Integrated Measurements for CMMI®

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Where are we?

Government Communications Systems Division

- $1.8B in Sales
- 8,000 Employees
- ISO 9001:2000
- CMMI® Level 3

DoD Programs

Civil Programs

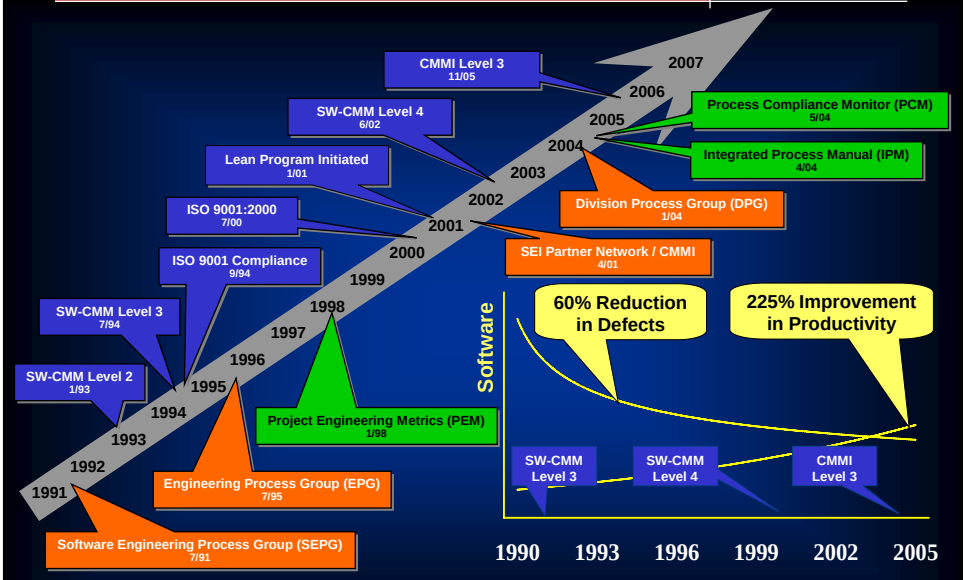
National Programs

Strategic Management and Business Development

Homeland Security Programs

Harris Technical Services Corporation

Process Improvement At GCSD



Why We Measure

- Characterize
  - Gain understanding of integrated processes, products, and resources
  - Establish baselines for future comparisons
- Evaluate
  - Measurement indicators show when projects and processes are drifting off track, so they can brought back under control
  - Assess achievement of quality goals and impacts of technology and process improvements on products and processes
- Predict
  - Predictive measures are also the basis for trending, so estimates for cost, time, and quality can be updated based on current evidence
  - Gain an understanding of relationships among processes and products for future prediction
- Improve
  - Identify roadblocks, root causes, inefficiencies, and other opportunities for improving product quality and process performance
  - Measures of current performance to compare against and judge whether or not improvement actions are working as intended and what the side effects may be

Goal-Driven Measurements

- Project Management
  - Planning, estimating, monitoring, and controlling project: costs, schedules and quality
- Process Improvement
  - Providing baseline data, measuring trends, tracking root causes of problems and defects, and identifying and implementing changes for process improvement
- Organizational Vision
  - Effectively applying unified end-to-end integrated processes and methods encompassing proven and emerging standards/approaches for the purpose of delivering high-quality cost competitive system solutions to our customers

Goal-Question-Metric (GQM)

Business Goals

What are our business goals?
- Improve customer satisfaction by reducing defects

Measurement Goals

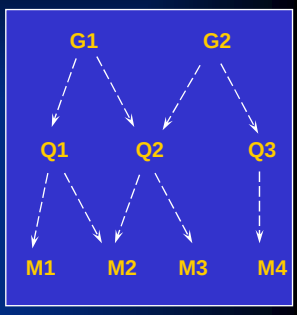
What do we want to achieve in order to satisfy our business goals?
- Reduce post-delivery defects to "N" per KLOC

Questions

What questions will help us plan & manage progress toward our goals?
- Where are defects introduced & removed?
- How effective are peer reviews?

Metric

What metrics are necessary to answer these questions?
- Defects detected in peer reviews, testing ...
- Defect categorization, rework time ...



The question is not:
What metrics should I use?

Rather:
What do I want to know or learn?
Why are we collecting the data?
How do we use the data?

Adapted from: Goal-Driven Software Measurement - A Guidebook, Park et al., CMU/SEI-96-HB-002, August 1996.

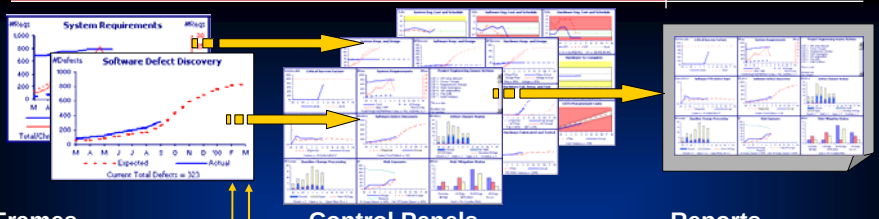
Integrated Measurement Process

- Planning
  - Metrics used to support quantitative management
  - Planned and/or expected performance in the metrics including any required goals and/or control limits
  - Variance implication and corrective action for metrics falling outside control limits
  - Source and collection mechanism of the measurement data
  - Responsible persons for collection, analysis, reporting, and managing
- Collection
  - Occurs at the periodic intervals defined in the project plans and is monitored for completeness, integrity and accuracy
  - Primary source for actual data is in the accounting systems used to manage the project (e.g., financial management, configuration management, change management, risk management)
  - Data is input into the division standard metric tool each period

Integrated Measurement Process

- Analysis
  - Metrics are communicated graphically for a clear and easily understood message
  - Better to have many graphs than it is to have many messages on one graph
  - Metrics are indicators that give warnings of problems associated with issues
  - An issue may be tracked with several metrics using different measures
  - Trend-based metrics when expected or planned values change regularly over time to determine whether the performance implied is achievable
  - Limit-based metrics when expected or planned values remain relatively constant over time to determine whether the performance crosses its established bounds
- Reporting
  - Quantitative management decisions are communicated to project team members, management and customers
  - Integrated into the management process and occurs as soon as possible after analysis has been completed to assure that there is time for corrective action
  - Metric's falling outside the control limits are reviewed and corrective actions are recorded and tracked to closure

Integrated Engineering Metrics



Frames
display one or more metrics

Control Panels
display one or more frames

Reports
contain one or more control panels

Metrics
are composed of measures

Metric 1 | Metric 2 | Metric 3

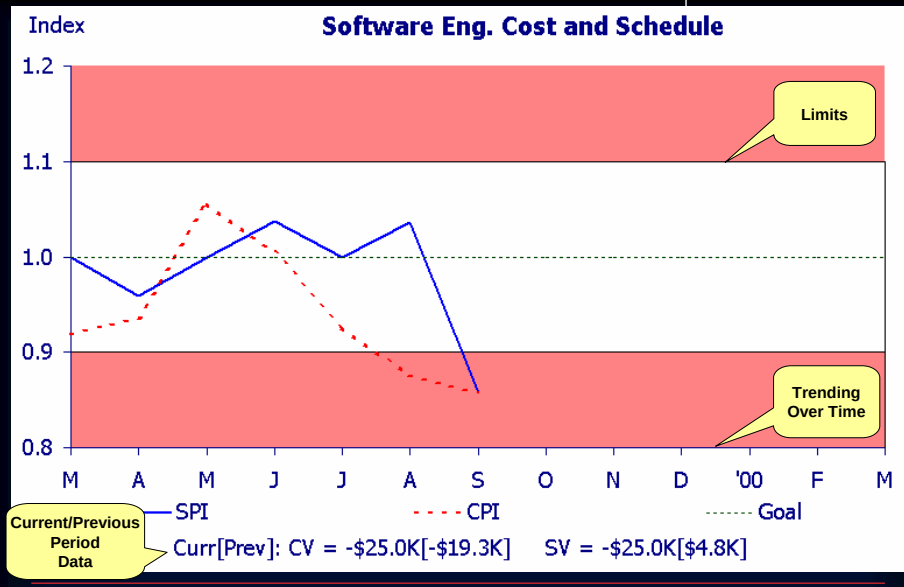
time

Measures
are units of measurement

Measure 1 | Measure 2 | Measure 3

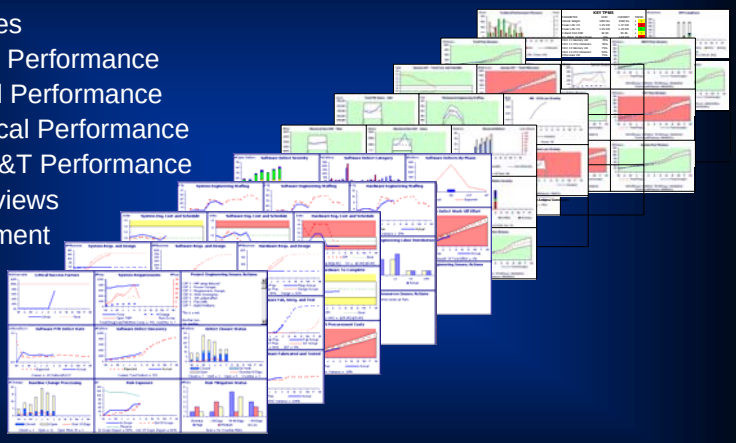
time

Frames

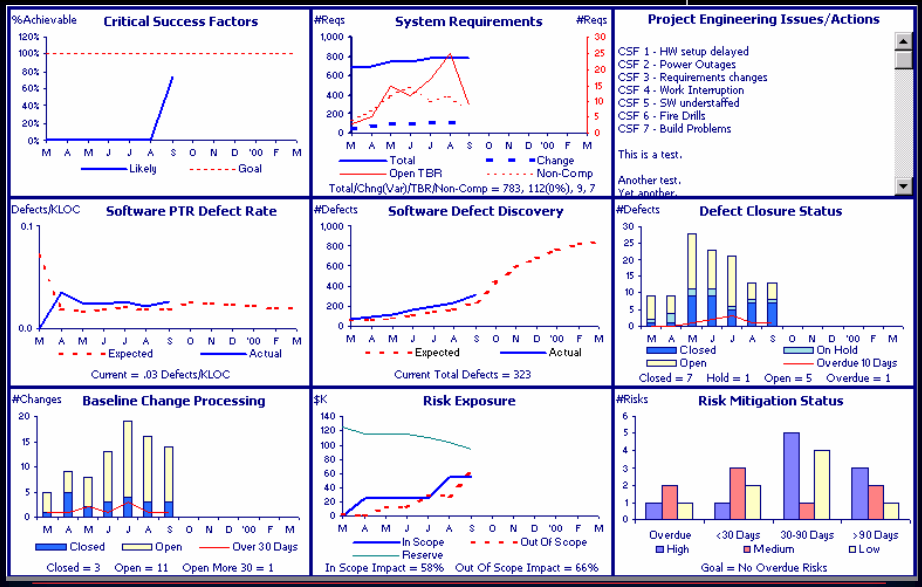


Integrated Project Compliance

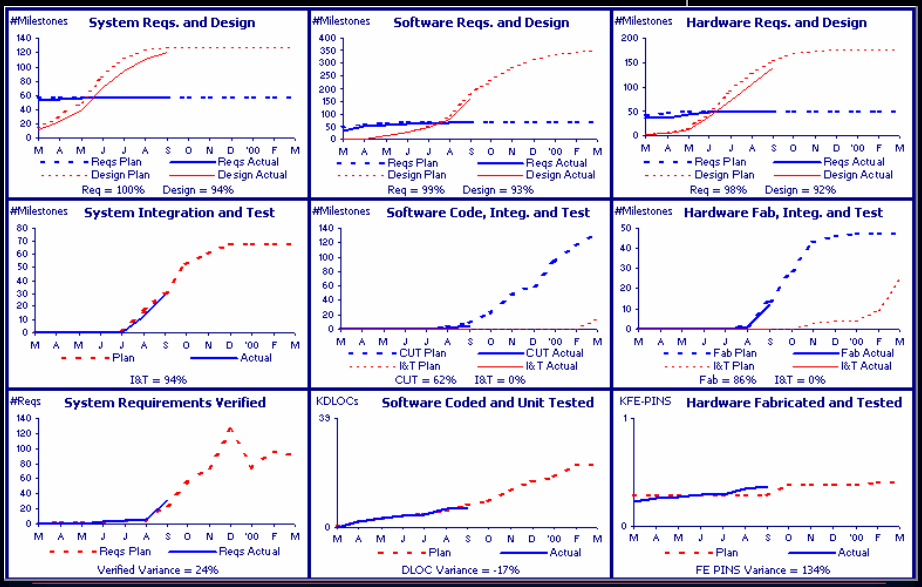
- Performance
- Progress
- Cost and Schedule
- Resources
- Software Performance
- Electrical Performance
- Mechanical Performance
- System I&T Performance
- Peer Reviews
- Management



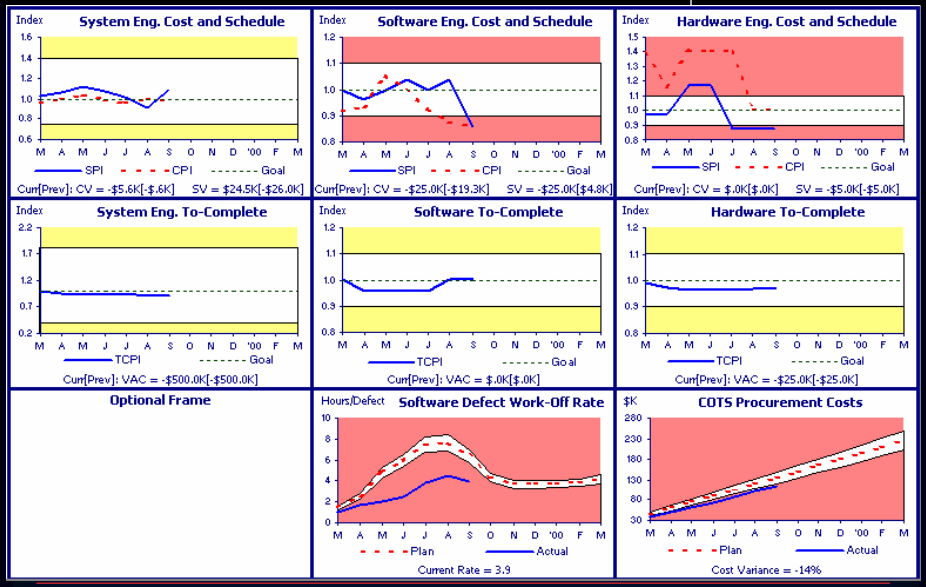
Engineering Performance



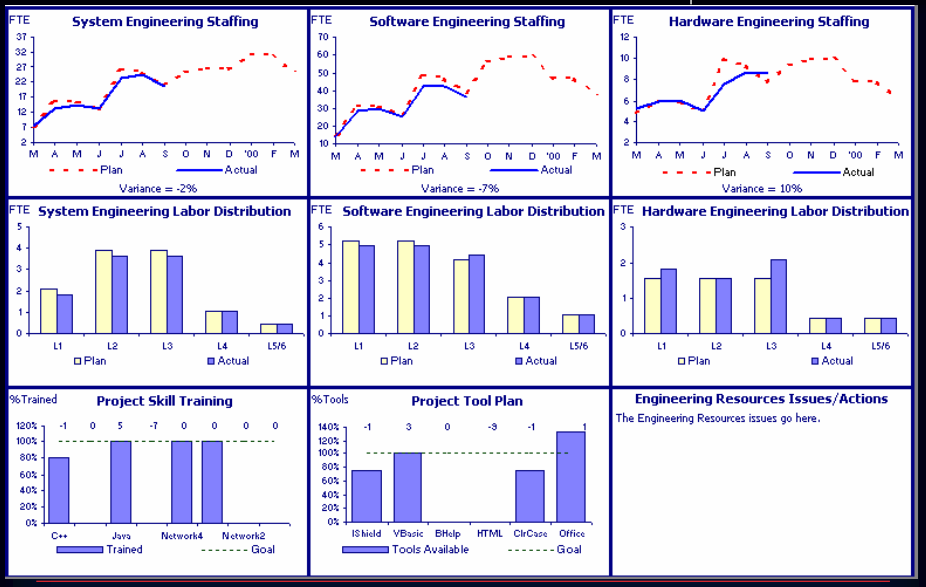
Engineering Progress



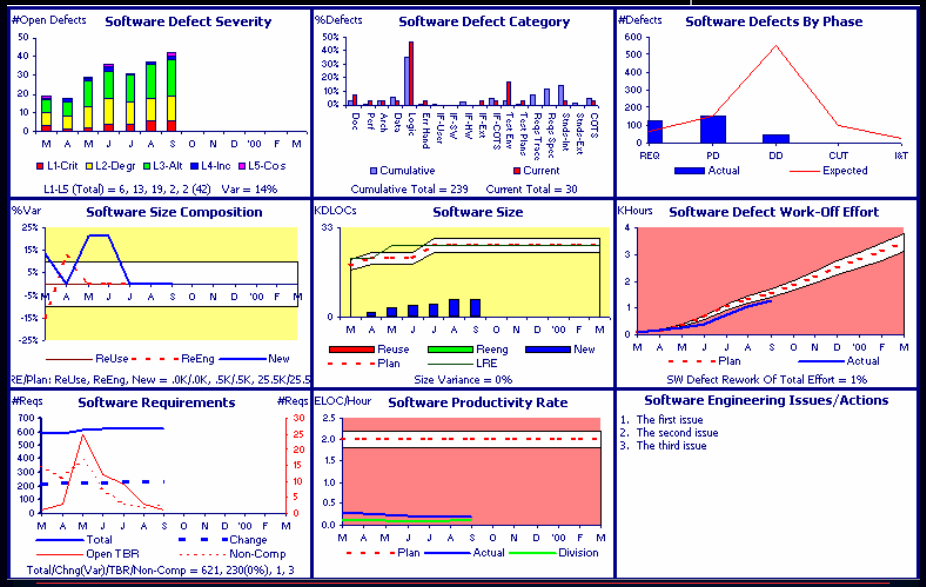
Engineering Cost & Schedule



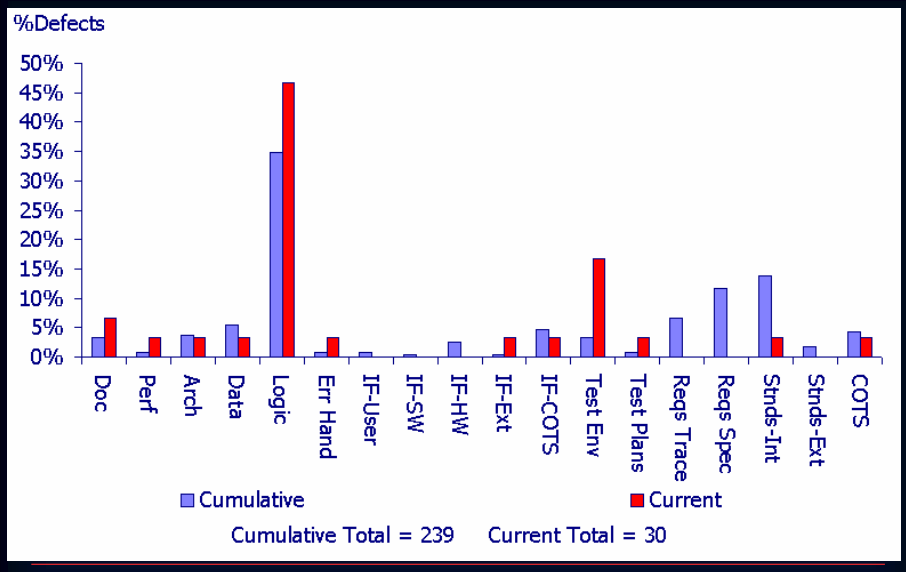
Engineering Resources



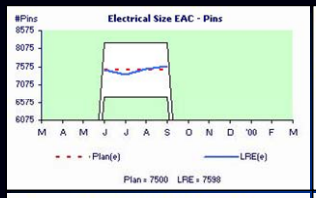
Software Performance

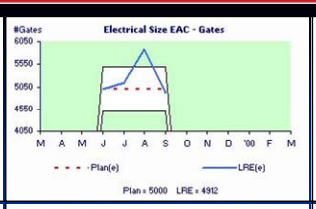


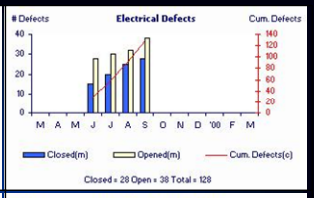
Software Defect Category (Zoom)

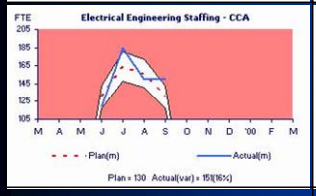


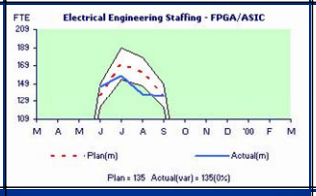
Electrical Engineering Performance

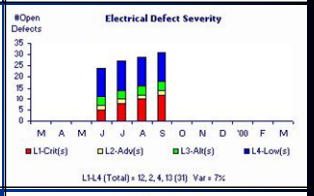










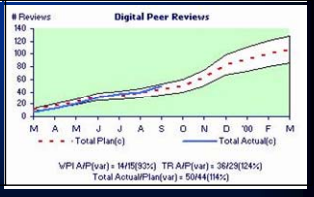


Electrical Engineering Pins Issues/Actions

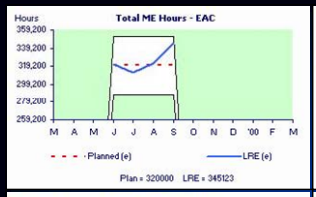
"Pins" issues/actions

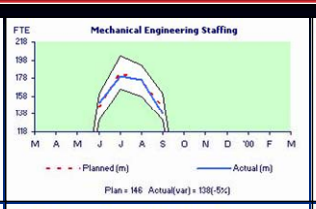
Electrical Engineering Gates Issues/Actions

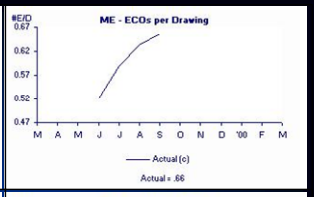
"Gates" issues/actions

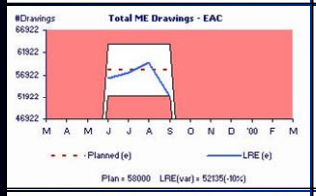


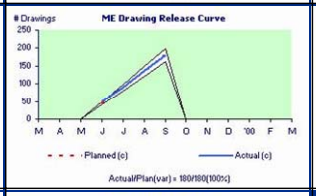
Mechanical Engineering Performance

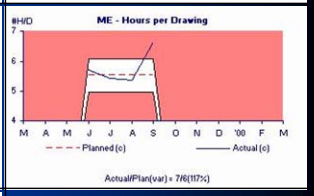


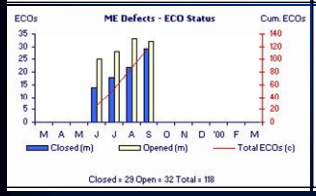


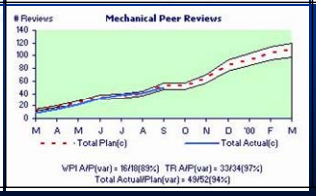








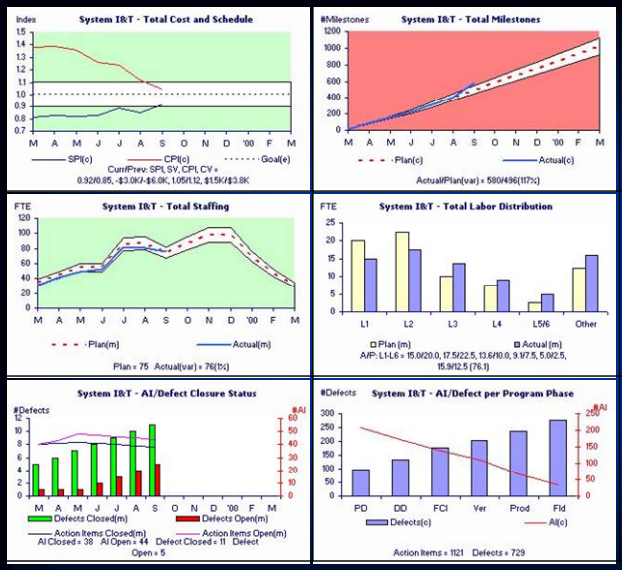




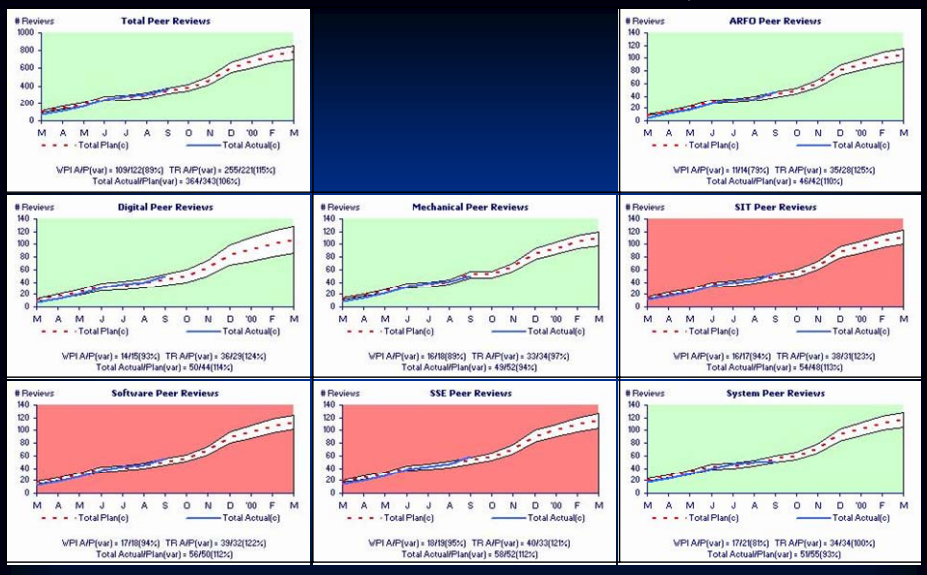
ME Issues/Actions/Comments

mechanical issues/actions

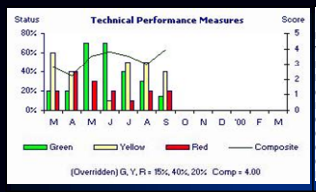
System I&T



Peer Reviews

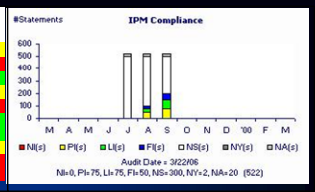


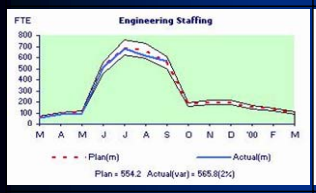
Management Review

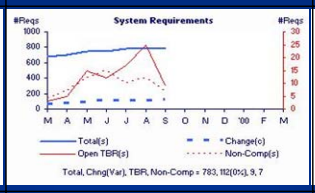


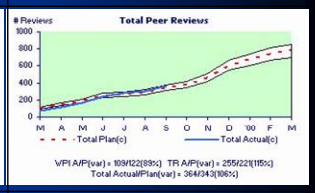
KEY TPMS

PARAMETER	SPEC	CURRENT	TREND	
Vehicle Weight	1560 lbs	1560 lbs	↓	Y
Power LRU #6	1.25 KW	1.37 KW	↑	R
Power LRU #5	1.25 KW	1.23 KW	↓	G
C-Band Xmit SNR	92 db	93 db	↓	Y
KU -Band Output Power	2kw	1.68 KW	↓	R
CSCI #1 Memory Util	75%	12%	↑	G
CSCI #1 CPU Utilization	50%	20%	↑	G
CSCI #2 Memory Util	75%	66%	↑	Y
CSCI #2 CPU Utilization	50%	67%	↑	R
FPGA Gate Util	75%	88%	↑	R





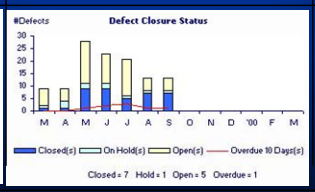




Project Engineering Issues / Actions

CSF 1 - HW setup delayed
CSF 2 - SW understaffed
CSF 3 - Requirements changes
CSF 4 - Work Interruption
CSF 5 - Power Outages
CSF 6 - Fire Drills
CSF 7 - Build Problems

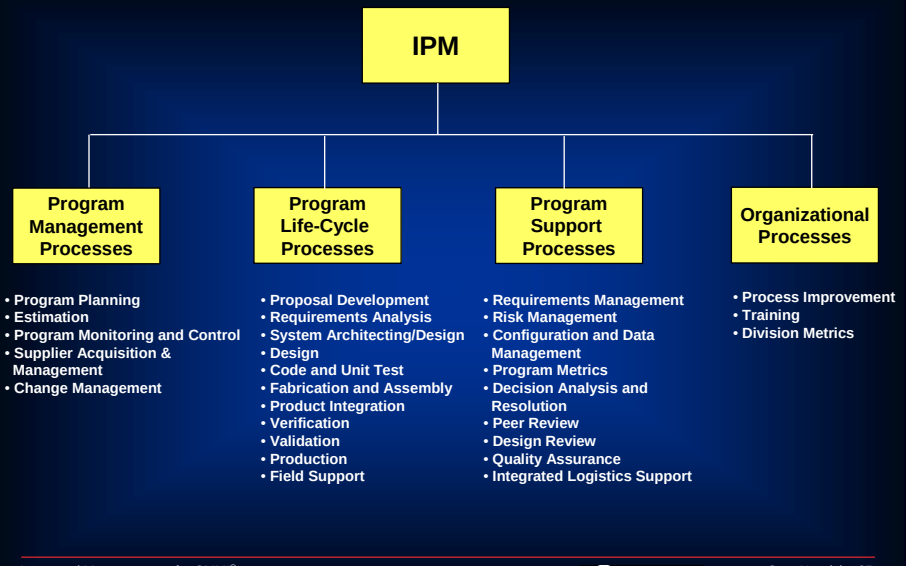
TPM 1 Notes
TPM 2 Notes
TPM 3 Notes
Etc, Etc...



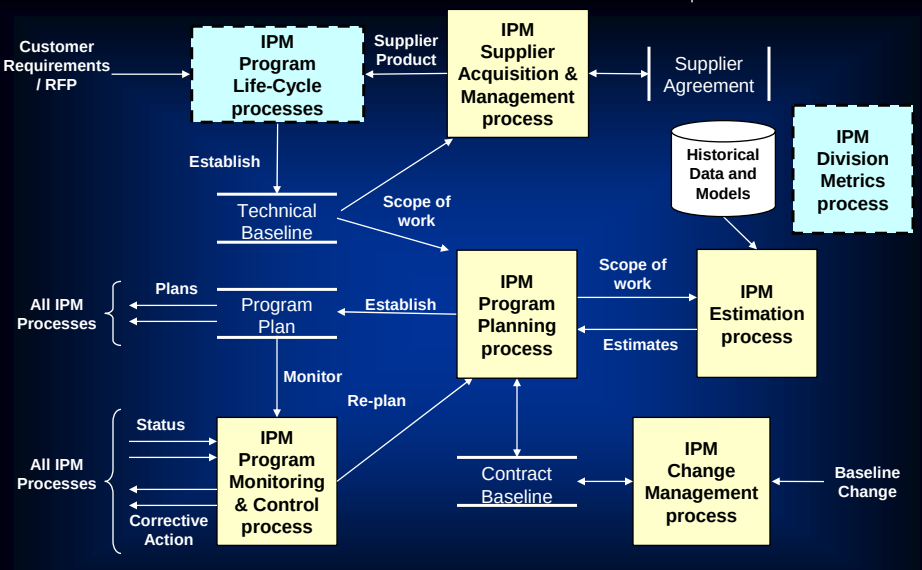
Measuring Process Compliance

- Integrated Process Foundation
  - Organizational requirements
    - Process Model compliance (CMMI®)
  - Integration and collaboration across functional organizations
  - Disciplined repeatable processes with objective criteria
    - Entry/exit criteria, inputs, outputs, verification, measures
  - Planning each process, and tracking against plan
    - Tailoring standard processes and assets
  - Budgets, schedules, resources
  - Managing established baselines
  - Managing Stakeholder involvement
  - Measuring progress and improvement

Integrated Process Manual



Program Management Processes



Program Life-Cycle Processes - 1

IPM Proposal Development process	IPM Requirements Analysis process	IPM System Architecting/ Design process	IPM Design process	IPM Fab/Assembly process IPM Code and Unit Test process	IPM Product Integration process
IPM Verification Process					
IPM Validation Process					

Program Startup Review

Life-Cycle Phase	Business Acquisition	System Requirements	System Design	Prelim Design Detail Design	Fab, Code, Integration		Verification
Baseline	Proposal Baseline	Requirements Baseline	Functional Baseline	•Allocated •Design	Developmental Configuration		Product Baseline
Milestones / Reviews	TBR PCR	SRR	SDR	PDR CDR		TRR	System Test PCA, FCA
Key Products	Proposal Prog Plans (P) Sys Arch (P)	Prog Plans Requirements CONOPS Operational Threads / Use Cases	Sys Arch Sys Design Interface Defn Technical Data Package Traceability	Prelim Design Detail Design Design docs Test cases / descriptions Traceability	Assembled Components Component test procs / results	Integration plan (F) Integration procedures Integration results	Test procedures Test results Traceability Delivered systems

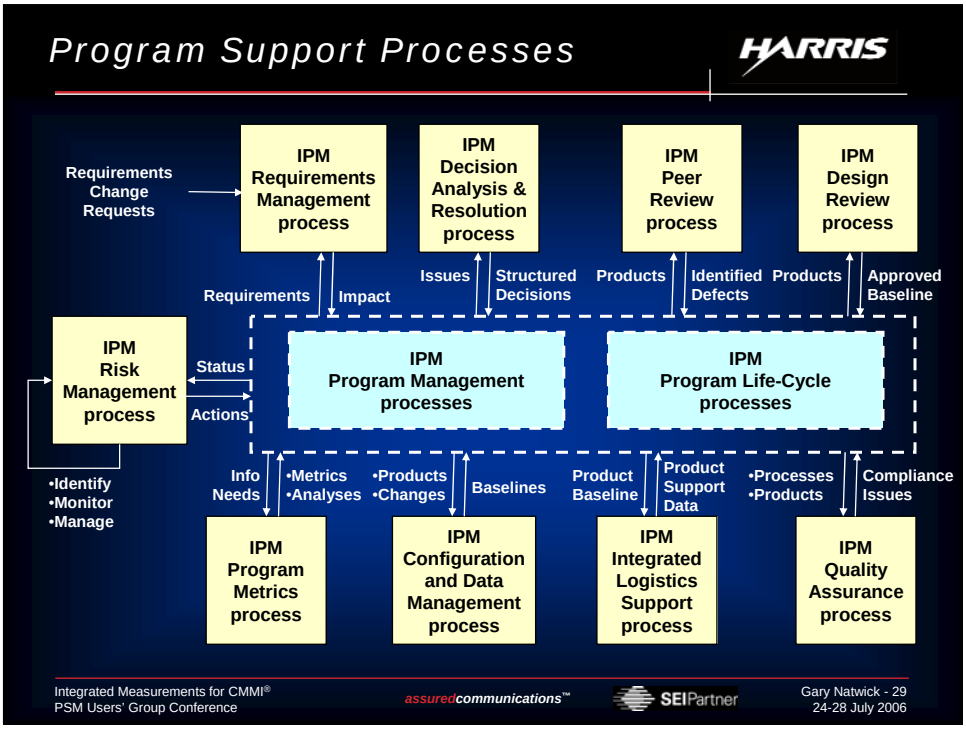
Program Life-Cycle Processes - 2

IPM Production process	IPM Field Support process
IPM Verification process	
IPM Validation process	
Other IPM Program Life-Cycle processes (as applicable)	

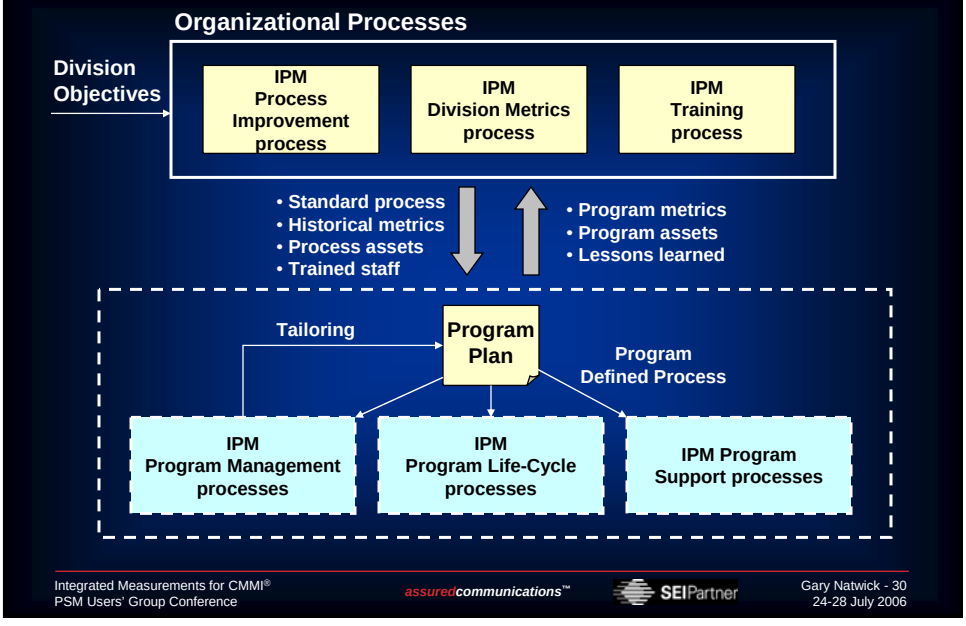
Life-Cycle Phase	Production	Field Support
Baseline	Product Baseline	Product Baseline
Milestones / Reviews	Production Readiness Review	
Key Products	Production plan Delivered systems As-built documents Test results	Site Transition / Install Plan Revisions to product baseline Test results

- IPM Production and Field Support processes apply only to the extent required by contract
  - May be not applicable
  - May implement revisions to the baseline products
  - May involve other life cycle processes
    - Requirements, design, implementation
- IPM Production Process
  - Produce and deliver multiple systems
- IPM Field Support Process
  - Site installation
  - Operations support
  - Engineering services

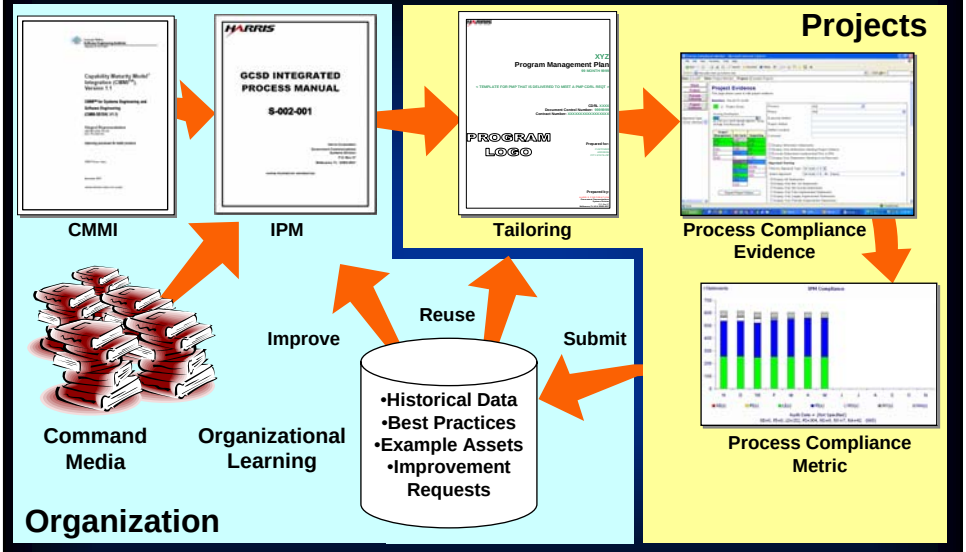
Program Support Processes



Organizational Processes



Integrated Compliance Approach



Process Compliance Evidence

Overview A brief description of the process intent	
Entry Criteria State, Prerequisites, Criteria	**Exit Criteria** State, Criteria
Inputs Needed work products, resources	**Outputs** Resulting work products
Required Activities Mandatory tasks to implement the process	
Measures Process performance against plans	
Organizational Improvement Information Metrics, reusable work products	
Verification Process compliance oversight	
Tailoring Approved tailoring, process specific	
Implementation Guidance Common implementation descriptions	
Supporting Documentation and Assets Applicable organizational references	

Program evidence needed to demonstrate IPM process compliance

Process Compliance Scores

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ASSESSMENT STATUS COLORS	NY	Not Yet	• To be appraised at a later date (i.e., the process has not yet been executed by the process and cannot be appraised)
	NA	Not Applicable	• Not applicable to the project (e.g., Code and Unit Test Process is not applicable to a production-type program)
	NS	Not Scored	• Pending an appraisal
PROCESS COMPLIANCE COLORS	FI	Fully Implemented	• Direct artifacts are present and appropriate • No substantial weaknesses
	LI	Largely Implemented	• Direct artifacts are present and appropriate • One or more substantial weaknesses
	PI	Partially Implemented	• Direct artifact is absent or inadequate • Substantiated by indirect artifact/affirmation • One or more substantial weaknesses
	NI	Not Implemented	• Any situation not covered by the above

Process Compliance Measures

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

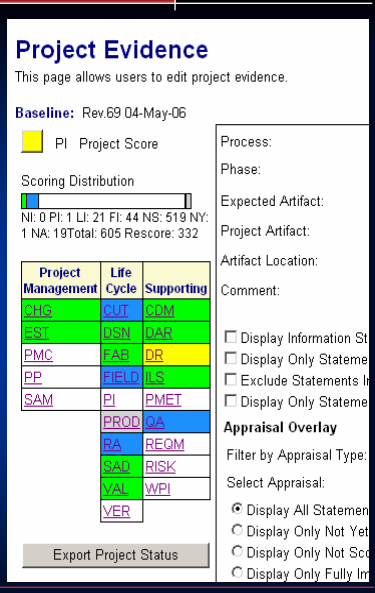
A

- Depicts scoring distribution over all process items
- More insight on the overall project score (A)

B

- 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 the process

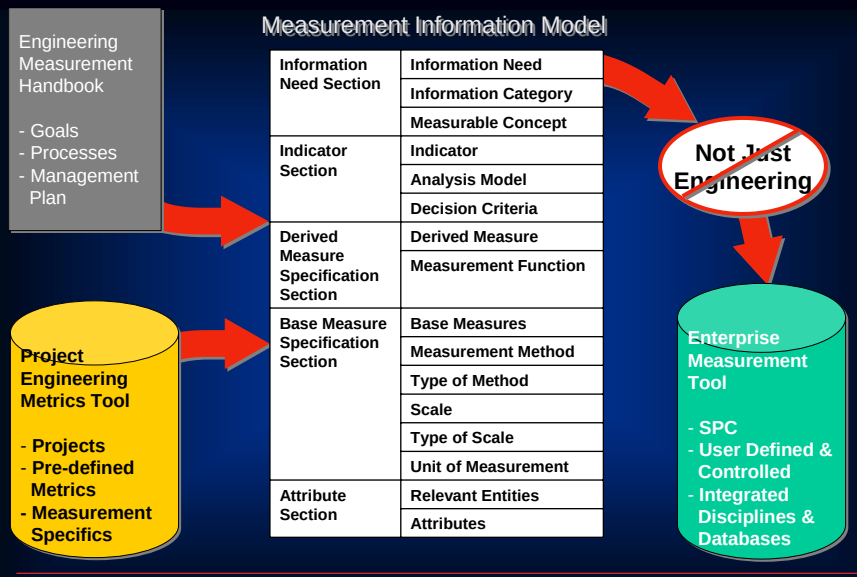
C



Lessons Learned - 1

- One metric doesn't tell the whole story
  - Need an integrated and many times orthogonal views
  - Trending is key
- Project planning is key
- Data collection is the hardest
- Having standard tools is highly desirable
  - Consistency
  - User friendly
  - Easy access
- Training is a must
  - Cultural change is hard
  - Train everything, even the obvious

Lessons Learned - 2



Contact Information

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