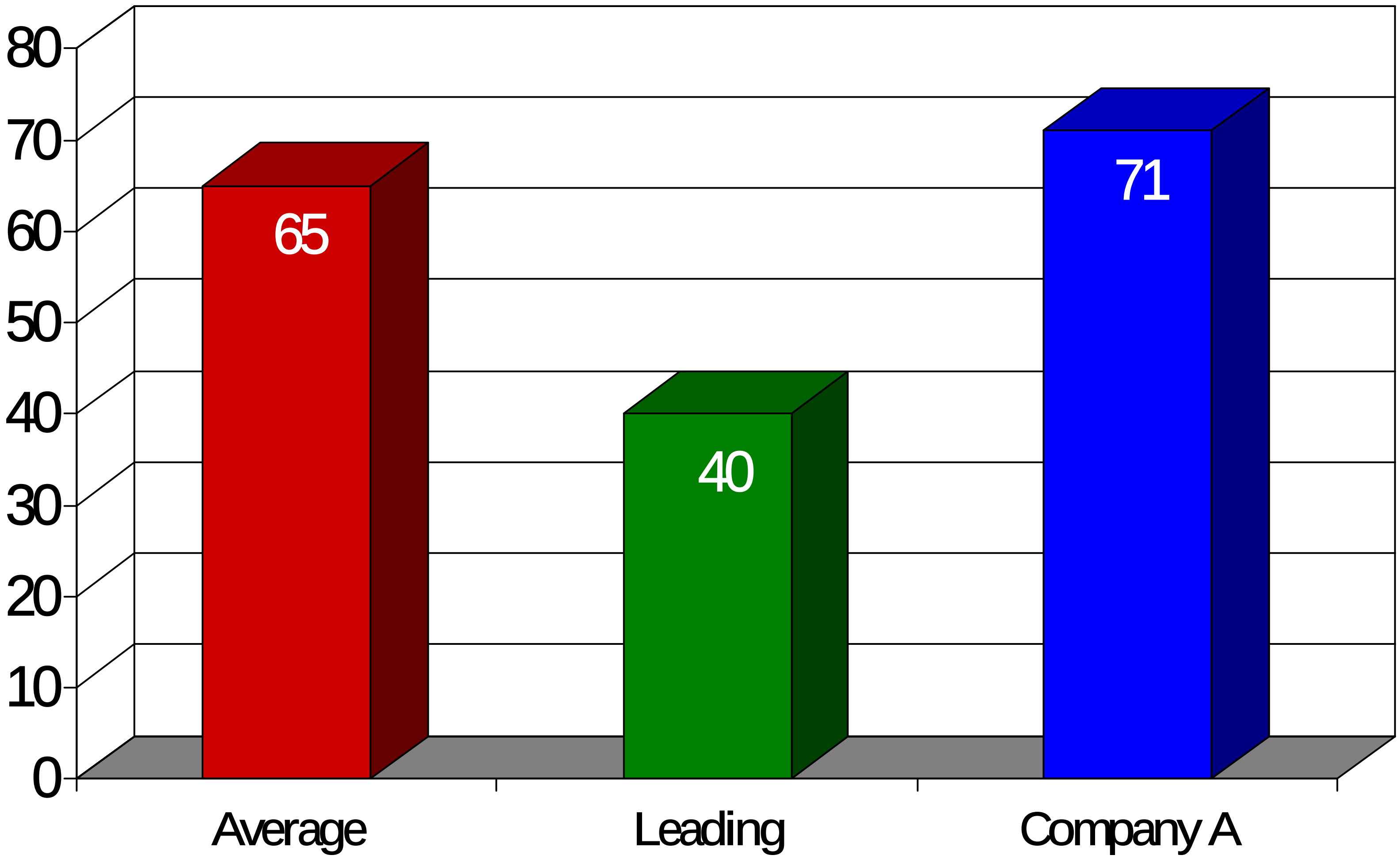
Supporting Details

Characteristics of Average/Leading Benchmarks

Average (CMM/CMMI ML1)	Leading (CMM/CMMI ML 3)
Total CoQ of 55% - 70%	Total CoQ of 40% - 50%[1]
External Failure Costs > 50%	External Failure Costs 15%-25%[2]
Spend 31% on Testing	Spend 15% on Testing[3] Includes process improvement, work product reviews, and classical SQA activities
Spend 8% on SQA	Spend 19% on SQA[3]
	20% Decrease in Cost & Schedule[3]
	80% Decrease in Released Defects[3]
	65% Increase in Productivity[3]

1: Dion, R., "Process Improvement and the Corporate Balance Sheet," *IEEE Software*, July 1993
2: Krasner, H., "Self-Assessment Experiences at Lockheed," *SEI/AIAA SPI Workshop*, Chantilly, VA 1990
3: Jones, C., "Measuring Software Process Improvement," *Software Process Improvement*, IEEE, 2001

Company A - Cost of Quality % Compared to Benchmarks



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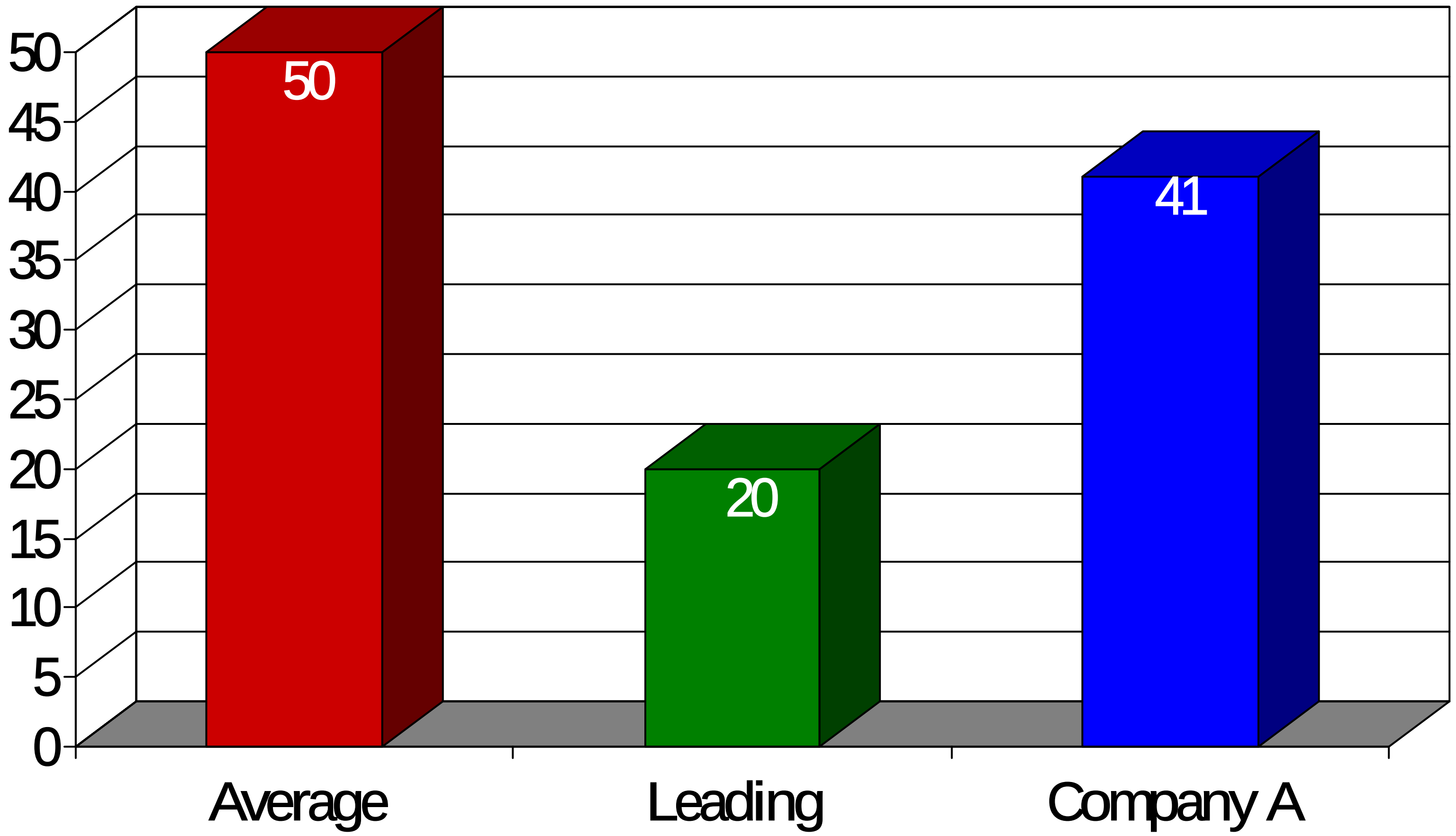
Company A - External Failure % Compared to Benchmarks



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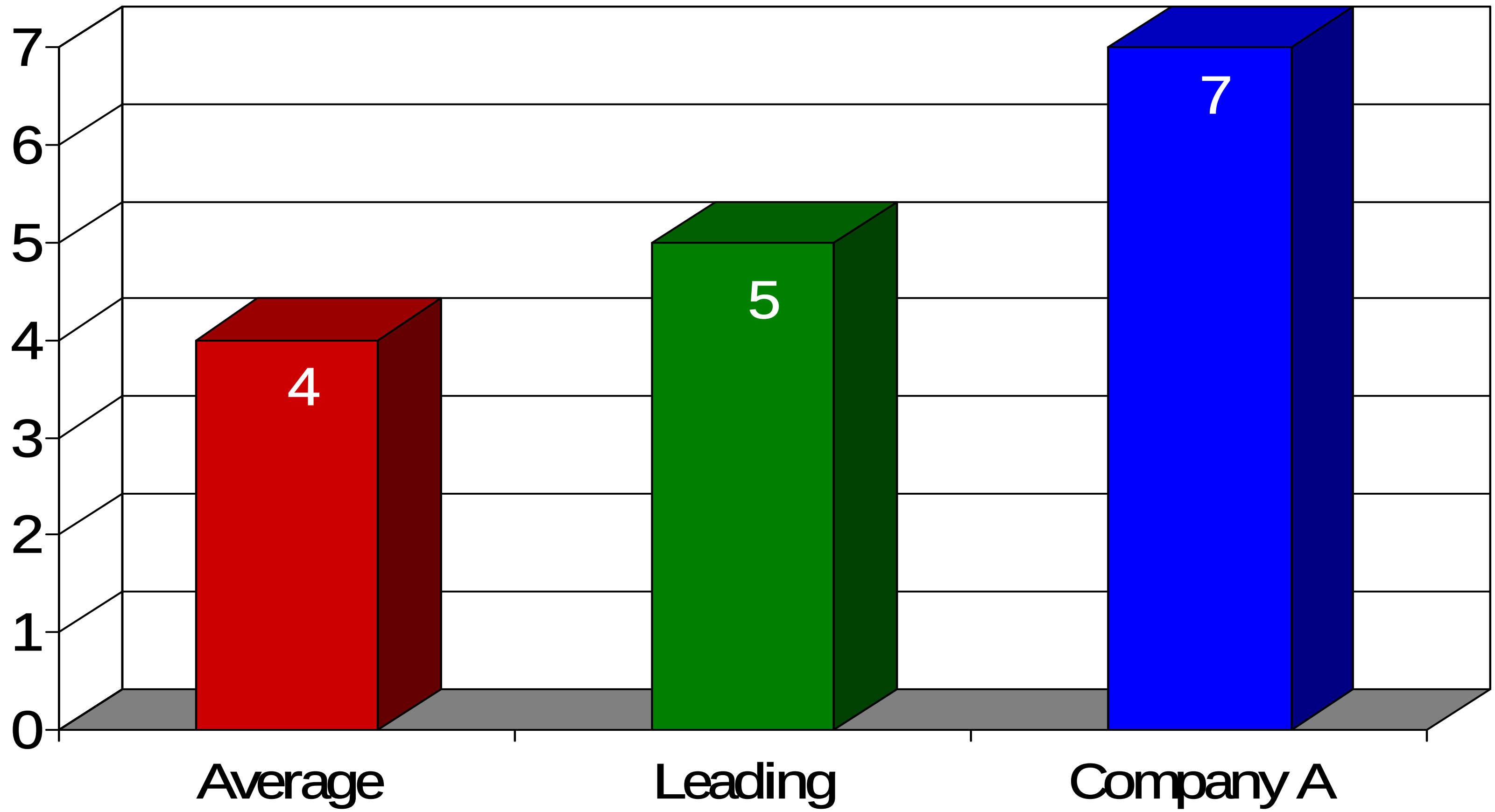
Company A - Requirements Effort % Benchmarks



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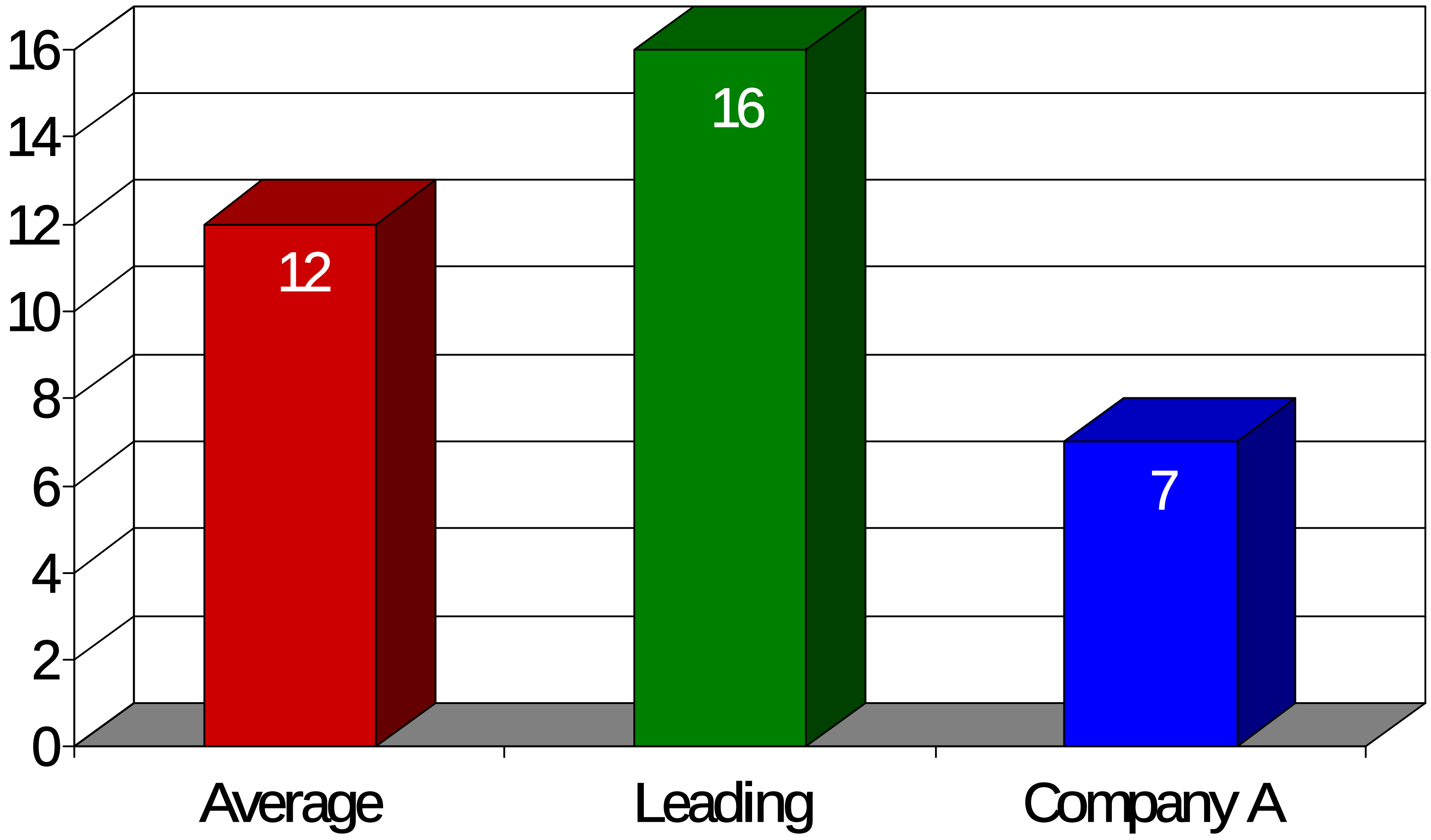
Company A - Design Effort % Compared to Benchmarks



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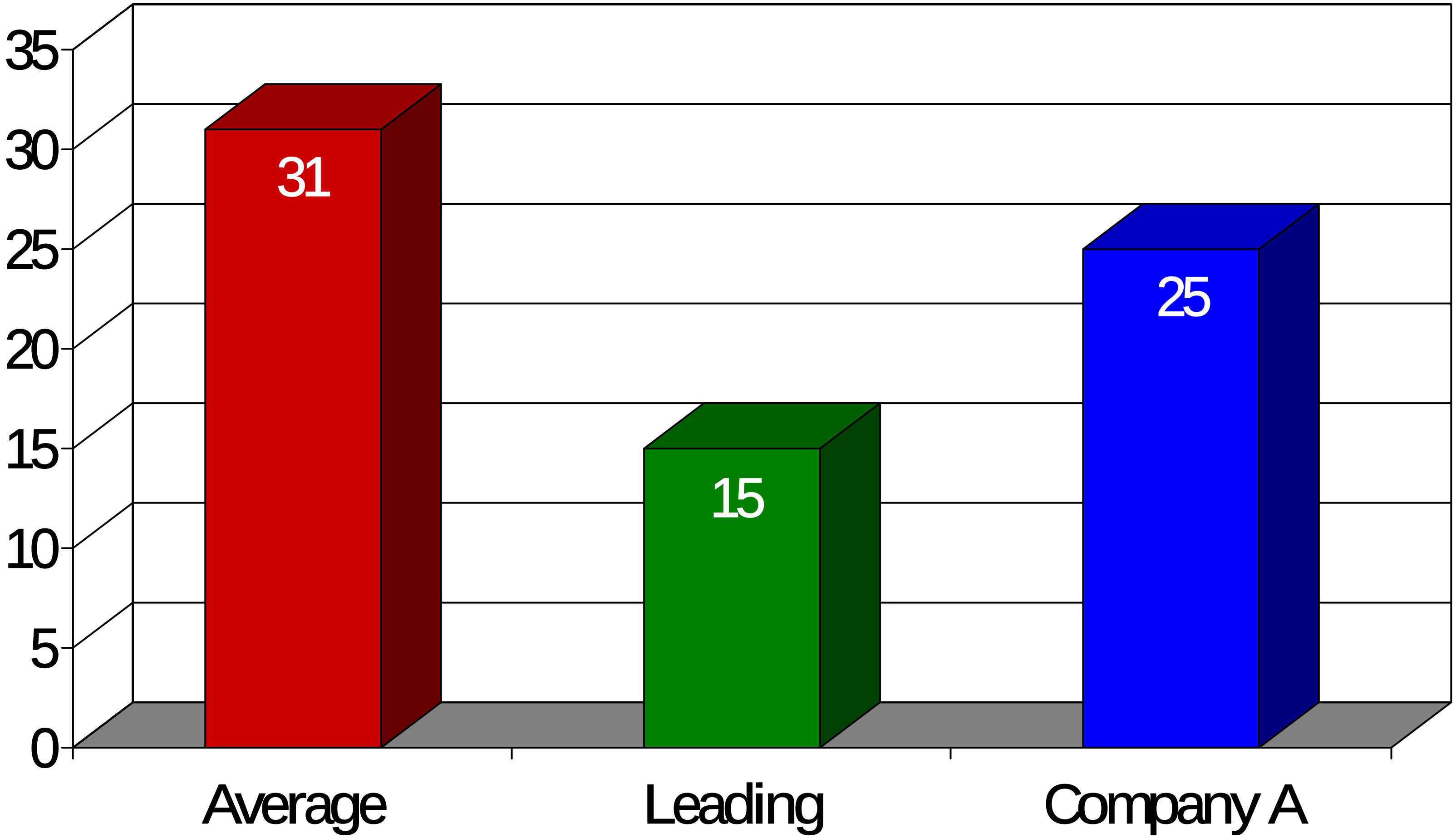
Company A - Testing Effort % Compared to Benchmarks



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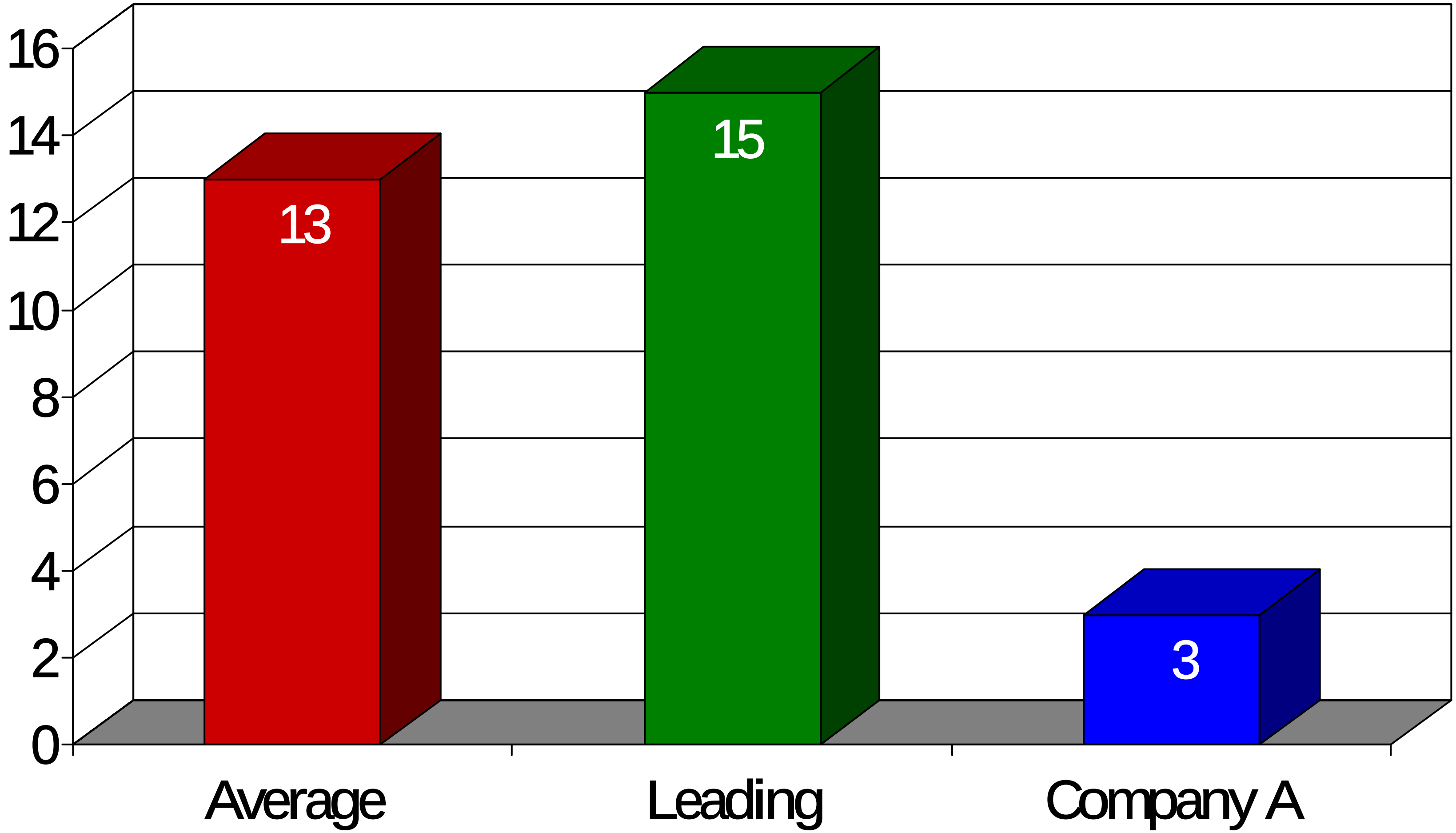
Company A – Project Management Effort % Compared to Benchmarks



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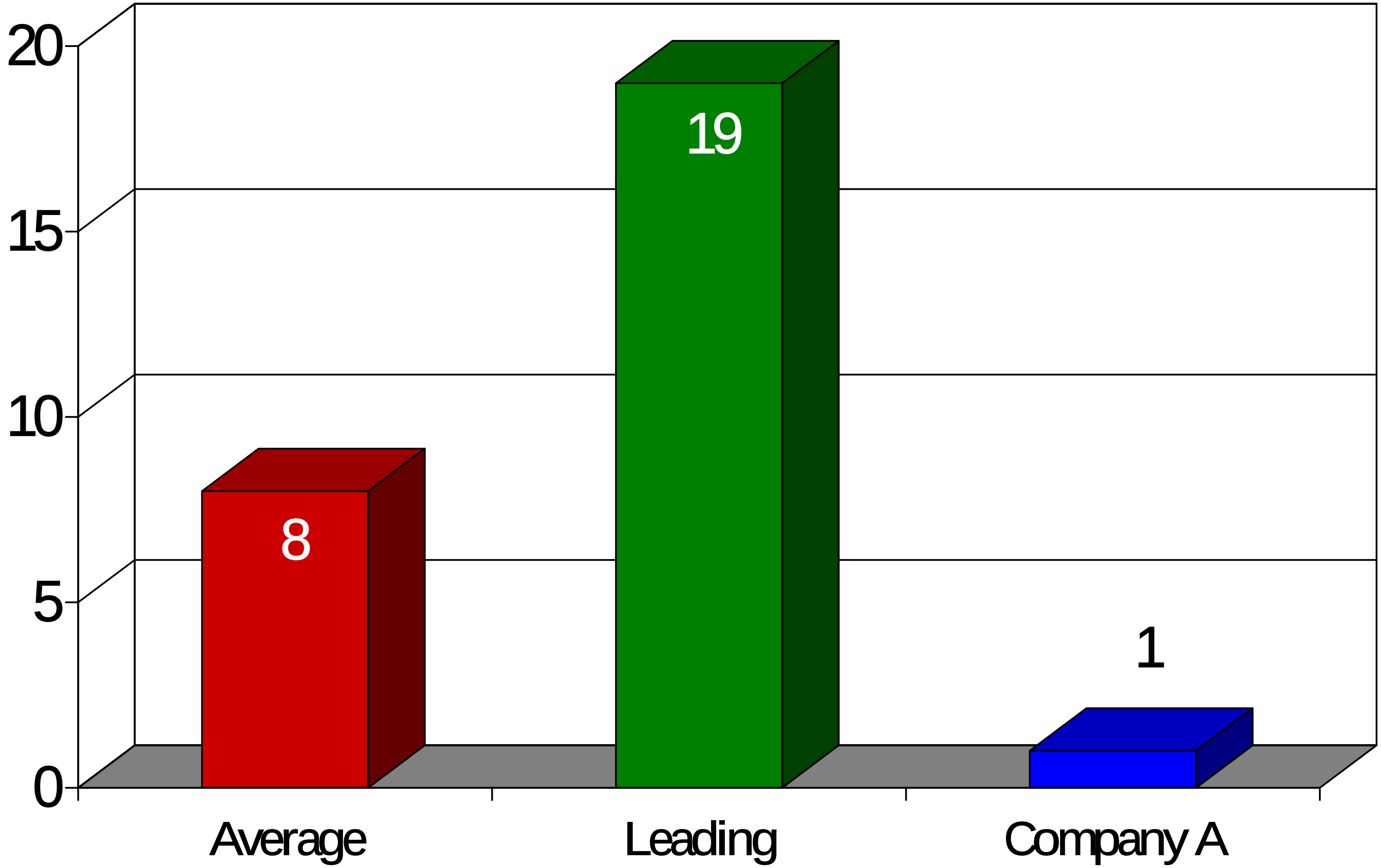
Company A SQA % Compared to Benchmarks



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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Requirements Development Strengths:

- NGS System Engineering process appears to be performing extremely well for the identification and gathering of NGS requirements.
- It was consistently conveyed that the to-date NGS product development process is resulting in a much better defined product than previous efforts.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Requirements Development Weaknesses:

- Descriptions of the subsystem-to-subsystem interface identified in the requirements have not yet been detailed.
- The subsystem teams do not have a documented operational scenario (free of design), or a documented operational concept (design dependent).

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Requirements Management Strengths:

- The understanding of requirements at the current phase of NGS is much better than the understanding of requirements on prior product requirements phases.
- The system engineers and subsystem teams commit to their subsystem requirements through the frequent subsystem team meetings.
- Changes to requirements have been documented in the different HOQ levels.

Example – Company A, “QuickLook” Engineering Processes Assessment Findings

Requirements Management Weaknesses:

- The requirements are documented in numerous spreadsheets and diagrams. Bi-directional traceability was not discovered.
- Subsystem teams have not yet driven the requirements into the project plans and schedules, nor are they allocated to the work product level.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Strengths:

- Each subsystem team has a work breakdown structure (WBS) embedded in their current schedule.
- The subsystem teams work within the high level product development life cycle described by the NGS Systems Engineering group.
- The subsystem teams identify and analyze technical risks.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Weaknesses – 1:

- Subsystem teams do not have a process for estimating the effort and cost required for the work products.
- The current processes used by the subsystem teams do not address the budget aspect of the project.
- Schedules exist but do not appear to address all desired information.
- Subsystem teams do not identify and analyze all project, budget, resource, and schedule risks.
- Subsystem teams do not plan for the management of data used or data created during the project activities.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Weaknesses – 2:

- Subsystem teams do not explicitly plan for resources (other than personnel) such as facilities, tools, and equipment resources.
- Subsystem teams rely heavily on subject matter experts to perform project activities. Few subsystem teams plan for the future knowledge and skill needs.
- Stakeholders are involved in the process, however the schedules provided for review do not appear to provide adequate visibility into the involvement of the relevant stakeholders.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Weaknesses – 3:

- Subsystem teams have not adopted or created individual project development plans (at the subsystem team level) and processes on how they will operate.
- Subsystem team personnel does not review other subsystem development plans, or development plans of others that impact the commitments to the subsystem teams' NGS activities.
- Subsystem teams do not all reconcile their requirements, activities, work products, development plans and commitments with available resources.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Weaknesses – 4:

- Commitments and other important decisions agreed upon between subsystem and lower level teams are not documented in a consistent fashion.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Monitoring and Control Strengths:

- All subsystem teams track technical issues.
- The subsystem teams identify and monitor their technical risks.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Monitoring and Control Weaknesses – 1:

- Subsystem teams do not collect and monitor project data against the plan.
- Subsystem teams monitor commitments made or accepted with outside individuals and groups, however the monitoring activity is not performed in a planned manner.
- Subsystem teams do not always address risks other than technical risks such as schedule, budget, resource, and other project type risks.
- Subsystem teams do not monitor the subsystem team data management activities.
- Subsystem teams do not monitor stakeholder involvement in a planned manner.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Monitoring and Control Weaknesses – 2:

- Project monitoring and control does not appear to be as detailed as it should be.
- The subsystem teams track technical issues (typically via the DFMEA process). However, other project issues are not typically recorded.
- The subsystem teams appear to have limited capability to take corrective actions on issues as they are constrained by resource and schedule.
- Few subsystem teams track and manage action items for specific issues to closure.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Product Integration Strengths

- An established process exists that:
  - Validates sub-system components independently
  - Requires CCB review prior to integration and delivery to DVT/EVT

Example – Company A, “QuickLook” Engineering Processes Assessment Findings

Product Integration Weaknesses:

- Past projects have performed differing levels of product integration.
- Some subsystem teams have procedures to perform build integration. These procedures do not appear to address integration sequencing activities or the integration of the hardware to the software at a planned time.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Verification Strengths:

- All subsystem teams plan for informal peer reviews of software work products.
- All subsystem teams perform informal peer reviews of the software work products.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Verification Weaknesses – 1:

- The subsystem teams have not defined the verification methods that will be used for each hardware and software requirement allocated to each lowest level component(s). Past projects have tested the component / subassemblies using a series of regression tests that do not appear to have been explicitly linked to the requirements allocated to software.
- Few subsystem teams have documented procedures for verifying the requirements allocated (NUD's, non-NUD's, interface and other requirements) to the components, subassemblies, or subsystems.

Example – Company A, “QuickLook” Engineering Processes Assessment Findings

Verification Weaknesses – 2:

- The subsystem teams do not collect or analyze data on the results of peer reviews of their software work products.
- Few subsystem teams collect and analyze data on the verification activities performed on the software work products at the component, subassembly, or subsystem levels.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Configuration Management Strengths:

- In most cases, code for existing products cannot be modified without a Pinnacle tracking number.
- Release notes that detail the contents of builds are always produced.
- Numerous documented procedures exist for creating code baselines and releases.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Configuration Management Weaknesses – 1:

- The subsystem teams have not identified categories or individual configuration items that must be controlled at the subsystem team level.
- The subsystem teams have multiple systems for use. In some cases, detail of the use of some of these systems is not documented.
- Baselines of other project documents and internal work products are not been identified.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Configuration Management Weaknesses – 2:

- The subsystem teams do not appear to track changes for non-deliverable project documentation, and other internal work products.
- The subsystem teams do not perform configuration audits (PCA's/FCA's) on configuration baselines.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Measurement and Analysis Strengths:

- Evidence was found that at least one subsystem team has identified measurements to collect, analyzes those measurements, and reports them to stakeholders.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Measurement and Analysis Weaknesses:

- Few subsystem teams have established measurement objectives, specified the measures to be collected, how the measures will be collected, or how they will be analyzed and reported.
- Few subsystem teams collect specified measurement data, analyze and interpret the data, manage and store the data, or report the data to relevant stakeholders.

Company A, Generic Goals/Practices Strengths:

- No generic practice strengths were identified.

Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Generic Goals/Practices Weaknesses – 1:

- Organizational policies for planning and performing the NGS product activities were not discovered.
- The plans and schedules reviewed do not address each of the activities expected in the process areas examined.
- Some subsystem teams do not appear to have adequate resources (staff, tools, facilities, licenses, etc.) for performing to the process and creating their project work products. The average staff work week is in excess of 45 hours per week.

Example – Company A, "QuickLook" Engineering Processes Assessment Results

Generic Goals/Practices Weaknesses – 2:

- The organization has a heavy reliance on subject matter and domain experts to complete the work activities. Planning and scheduling of additional training required to increase the capability of the team does not appear to be typically considered.
- The subsystem teams have not planned and scheduled for appropriate levels of configuration management on the subsystem team work products.

Example – Company A, "QuickLook" Engineering Processes Assessment Results

Generic Goals/Practices Weaknesses – 3:

- The subsystem teams have not planned and scheduled for the identification and involvement of the relevant stakeholders in the product development process.
- The subsystem teams have not planned and scheduled for an objective evaluation of the process and work products against the standards and procedures that define them.
- The subsystem teams have not planned and scheduled for process reviews that should occur with higher level management.

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