

eQube at Northrop Grumman Integrated Systems

Leveraging TeamCenter Investment
eQube – A Reporting and Analytics Solution

Northrop Grumman and the eQube Team

- **Jim Hannon – Manager, Engineering Release and Visibility**
 - Northrop Grumman
- **Fred Alegria - Software Engineer**
 - Northrop Grumman
- **Joe Perry – Software Engineer**
 - Northrop Grumman
- **Dinesh Khaladkar – President & CEO**
 - eQ Technologic
- **Sanjeev Tamboli – Executive Director**
 - eQ Technologic

eQ Technologic

- **Provides solutions for “Visibility Infrastructure”**
 - Reporting / Ad-hoc Reporting
 - Analytics
 - Key Performance Indicators (KPIs) Tracking

- **The Makers of eQube**



- **World Wide Customer Base**

- Aerospace & Defense
- High-tech

- **Recently Signed a Major Agreement With UGS**

- eQube = Teamcenter Reporting & Analytics
- A Standard Teamcenter Offering

Northrop Grumman Integrated Systems

- **Northrop Grumman's Integrated Systems (IS) sector Delivers Best-value Solutions, Products and Services that Support Military and Homeland Defense Missions in the Areas of Intelligence, Surveillance and Reconnaissance; Space Exploration; Battle Management Command and Control, and Integrated Strike Warfare.**
- **Business Area and Major Programs:**
 - **Western Region – F-35, F/A-18, B-2, MP-RTIP, Global Hawk, Fire Scout, Hunter, N-UCAS, Targets, F-5 / T-38**
 - **Airborne Ground Surveillance & Battle Management Systems – Joint Stars, E-10A and NATO AGS**
 - **Airborne Early Warning & Electronic Warfare Systems – E-2C and Advance Hawkeye, EA-18G, EA-6B**

IES Team

- **Integrated Enterprise Solutions (IES)**
- **Mission**
 - Define Common Tools and Processes
 - Implement Integrated Systems sector Tools And Processes
- **Goal**
 - To Simplify New Program Startup
 - Allow Interchange Of Personnel Between Programs
 - One Northrop Grumman; Design Anywhere!
- **Recommended Tools Include**
 - Teamcenter
 - Enterprise Edition
 - Rich Client
 - CATIA
 - eQube Reporting

Tool Selection Overview / History

Overview

- **Tool Selection Overview / History**
- **Chart Selection Process**
- **Current Standards**
- **Schedule**
 - Schedule Status and Performance
 - Schedule and Design Management
- **Design Quality**

IES Reporting Tool Selection Highlights

- **Representatives From Each Business Area and ITS Participated**
- **Participants Defined Evaluation Criteria**

1	Ease of Initial TcE Report Development	15	Availability of report developers
2	Skill level required to develop reports	16	Maturity of Existing Report Library
3	Ease of use for consumers of reports	17	Maturity of Product
4	TcE Security	18	End User Support Pool
5	Ability to access any data in PDM	19	User interface provides pick lists for parameters
6	Web UI	20	Able to save report definition
7	Tight integration with TcE object model	21	Time to deploy the reporting tool on a program
8	Ease of report maintenance/migration	22	Reliability
9	Ease of report deployment	23	Total Cost of ownership
10	Schedule reports to run during off hours	24	Report viewing
11	Capability to "Embed" into TcE web UI	25	Multiple platform support - server
12	Performance	26	Multiple platform support - client
13	HW req'd to support Production use of reports	27	Ability to create custom functions
14	Report formatting/Design Functionality and Range of Features	28	Scalability

- **Candidates Included Internally Developed and External COTS Packages**
- **Each Business Area Weighted the Criteria and Scored Each Tool**

Evaluation Results

- **1st eQube: 5 Teams Rated Number 1 Pick Of The Four Candidates**

Business Elements represented:

- **Western Region – El Segundo & Rancho Bernardo**
- **AGS & BM Systems**
- **AEW & EW Systems**
- **Information Technology sector**

eQube at Northrop Grumman - Features

- **Web Based Reporting Tool Providing**
 - Ability To Create Detailed Graphs And Reports
 - Report Presentation Within eQube
 - Interactive Report Formatting
- **Uses PDM APIs To Interface With PDM Data Repositories**
 - Uses Teamcenter Security
 - No Additional User Account Maintenance
 - Able To Retrieve PDM Specific Data Structures And Relationships
- **Interfaces With Any ODBC/JDBC Compliant Database**
 - Oracle, MS SQL, DB2, MS-Access Legacy Systems
 - Can Act On XML Data Files/Exports
 - Cannot Directly Interface With IMS Based Systems
 - Can Act On An IMS Extract
- **Accesses Data Repositories In Real Time For Ad Hoc Reports**
- **Scheduling Capabilities To Run Large Volume Of Reports On Off Hours**

Graph Example Output

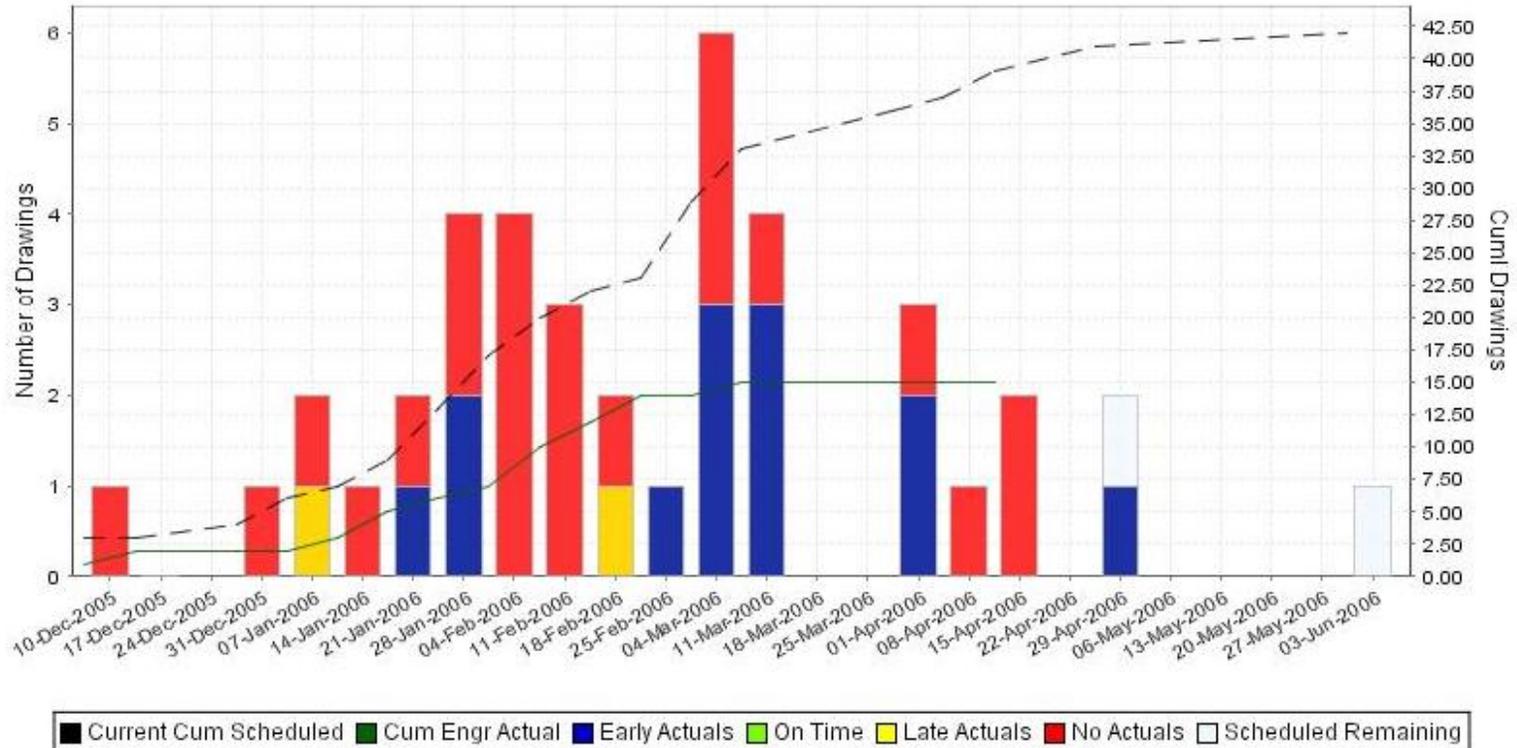
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IES-VS Design Status by Lifecycle State - Release

Total Designs	46		Total Actuals	15	32.61 %
Unscheduled Designs	4	8.70 %	Total Late to Schedule	27	58.70 %

Report created on : 04-16-2006 04:28:08 PM

Selected filters: **Week-** (Lifecycle Step = LCM BaseLine AND * Program Name = Fighter Jet AND Date Range > 01-12-2005)



Report Example Output

Late Change Notice Report

Report created on : 10-05-2005 03:22:54 AM

Selected filters: **Late CN-** (CN Type In (DRN, DCN, EO) AND Organization Id In (70974,) AND Program = Training AND Project Team = Team1)

Late CN	Title ▲▼	Change Notice ▲▼▲▼	Start ▲▼	Offbrd ▲▼	S/O Rm ▲▼	Rls ▲▼	Team ▲▼
<input type="checkbox"/> Top		320					
<input checked="" type="checkbox"/> Late To Release		237					
<input type="checkbox"/> Late To Team Signoff		33					
TechDoc 1574	TechDoc 1574	ChangeNotice 1574 DRN	S E A 2005-08-30 -	2005-09-12 -	2005-10-04 -	2005-10-17 -	Team1
TechDoc 1571	TechDoc 1571	ChangeNotice 1571 DRN	S E A 2005-08-30 -	2005-09-12 -	2005-10-04 -	2005-10-17 -	Team1
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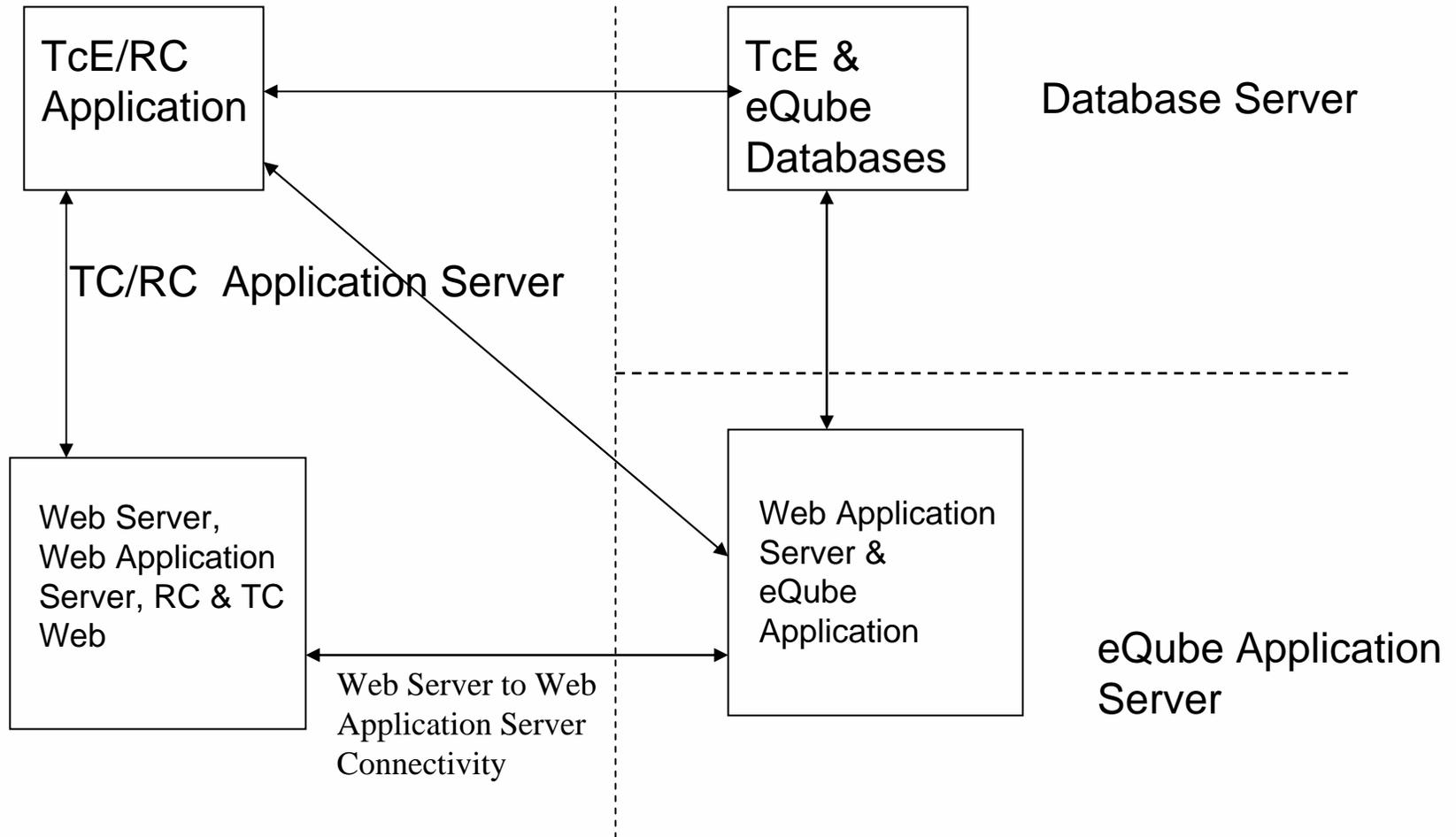
eQube Timeline

- **Nov – Dec '04 eQube Brought On-site To Install The Software –**
 - Four eQube Staff On-site With Support From Staff
 - Created A Set Of Initial Reports And Graphs
 - Reports/Graphs To Be Presented At Program Level (All Up)
 - And Sorted By Each Integrated Project Team (25 IPTs)
- **Jan 2005 -**
 - Performance Problem Discovered
 - Report Batch Processing Exceeded Availability Window

eQube Timeline

- **Feb - Mar '05, eQube 2nd Site Visit -**
 - Corrected Performance Issues
 - Customized Batch Processing Scheduling
 - Snapshot Filtering Technique, Creates Project Level Reports From Program Level Report Added To Support NGC Requirements
 - Rewrote All Report/Graph Code To Retrieve PDM Physical Attributes, By Replacing Dynamic Attributes (Corrected Major Performance Impact)
 - Full Set Of 1,200 Reports Completed Each Night In Less Than 100 Minutes
 - Created Report Presentation Front-end To Provide User Friendly Access

Recommended System Architecture East Coast & West Coast Sites



eQube Server Sizing

- **Key Parameters**

- Report Size - As Determined By The Number Of Objects Required To Be Fetched To Generate The Report.
- Number Of Concurrent Users
- Time Window To Run The Nightly Report Batch

- **Number Of Objects in TC**

- Tec Docs - 50,000
- Change Notices - 35,000
- Parts (Assm+ Cmpnt) - 62000
- b2SchHst - 100,000
- ProcHist - 100,000
- RevSig - 20,000
- Active Users - 1,000

Assumptions

- **Assuming The Concurrency Of 1 To 10. E.G. If There Are 1000 Active Users The Assumption Is 100 Concurrent Users Will Be Connected To The eQube Server.**
- **Most Of The Users Will Be Retrieving The Snapshots. Few Users (20%) Of The Connected Users Will Be Running Ad-hoc Reports With Filters.**

Server Recommendation

Based On The Chart On The Previous Page

- For 1000 Named Users
- Server Alternatives
 - Option 1
 - SUN Fire 440.
 - 4 CPU, 6 GB RAM
 - Option 2
 - SUN Fire 490
 - 2 CPU, 6 GB RAM
 - Option 3
 - Start With SUN Fire 240 Server (2 CPU, 6 GB)
 - If Performance Is An Issue Add One More SUN Fire 240 And Load Balance. Will Require Additional WebSphere License And Load Balancer (WebSphere ND Option)

Schedule Status and Performance Visibility

Visibility Philosophy

Power of Metrics:

- **Standard Performance Metrics Provide a “Apples to Apples” View Across All Programs**
- **Provide Clear Expectations and Performance Goals**
- **Encourages / Influences Common and Best Practices**
- **Promotes Good Behavior and Rewards High Achievers**
- **Ensures Good and Bad News Travels Equally as Fast**
- **If You Don't Plan, Schedule & Measure It, It Doesn't Happen!**
- **Comparable Metric Benchmarks Between Programs**
- **Exposes Poor Processes and Data Quality**
- **Creates a “Pull” Environment and a Sense of Urgency**

Visibility Metrics

Standard visibility is being addressed in three areas

1. Design Status and Schedule Release Performance -
 - S-Chart
 - Step Chart
 - Work to Go Chart
2. Design Management –
 - Indentured Parts List
 - Flat Engineering Bill of Materials
 - Design Change Tracking – Incorporation Report
 - Design Tracking – Change Category Report
3. Design Quality - Pre and Post Release and Error Reduction
 - Record Errors for Down Stream Analysis & Corrective Action

Design Status by Lifecycle State

- Design Status For Four Milestones – Design Start, Off-board, Review Complete And Release
- Depicts Cum Actuals Against Cum Scheduled
- Provides Visibility Of Early, On Time, Late, And Incomplete Status.
- Backup Data Is Available To Drill Into Any Column On The Chart If Viewed In eQube.

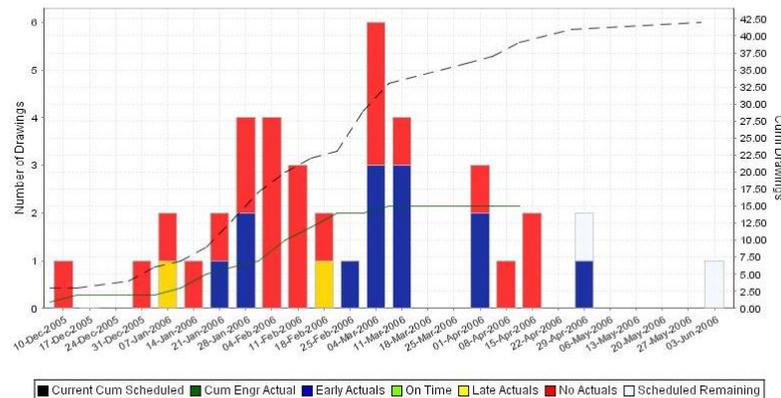
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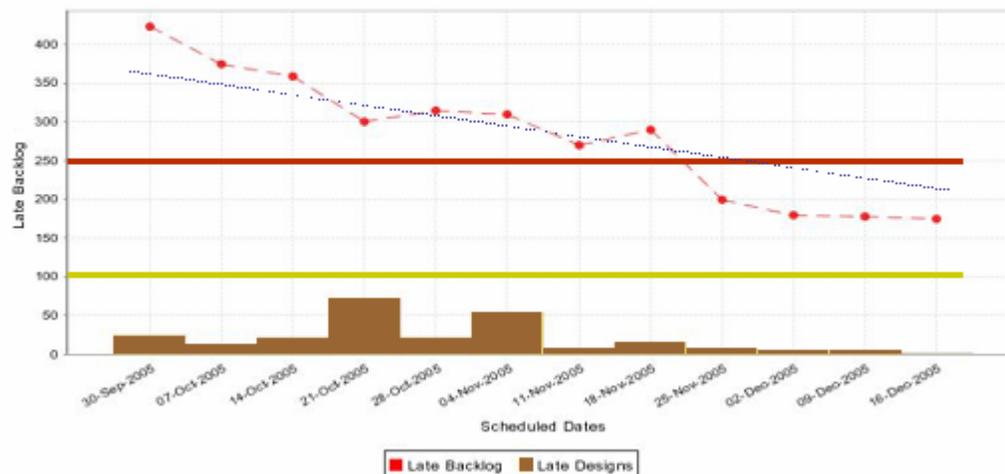
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Design Completion Trend

- Provides Visibility Of The Number Of Late Designs Each Week And The Remaining Backlog.
- Depicts Performance Thresholds To Easily See The Health Of The Program.
- Presents A Trend Line Of How The Backlog Is Changing.
- Backup Detail Data Is Always Available.

NORTHROP GRUMMAN Design Completion Trend

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Design Step Chart

- **Summary And Detail Status Of Design Progress.**
- **Pinpoint Late Design Activity Early In The Lifecycle Allowing Potential Recovery To Plan.**
- **Drill Down To The Individual Design And Responsible Engineer.**

Step Chart Sample

Section 1

Selected Filters : Program = Training

Legend		Status as of Week: 06-20-2005 05:52:24 PM																																													
More than 3 days late	225																																														
1-3 days late	24																																														
0-3 days early	0																																														
More than 3 days early	24																																														
Not late to Start	2422																																														
Date of Release Commitment	Total	Open	Start			Off-Board			Signoff Complete			CM Release																																			
LATE	0	0	0			0			0			0																																			
Jul 1, 2005	10	10	10																																												
Jul 8, 2005	19	19	19																																												
Jul 15, 2005	81	80	80																																												
Jul 22, 2005	40	40	36			4																																									
Jul 29, 2005	49	40	30						10																																						
Aug 5, 2005	91	91	50			20			10			10																																			
Aug 12, 2005	90	84	81						1			1																																			
Missing Plan Dates	41		8%			1%			91%			67%			33%			100%			100%																										
Totals			225			20			2422			0			4			0			2			0			0			0			11			0			0			0			11		

Section 2 [Detailed Report]

Doc	Rev	EO	Comments	RE	Current Status	Next Plan Date	Days Late	Plan Release
TD TEST102	-1	ECN TEST 102			In Start	05-16-2005	26	07-01-2005
TD 4	-1	ECN 4			In Start	05-16-2005	26	07-01-2005
TD 3	-1	ECN 3			In Start	05-16-2005	26	07-01-2005
TD 2	-1	ECN 2			In Start	05-16-2005	26	07-01-2005
TD 7	-1	ECN 7			In Start	05-16-2005	26	07-01-2005
TD 8	-1	ECN 8			In Start	05-16-2005	26	07-01-2005
TD 5	-1	ECN 5			In Start	05-16-2005	26	07-01-2005
TD 1	-1	ECN 1			In Start	05-16-2005	26	07-01-2005
TechDoc 85	-1	ChangeNotice 85			In Start	06-16-2005	3	08-03-2005
TechDoc 89	-1	ChangeNotice 89			In Start	06-16-2005	3	08-03-2005
TechDoc 90	-1	ChangeNotice 90			In Start	06-16-2005	3	08-03-2005
TechDoc 401	-1	ChangeNotice 401			In CM Release	08-05-2005	-33	08-05-2005
TechDoc 406	-1	ChangeNotice 406			In CM Release	08-05-2005	-33	08-05-2005
TechDoc 405	-1	ChangeNotice 405			In CM Release	08-05-2005	-33	08-05-2005

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Design Step Chart – Backup Detail Data

- Individual Design Status Including Days Late.
- Current Status, Next Plan Date And Plan Release Provide Concise Data About The Progress Of The Design.

Doc	Rev	EO	Comments	RE	Current Status	Next Plan Date	Days Late	Plan Release
TD TEST102	-,1	ECN TEST 102			In Start	05-16-2005	26	07-01-2005
TD 4	-,1	ECN 4			In Start	05-16-2005	26	07-01-2005
TD 3	-,1	ECN 3			In Start	05-16-2005	26	07-01-2005
TD 2	-,1	ECN 2			In Start	05-16-2005	26	07-01-2005
TD 7	-,1	ECN 7			In Start	05-16-2005	26	07-01-2005
TD 8	-,1	ECN 8			In Start	05-16-2005	26	07-01-2005
TD 5	-,1	ECN 5			In Start	05-16-2005	26	07-01-2005
TD 1	-,1	ECN 1			In Start	05-16-2005	26	07-01-2005
TechDoc 85	-,1	ChangeNotice 85			In Start	06-16-2005	3	08-03-2005
TechDoc 89	-,1	ChangeNotice 89			In Start	06-16-2005	3	08-03-2005
TechDoc 90	-,1	ChangeNotice 90			In Start	06-16-2005	3	08-03-2005
TechDoc 401	-,1	ChangeNotice 401			In CM Release	08-05-2005	-33	08-05-2005
TechDoc 406	-,1	ChangeNotice 406			In CM Release	08-05-2005	-33	08-05-2005
TechDoc 405	-,1	ChangeNotice 405			In CM Release	08-05-2005	-33	08-05-2005
TechDoc 407	-,1	ChangeNotice 407			In CM Release	08-05-2005	-33	08-05-2005
TechDoc 409	-,1	ChangeNotice 409			In CM Release	08-05-2005	-33	08-05-2005
TechDoc 408	-,1	ChangeNotice 408			In CM Release	08-05-2005	-33	08-05-2005
TD 54	-,1	ECN 54			In Start	06-20-2005	-1	08-05-2005
TD 52	-,1	ECN 52			In Start	06-20-2005	-1	08-05-2005

Design Work-To-Go Status Chart

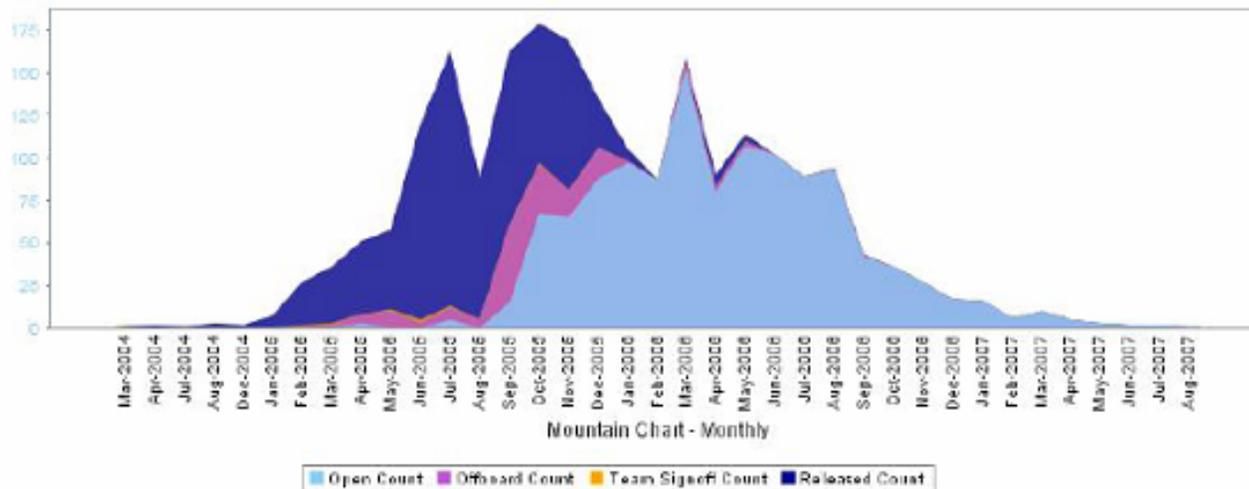
- Provides Quick High-level Visibility Of Design Status.
- Depicts The Work Remaining Based On The Criteria Selected For The Chart.
- Relative Design Progress Against The Plan.

Status Of Work To Go - Monthly - All
DRN,DCN,EO

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Report created on : 12-14-2005 09:09:55 PM

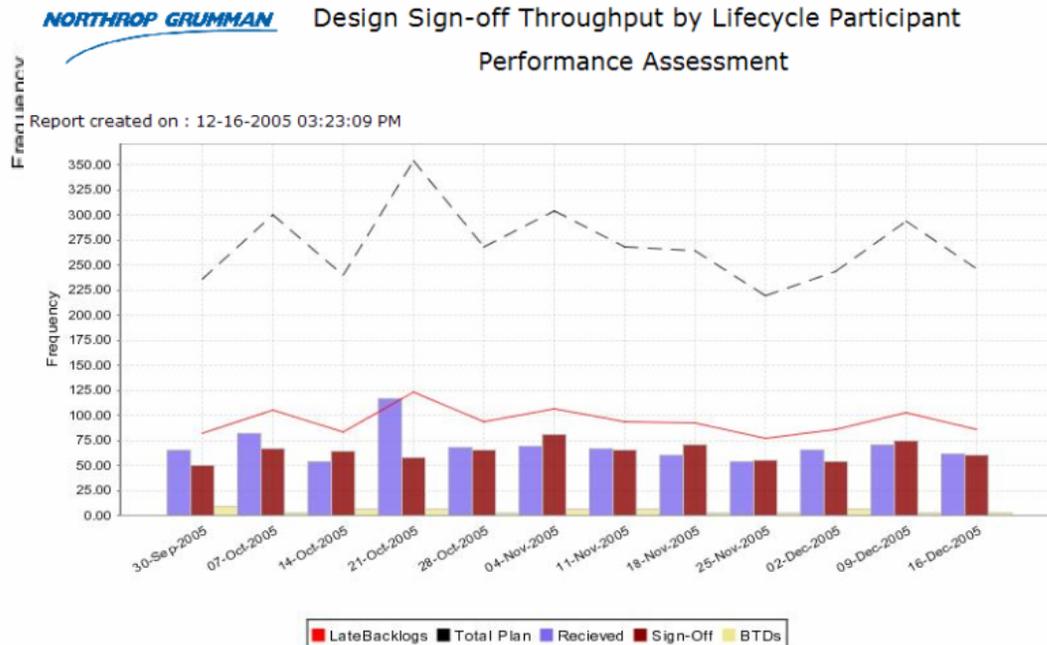
Selected filters: Month- (Change Type In (DRN, DCN, EO) AND Program =)



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Design Sign-off Throughput by IPT/Group

- Design Package Integrated Product Team (IPT) /Group Sign-off Activity – Packages In, Approved, And Rejected Back To Design.
- Identification Of Continuing Backlog.
- Reference Line Of Total Plan For All IPTs/Groups.



Design Management

Report Example Output

Late Change Notice Report

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Design Quality

Design Quality

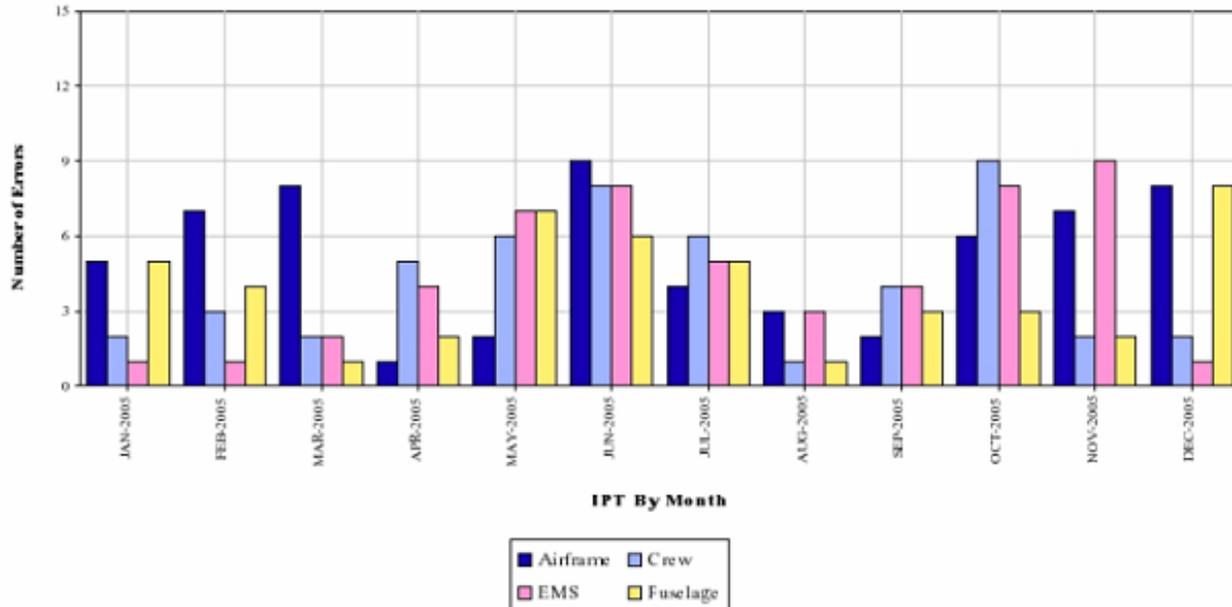
- **Design Error Count by IPT (Pre-Release)**
- **Design Error Analysis with Sign-off Detail**
- **Design Error Frequency (Pre-Release)**
- **Design Approval/Rejection Analysis**
- **Design Quality Analysis – Critical Reasons for Change**
- **Reason for Change Analysis Over Time**
- **Design Quality – Engineering Errors**
- **Design Quality – Engineering Errors Qtrly Dashboard**

Design Error Count by IPT (Pre-Release)

- Design Errors Identified During Sign-off.
- Count Of Errors Forcing Rejection Of The Design Back To The Engineer, Depicted Over Time.

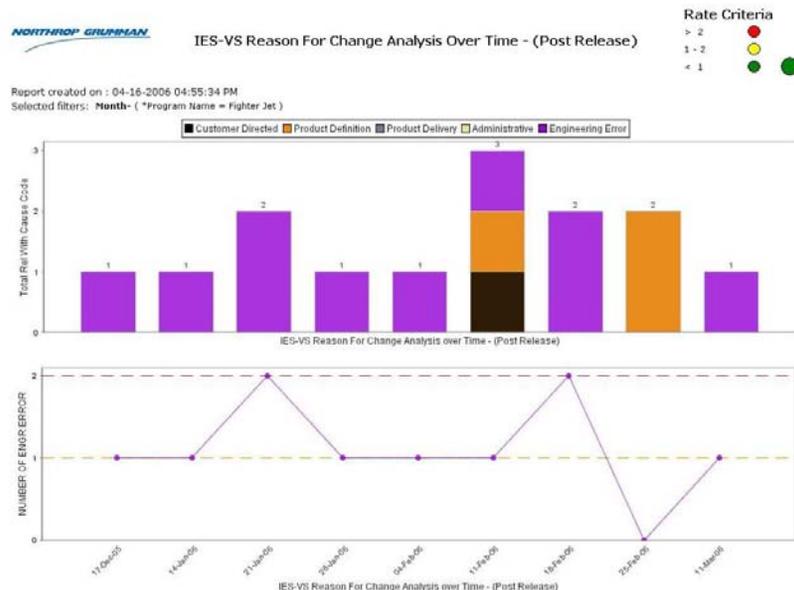
NORTHROP GRUMMAN Design Error Count by IPT Group

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Reason for Error Analysis Over Time

- Provides Visibility Of The Frequency Of Different Types Of Errors Over Time.
- May Provide Insight Into The Types Of Errors Occurring Around Certain Program Deliverable Milestones.
- Depicts Engineering Errors Against Performance Thresholds To Measure Quality And Improvement.

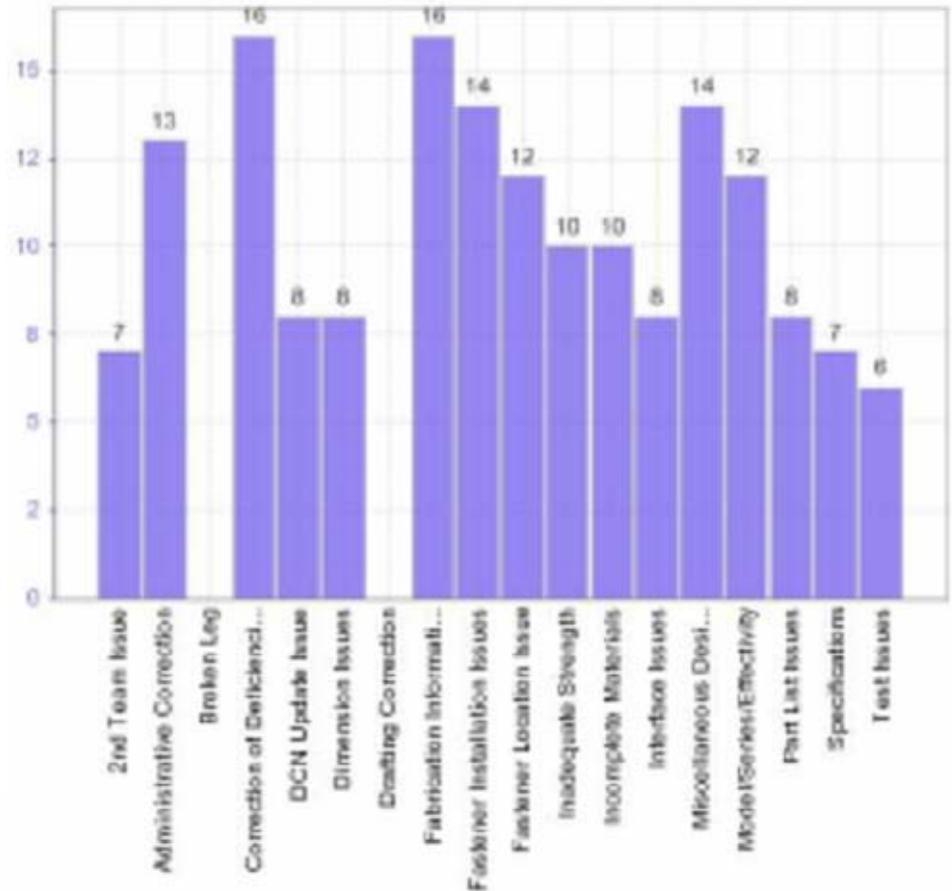


Design Quality – Engineering Errors

- Provides An Analysis Of Engineering Errors For A Period Specified By The User.
- Visibility To The Counts Of Different Engineering Errors Allows Management To Address Training And Process Issues To Move Toward Improvement.

NORTHROP GRUMMAN Design Quality - Engineering Errors (Post-Release)

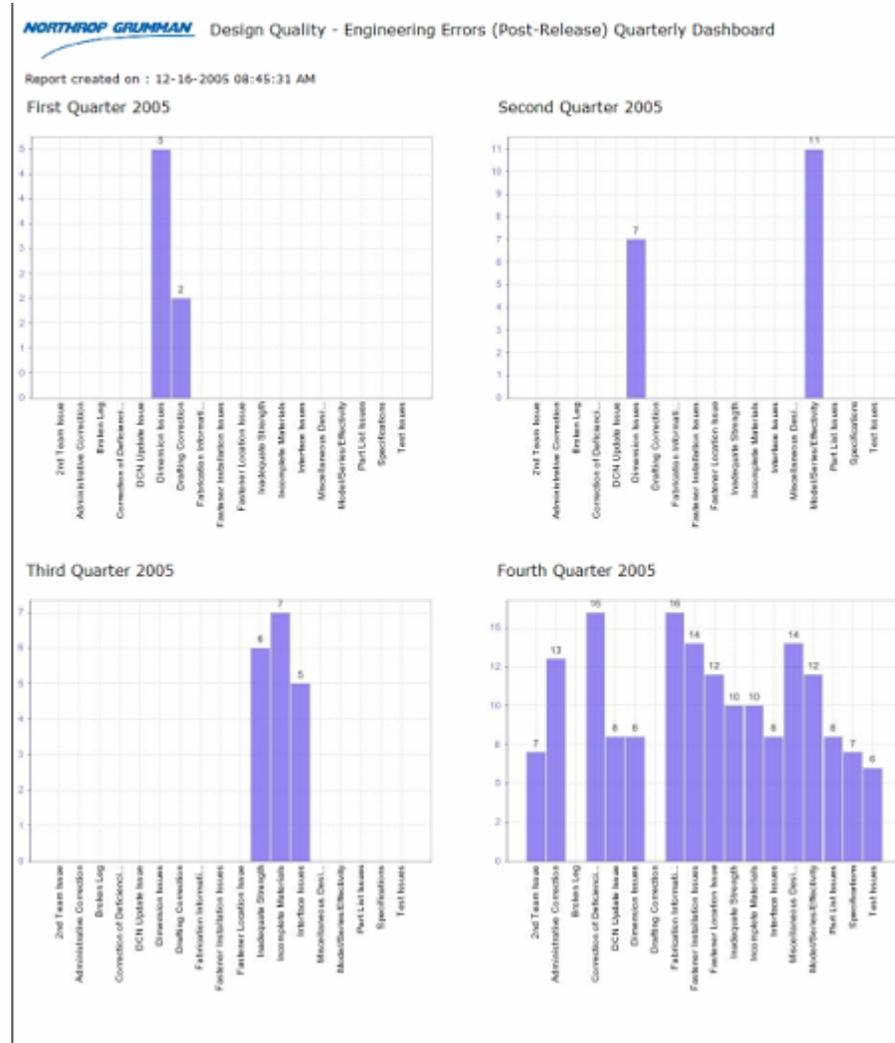
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Design Quality – Engineering Errors (Post-Release) Quarterly Dashboard

- Provides A Comparison Of Engineering Errors By Quarter.
- Is Quality Getting Better Or Worse?
- Are The Same Errors Being Encountered Or Are They Changing?



Presenters

- **Jim Hannon - Engineering Release and Visibility - NGC**
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- **Joe Perry – Software Engineer III - NGC**
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