Success Stories for Data Analytics and Visualization

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Background

- ASI presented previous RAM Engineering projects:
  - Reliability-Centered Maintenance (RCM) Analysis
  - Supportability Optimization Model (SOM)
  - Weibull (Life Data) analysis
  - Reliability Block Diagrams (RBDs) to predict spares procurements

- RAM projects involved numerous types of physical assets:
  - Aircraft (Fixed Wing, Helicopters, UAVs)
  - Ground Vehicles (BFV, FMTV, LVSR)
  - Facilities (Data centers, Hospitals)
  - Mining Equipment (Scalers, Elevators, Conveyors)
  - Other equipment (Engines, Tug Boats, S.E.)

Background

- ASI tasked with utilizing Data Analytics and Visualization tools to:
  - Develop Depot and Intermediate Level Metrics of Effectiveness specific to component repair in support of Navair fleet readiness
  - Include the ability to perform Root Cause Analysis
  - Integrate and organize various data sources and elements into a one-stop-shop for stakeholders
  - Develop Dashboards to identify areas for improvements in repair effectiveness and efficiency
- Dashboards were developed to calculate and visualize key metrics:
  - Induction/Production Performance
  - Adherence to Workload Standards
  - Work in Progress snapshots
  - Retail Health

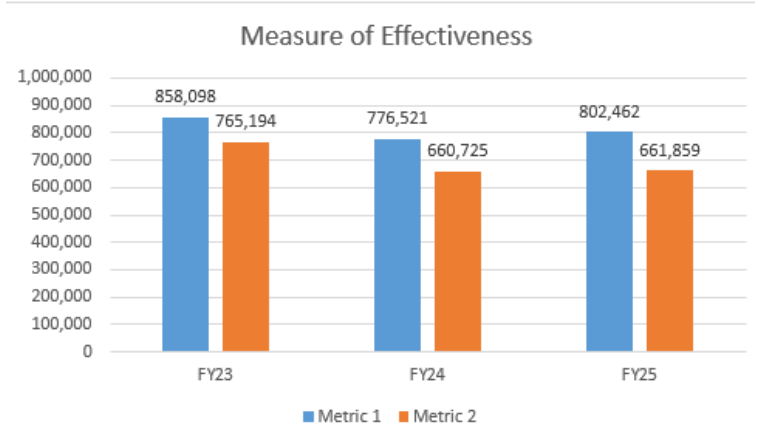
3

Background

- Data Analytics help to build the foundations of a story
  - Transforms what you see on the floor into building blocks that lead to actionable items
  - Organizes and connects different elements of the story for a holistic view
  - Reveals metrics and trends that would otherwise be lost in a sea of information
- Visualizations help to communicate the story
  - All stakeholders can easily derive useful information efficiently
  - Ease of reporting up and down the command chain
  - Dynamic visualizations empower stakeholders to perform their own root cause analysis

FY	Metric 1	Metric 2
FY23	858,098	765,194
FY24	776,521	660,725
FY25	802,462	661,859

VS



Data Analytics Languages

- Choosing the best language is dependent on the application
  - Structured Query Language (SQL)
    - Useful for querying, managing, and transforming simple data across relational databases
    - Easier to learn and straightforward
  - Python/Anaconda
    - Flexible and customizable, but slow runtime
    - Better for general purpose programming
  - R
    - Can be used as a combined analytics and visualization tool
    - Mostly used for statistical computing and data science
  - Java, JavaScript, C/C++, MATLAB, etc.

Visualization Applications- Tableau

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Delay Desc	WO Qty	Qty Late	Avg Days IP	Avg Days in Opn
Queue	1,093	1,061	226	83
Material	540	497	388	160
Capacity Issue	415	411	419	124
Routed Parts	401	376	476	253
Facilities	196	196	263	80
Engineering REI_TEI	180	177	399	91
Awtng Equipment	142	141	640	81
Man-Power	120	109	219	54
PQDR	93	93	460	213
Additional Processing	87	86	910	108
Misc Dly	68	67	327	131
Pending MMR Creati..	53	50	426	121
BER	50	49	427	84

Delay	Delay Desc	Delay %	Avg. Status Days
	Queue	43%	42.03
234	Material	17%	16.52
235	Routed parts	14%	13.33
231	Manpower	6%	5.39
232	Engineering/Technical	5%	4.97
286	Equipment	3%	2.73
241	Additional processing	2%	1.98
265	E&E	2%	1.78
267	Misc. Delay	2%	1.48
238	BER	1%	1.36
264	MMR Creation	1%	0.98
285	Facilities	1%	0.88
284	SDR	1%	0.55

6

Visualization Applications- Qlik Sense

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Daily Component Summary as of: 10/6/2022

FRC | RShop | FIC | IIC | Customer | Workload Type Cd

Non-FE
FE
All Workload

NAVSUP NMCS IPG1s
14

NAVSUP IPG1s
146

NAVSUP Backorders
630

All Sites Weekly Backorder Report as of: 09-26-2022

FYTD Inductions
7,876 ▲ 8,714 FYTD Projected Inductions

Current WIP
3,911

FYTD Sales
8,383 ▲ 9,144 FYTD Projected Sales

Sold Inductions
5,333 2,469 IP Inductions

Fallout
576

Workable
1,128

Workable / In-Delay
1,243

In Delay
1,540

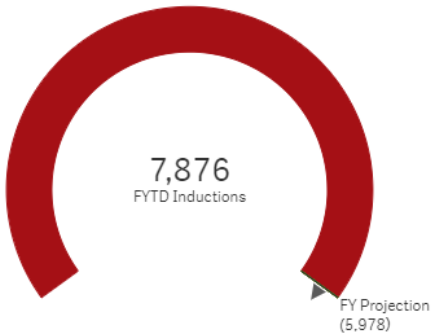
IIC's Below Projection
98 371 Quantity of WOs Below

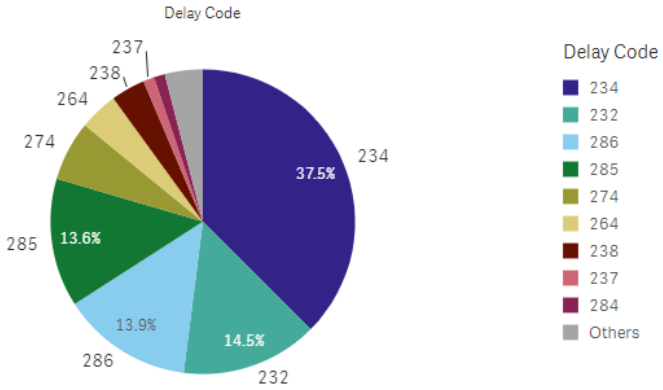
IIC's on Projection
321 333 Quantity of WOs

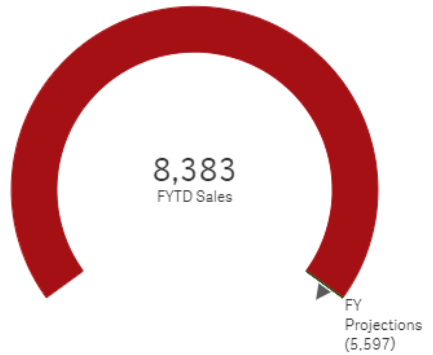
IIC's above Projection
654 7,753 Quantity of WOs Above

Charts | Details | Workable / In-Delay Details

WIP Delays







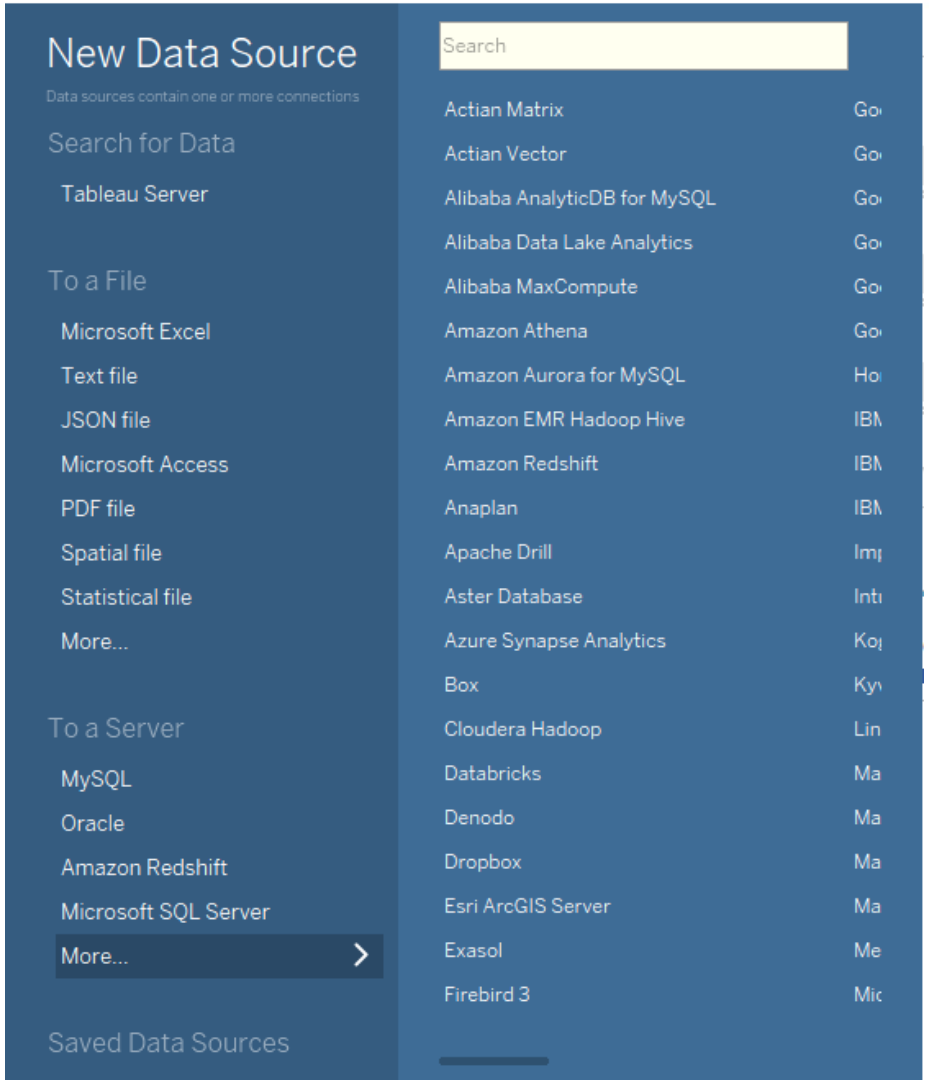
7

Visualization Applications

- Applications allow a central location for all stakeholders to connect to
- All developers can access the same raw data
  - Regular dashboard updates can be automated with direct connection to a data source
- Embedded filters allow drill down capabilities for the user
- Visualization applications have some data analytics proficiency, but not as robust as back-end apps
  - Finding a balance between back-end and front-end development is key for data processing efficiency and flexibility
- Other apps are emerging and growing as the need for Business Intelligence (BI) increases
  - Microsoft Power BI, Excel, Sisense, SAP Business Objects, etc.

Inputs and Data Sourcing

- Navair data is spread through several data repositories
  - Deckplate, BOE, CNAF, etc.
  - The DataVis Tableau server is maintained with regularly updated data that developers can connect to
  - Qlik Sense has the ability to connect to Tableau
  - Tableau and other applications can also accept backend code/applications

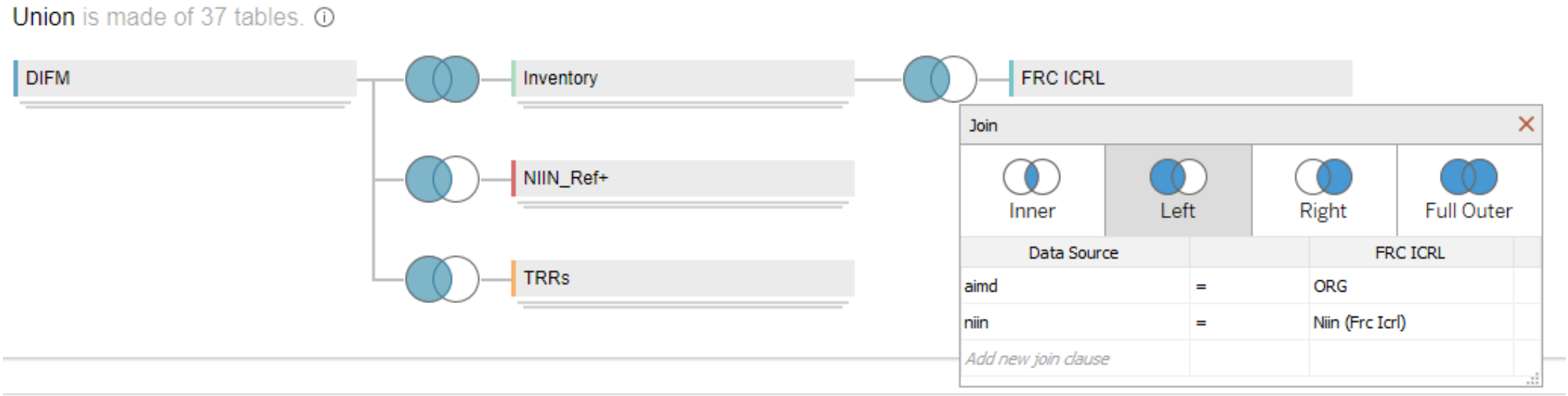


9

Inputs and Data Sourcing

➢Unions, Joins, and Data Blending

- The wide array of data sources from Navair necessitate unions and joins
- Focus on joining the correct columns is imperative. Know and understand the data!



Inputs and Data Sourcing- Tableau Prep

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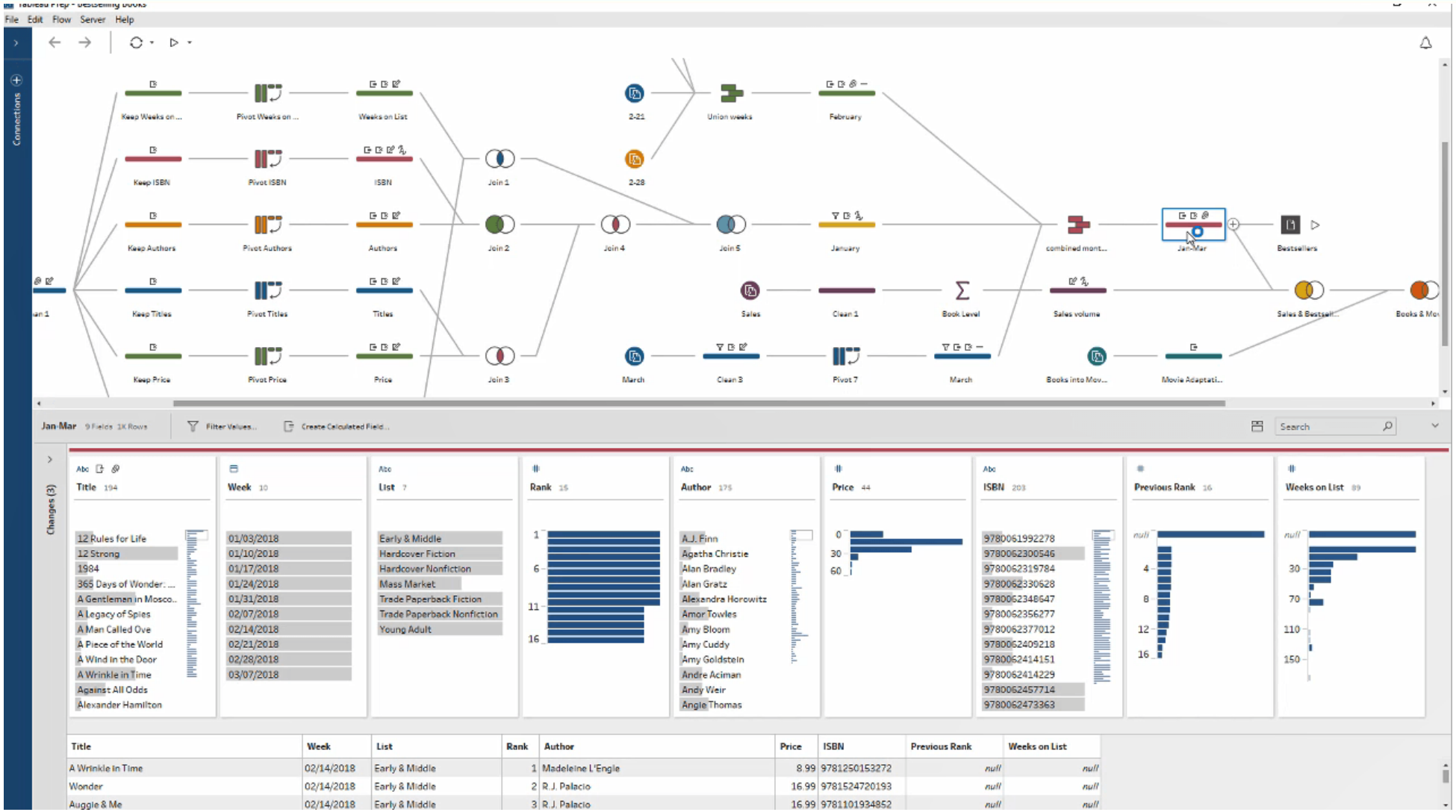
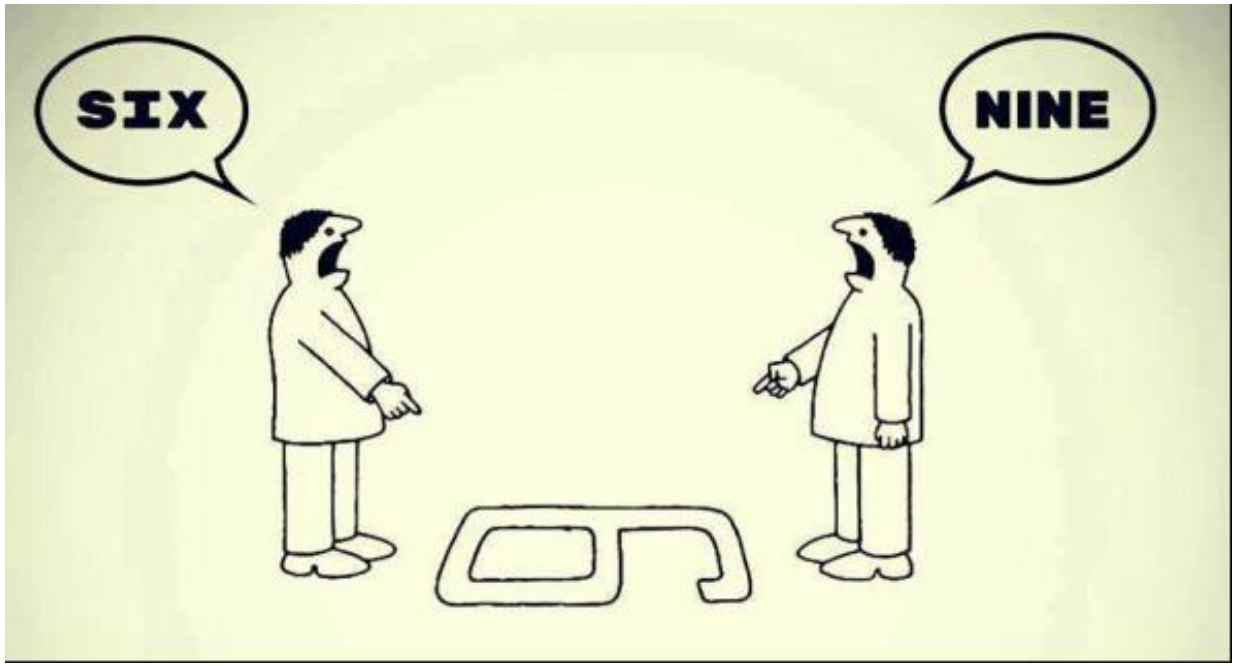


11

Measures of Success Approval Process

Metrics mean different things to different people!



Analytics and visualization are only beneficial if they are useful to the stakeholder.

Communication is critical!

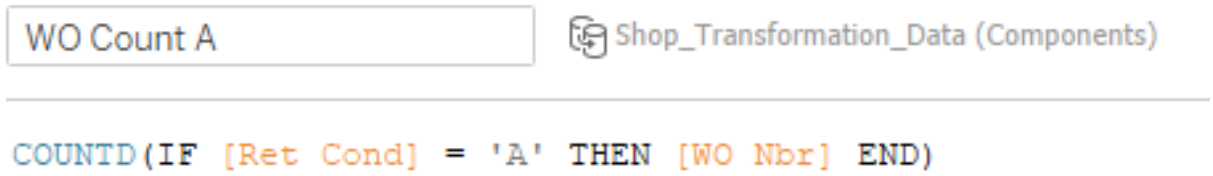
Measures of Success Approval Process

- Example: What is Production to Plan?
  - Is it what you produce compared to what you planned to produce?
  - Is a scrapped item a production?
  - Which customers are included? Workload types?
  - Do we count over production for a specific part?
  - How are interchangeable parts reflected?
  - Do scrapped items affect induction to plan? How does the metric affect other metrics?

- As metrics evolve, a monthly meeting with voting members decides what assumptions are included in the metrics, how the metric is calculated, etc.
- Agreed upon metrics are submitted for documentation and official approval.

Data Analytics Within Visualization

- Calculations are developed within the Visualization application via code and the developer's user interface.



- Calculations can be done on the backend, but it's much less flexible to inevitable changes.
- Parameters can act as global variables within calculations.
- The calculations become the mortar to the building blocks (raw data) of the houses (visualizations).
  - The houses become part of the story!

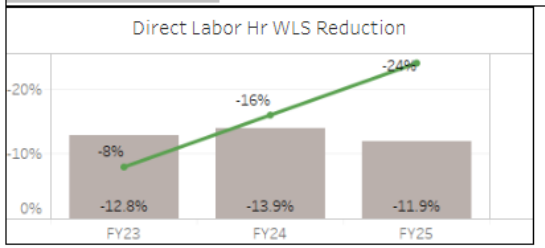
WLS Reduction Dashboard

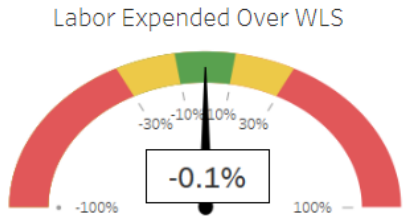
Data Updated: 8/27/2023

Site: All | Tech Class: All | IWST: (Multiple ... | Niin: (Multipl...

Download WLS Data

Direct Hrs WLS Reduction





Market Basket: Common

Cumulative Progress

	Total	FRCE	FRCSE	FRCSW
YTD Status	-13.0%	-21.4%	-10.7%	-12.1%
Savings	$4,920,490	$1,053,291	$921,845	$2,945,353

Projections

	FY23	FY24	FY25
Direct Hr Change Goal	-8%	-16%	-24%
Direct Hrs Std	-12.8%	-13.9%	-11.9%
Avg. Direct Hr WLS	37.5	47.9	49.0
ABP	$5,171,472	$8,758,515	$7,960,636
Component Unit Price (CUP)	-0.7%	-9.6%	-8.0%
Avg. CUP Price	$19,496	$25,413	$25,484
ABP	$454,591	$21,291,226	$20,488,541
Support Hr Std	-4.0%	13.4%	14.6%
Avg. Support Hr WLS	12.4	15.8	16.2
ABP	$437,164	-$2,012,665	-$2,377,251
Material Std	-0.9%	-25.8%	-25.2%
Avg. Material WLS	$11,236	$14,680	$14,511
ABP	$580,040	$25,051,443	$26,168,756
Stabalized Rate	11.6%	13.1%	13.1%
Avg. Stabalized Rate	$166	$168	$168
ABP	-$5,734,086	-$10,506,067	-$11,263,599
Number of Inductions	5,721	6,915	8,558

*FY23 Projections based on actual to date and remaining I2P Plan

Top NIIN Drivers

Descending

NIIN	FRC	Inductions FYTD	New Inductions	FY22 DH WLS	FY23 DH WLS	Hrs Change	YTD Hrs Change
014086637	FRC SW	6	0	287	365	0	464
014652501	FRC SW	42	0	27	35	0	317
015288338	FRC SW	2	0	680	828	0	297
014456380	FRC SW	3	0	104	193	0	267
011589694	FRC SW	24	1	27	37	11	262
	FRC SE	14	0	30	30	0	0
014476080	FRC SW	4	0	69	133	0	256
	FRC SE	1	0	54	32	0	-23
014559797	FRC SW	3	0	259	331	0	216
015288339	FRC SW	6	0	792	828	0	216

Work Order Details

WO Nbr	FRC	NIIN	Date Act Ind	Return Cond	FY22 DH WLS	FY23 DH WLS	Hrs Change	WLS Change
55347338	FRC SW	014086637	10/20/2022	A	287	365	0	77
55381140	FRC SW	014086637	12/1/2022	A	287	365	0	77
55472648	FRC SW	014086637	1/25/2023	IP	287	365	0	77
55472751	FRC SW	014086637	2/15/2023	IP	287	365	0	77
55680473	FRC SW	014086637	4/19/2023	IP	287	365	0	77
55680948	FRC SW	014086637	5/22/2023	IP	287	365	0	77
55586331	FRC SW	014652501	3/21/2023	IP	27	35	0	8
55586334	FRC SW	014652501	3/21/2023	A	27	35	0	8
55586336	FRC SW	014652501	3/6/2023	A	27	35	0	8
55586337	FRC SW	014652501	3/10/2023	A	27	35	0	8

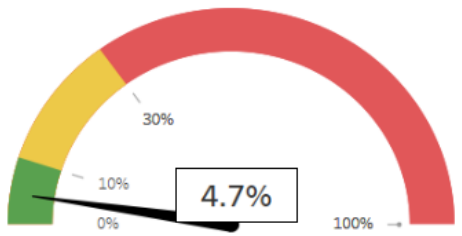
D-Level Direct Labor Hrs Expended on Scrap

Data Updated 8/27/2023

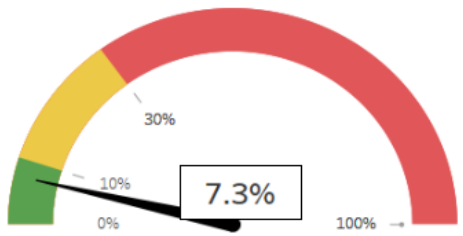
By FY Inducted
By FY Completed

FRC: All | Tech Class: All | IWST: (Multiple values) | Niin: (Multiple values)

% Direct Labor Hrs Expended on Scrap



Scrap Rate

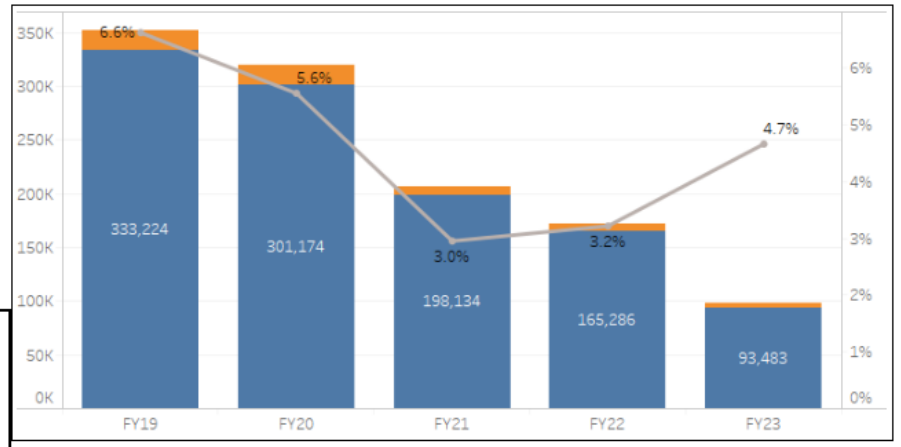


Total Hrs Expended on Scrap	4,652	Total Cost Expended on Scrap	$766,325

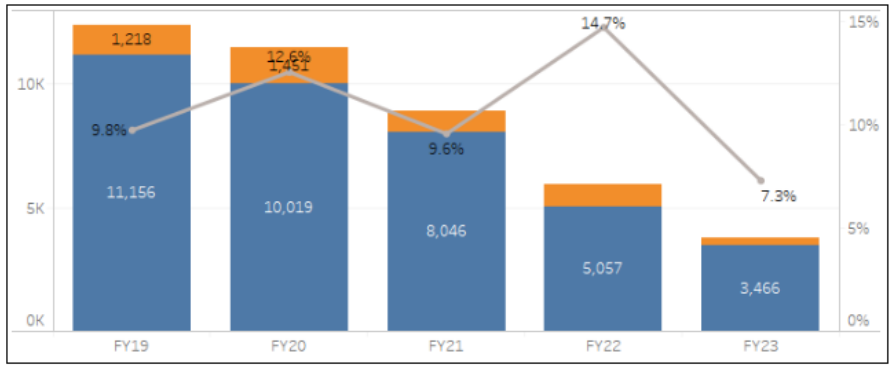
NIIN	FRC	FIC	IIC	WS	Scrap Rate	Scrap Hours	Total Cost
014467874	FRC SE	JWVB	WCL0	FE	63.4%	773.0	$136,435
	FRC SW	JWVB	WCL0	C07	20.0%	331.3	$52,351
012204432	FRC SW	ECXB	RQS4	F1	66.7%	212.8	$33,623
015221435	FRC SE	BM6B	XV06	FE	6.9%	187.5	$33,085
012489207	FRC SW	DQRB	R114	F1	33.3%	175.8	$27,776
014063444	FRC SW	JXNB	VRF3	F1	66.7%	167.6	$26,480
013513373	FRC SW	HF2B	T3D2	F1	62.5%	148.8	$23,516
000049856	FRC SW	JTR4	JTR4	F2	27.3%	141.5	$22,363
001674369	FRC SW	KLB1	KLB1	F1	35.7%	139.3	$22,007
013148546	FRC SW	ZCIB	STB7	C07	57.1%	126.6	$20,000
000049870	FRC SW	JTR6	JTR6	F2	50.0%	119.4	$18,870
013087877	FRC SW	SV71	SV71	C07	100.0%	115.8	$18,293
011435706	FRC SW	P624	P624	F1	100.0%	106.8	$16,871
008721731	FRC SW	D3F7	D3F7	F1	50.0%	74.0	$11,695
011677482	FRC SE	QSN7	QSN7	C02	28.6%	54.3	$9,575
013093807	FRC SE	SWR8	SWR8	FE	16.7%	49.5	$8,737
012281571	FRC SW	HDUB	RWP2	C07	16.7%	54.0	$8,534

*Metrics are based on closed WOs and aggregated by FY.

Scrap Hours - *5 Year Trend*



Scrap Rate - *5 Year Trend*



Beyond Economic Repair (BER) Request Summary

Site: (Multiple values)

Performance to Plan (P2P)

BER Cost

$7,279,124

Original CUP Cost

$14,576,014

Scrap Cost

$1,769,935

Decision TAT

68%

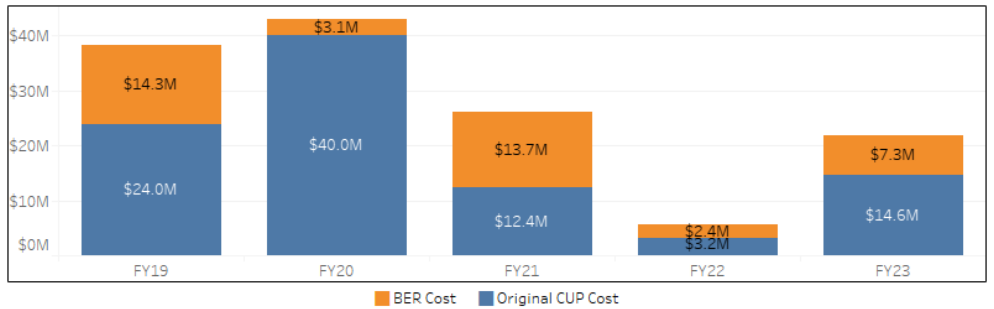
Goal: 90% ≤ 5 work days

Funding TAT

60%

Goal: 90% ≤ 14 work days

5 Year Trend



BER Requests

469

Funded	274	%	58.4%
Scrapped	186	%	39.7%
Cancelled	6	%	1.3%
In-Work	3	%	0.6%

BER by NIIN

Niin	Nomenclature	FIC	IIC	Site	Inductions	# of BER Requests	# of BER Approvals	Approval %	BER Cost
004948606	STRUT ASSEMBLY,RIGH	JAX1	JAX1	FRC SW	0	3	3	100.0%	$999,292
014871910	FUEL CONTROL,MAIN,T	GUQB	XDL3	FRC SE	25	10	10	100.0%	$814,654
014865747	FUEL CONTROL,MAIN,T	B72B	XCV4	FRC SE	58	12	12	100.0%	$537,792
004798749	SHOCK STRUT ASSY,LA	JAX0	JAX0	FRC SW	0	2	2	100.0%	$531,779
000030392	DRAG BRACE,LANDING	JAX4	JAX4	FRC SW	8	2	2	100.0%	$415,209
012132229	LANDING GEAR,RETRAC	RKY1	RKY1	FRC SW	0	1	1	100.0%	$391,456

Sample Dashboards

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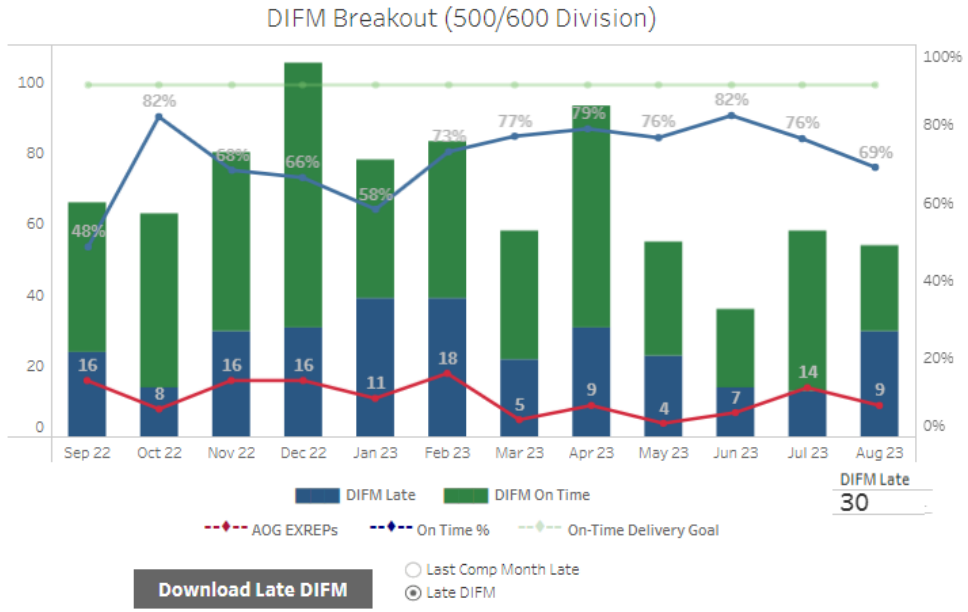
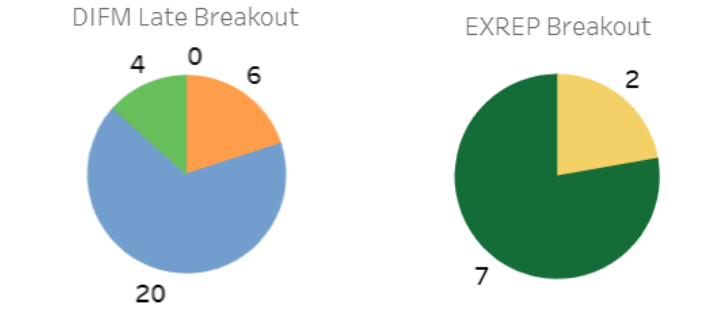
Retail Health:





Org Code

TMS

Tec
(All)

Niin
(All)

*AWM/IW: IW, M3, M8

AWM Other: All other JS starting with M, CT

Administrative delay: A1, JC, RJ, DD

Org	S1 Time 500 Div (Current)	S1 Time 600 Div (Current)	S1 Time 500 Div (12 Mo)	S1 Time 600 Div (12 Mo)
	0.0	0.0	0.4	0.1

Org	SOIOU
P9R	9

Late DIFM/Comp as of Aug 24, '23:

Org	Wc	HOF NIIN	Nomenclature	JobStatus	Mgmt_Cd	Mcn	Jcn	TRR	S1	DIFM Days	wpurp_faq	so_iou_qty	Member NIIN Allowances
	65B	016800624	DISPLAY UNIT FLIGHT	M9	SO	P9RM5BA	Q73202713	20	0	34	0	0	
	65B	016815620	AUDIO COMPUTER	WQ	ER	P9RM4ZE	QQ0165376	20	0	42	0	0	
	65B	016815863	COMPUTER SYSTEM\ SPECIAL	IW	SO	P9RM5JR	Q62175250	20	0	30	0	0	
	65B	016815863	COMPUTER SYSTEM\ SPECIAL	WQ	SO	P9RM4DK	Q70179364	20	0	56	0	0	
	65B	016815999	DISPLAY UNIT\ FLIGHT INF	M5	ER	P9RM5GM	QQ0179099	20	0	31	4	0	
	65B	016815999	DISPLAY UNIT\ FLIGHT INF	M9	ER	P9RM5ZT	BF1040196	20	0	21	4	0	
	65B	016906123	COMPUTER\ DIGITAL	WQ	SO	P9RM5TX	Q73173461	20	0	24	11	0	
	520	011783292	BRAKE\ MULTIPLE DISK	M3	SO	P9RM5VZ	BF1122A38	20	0	23	46	0	
	520	013163747	TUBE ASSEMBLY\ METAL	M3	ER	P9RM4Y4	QQ0158177	20	0	43	22	0	
	520	013163747	TUBE ASSEMBLY\ METAL	M3	SO	P9RM5PG	Q71207303	20	0	27	22	0	

Org	HOF NIIN	Niin	Nomenclature	Member NIIN Allowances
	016815620	015685082	AUDIO COMPUTER	0
		015982109	AUDIO COMPUTER	0
		016271691	AUDIO COMPUTER	0

18

Sample Dashboards

Organic Component Dashboard- FY22 Component Schedule

Data last updated: 09/30/2022

NIIN: CUP:
FIC: LRC:
Site: IWST:

FRC Asset Info

WIP	3,505	Sched TAT	22
Avg WIP Age	723	Avg TAT	82
F at Site	7,551	ERP RTAT	64
FRC Scrap/Rate	442 3%	G at Site	0

Site: (Multiple values) | Customer: (All)
Niin: (All) | WL Type: (Multiple values)
FIC: (All) | IWST: (All)
IIC: (All) | Tech Class: (All)
RShop: (All)

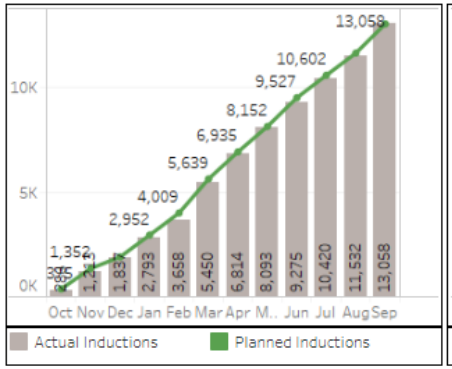
Target RTAT: Scheduled ECDs / ERP RTAT
Buffer: 15
RWR NIIN Selection: RWR NIINs Only / All NIINs
RWR Scheduled Adds: 117

8-Qtr Forecast	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
	3,491	4,503	4,559	4,574	3,285	3,272	3,100	3,271

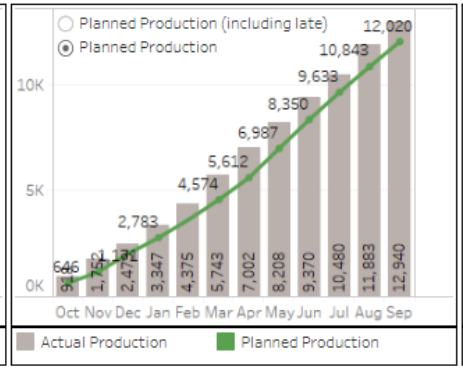
Schedule by Fiscal Year

FY Ind	Ind	Comp	WIP	Qty Late	Avg RTAT	On Time	Scrap
2022	13,353	77%	3,080	3,071	45	78%	2%
2021	12,943	98%	313	313	83	63%	3%
2020	14,933	100%	69	69	78	65%	4%
2019	14,967	100%	23	23	66	74%	5%
2018	14,568	100%	8	8	63	76%	5%
2017	13,034	100%	8	8	68	75%	5%
2016	7,777	100%	4	4	65	75%	4%
2015	4,403	100%	0	0	64	81%	2%
2014	4,616	100%	0	0	68	81%	2%
2013	4,240	100%	0	0	66	80%	2%

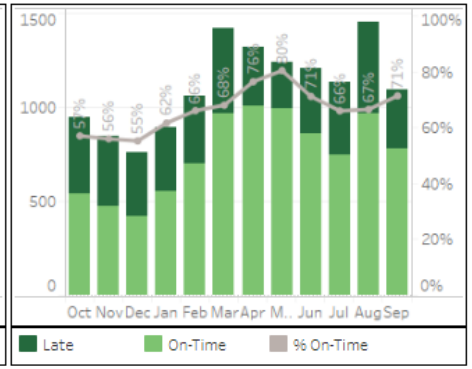
Inductions to Plan (I2P) 102%



Production to Plan (P2P) 108%



On-Time Delivery 67%



Work In Process (WIP)

Qty On Time | Qty Late | No Backorders | NMCS UCOs | UCOs

Select Risk: (All)

Current WIP
3,505
Overdue WIP
3,496

Niin	Nomenclature	Site	TMS	WIP
010121938	NAVIGATION SET,TACT	FRCSW	Common	184
013647174	Null	FRCSE	Null	124
014708683	ELECTRONIC COMPON..	FRCSW	FA-18 EFG	101
013024410	CONTROL,ELECTRIC LI	FRCSW	FA-18 AD	92
015452661	CIRCUIT CARD ASSEMB	FRCSW	FA-18 EFG	90
015728827	SUPPORT,TURBINE CO..	FRCSE	Engines	88
014873454	ROTOR,TURBINE,AIRCR	FRCSE	Engines	82
010999690	Null	FRCSE	Null	81

WIP Status

Delay Desc	WO Qty	Qty Late	Avg Days IP	Avg Days in Opn
Queue	1,699	1,699	116	64
PBL Material Delay	574	574	145	85
Routed Parts	375	375	161	113
Capacity Issue	311	307	140	45
Material	115	115	313	104
HAZMAT Material	61	61	105	62
Awtng Equipment	60	60	546	53
Man-Power	50	49	51	21
Facilities	50	50	223	49
Outside Vendor	49	49	393	182

% Workable 66%

Trended Delay Data

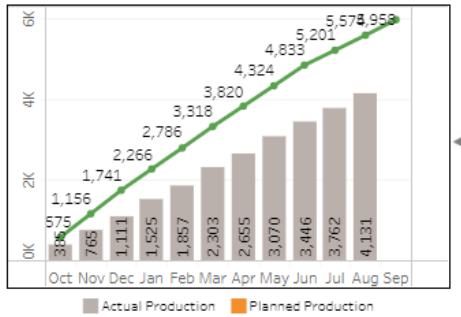
Delay	Delay Desc	Delay %	Avg. Status Days
	Queue	60%	40.93
235	Routed parts	15%	10.10
224	Partner material	11%	7.30
231	Manpower	4%	2.43
234	Material	3%	1.92
286	Equipment	2%	1.28
285	Facilities	2%	1.09
232	Engineering/Technical	1%	0.68
218	Storage	1%	0.42
225	Outside vendor	1%	0.35

19

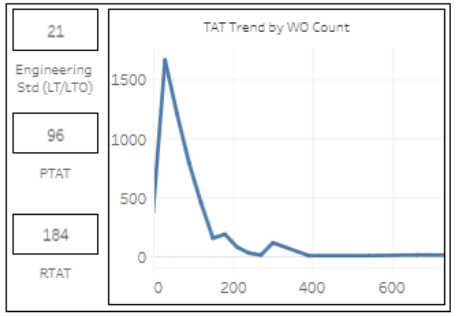
Work Order Effectiveness Drilldown Dashboard

FRC
WL Type
Niin (All)
FIC (All)
IIC (All)

Production to Plan (P2P) 79%



Repair Turnaround Times



Work Order Effectiveness

- Manpower 60%
- Supply 54%
- Infrastructure 90%
- Engineering 87%

Goal: 90% of work orders wait ≤ 3 days for a logistic element.

Manpower

- Capacity Constraint 68.8%
- Manpower 85.7%
- Frozen/WIP Pull 100.0%

Infrastructure

- Facilities 96.3%
- Equipment 93.4%
- Tools 99.8%

Material

- Partner Material 99.9%
- Squadron Exchange 100.0%
- Material 61.8%
- Routed Parts 89.0%
- Pending G Condition 97.5%
- PEB Material 99.6%
- HAZMAT 99.5%
- Manufacturing 100.0%
- MMR Creation 96.0%
- Outside Indirect Material 100.0%

***Green**: ≥ 90% of work orders*
***Yellow**: ≥ 80% of work orders*
***Red**: < 80% of work orders*

Production Delay Dashboard

Objective: Enable on-time delivery of component production by identifying and mitigating the root cause drivers of production delays responsible for missed on-time delivery. Data current through 8/27/2023.

FRC On-Time Delivery | On-Target HOFNIINs: 100 of 213

Metric	FYTD	Target
On-Time Delivery	71%	90%

Top Degraders to On-Time Delivery

Rank ..	Site	HOFNIIN	Nomenclature	Prod to Req	OTD	Gap to Req.	NMCS Impact*
1	FRCSE	011794064	CONVERTER, LIQUID OX	5	13%	34	0.26
2	FRCSE	011520879	ACTUATOR,EL..	16	36%	28	0.00
3	FRCSE	011240903	ACTUATOR ASSEMBLY	8	23%	27	0.00
4	FRCSE	011544774	HEAT EXCHANGER,F..	0	0%	25	0.00
5	FRCSE	014871910	FUEL CONTROL, MAIN,T	16	39%	25	0.00

Work In Process (WIP)

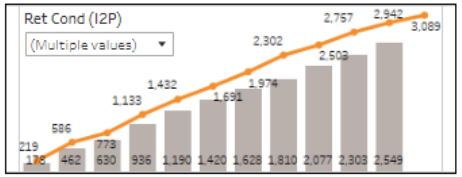
WO Nbr	Niin	Nomenclature	FIC	IIC	FRC	RShop	IWST	PTAT	Days IP	Delay Time
31038899	004646297	DETECTOR ASSEMBLY	9GJ5	9GJ5	FRC ..	62322	P-3		3,769	0
31139178	014855868	LAUNCHER,GUIDED ..	XAG7	XAG7	FRC ..	62328	FA-18 AD	90	3,632	2,277
31270290	014855868	LAUNCHER,GUIDED ..	XAG7	XAG7	FRC ..	62328	FA-18 AD	90	3,398	0
31279459	012571968	RACK,BOMB EJECTO..	SB10	SB10	FRC ..	62328	Common		3,439	0
31280102	012571968	RACK,BOMB EJECTO..	SB10	SB10	FRC ..	62328	Common		3,439	0
31327331	012571968	RACK,BOMB EJECTO..	SB10	SB10	FRC ..	62328	Common		3,385	0
31327334	012571968	RACK,BOMB EJECTO..	SB10	SB10	FRC ..	62328	Common		3,358	0
31327388	014584694	LAUNCHER,GUIDED ..	WN47	WN47	FRC ..	62328	Common		3,391	0
31327395	014584694	LAUNCHER,GUIDED ..	WN47	WN47	FRC ..	62328	Common		3,351	0

*NMCS Impact: Avg NMCS A/C per month

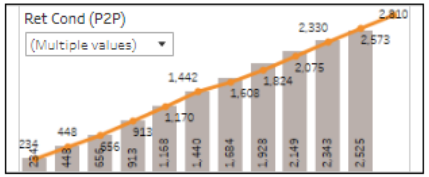
NMCS Degrader Analysis >

Root Cause Analysis

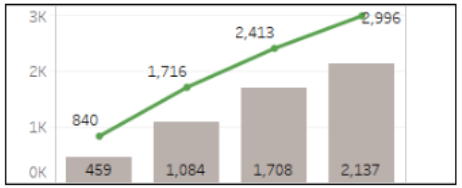
Inductions to Plan (I2P) 88%



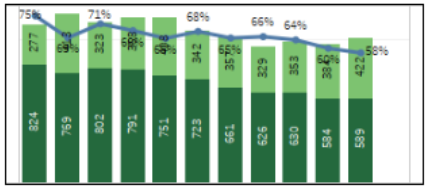
Productions to Plan (P2P) 107%



On-Time Delivery (FE) 71%



Overdue WIP 58%

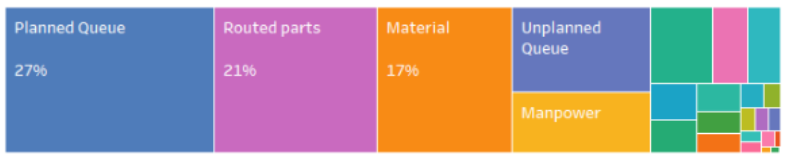


Delayed WIP 62%

Delay Desc	WO Qty	HOFNIINs Impacted	Overdue WIP	Avg Days IP	Avg Days in Opn
Routed parts	190	35	126	377	265
Material	144	39	119	517	272
Capacity Constraint	119	27	34	68	39
Equipment	43	7	32	165	55
Manpower	37	11	18	234	63
Additional processing	32	14	28	543	92
Engineering/Technic..	26	12	22	308	101
BER	15	6	13	156	88
E&E	7	3	4	338	23

WOE	69%
DLA WOE	69.6%
NAVSUP WOE	73.3%
DLA WOE Misses	4 to 30 Days 49.8% 31 to 90 Days 27.5% 90 to 180 Days 13.2% >180 Days 9.5%
NAVSUP WOE Misses	8 to 30 Days 27.3% 31 to 90 Days 13.6% 90 to 180 Da.. 9.1% >180 Days 50.0%

Production Delay Trends



FRC
RShop (All)
IWST (All)
Workload Type Cd
Tech Class (All)
Customer (All)
FIC (All)
IIC (All)
HOFNIIN (All)
Niin (All)
Target TAT Site PTAT

Realized Benefits

- Stakeholders have immediate access to snapshots of their performance and can react accordingly
- Current status and future predictions are condensed to an easily digestible format
- Drill down capabilities enables the user to perform root cause analysis efficiently and narrow their efforts towards improvement
- Negotiation with customers has become more succinct with ease of access to historical trends
- Leads to better maintenance practices and scheduling, more accurate supply availability, and predictions to prepare for operations.