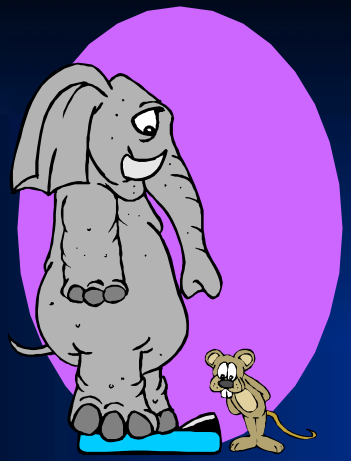
HARRIS

How Do We Get On The Road To Maturity?

Debra J. Perry
Harris Corporation

ant?

HARRIS



From this…

To this…

But how?

Start?

HARRIS

ommunications ion: What We Do...

HARRIS

Aviation electronics

Communications and information networks

Intelligence, surveillance, and reconnaissance

Space and ground satellite communications systems

Operations and support services

We innovate, integrate, and manage technology.

Getting There 1 of 3

HARRIS

- ROI Need
  - Convince management of payoff
  - Convince other stakeholders management is convinced
  - Convince other stakeholders process improvement helps them

Getting There 2 of 3

HARRIS

- ROI Need
  - Convince management of payoff
  - Convince other stakeholders management is convinced
  - Convince other stakeholders process improvement helps them
- Convince Management
  - Share process improvement vision
  - Provide external ROI
    - SEI data
    - Other companiesôdata
  - Provide internal ROI
    - Harris examples
    - Other possibilities

Getting There 3 of 3

HARRIS

- ROI Need
  - Convince management of payoff
  - Convince other stakeholders management is convinced
  - Convince other stakeholders process improvement helps them
- Convince Management
  - Share process improvement vision
  - Provide external ROI
    - SEI data
    - Other companiesôdata
  - Provide internal ROI
    - Harris examples
    - Other possibilities
- Convince Other Stakeholders
  - Show management support
  - Educate and train
  - Show value for them

gement

HARRIS

- ROI ï Return on Investment
- Convince Management of Payoff
  - ï External Research
    - Read and Research
    - Attend SEI Courses
    - Hire consultants
  - ï Internal Research
    - Develop a plan
    - Develop ROI
  - ï Educate management
  - ï Start or improve your process group

- The Quality of a System is Highly Influenced by the Quality of the Process Used to Acquire, Develop and Maintain It
- This Premise Implies a Focus on the Processes as well as on Products:
  - This is a long-established premise in manufacturing
  - Belief in this premise is visible worldwide in quality movements in manufacturing and service industries (e.g., ISO standards)
  - This premise is also applicable to development

(Introduction to CMMI Version 1.2)

esses

HARRIS

- Processes are Not Well Defined and Improvised by Practitioners and their Management
- Process Descriptions are Not Rigorously Followed or Enforced
- Performance is Highly Dependent on Current Practitioners
- Understanding of the Current Status of a Project is Limited
- Immature Processes Result in Fighting Fires:
  - There is no time to improve instead practitioners are constantly reacting
  - Firefighters get burned
  - Embers might rekindle later

(Introduction to CMMI Version 1.2)

cesses

HARRIS

- Process Descriptions are Consistent with the Way Work is Actually Done
- They are Defined, Documented and Continuously Improved
- Processes are Supported Visibly by Management and Others
- They are Well Controlled ï Process Fidelity is Evaluated and Enforced
- There is Constructive Use of Product and Process Measurement
- Technology is Introduced in a Disciplined Manner

(Introduction to CMMI Version 1.2)

mproving Processes

HARRIS

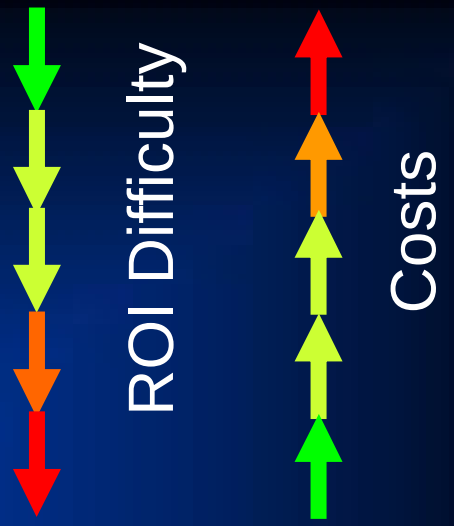
- Processes Enable you to Understand What is Going on
- People Develop their Potential More Fully and are More Effective Within the Organization
- By Defining, Measuring and Controlling the Process, Improvements are More Successful and Sustained
- The Likelihood that Appropriate Technology, Techniques and Tools are Introduced Successfully Increases
- More Benefit Information is Available in the August 2006 SEI Technical Report, Performance Results of CMMI-Base Process Improvement (CMU/SEI-2006-TR-004) at: http://www.sei.cmu.edu/publications/documents/06.reports/06tr004.html

(Introduction to CMMI Version 1.2)

ent Levels

HARRIS

- Process Improvement Start Up
- Reaching Next Level of Maturity
- Out of Phase Defect Removal
- Reach Higher Levels of Maturity
- Optimization and Maintenance



ROI Should be More Specific as you Move Up in Maturity

Profiles of Level 5 CMMI Organizations

- Little has been done to study the return on investment (ROI) of high maturity organizations that have reached Level 5

Stakeholders 1 of 2

HARRIS

- Convince Other Stakeholders Management is Convinced
  - Show management is investing in process improvement
  - Show management is enforcing compliance

Management should fund and provide oversight for process improvement efforts and review and reward process compliance.

Stakeholders 2 of 2

HARRIS

- Convince Other Stakeholders Management is Convinced
  - Show management is investing in process improvement
  - Show management is enforcing compliance

- Convince Other Stakeholders Process Improvement Helps Them
  - Relieves chaos
  - Reduces defects and rework
  - Facilitates improvements
  - Saves time and money

Toyota makes process improvement a way of life.

- Share Process Improvement Vision
- Provide External ROI
  - SEI data
  - Other companiesôdata
- Provide Internal ROI
  - Harris examples
  - Other possibilities

sion

HARRIS

- Find a Strong Leader with Clout and Credibility
- Develop a Vision ï What Will Motivate?
  - ï Fewer problem programs
  - ï Faster, cheaper, better
  - ï Need CMMI to compete
- Develop a -Plan
- Determine Estimated ROI
- Present the Plan to Management
- Be Determined!
- Get Management Commitment

- **Enhance the Current Processes to:**
  - **Improve efficiency and value for all stakeholders**
  - **Reduce cost and rework**
  - **Provide predictable program execution**
  - **Increase competitive advantage**

ovement Steps

HARRIS

- Establish Process Group, if Possible
- Document Current Processes
- Institutionalize Processes
- Determine Process Improvement Goals
  - Short term goals (start with PP, PMC, MA)
  - Long term goals (add PAs, plan for SCAMPI)
  - Estimate ROI
- Prioritize Process Improvement Goals
- Develop Process Improvement Plan
  - Determine process improvement measurements
  - Begin measurement collection efforts

esults of CMMI®-Based ement 2006

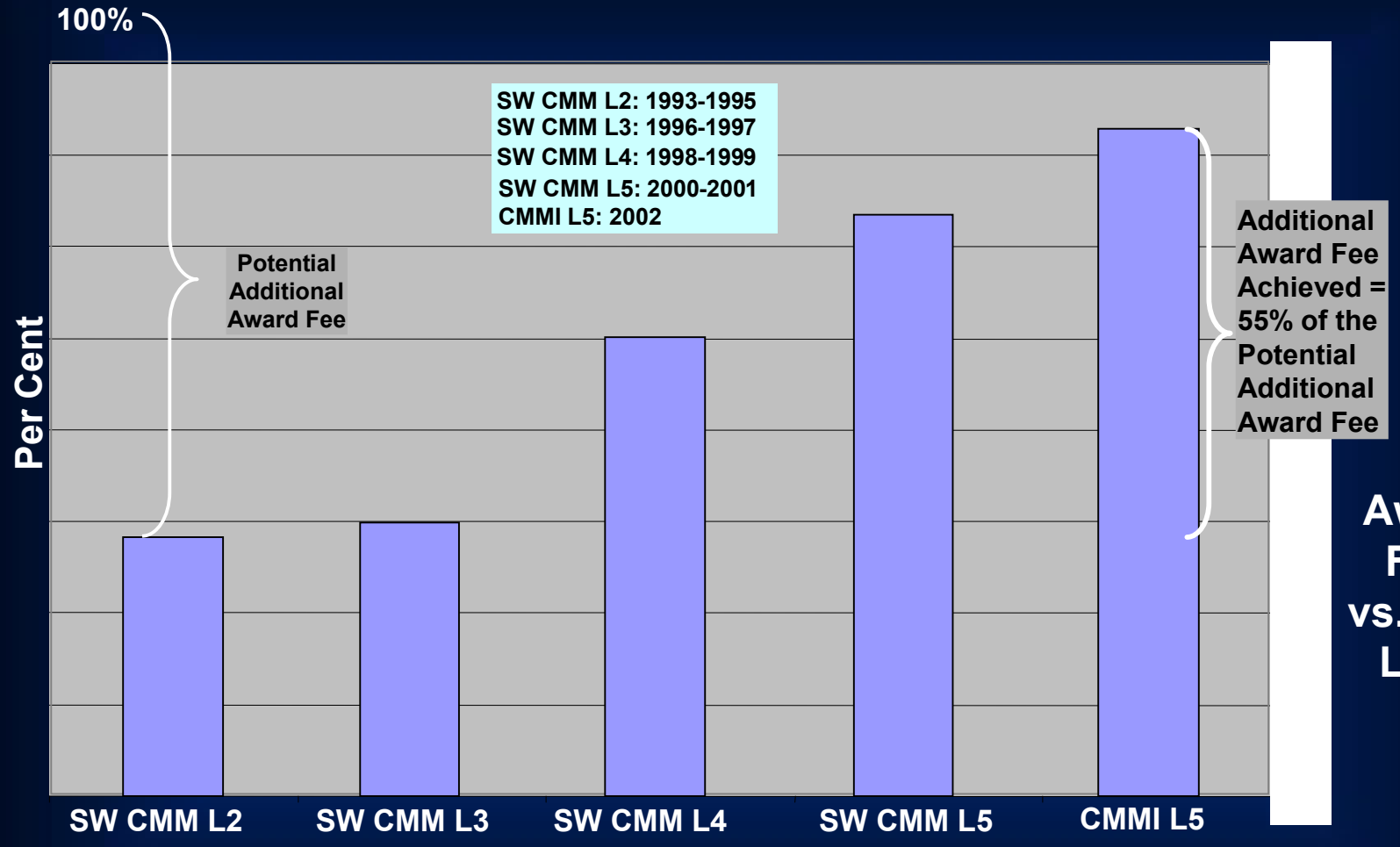
HARRIS

Improvements	High	Low	Median	Number Data Points
Cost	87%	3%	34%	29
Schedule	95%	2%	50%	22
Productivity	329%	11%	61%	20
Quality	132%	2%	48%	34
Customer Satisfaction	55%	-4%	14%	7
Return on Investment	27.7:1	1.7:1	4.0:1	22

r Satisfaction:

HARRIS

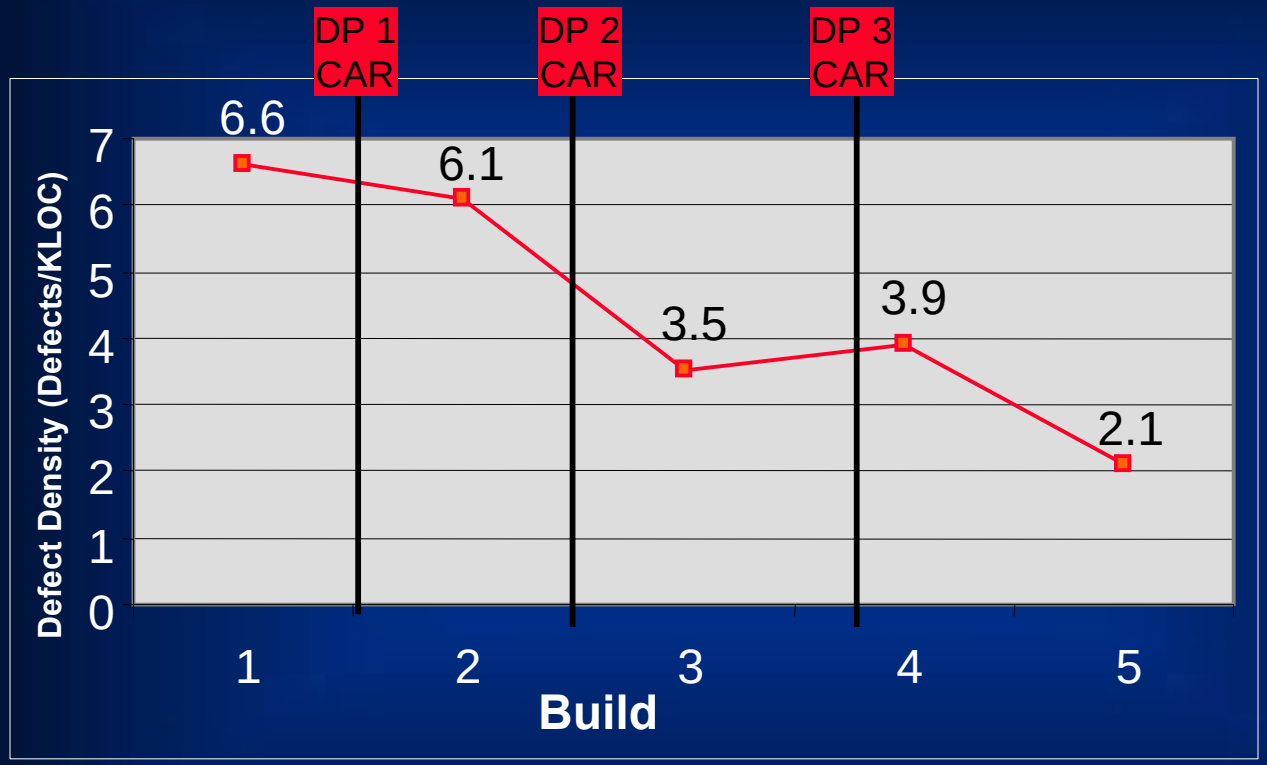
Award fees increased by 55% compared to an earlier SW-CMM ML2 baseline.



Customer Satisfaction Continues to Improve

HARRIS

Defect Prevention Using PSP and CAR at CMMI ML5



Improvements in:

Quality

Integrating PSP℠ and CMMI® Level 5. Gabriel Hoffman, Northrop Grumman IT . May 1, 2003

HARRIS

Appraised at CMMI ML 5 in December 2002

Results

met 25+ milestones in a row

earned a rating of ñExceptionalòin every applicable category on a formal Contractor Performance Evaluation Survey

Hours Invested: 124 in Defect Prevention (CAR)

Hours saved: 1650 hours (15 hours per defect)

ROI: 13:1

Improvements in:

- **Schedule / cycle time**
- **Customer satisfaction**
- **Quality**
- **Cost of quality / ROI**

Integrating PSP℠ and CMMI® Level 5. Gabriel Hoffman, Northrop Grumman IT . May 1, 2003

PROCESS IMPROVEMENT

Support Expenditures	$207,000
Training costs	$69,000
Execution of Inspections	$358,000
Total Costs	$634,000
Savings from Inspections	$2,524,000
Total Cost Savings	$1,890,000

– Others page 1 of 2

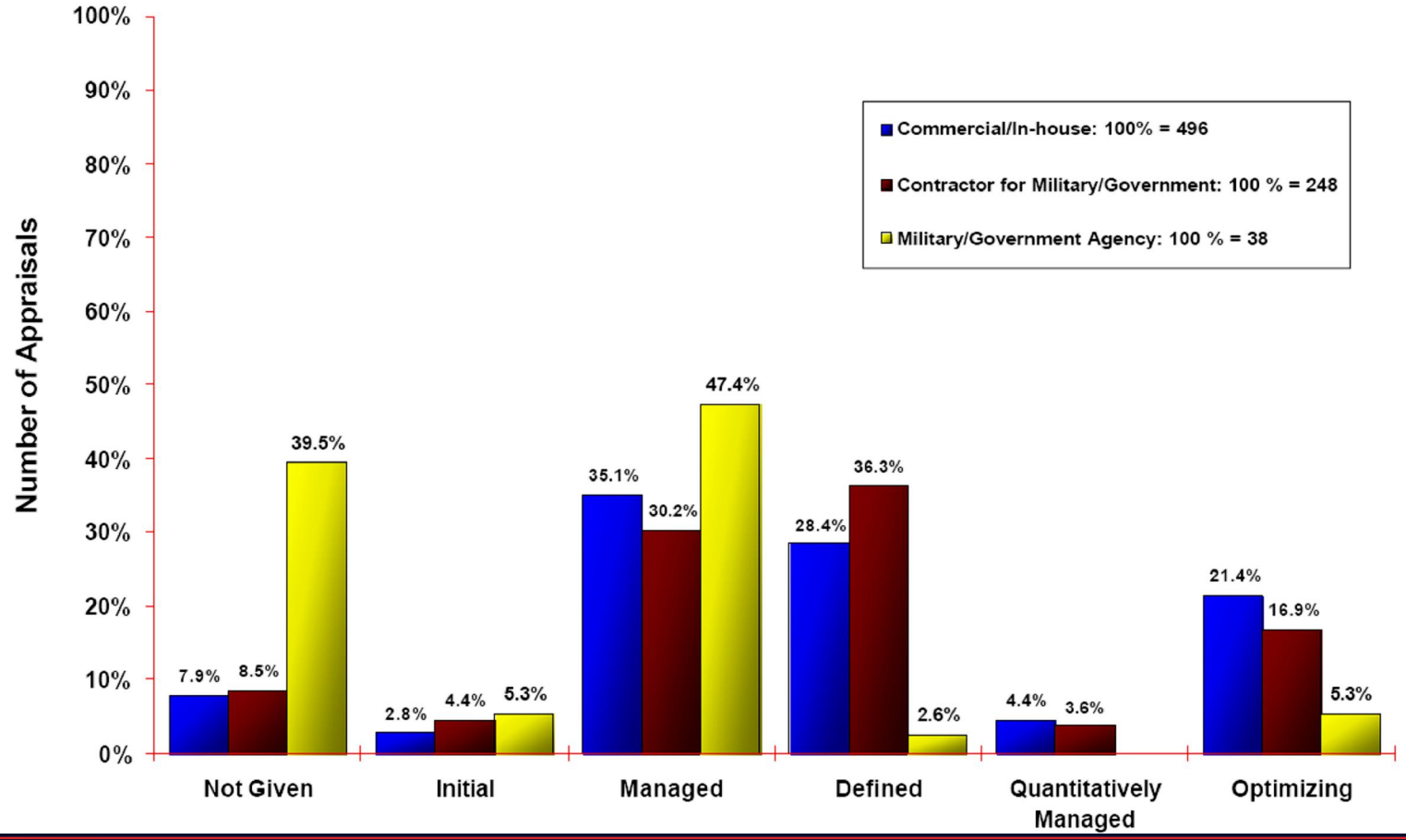
HARRIS

Carnegie Mellon
Software Engineering Institute

CMMI® v1.1 – SCAMPI v1.1 Class A Appraisal Results

CMMI

Process Maturity Profile by Reporting Organization Categories



HARRIS

Industry Published SCAMPI Results

Federal Contractor	Level 4	Level 5	Delta 6/06
BAE		3	0
Boeing		11	3 ↑
Computer Sciences Corporation		2	1 ↑
General Dynamics		5	3 ↑
Lockheed Martin	3	4	0/2 ↑
Northrop Grumman (including Mel.)		36	15 ↑
Raytheon	2	5	0/0
SAIC		7	2 ↑
Sikorsky Aircraft	1		0

ample

HARRIS

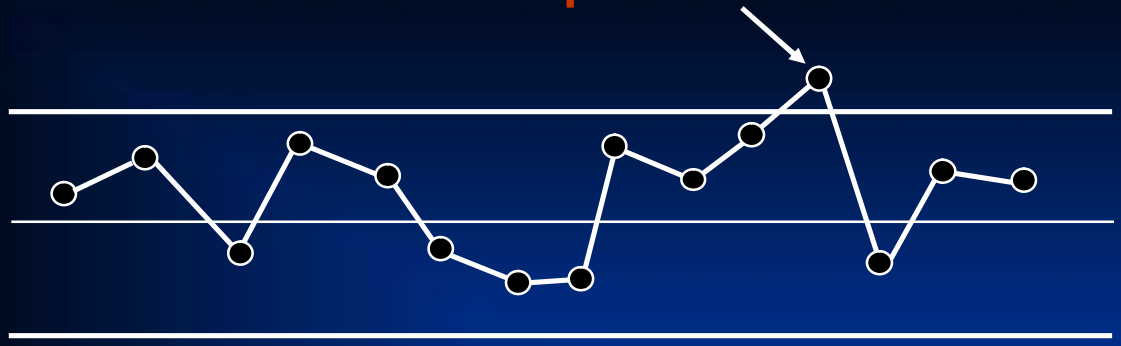
- Program Collected Metrics
- Program Analyzed Metrics
- Program Made Process Improvement Changes
- Process Changes Improved Metrics

Management

HARRIS

Level 4

Indicates a problem

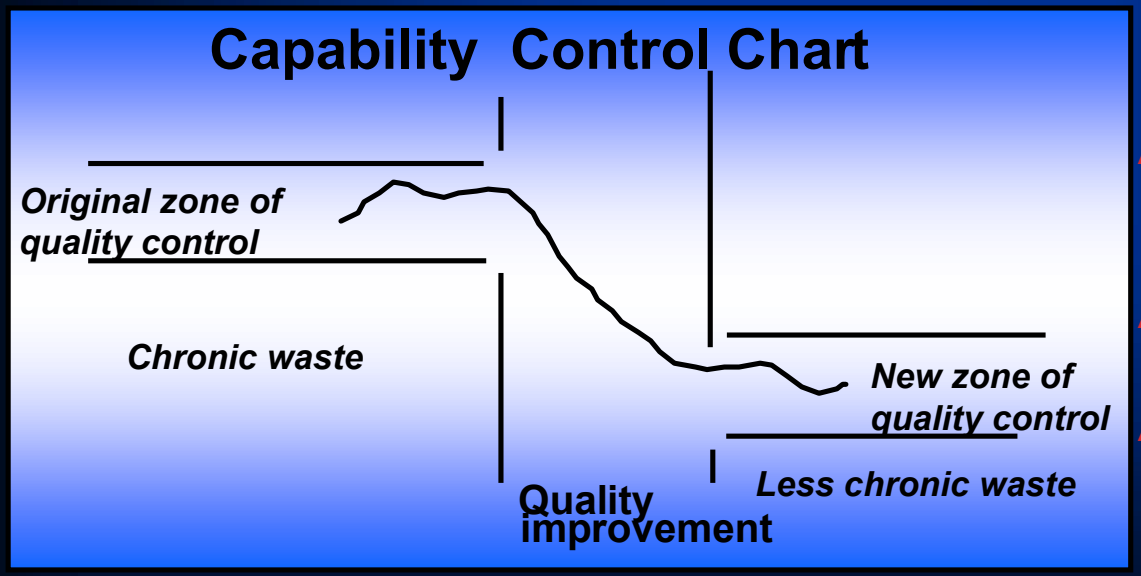


Control chart

ñVoice of the Processò

- Predictable & quantitatively understood
- Statistics & quantitative techniques to manage processes & results
- Address “Special Causes”

Level 5



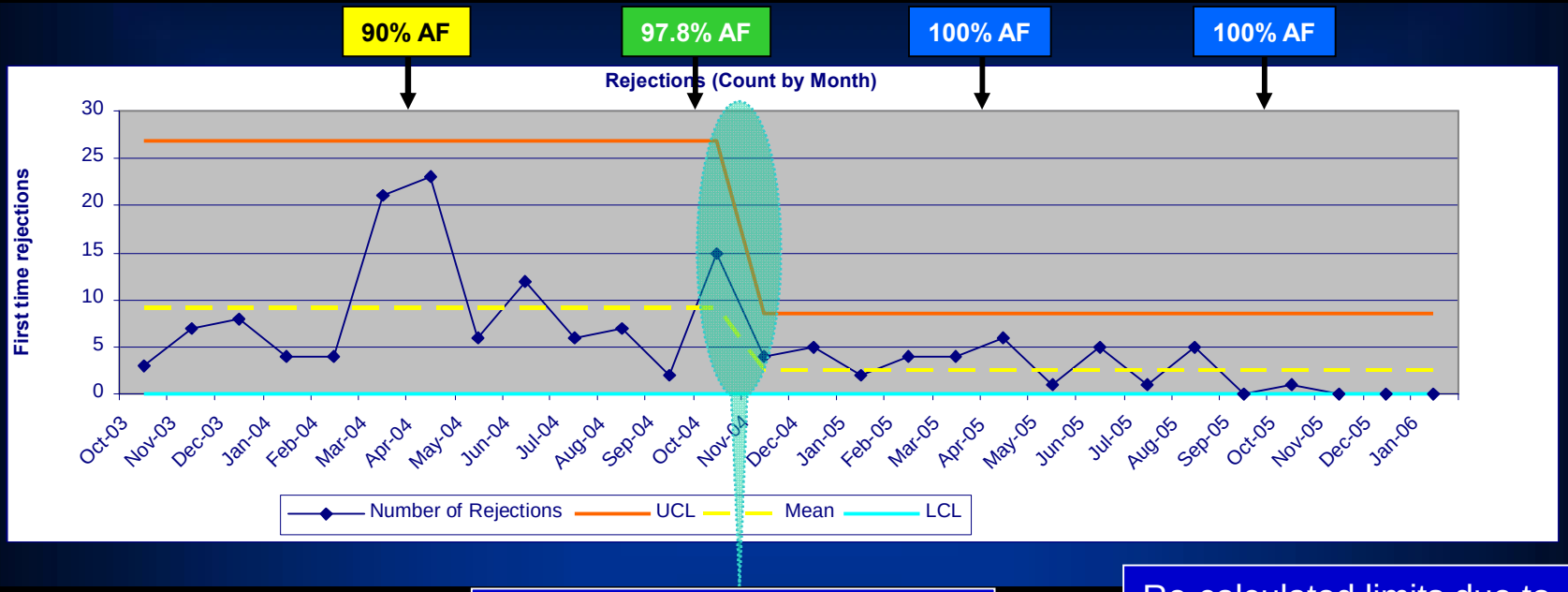
ñVoice of the Customerò

- Continual & measurable process improvement to meet business objectives
- Incremental & innovative process improvements
- Address “Common Causes”

ovements
- Defect Reduction

HARRIS

Å Modified Objective: ñMonitor key functional processes for predictability and measurable improvement (e.g., 10% productivity, 20% quality)ò



ÅStable performance (within control limits*)

ÅPredictable average of 9.1 rejections per month (capability)

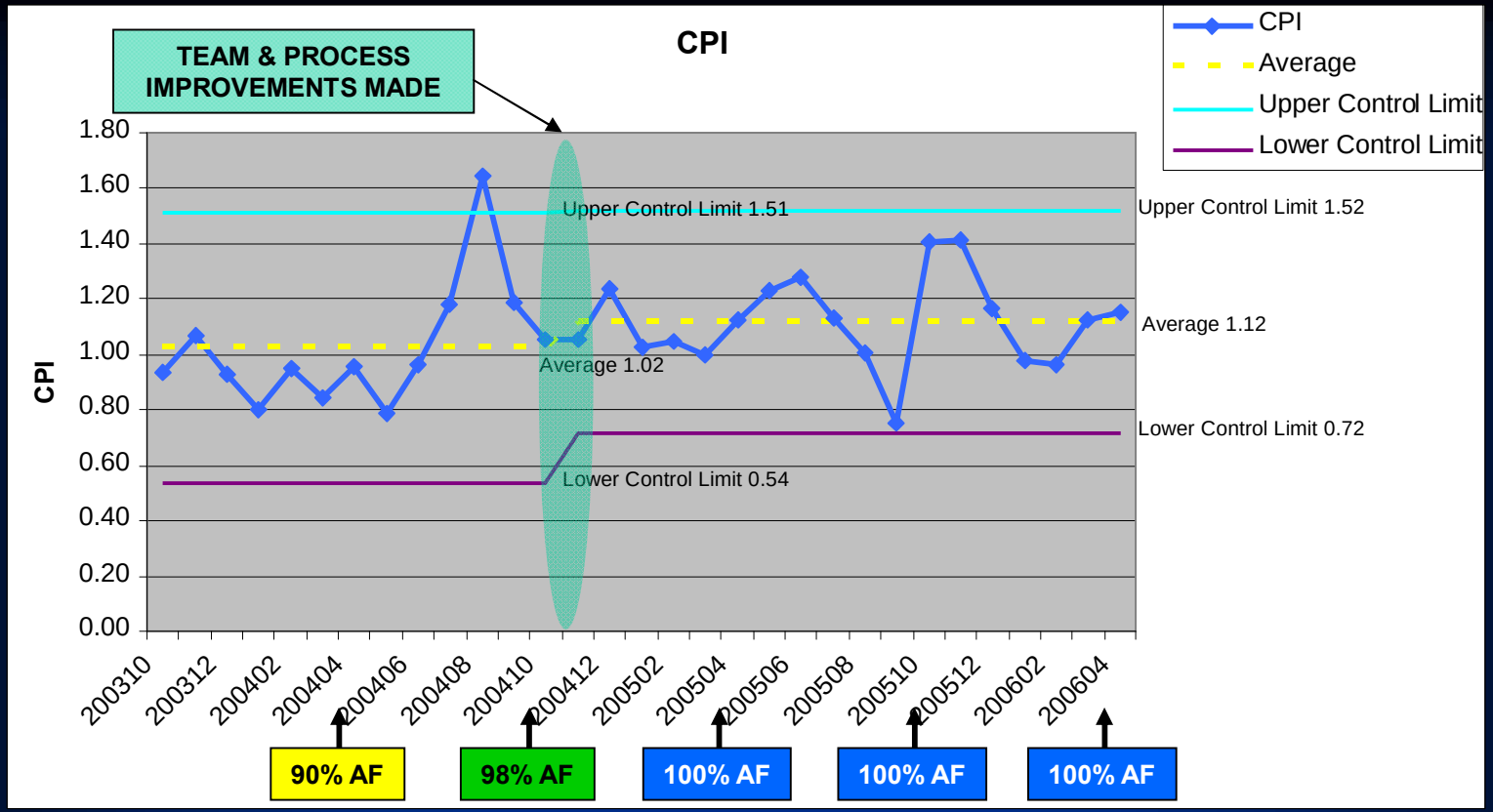
Changes made:
ÅTeam personnel changes
ÅStakeholder participation formalized
ÅPeer Review process deployed more formally
ÅReturn to Green

Re-calculated limits due to process changes ï
ÅStable performance (within tighter control limits*)
ÅPredictable average of 2.5 rejections per month (capability) shows 73% measurable improvement

* not enough data points to classify as statistical control but can use trial limits

ovements
- CPI

HARRIS



- After process improvements implemented:
  - Average cost performance improved 10%
  - Lower end of predictable performance range improved 33%

  BENEFITS: Higher productivity, cost stability, higher award fees

deas

HARRIS

- Rework ROI
  - Estimate rework cost
  - Estimate defect reduction
  - Estimate cost avoidance
- UPS ROI
  - Estimate cost for downtime
  - Determine cost of UPS
  - Estimate savings
- Automation ROI
  - Estimate manual effort
  - Estimate automated effort
  - Estimate savings
- Other Suggestions?

er Stakeholders

HARRIS

- Show Management Support
- Educate and Train
  - Motivate to change
  - Communicate vision
  - Teach Tools and Techniques
  - Reward compliance
- Show Value for Them

ement Support

HARRIS

- ñWhat You Measure You Will Improve.ò
  - ï author unknown
- Harris Process Compliance Monitor
  - ï Monitors all required processes
  - ï Appropriate tailoring allowed
  - ï Artifacts of compliance entered into tool
  - ï Online product-centric evidence collection, objective auditing
  - ï Online real-time project and organizational monitoring of process compliance
  - ï Required compliance

pliance Color Scores

HARRIS

ASSESSMENT STATUS COLORS	NY	Not Yet	Å To be appraised at a later date (i.e., the process has not yet been executed by the program and cannot be appraised)
	NA	Not Applicable	Å Outside the scope of the project (e.g., Code and Unit Test Process is not applicable to a production-type program)
	NS	Not Scored	Å Pending an appraisal
PROCESS COMPLIANCE COLORS	FI	Fully Implemented	Å Direct artifacts are present and appropriate (Note 2) Å No weaknesses noted (Note 1)
	LI	Largely Implemented	Å Direct artifacts are present and appropriate (Note 2) Å One or more weaknesses noted (Note 1)
	PI	Partially Implemented	Å Direct artifacts are missing in the initial scoring audit or direct artifacts are present but inadequate (Note 3) Å One or more weaknesses noted (Note 1)
	NI	Not Implemented	Å Direct artifacts are missing for more than 30 days from the initial scoring audit

Note 1: A weakness ("gap") is considered if it is an impact to or risk of implementation of the process statement
Note 2: An appropriate artifact is the IPM Expected Artifact or equivalent that demonstrates implementation of the process statement
Note 3: An inadequate artifact does not demonstrate implementation of the process statement

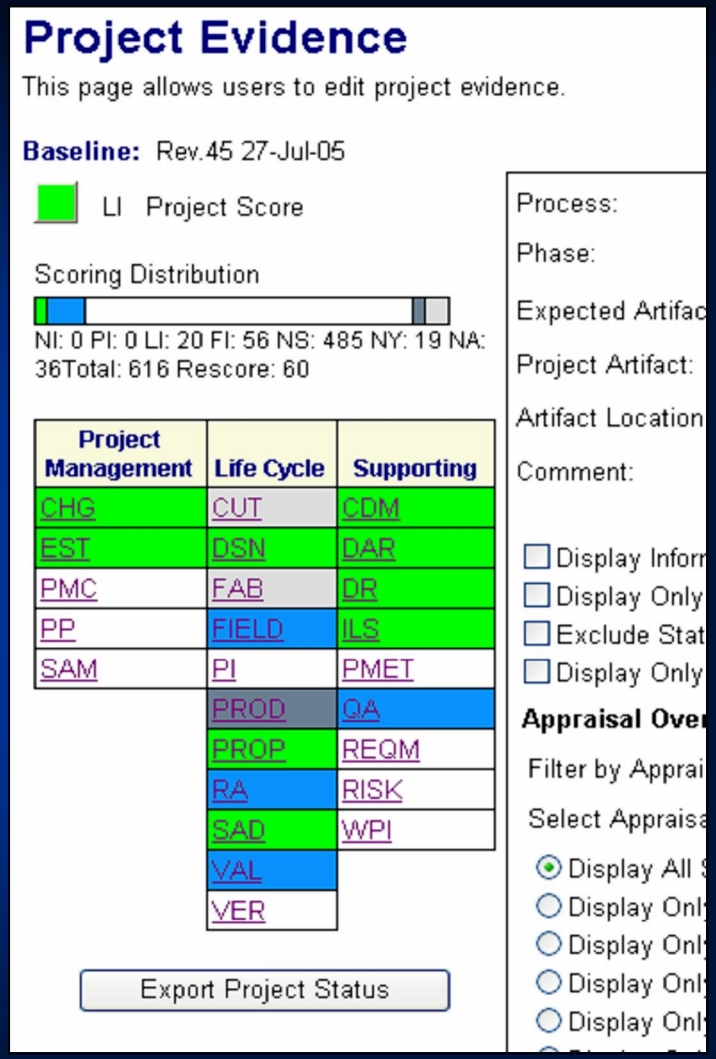
pliance

HARRIS

- Represents overall process compliance score for program
- Based on lowest color score ï harsh, but in keeping with CMMI standards

- Depicts scoring distribution over all process items
- More insight on overall project score

- Depicts score for each process executed or being executed by this program
- 3 columns identify types of processes
- In PCM, point+click on underlined acronym drills down to scoring details for process



Community

HARRIS

- Practical Software and Systems Measurement
- SEI Training Courses on Process Improvement
- Six Sigma Training
- Provide Technical Expertise
- Train Them to:
  - Follow the processes
  - Collect consistent measures
  - Analyze data
  - Suggest improvements
- Train for Appraisals

or Stakeholders

HARRIS

- Process Improvement Proposal: Business Intelligence Implementation
- Invest in Tool, Save in Usage
- Current Estimates for Creating Metrics and Reports Monthly ~$1.5 million per Year
- Current Estimate for Incorporating BI ~$2M
- Time Saved Each Month Can be Used Elsewhere
- Other benefits
  - Consistent, timely, accurate data
  - Flexibility in reporting
  - Easier new analysis

HARRIS

- Without a Vision, There Can Be no Improvements
  - **State, Share and Spread** the Vision Of Process Improvement
- Management Acts Based on the Bottom Line
  - **Show and Tell** how process improvement can improve their business (ROI)
- Other Stakeholders Tend to Follow Management
  - **Convince Other Stakeholders** that management is convinced and is watching
- Teams Want Improvement
  - **Show and Tell** how process improvement will help them (ROI)

Debra J. Perry
SW Engineer
Division Process Group
Harris Corporation
debra.perry@harris.com
321-727-6830

Harris Corporation **http://www.harris.com/**
P.O. Box 37
Melbourne, Florida 32902-0037

HARRIS

BACKUP SLIDES

HARRIS

- Page 9-12 Introduction to CMMI Version 1.2 http://www.sei.cmu.edu/products/courses/p44b.html
- Page 13 Profiles of Level 5 CMMI Organizations http://www.stsc.hill.af.mil/crosstalk/2007/01/0701Reifer.html
- Page 15 No Satisfaction at Toyota http://www.fastcompany.com/magazine/111/open_no-satisfaction.html

HARRIS

- Page 20 - Performance Results of CMMI®-Based Process Improvement 2006 http://www.sei.cmu.edu/pub/documents/06.reports/pdf/06tr004.pdf
- Page 21 - Lockheed Martin results http://www.sei.cmu.edu/activities/cmmi/results/pdfs/2003-CMMI-016.pdf
- Page 22 - Integrating PSP^{sm} and CMMI® Level 5. Gabriel Hoffman, Northrop Grumman IT . May 1, 2003

HARRIS

- Page 24 - Case Study of an Improvement Program Featuring Reviews and Inspections, by: Robert MacFarland, Ericsson Ltd.; American Society for Quality, Software Quality Professional, June 2001, Vol. 3, No. 3

- Page 25 ï Process Maturity Profile CMMI v1.1 SCAMPI v1.1 Class A Appraisal Results 2005 Mid-Year Update, September 2005 http://www.sei.cmu.edu/appraisal-program/profile/pdf/CMMI/2005sepCMMI.pdf

- Page 26 - SEI CMMI Published Appraisal Results http://sas.sei.cmu.edu/pars/

HARRIS

- Page 34-35 ñGetting There: Tips and Considerations for Marching Toward CMMI Maturity Level 4 or 5ò, by Gary Natwick, Debbie Perry and Sophie Boyd, SEPG Conference 26-29 March 2007

rovement Plan

HARRIS

Level	3	4	5
Management	Process	Capability	Change
Process Capability	Not Understood Quantitatively	Stable and Controlled	Optimized
Process Approach	Proactive	Predictive	Continuous Improvement
Improvement Focus	Project	Division and Project	Division and Project
Measurement Focus	Monitor and Control	Decision Making	Systemic Issues
Analysis	Comparative	Statistical	Causal
Benefits	Repeatable Practices	Predictable Results	Innovation and Improvement

gement Example 1 of 2

HARRIS

Benefit Category	Benefit Range/Time ($ saved/months to realize)+			
	Starting Up	Reaching the Next Level	Optimization and Maintenance	Out-of-Phase Defect Focus
Cost Avoidance	2 to 12% savings/ 18 to 20 months*	3 to 16% savings/ 16 to 18 months	Flat	Finding escapes results in 6 to 8% savings/ annually
Productivity Gains	5 to 10% annually*	8 to 18% annually	Flat	1 to 3% annually
Faster Time-to-Market	Not applicable during startup	Improved ability to predict/meet schedule	Improved ability to predict/meet schedule	Improved ability to predict/meet schedule
Quality Improvement	Not enough data	8 to 18% fewer errors/post release	12 to 26% fewer errors/post release	18 to 30% fewer escapes
Estimated ROI	15 to 51%/ 18 to 20 months	18 to 103%/ 15 to 18 months	12 to 36%/ annually	24 to 138%/ annually
Minimum Time (to achieve ROI)	18 months	15 months	Performed on an annual basis	Performed on an annual basis
Other benefits:				
▪ Improved customer satisfaction	Fewer customer complaints	Increased customer praise	Continued customer praise	Customer views you as best in class
▪ Improved competitive positioning	Perceived competitive gaps closed	Perceived competitive gaps closed	Continued commitment to process maintained	Perceived competitive advantage
▪ Other				

(Profiles of Level 5 CMMI Organizations)

gement Example 2 of 2

HARRIS

Scenario	Range of Cost/Time ($ expended/months to complete)+		
	Small	Medium	Large
Starting Up	$1 to 1.5M/ 18 to 20 months	$1.5 to 2.5M/ 18 to 22 months	$2.5 to 3M/ 20 to 24 months
Reaching the Next Level in Process Maturity	$0.75 to 1M/ 12 to 16 months	$1 to 1.5M/ 15 to 18 months	$1.5 to 2M/ 18 to 21 months
Optimization and Maintenance	$0.35 to 0.5M/ 12 months++	$0.5 to 0.75M/ 12 months++	$0.75 to 1M/ 12 months++
Out-of-Phase Defect Focus	$0.5 to 0.78M/ 12 months++	$0.78 to 1.0/ 12 months++	$1.0 to $1.3M/ 12 months++

(Profiles of Level 5 CMMI Organizations)

th TX – L5

CMMI Level 5: Return on Investment for Raytheon N TX

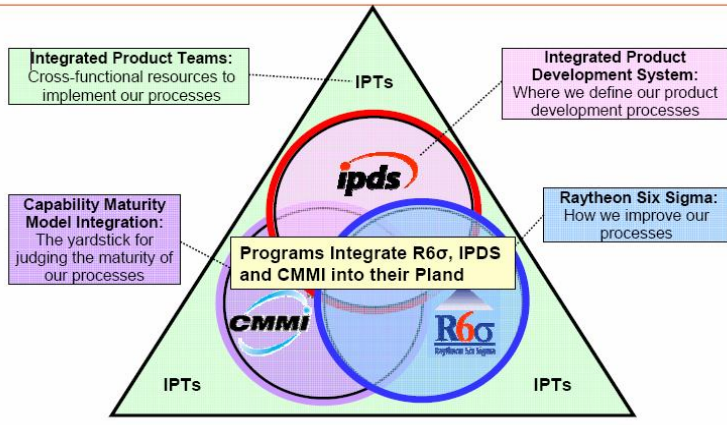
Donna Freed
Network Centric Systems, McKinney, TX

HARRIS

ñé we want to achieve the performance excellence goals required by our business. We are focused on achieving performance excellence and recognition as the preferred supplier for new business è

Raytheon

Envision Improvement



Raytheon

Operational Results

- Achieving CMMI Level 5 Certification for Raytheon image and competitive advantage is one thing, but look at the operational results.
- "Meeting Commitments" all improved concurrent with SEI CMMI Level 5 certification Across the organization, we improved:
  - CPI by 5 percentage points, and reduced variation by 34%.
  - SPI by 8 percentage points, and reduced variation by 50%
  - Defect Density by 44 percentage points, and reduced variation by 31%

Raytheon

Improvement Results

- **Demonstrated the linkage between R6σ and CMMI Levels 4 & 5.**
- **Characterization included over 300 applications of R6σ tools such as ANOVA, cause and effect, regression analysis, histograms, Cpk, hypothesis testing, logical process mapping, and others.**
- **Identified five projects to reduce variation in organizational performance and support the CMMI Level 5 timeline.**
- **Enabled CMMI Level 5 certification.**
  - **Improvement of Business Performance was recognized by Assessment Team as global strength in the CMMI Level 5 Assessment.**
- **Contributed ROI of 3:1 through significant cost avoidance realized by organization improvements**

mman – L5

November 14-17, 2005
Warren Scheinin
Systems Engineer
Northrop Grumman Corporation

HARRIS

To Be Top-Tier is to See With New Eyes

- **Process improvement is built into the system**
  - Evidence Books used as patterns from previous appraisals were not sufficient to meet later expectations
  - Needed to add more evidence as our understanding of what makes a good process has grown
- **The culture has changed**
  - Process improvement is the object of many CAR and Six Sigma projects
  - Process people are not the first to go when budgets are cut
- **It gets easier each time**
  - Familiarity leads to quicker startup
  - Less training needed, less resistance to change

NORTHROP GRUMMAN

Projects Gain

- **Produced more value-added products with reduced effort and time**
  - Instead of overrunning budgets and schedules, products are delivered early and on budget
- **Needed less "help" from senior management**
- **Lots of new work began pouring in**
- **Communications with other groups was easier**
- **Meshed well with cost reduction efforts**
- **Easier to understand the role of Systems Engineering in Software Development**

NORTHROP GRUMMAN

Project Leaders Gain

- **More up front thinking means less work later**
- **Fewer problems and risks along the way**
- **Improved processes added slack to cost and schedule curves**
  - Fewer replan exercises
  - Easier to give back resources
  - Easier to help other projects
- **Other projects consulted us to find out why things were going so well**

NORTHROP GRUMMAN

Individuals Gain

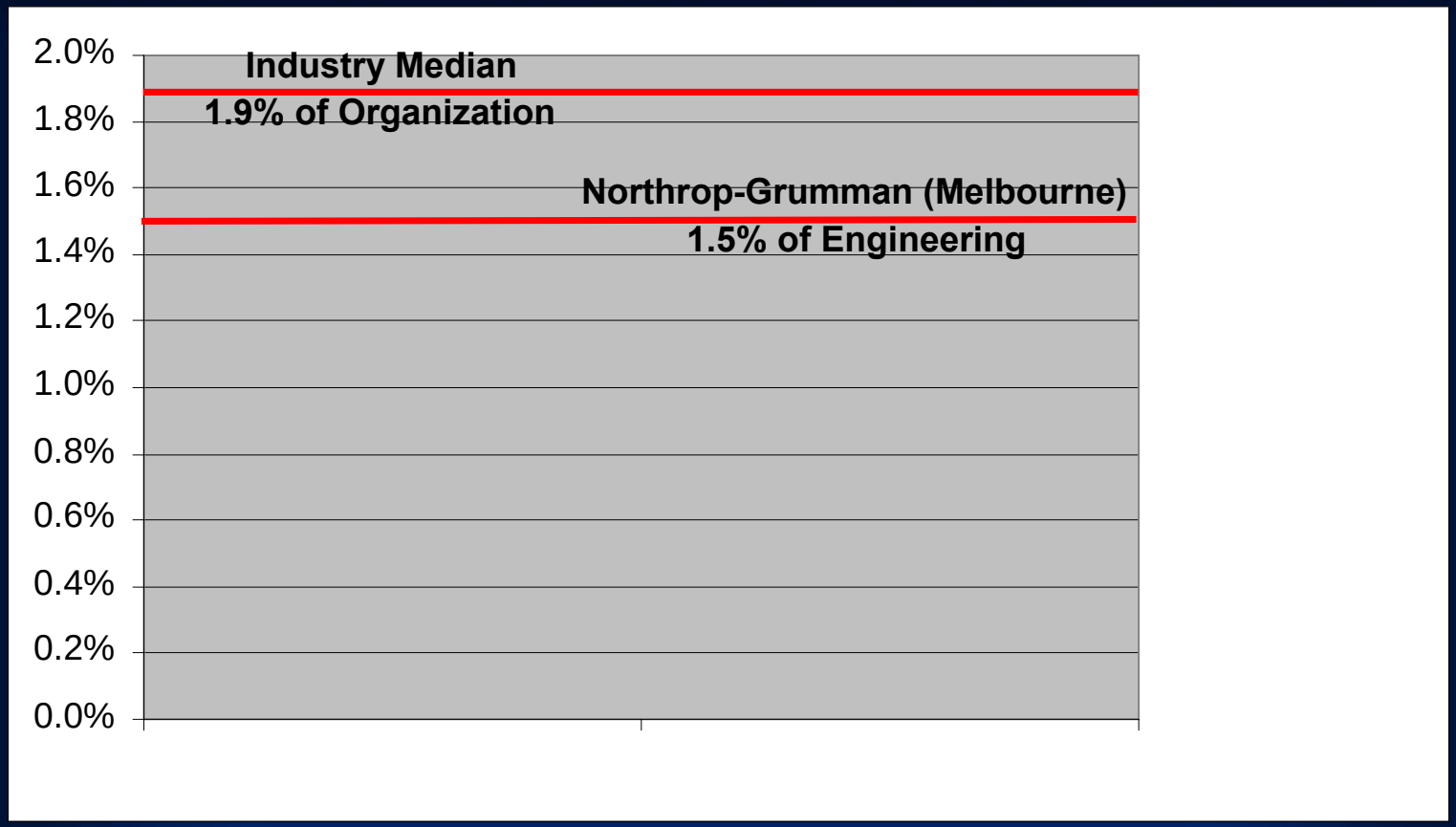
- **Better understanding of how to get job done**
- **Less stress**
- **Less time doing rework**
- **Easier to transfer from project to project**
- **Easier to understand need of Systems Engineering in Software Development**
- **Concerns were escalated more quickly to the proper level of attention**
- **More enthusiastic about looking for improvement opportunities**
- **Down side: SPIN meetings are much less popular**

NORTHROP GRUMMAN

stment In Process

HARRIS

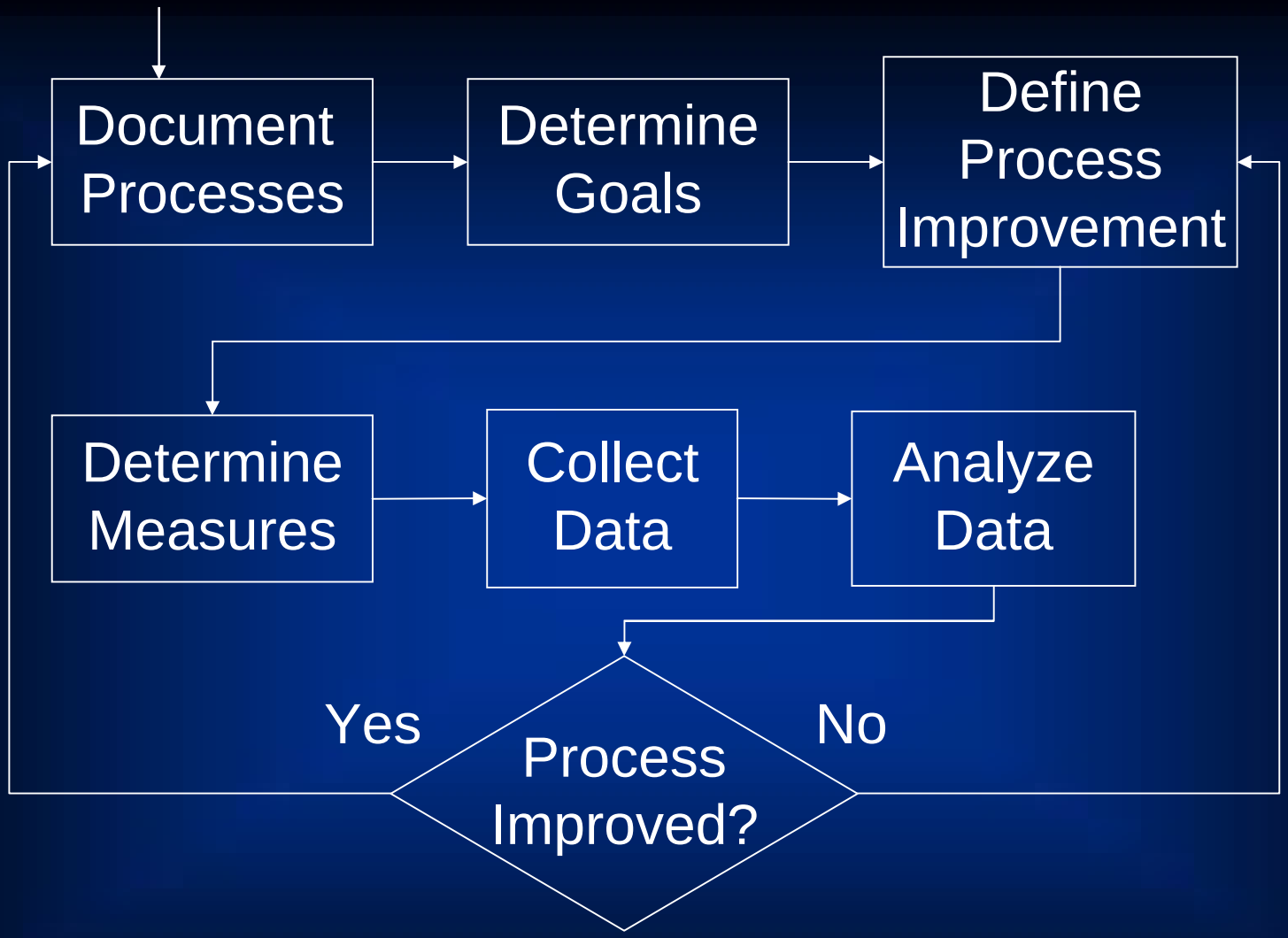
GCSD vs. Industry Headcount from SEI Survey (December 2004)



Where does you company fit?

ovement Flowchart

HARRIS



Flowchart

HARRIS