



Storytelling as a Management Tool: IQ when profit is not the bottom-line

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Executive Summary:

Poor information and data quality cost organizations in lost sales and revenue due to scrap and rework and contributes to ineffective decision-making by senior management. In a governmental non-profit environment such as the Naval Inventory Control Point (NAVICP), the data resident within the operational databases and systems is the precious commodity that connects the organization with its customers. Data integrity is essential to the NAVICP's credibility as the Navy's logistics leader in supply chain operations for all sea, land and air support services. In addition, the greatest constraint of the newly acquired Enterprise Resource Planning (ERP) management platform is the interoperability of the data.

The Data Integrity Management Center (DIMC) is the NAVICP's solution to ensuring optimum information effectiveness from Legacy systems data through migration and into ERP. Serving as the flagship model for data integrity among four major ERP implementations, the DIMC's information-centric root cause analysis methodology is strongly supported by academic and industry research and practices, respectively. The DIMC consists of three major components: Unit 1, Database Integrity and Policy (DBIP); Unit 2, Research, Development, Analysis and Validation (RDAV); and Unit 3, Data Accuracy Review Training (DART). The multi-faceted goals of the DIMC evolve to create an environment of effective decision-making.



Info-Centric Quality Management (ICQM)



The NAVICP Response to Information Quality Support (IQS)



What is Information Quality?

Information that is effective and fit for purpose.

Information that is:

- Real – accurate reflection of real world
- Recent – up-to-date information
- Relevant – information our customers and the business needs to make informed decisions

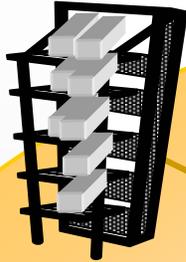
What is the relevance of this information?

12-6-78-723-30-1

1-267-872-3301



ERP Logistics - One System - One Database - One Touch



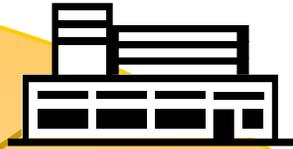
Adjusts inventory



Posts to demand forecast



Debits OPTAR



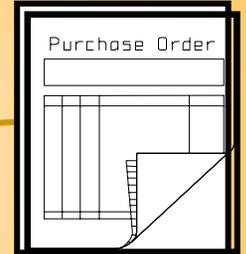
Sends pick to warehouse



Arranges transportation



Repair Parts AK drops requisition



Releases P.O. at Reorder Point



Updates cost accounting



Updates configuration data



Tracks carcass



Arranges special shipping equipment



Living Together - The Real Challenge

Move Day – 02 DEC



**We are bringing our own ways of living, preferences, attitudes with us.
A different level of cooperation and coordination is required for us to
live together (productively/peacefully) in the same house.**



Office of Management and Budget

The Executive Office of the President

- OMB SECTION 515 states that federal agencies must:
 - ◆ Issue government-wide guidelines ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by the agency;
 - ◆ Establish administrative mechanisms allowing affected persons to seek and obtain correction of information maintained and disseminated by the agency that does not comply with the guidelines issued by the Government;
 - ◆ Report periodically to the Director-
 - the *number and nature of the defects* received by the agency regarding the accuracy of information disseminated by the agency; and
 - how was the defects handled/resolved* by the agency.



Increasing Combat effectiveness through Information Interoperability – JITC test certification

- **Information Superiority** – a powerful tool for the war fighter in the international battle space... a grand challenge since Desert Storm... Logistics played an integral role;
- **Information Interoperability** – joint service systems working effectively together to provide optimum information support;
- **Interoperability Test Certification** – no longer a “nice to have”; joint task forces currently the norm for deployments and executions.

What interests my Boss... fascinates the hell out of me!



NAVICP Information Quality History (1979 – Present)

- **Started the Data Base Integrity (DBI) group**
 - ◆ **Data defect study using sampling**
 - ◆ **Diagnostic development**
 - ◆ **TQM/Process Improvement**
 - ◆ **ADP initiatives**
 - ◆ **Source Data Entry system development**
 - ◆ **Data Integrity Management Center (DIMC)**



OPERATIONS ANALYST & RESEARCH (OA/OR) ENGINEERING

- The **scientific method** of providing executives with a quantitative basis for decisions regarding the operations under their control.
- The objective of OA/OR is to be **systematic in the analysis** of possible actions to provide the decision-maker with a basis for making a rationale choice.
- The OA/OR approach involves the use of scientific methods to **bring objectivity** to the results, and to **make verification possible**. The methods are quantitative, using techniques of mathematics, computers and other sciences to deal with the quantifiable aspects of a problem.



OPERATIONS ANALYST & RESEARCH (OA/OR) ENGINEERING TOOLS and TECHNIQUES

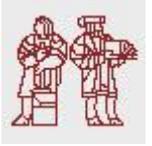
- Project Management
- Risk Management
- Payoff Matrix
- Utility Theory
- Earned Value Management
- Cost-effectiveness – Multiple MOEs
- Fault/decision trees
- Linear/non-linear Programming Formulation
- Statistical Process Controls (SPC)



Why Information Quality Problems?

Information quality problems are caused by people not performing an action that they are expected to perform. If the action is incomplete, it's because of one of the following reasons:

- “I didn’t know I was supposed to do it.”
 - ✓ **I didn’t know I was supposed to** log the transaction in the system when I issued the part at NNZ
- “I don’t know how.”
 - ✓ **I didn’t know how** to debit the master record for the stock issue.
- “I can’t do it.”
 - ✓ **The system was down; I couldn’t log on; I forgot my password.**
- “I didn’t know why I was supposed to do it.”
 - ✓ **I didn’t know that logging the transaction was important** to another function or process.
- ❖ A negative consequence follows positive action.
 - ✓ **Conflicting message – managers chastises worker for taking time** to log the transaction.
- ❖ No negative consequence follows negative action.
 - ✓ **No feedback loop – worker doesn’t see how his action caused gas not to be ordered.**
 - = where training and documentation can help
 - ❖ = where change management can help



Info-Centric Quality Management Methodology

The foundation of logistic support is data

The “health” of our systems are dependent on quality data

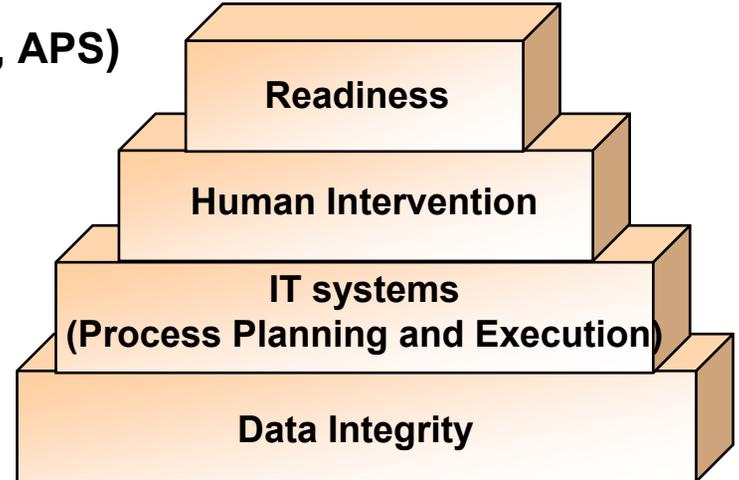
- . Our data... (UICP & SAP)
- . Data our system consorts with... (U2, FLIS, APS)

ERP/SAP Implementation...

Movement to more data driven
IT systems / management...

Without data integrity, more human
intervention is required ... A high risk
strategy.

Info-Centric Quality Management Power Pyramid



**Data Cleansing focuses on
Root Cause Analyses**

*IQE Industry
Partners:
Pratt & Whitney...
Rolls Royce...
New Zealand DOD...
British Ministry of
Defence*

*IQE Academic/Research
Partners:
MIT...
VCU Inst for Data
Research...
NPS... Dept of OR
Information Impact...*



- **Data Integrity** is the operation of ensuring that NAVICP computer systems (data quality rules) reflect current NAVICP business processes.
- **Data Integrity Management Center (DIMC)** houses
 - Unit 1: Research, Development, Analysis and Validation (RDAV);
 - Unit 2: Data Base Integrity and Policy (DBIP);
 - Unit 3: Data Accuracy Review Training (DART).
- **Data Integrity Council (DIC)** is comprised of senior managers from each operational code (Aviation and Maritime) that provide guidance and governance for IQS.
- **Information Quality Support (IQS)** is the overall function of ensuring total file integrity and information accuracy in the legacy, migration and ERP environment.

“Accurate information is a critical component for effective strategic decision making”. [4]

Info-Centric Quality Management Circles of Excellence





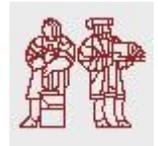
A Database is Like a Lake



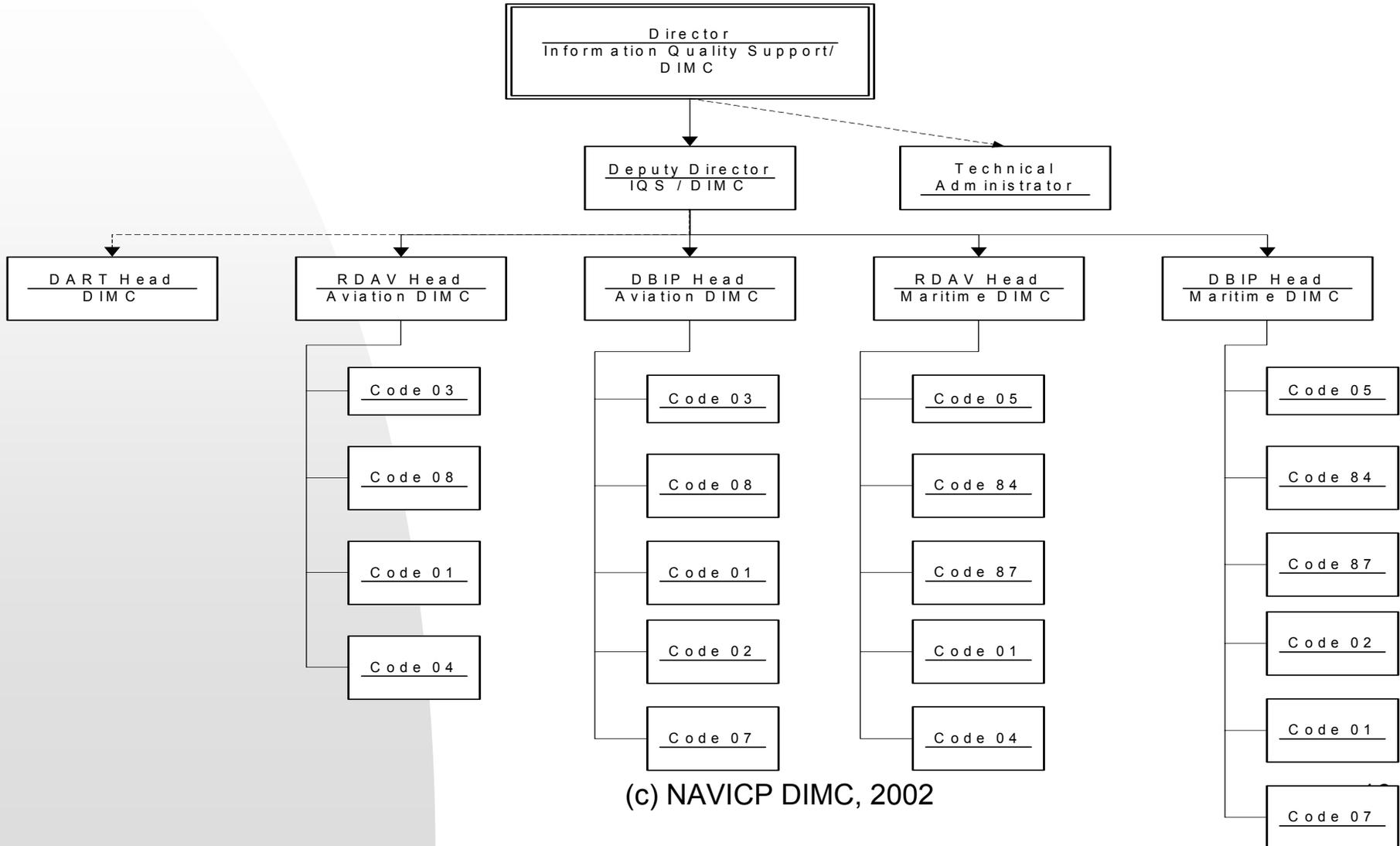


Information Quality Support Solutions (IQS²)

- Data Integrity Diagnostic Feedback Reports
- TITAN Data Integrity Management Systems – Aviation & Maritime
- MAXIMUS Virtual Logical Data Model
- QM Module Risk Assessment Study
- ERP project Data Quality Overlap and Conflict Assessment
- Road-show and in-house technical training
- Data Conversions Validation Reports
- Loss referrals and DLA 339 processing



Information Quality Support Matrix Org Chart



(c) NAVICP DIMC, 2002



Data Integrity Diagnostics Feedback Report

Assignment Number:01-004

Date:11/07/2001

Submitter:J Egan

Ext: 9999

Code: Group 999

LRC:N/A

Error Code:"B"

Error File Type: Family I&S

Error Definition: Den F018 total between family members for the same applications
Is less than 100%.

Problem Description: This was a four member family. Upon checking all the D009's
that would pertain to the P-3 area i.e. AP—AU—AR applications they totaled 100%. No error.

Sample NIINs: None01-348-1008—01-227-4291—00-906-9917—00-019-8390

Suggested Resolution: Set the system so that it sends the errors to the correct IWST.

Do not type below this line

Official Resolution:

I'LL DOUBLE CHECK THE NIIN YOU PROVIDED BUT IN THE MEANTIME DID YOU CHECK ALL THE D009'S AGAINST THAT NIIN FOR F018 INCONSISTENCIES? IF THERE ARE PROBLEMS WITH THE F018'S AS THEY RELATE TO ALLOWANCE LISTS, THAT'S A PROBLEM WITH THE DIAGNOSTIC LOGIC, BUT IF THE PROBLEM IS WITH AN F018 VALUE THAT PERTAINS TO A NON-P3 NEXT HIGHER ASSY THAT IS APPLIED AGAINST AN ITEM WITH AN 'L' LRC THEN IT IS STILL UP TO YOU TO FIX. YOU MAY HAVE TO GO SEE AN E.S. IN THE BRANCH THAT SUPPORTS THAT PARTICULAR WEAPONS SYSTEM BUT THE MAINTENANCE ACTION IS YOUR RESPONSIBILITY.



Prioritization Criteria

Criteria For Prioritization

1. ERP DEN, Family, $AQD > 1$
2. ERP DEN, $AQD \leq 1$
3. Non-ERP DEN, $AQD > 1$
4. Non-ERP DEN, $AQD \leq 1$



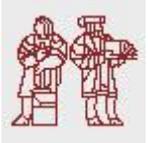
Data Integrity Reporting

EXAMPLE	
CODE: 978	JANUARY 2002
NUMBER OF REGULAR HOURS	10
NUMBER OF OVERTIME HOURS	20
NUMBER OF NIINS WORKED	250
NUMBER OF ERRORS WORKED	375

**** MONTHLY BASIS TO COORDINATOR**

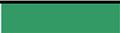
**** MONTHLY BASIS TO DATA INTEGRITY**

**** QRTLTY METRICS BRIEF ICP 00/SUP 00**



Sample Data Integrity Monthly Error Count Report

	Priority	1	2	3	4	TOTAL ERRORS	% of Total ERRORS	TOTAL FIXED	QUALITY RATING
SYSTEM	CODE								
Weapon Systems	911	233	3,402	3	27	3,665	24.2%		0.0%
Logistic Support	912	429	5,859	62	701	7,051	46.6%		0.0%
Quality Assurance	913	187	3,819	104	291	4,401	29.1%		0.0%
OVERALL RATING		849	13,080	169	1,019	15,117		0	0.0%
Quality	GREEN	20-100%				15,117			
Improvement	YELLOW	5-19.99%							

Quality	GREEN	20-100%	
Improvement	YELLOW	5-19.99%	
Rating	RED	0-4.99%	



Sample Data Integrity QTRLY Metric Report Card

SYSTEM	LRC	CODE	IWST REPORT ED FY02 Q1 FIX TOT	JAN 02	FEB 02	MAR 02	IWST REPORT ED FY02 Q2 FIX TOT	TOT FROM 01JAN02	IWST FIX RATIO	Diagnostic Tracking	delta	Fix Ratio
TRUCK A	A	0911	1,041	256	696	524	1,476	16,468	15.28%	16,338	130	0.79%
TRUCK B	B	0912	266	26	52	34	112	10,307	3.67%	10,207	100	0.97%
TRUCK C	C	0913	76	114	266	256	636	5,447	13.07%	5,443	4	0.07%
TRUCK D	D	0914	595	107	135	124	366	6,947	13.83%	6,777	170	2.45%
TRUCK E	E	0915	1,037	374	654	807	1,835	3,531	81.34%	3,293	238	6.74%
TRUCK F	F	0916	1,054	506	643	822	1,971	6,166	49.06%	5,632	534	8.66%
TRUCK G	G	0917	274	34	78	99	211	7,976	6.08%	6,776	1,200	15.05%
TRUCK H	K	0918	1,081	159	162	178	499	5,104	30.96%	4,765	339	6.64%
TRUCK I	L	0919	2,906	2,576	3,306	4,565	10,447	16,728	79.82%	15,032	1,696	10.14%
TRUCK J	M	0920	5,701	1,153	1,030	1,104	3,287	17,186	52.30%	14,567	2,619	15.24%
TRUCK K	N	0921	1,946	437	552	632	1,621	69,846	5.11%	54,032	15,814	22.64%
TRUCK L	O	0922	706	287	1,602	1,784	3,673	5,617	77.96%	4,456	1,161	20.67%
TRUCK M	P	0923	109	78	127	132	337	4,230	10.54%	3,012	1,218	28.79%
TRUCK O	Q	0924	392	37	89	76	202	5,070	11.72%	3,090	1,980	39.05%
TOTAL			17,184	6,144	9,392	11,137	26,673	180,623	24.28%	153,420	27,203	15.06%

Quality	GREEN	20-100%
Improvement	YELLOW	5-19.99%
Rating	RED	0-4.99%



Information Quality Metrics Chart

Data / Information Quality									
Code		Total Errors Corrected	Total Errors Identified	Quality Improvement Rating				Comments	
				Q4/02	Q3/02	Q2/02	Q1/02		
Truck A	↑	3,730	3,842		97.1%	5.2%	N/A	Carcass Tracking DENS	
Truck B	↑	32,288	97,000		33.3%	46.2%	N/A	ITIMP and Dynamic DENS	
Truck C	→	22,364	237,936		9.4%	12.6%	21.0%		
Truck D	→	N/A	N/A		15.0%	10.0%	N/A	FMT / ITIMP / TITAN	
Truck E	↑	5,030	8,433		72.7%	24.5%	39.9%		
Truck F	↑	236	982		24.0%	52.9%	N/A	MILSTD-2073.1D	
Truck G	↑	1,501	5,712		26.3%	21.0%	N/A	CRCS / CAD	
Truck H	↑	813	5,260		49.5%	37.3%	N/A		
Truck I	→	169	3,363		5.0%	25.0%	N/A		
Quality Improvement Rating Legend:									
20.0% - 100.0%			Green						
5.0% - 19.9%			Yellow						
0.0% - 4.9%			Red						



Data Quality Tools at NAVICP

- File Maintenance Tool
- Integrated Computer Aided Provisioning System
- INTEGRITY Data Interrogation Tool
- MAXIMUS Virtual Logical Data Model
- SAP Data Validation Model
- TITAN Data Integrity Management Tool



Titan Database Application - [Data Integrity]

File Edit View Insert Format Records Tools Window Help

Titan Maritime Error Reporting System

Select an Option:

- Data Integrity Reports
- Data Integrity Errors
- Add/Modify Query Description
- Exit Application**

OK

NAVICSUP
NAVAL SUPPLY SYSTEMS COMMAND
NAVAL INVENTORY CONTROL POINT
Version 1.6

NAVICP - MECH
Mechanicsburg, PA

Form View

Start Bush ap... Explorin... Explorin... [12]<00:... Titan ... Master ... Microsof... NUM 2:40 PM

Main Menu.



Titan Database Application - [Data Integrity]

File Edit View Insert Format Records Tools Window Help

Titan Maritime Error Reporting System

Select Report Option:

- 05 Data Integrity Reports
- 84 Data Integrity Reports
- 87 Data Integrity Reports
- Consolidated Titan Diagnostic Report
- SQL Logic Description Report

Preview

Print

Close

Form View

NUM

Start Bush ap... Explorin... Explorin... [01]<04:... Titan ... Master ... Microsof... EN 2:41 PM

Preview / Print Data Integrity Reports for Code 05 / 84 / 87.



Titan Database Application - [Data Integrity]

File Edit View Insert Format Records Tools Window Help

Titan Maritime Error Reporting System

Select an Option:

- 05 Data Integrity Errors
- 84 Data Integrity Errors
- 87 Data Integrity Errors

OK

Close

NAVICSUP
NAVAL SUPPLY SYSTEMS COMMAND
NAVAL INVENTORY CONTROL POINT
Version 1.6

NAVICP - MECH
Mechanicsburg, PA

Form View

Start Bush ap... Explorin... Explorin... [01]<01:... Titan ... Master ... Microsof... NUM 2:44 PM

View Data Integrity Error Records for Code 05 / 84 / 87.



Titan Database Application - [Data Integrity]

File Edit View Insert Format Records Tools Window Help

Tuesday, November 05, 2002

Code 84 Queries (1) thru (24)

Select Query:

- 84Query1
- 84Query2
- 84Query4
- 84Query5
- 84Query8
- 84Query9
- 84Query10
- 84Query11
- 84Query12
- 84Query14
- 84Query15
- 84Query16
- 84Query17
- 84Query18
- 84Query19
- 84Query20
- 84Query21
- 84Query22
- 84Query23
- 84Query24

OK

Close

Click On Down Arrow to see additional Queries:

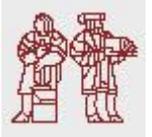
NAVICSUP
NAVAL SUPPLY SYSTEMS COMMAND
NAVAL INVENTORY CONTROL POINT
Version 1.6

NAVICP - MECH
Mechanicsburg, PA

Form View

Start Bush a... Explorin... Explorin... [02]<00... Titan ... Master ... Microso... NUM 2:50 PM

84 Query Option Screen.



Titan Database Application - [84 Query9]

File Edit View Insert Format Records Tools Window Help

Error Records For 84Query (9)

Find Specify NIIN

D046D	C003	D012	D012	D013C	B002B	B002C	CODE_BR
LLH819264	3H	P	A	Z	WA6	W1	8423
LLH819542	3H	P	A	Z	WA6	W1	8423
013938826	3H	P	F	O	WD0	W4	8423
LLH781529	3H	P	F	Z	WD4	W4	8423
LLH784092	3H	P	A	Z	WD4	W4	8423
LLH822571	3H	P	A	O	WD5	W4	8423
013818809	3H	P	A	O	WE1	W5	8423
014174011	3H	P	B	O	WE1	W5	8423
014336602	3H	P	A	O	WE1	W5	8423
014419019	3H	P	A	O	WE1	W5	8423
013493520	3H	P	B	O	WE3	W5	8423
013743526	3H	P	F	Z	WE3	W5	8423
014198896	3H	P	B	O	WE5	W5	8423
LLH783405	3H	P	A	Z	WF5	W6	8423
LLH783483	3H	P	A	Z	WF5	W6	8423
014321296	3H	P	F	O	WT2	RP	8423
009437271	3H	P	B	O	WVC	RP	8451
010268127	3H	P	A	O	WVC	RP	8451

Total Records: 68

Use the (Page Down) and (Page UP) keys to see additional Records.

Print Screen

Close

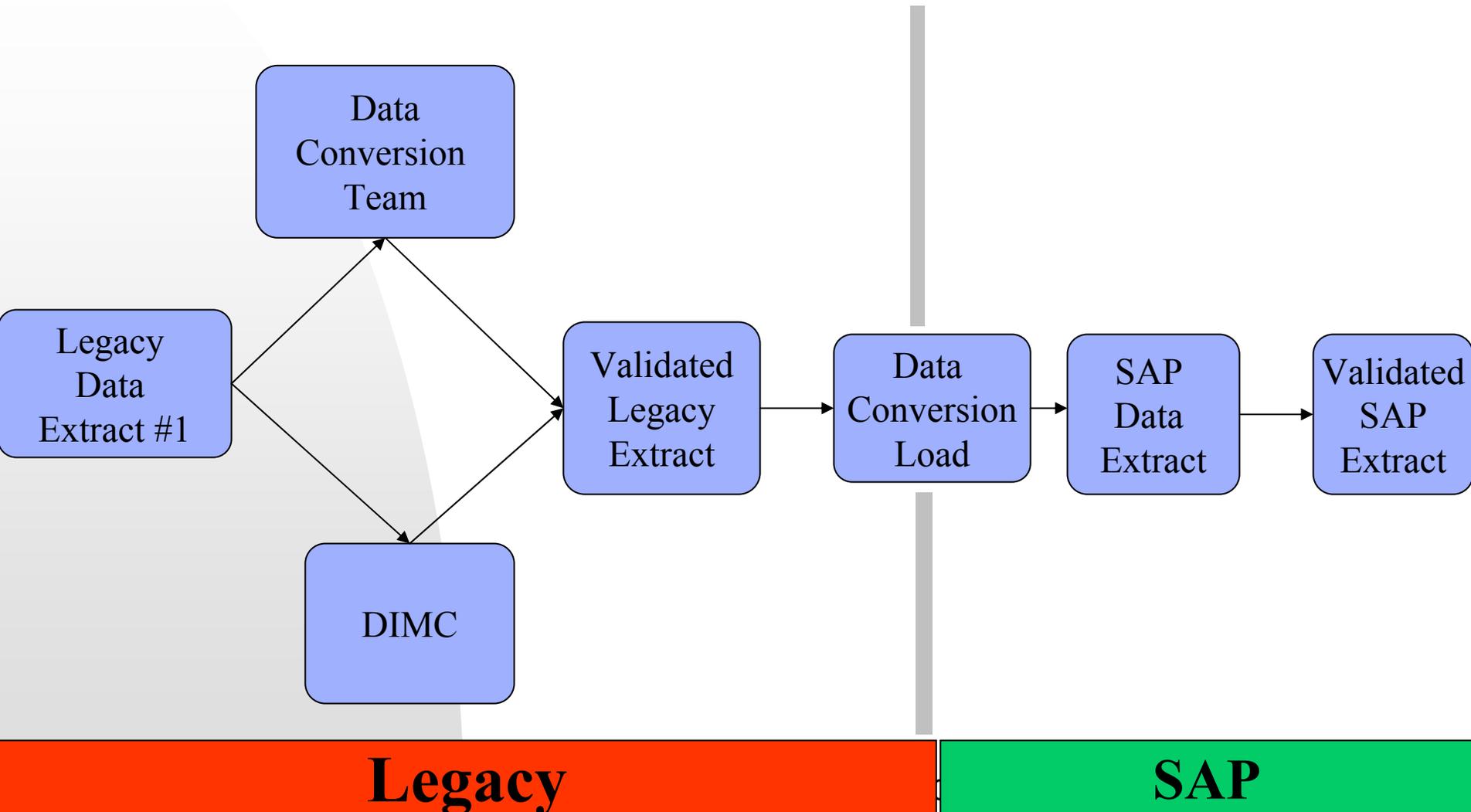
Form View

Start Bush ap... Explorin... Explorin... [03]<04:... Titan ... Master ... Microsof... NUM 2:51 PM

View Error Records for code 84 Query 9.



Data Validation Flow Model





DIMC DATA VALIDATION REPORT

VALIDATION REPORT NUMBER:	VC152-001
CONVERSION:	C152
PROCESS:	RTAT

SECTION I: STATISTICAL REVIEW

	LEGACY	SAP	RESULTS
# of Evaluated Records:	23074	15588	
# of Record Matches:			13923
# of missing Records:			9155
# of unidentified new records created by conversion:			1727
# of unmatched G conditions:			11
# of unmatched RTAT values:			62
# of duplicate DOC & SEQ values:	60	2	
# of unique DOP/Vendor no.:	33	6	
# of unique G conditions:	10	10	
# of unique QTY:	3	2	

SECTION II: ELECTRONIC FILES

	Table Name in Access	Query Name
A: # of unidentified new records created by conversions:	SAP no match to Legacy	
B: # of unmatched G conditions:		G not equal
C: # of unmatched RTAT values:		RTAT not equal
D: # of duplicate DOC & SEQ values:	duplicate DOCSEQ	

SECTION III: RECOMMENDATIONS AND CONCLUSIONS

See Word Document



7th International Conference on Information Quality (IQ-2002)



Category	Finding	SAP Impact	Recommendation
Add Ref'ing Repairables	CAGE and Part Numbers of an alternate source or new iteration of repairables are listed under one NSN.	<ul style="list-style-type: none"> ■When multiple procurable Reference Numbers of various manufacturers are assigned to the same MMR, all logistics elements could be adversely impacted. ■Valuation of inventory, configuration management and asset tracking may be incorrect 	<p>Isolate all current occurrences of the problem.</p> <p>Perform the provisioning process to ensure National Stock Numbers are assigned for each procurable Reference Number.</p>
Unit of Measure/ Unit of Issue	<ul style="list-style-type: none"> ■Missing Unit of Issue or Unit of Measure Values ■Items with invalid Unit of Issue or Unit of Measure values. 	<ul style="list-style-type: none"> ■The Base Unit of Measure (BUM) is the basis for inventory evaluation and management in SAP. ■ Affects Inventory Management, which is directly linked to MRP (safety stock, reorder level, availability check), Accounting (price and general ledger), Purchasing (over or under-delivery tolerances, order unit), Invoice Verification (payments to vendors), Sales and Distribution (sales orders), and Plant Maintenance (work orders). 	<ul style="list-style-type: none"> ■For Navy managed items, review and assign correct Unit of Measure and Unit of Issue and ancillary DENs. ■For DLA managed items, forward the NSN's to FLIS to extract the correct data and overlay the incorrect data in the legacy system. <p>SMART has aligned with NEMAIS and BSM to use legacy value Unit of Measure versus Unit of Issue</p>
Quantity Per Application	<ul style="list-style-type: none"> ■Pseudo-quantities in the Quantity per Application Field ■Items with a zero quantity loaded in the Quantity per Application field ■Quantities greater than 1,000 loaded in the Quantity per Application field 	<ul style="list-style-type: none"> ■Adversely affects many aspects of Material Management including creation of Bill of Materials , Equipment Master, purchasing info records, physical inventory management, inventory balances on financial statements, planning and forecasting, and warehouse management. 	<ul style="list-style-type: none"> ■Review pseudo values and replace with a finite value ■Review zero quantities and determine correct quantity ■Verify that large quantities correct as required
SM & R Codes	<ul style="list-style-type: none"> ■Depot-level repairable Recoverability Codes with a 9-cog ■Consumable Recoverability Codes with a 7-cog ■Source Code of X* with an assigned NSN ■Invalid Service Option codes 	<ul style="list-style-type: none"> ■Adversely affects the entire Material Management process in SAP, BOM creation and maintenance, Procurement, inventory valuation, stock transports, and warehouse management. 	<ul style="list-style-type: none"> ■Identify all incorrect SM&R assignments. Team with the technical community to correct SM&R assignments and load corrected values to the legacy data base.



Step 2: Add a Center Line and Control Limits to the time-series plot

$$Centerline(CL) = \hat{p} = \text{average of } p's$$

$$UpperControlLimit(UCL) = CL + 3s = \hat{p} + 3\sqrt{\hat{p}(1-\hat{p})/n}$$

$$LowerControlLimit(LCL) = CL - 3s = \hat{p} - 3\sqrt{\hat{p}(1-\hat{p})/n}$$

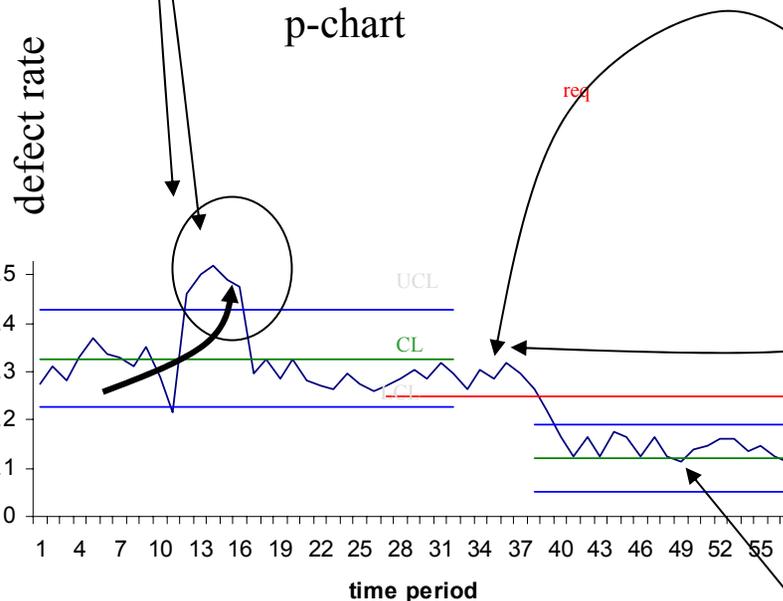
Step 1: Develop a time series plot of the defect rate.

- Use historical data
- Add points in real-time

Step 3: Determine if underlying mechanism is in control.

- If not, find and eliminate special causes.
- Repeat this every time a new point is added

Steps in Creating and Using a p-chart



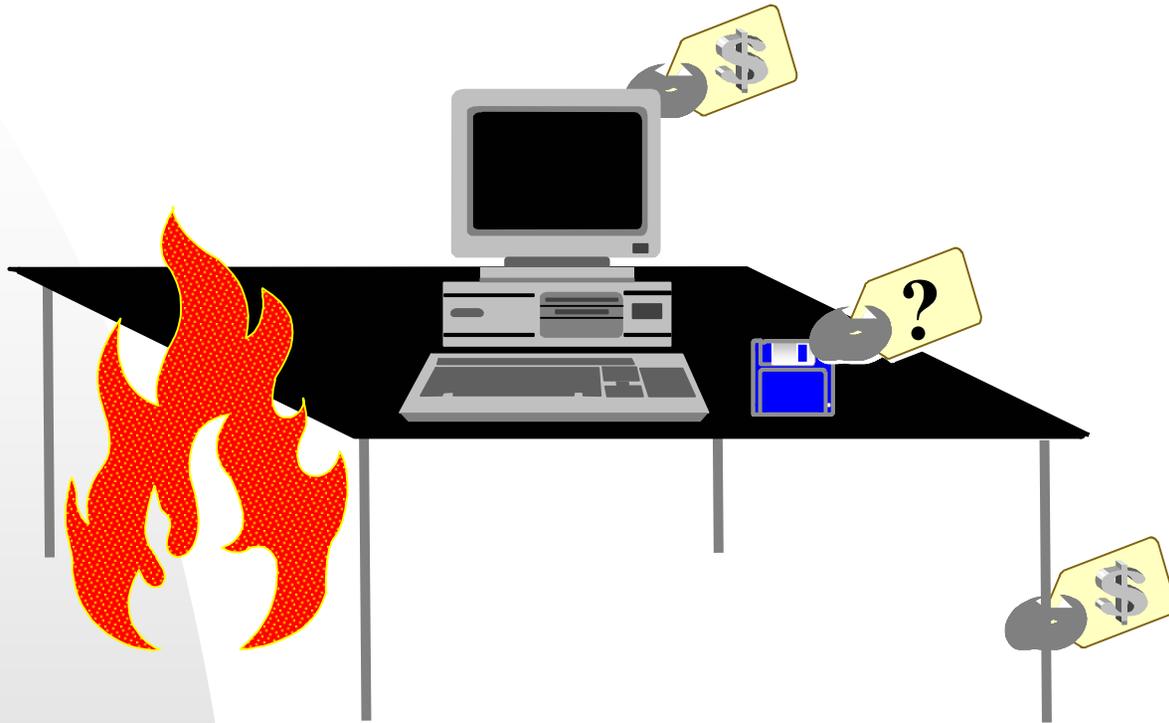
Step 4: Once control is established, add the customer requirements line to the plot.

- Compare performance with requirements.
- Conduct improvement projects as needed.

Step 5: Re-establish control (repeat steps 1-3)



The Value of Information



What is worth saving? What is the hardest/most costly to replace? Is it the table, the computer, or the information in the computer?



Corporate Balance Sheet

Assets

- Sales
- Royalties
- Information Quality
- Lost referrals recovery \$1.1M/mo
- DLA 339 processing \$80K/mo

Liabilities

- Information Technology
- Salaries
- Information Quality
- IQ operating expenses < \$1.1M/yr

The rules of corporate are universal... either make or save money to be a benefit to the business plan.

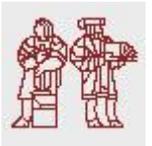


What do you need to take away!

- Information is a non-consumable corporate resource.
- Put the right skill mix on the correct level of issue.
- Information Quality is a much bigger issue than Data Quality.
- Change management is key to the success of any IQ challenge
- Marketing and Risk management skills are crucial.



7th International Conference on Information Quality (IQ-2002)



For our customers, quality information is a matter of life or death ... success or failure... literally!



References

- [1] Adelman, S., Moss, L.T.; *Project Management... Warehouse.*
- [2] Aiken, P., *Slaying the Legacy Dragon and various discussions.*
- [3] Davidson, Bruce N., *Various discussion on organizational job descriptions.*
- [4] Dobbs, S., Orr, L.; *Information Quality at the NAVICP.*
- [5] English, Larry; *Improving Data Warehouse and Business Information Quality.*
- [6] Huang, K.T., Wang, Y.W., Lee, R.Y.; *Quality Information and Knowledge.*
- [7] Loshin, D.; *Enterprise Knowledge Management.*
- [8] McGilvray, D.; Presentation at IQ2002 Denver, Colorado. *Information Quality in an Integrated World.*
- [9] Redman, Thomas C.; *Data Quality: The Field Guide.*
- [10] Office of Management and Budget, Executive Office of the President, www.OMB.gov