Predict and Improve Support Cost and KPI for TERRIER Combat Engineer Vehicle

Presented by:

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Content

- Overview of proposed usage and support for TERRIER.
- Requirements:
  - Ministry Of Defence (MOD) - Key Performance Indicators (KPI).
  - BAES GCS-V - commercial / risk quantification.
- What is stochastic modelling?
- Why use stochastic modelling?
- Overview of some Outputs from the TERRIER Demand Satisfaction Rate Confidence (T DSR C) tool.
- Overview of how T DSR C works.
- Value added by T DSR C.

Overview of Proposed Usage and Support for TERRIER

- Fleet of 60 vehicles.
- Each vehicle modelled as an assembly of over 900 hardware articles.
- KPIs measured at a single interface.
- BAES to provide spares support for a minimum of 5 years.
- Fleet size and usage ramp up during first 2 years.
- Fixed price contract for usage up to a baseline threshold.
- Deployed for continuation training in UK, Canada and Germany.
- Spares scale for baseline usage already determined.
- There may be operational deployments to additional theatres:
  - Assumed 2 simultaneous deployments during 4th year of support.
- Additional prices for tiers of usage up to higher thresholds.

The MOD KPI Requirements

- Notes:
  - 1 - Articles are grouped into the following categories:
    - Consumable – everything that is routinely scrapped on failure.
    - Repairable – everything that may be repaired on failure, although each of these articles has a Beyond Economical Repair (BER) Rate; hence, some scrap.
  - 2 – KPIs to be measured at a single interface.

- KPI 1 - Demand Satisfaction Rate
  - Each period to be defined in blocks of 3 months.
  - Each period must have at least 40 demands.
  - Results presented for each article category.
- KPI 2 – Long Demand Satisfaction Time
  - No demands outstanding after 90 calendar days.

The BAE Systems Commercial / Risk Quantification Requirements

- If usage is increased with the baseline spares package, how will KPI values degrade?
- If usage is increased, what additional spares would be required to retain KPI values?
- With high confidence, what will be the maximum cost (spares and throughput) for each level of usage?
- How would KPIs be affected by holding some spares forward?
- What additional spares (hence, cost) would be required to retain KPIs values when some spares are held forward?
- With regard to spares availability, how long will it take to supply all spares to be deployed at the start of Operations?
- What is the likely profile of demands to be placed on suppliers over the support period?
- Even with achieved KPI targets, will there be issues that may affect company reputation?
- If there are deficiencies then what should be the remedies?

What is Stochastic Modelling?

- Deterministic models use a single value for a piece of input data; eg, time to return a failed article.

- Stochastic models (or Monte Carlo simulation) use:
  - A distribution to represent a piece of input data; eg, a triangular distribution for a transport time.
  - Each time data is required the distribution is sampled.
  - Many replications of the same scenario but potentially with different values (taken from the distribution) for each input data for each replication;
    - Replications may be conceptualised as ‘parallel universes’.
  - Results from the many replications are analysed statistically.

Why Stochastic Modelling?

- The time sequence of events is assessed.
- The ‘butterfly wing’ effect.
  - A minor event early in a simulation may have dramatic consequences that deterministic models could overlook.
- Results from many replications with potentially different outcomes are required to assess confidence levels.
  - These are unavailable from deterministic models.

OVERVIEW OF SOME OUTPUTS FROM THE TERRIER DEMAND SATISFACTION RATE CONFIDENCE (T DSR C) TOOL

Output Categories

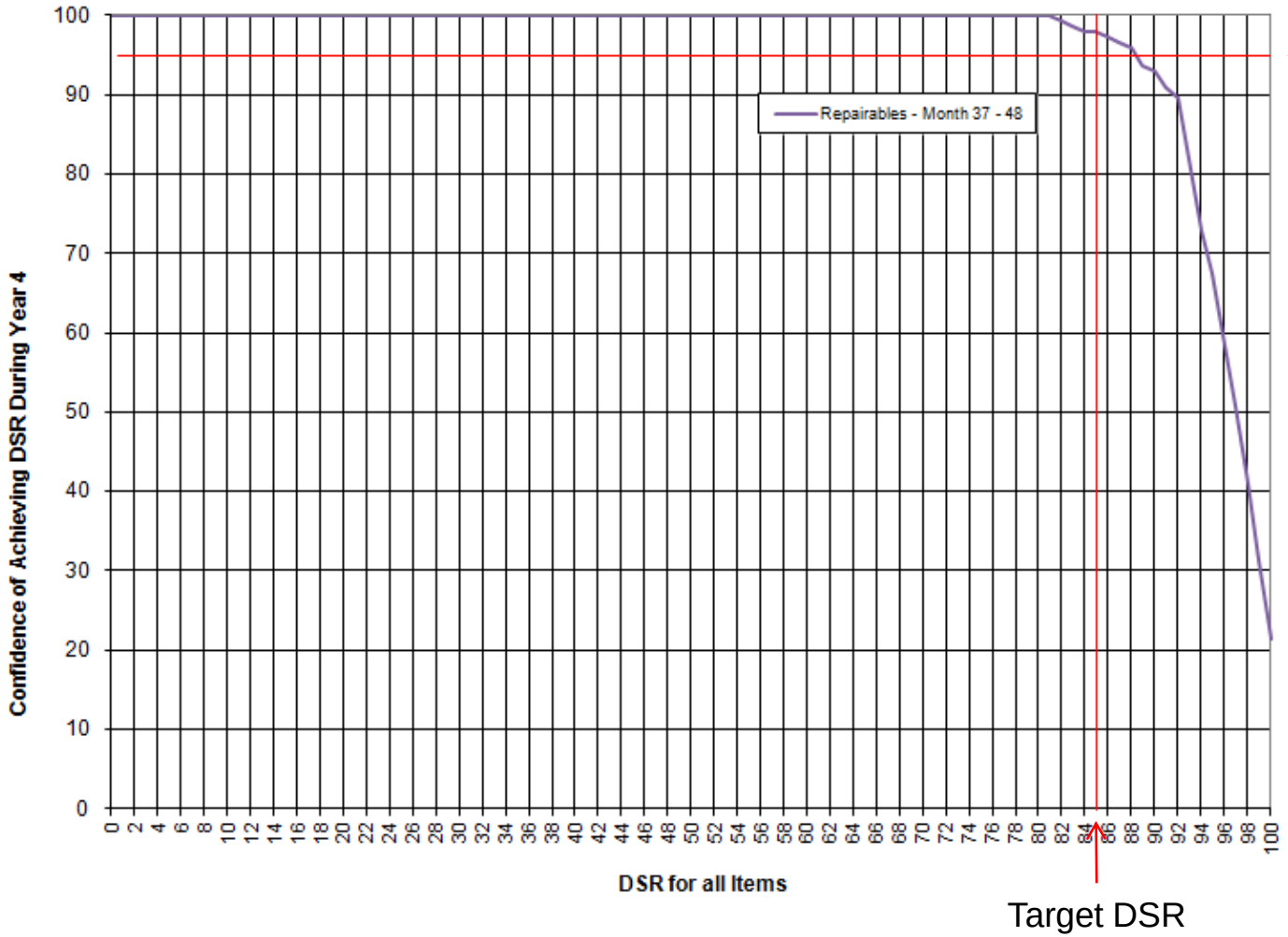
- 15 Outputs in 3 Categories:
  - DSR / SOR.
  - Cost.
  - Supply Chain.

- The following examples use a dummy data-set.

OVERVIEW OF THE DSR / SOR OUTPUTS

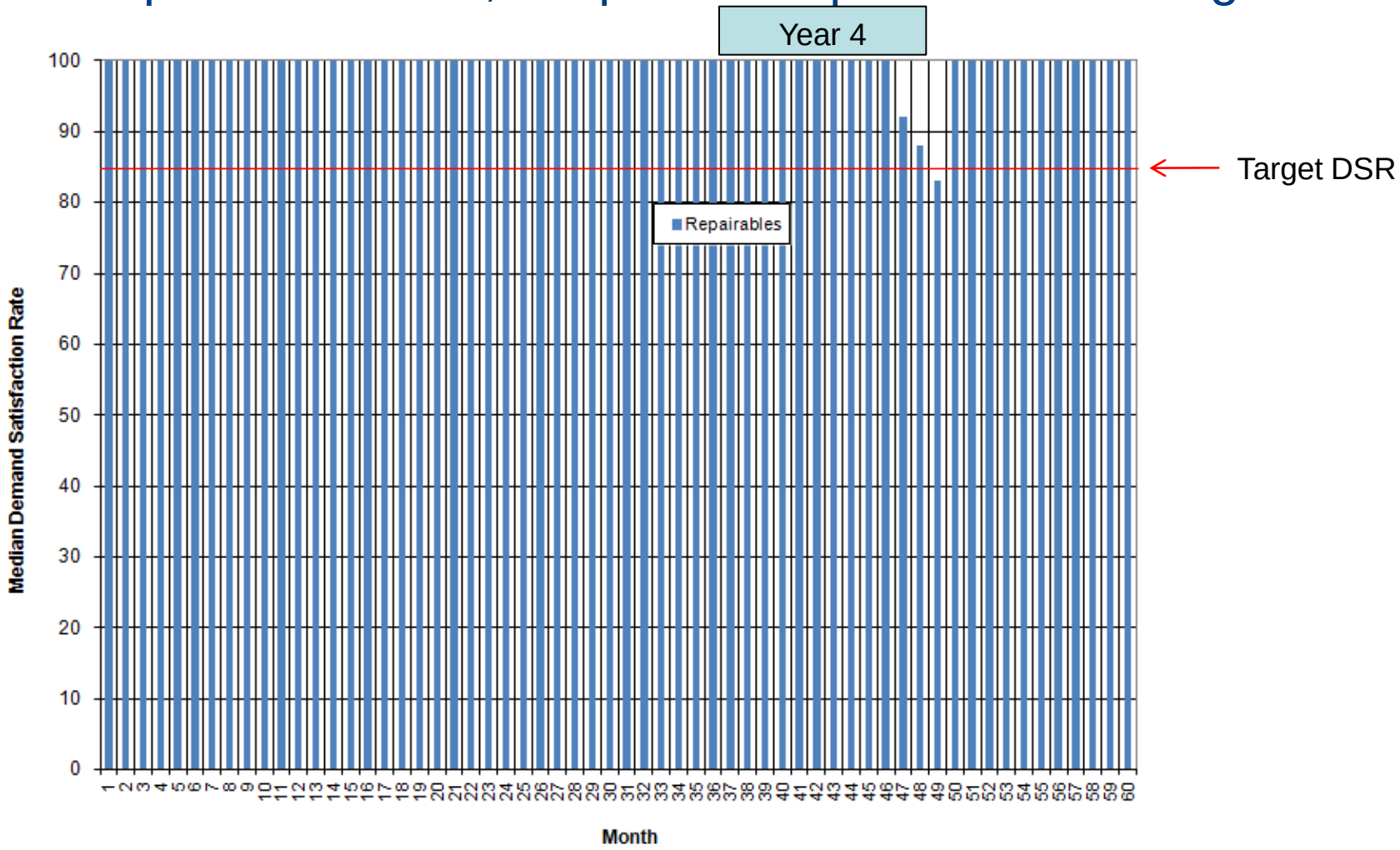
Output1 – Confidence v DSR

- Output1 was an earlier KPI - DSR during support Yr4.



Output2 – Median DSR by Month

- Output1 - KPI met; Output2 – Reputational damage.



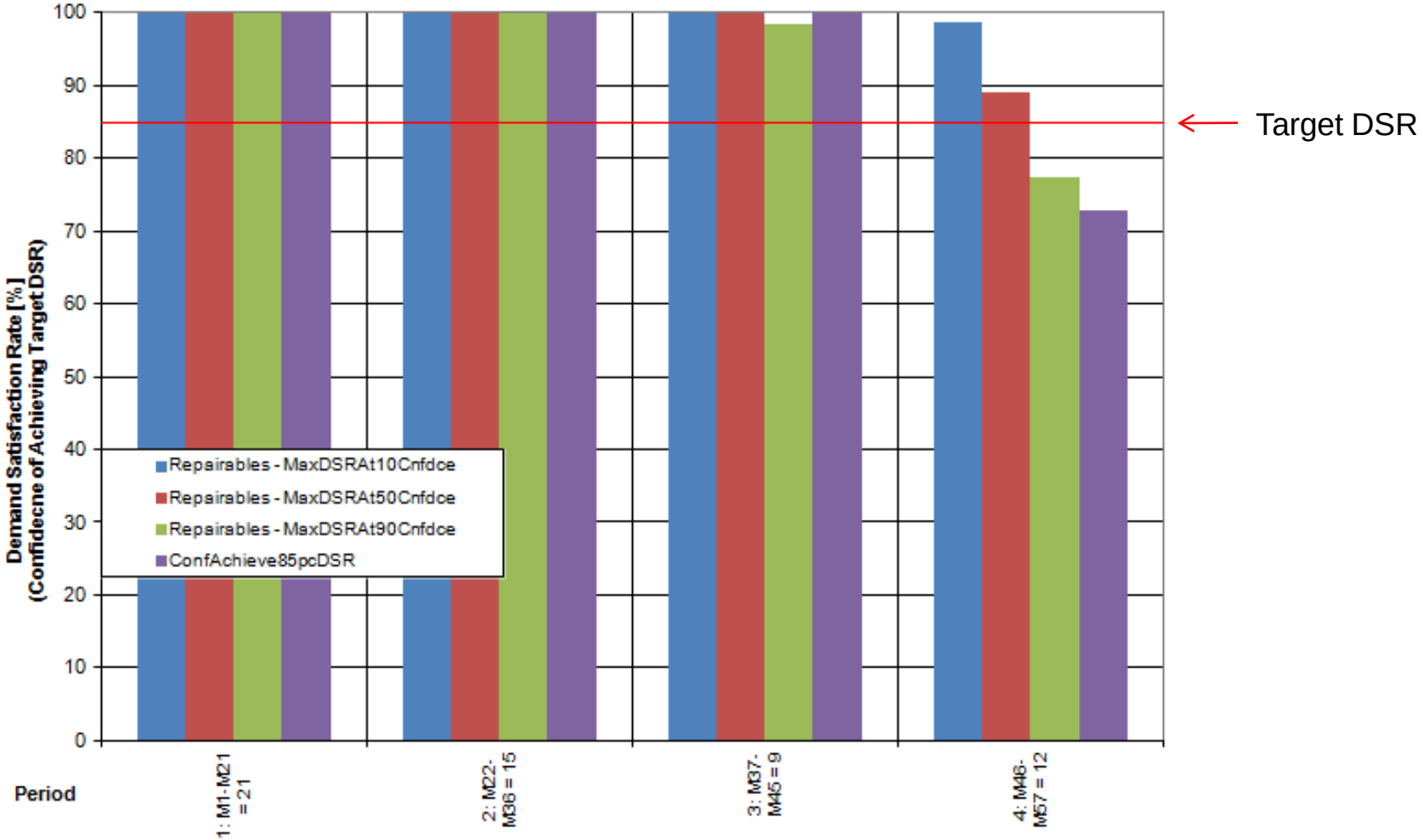
Output3 – Article Ranked by Stock Out Risk

- Output3 – Articles with high SOR (during month 49).

BAEPartRef	NSN	Description	MaxSORAt10Cnfdce	MaxSORAt50Cnfdce	MaxSORAt90Cnfdce
865	...	A	0	0	100
916	...	B	0	0	100
856	...	C	0	0	100
880	...	D	0	0	35
918	...	E	0	0	0
923	...	F	0	0	0
878	...	G	0	0	0
893	...	H	0	0	0
1001	...	I	0	0	0
1002	...	J	0	0	0

Output11 – Max DSR by Period

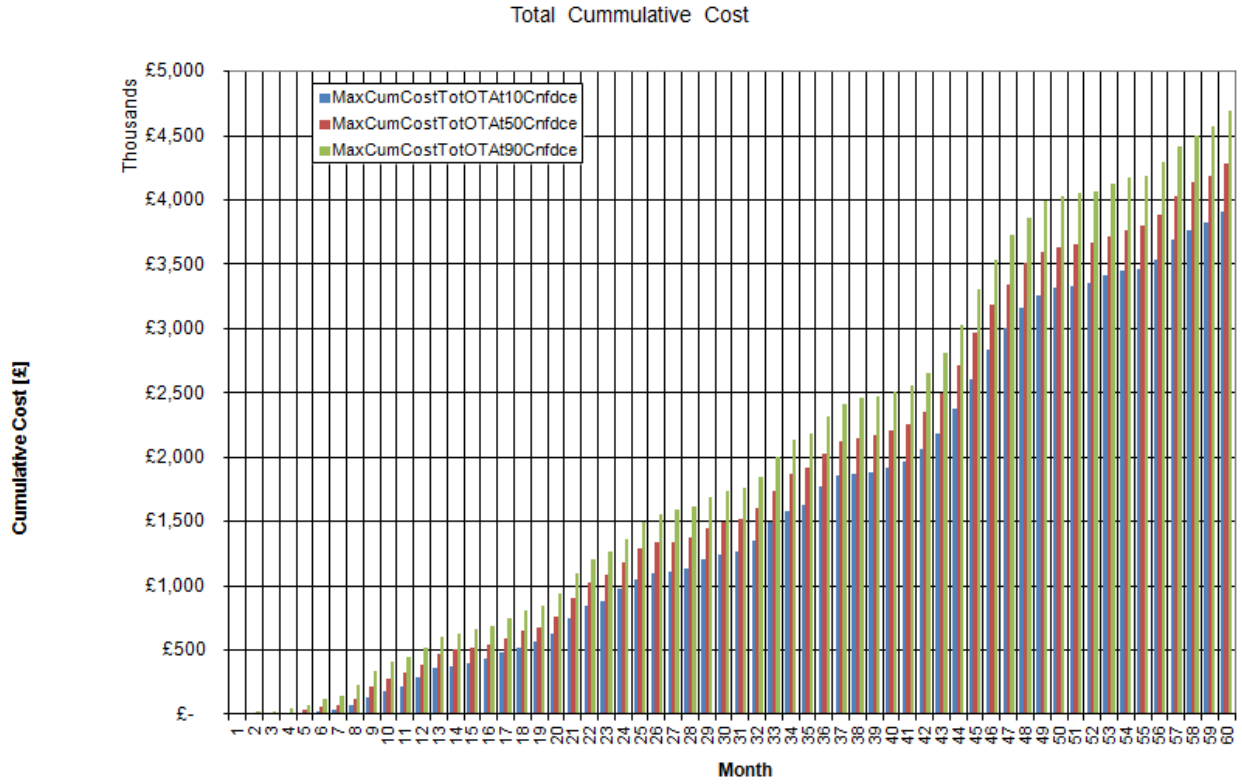
- Output11 is the current primary KPI.



OVERVIEW OF SOME COST OUTPUTS

Output4 – Cost by Month

- Output4 – Max cost of repair and reorder with user-input confidences:
  - Cost allocated to month in which demand placed.
  - Cumulative cost shown here.



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Output6 – Cost Drivers by Article

- Output6 – Cost driving articles:
  - Ranked in descending order by cost.
  - Max cost with user-input confidence.

BAEPartRef	NSN	Description	MaxCostTotAt10Cnfdce	MaxCostTotAt50Cnfdce	MaxCostTotAt90Cnfdce
865	...	A	£ 906,625	£ 1,173,250	£ 1,431,225
1001	...	I	£ 823,174	£ 1,162,128	£ 1,492,738
878	...	G	£ 512,007	£ 606,996	£ 696,902
880	...	D	£ 490,248	£ 584,475	£ 693,597
893	...	H	£ 390,250	£ 542,500	£ 752,500
856	...	C	£ 446,369	£ 541,918	£ 656,006
916	...	B	£ 335,250	£ 482,775	£ 657,120
1002	...	J	£ 188,416	£ 304,629	£ 400,384
923	...	F	£ 128,633	£ 194,160	£ 273,980
918	...	E	£ 61,800	£ 113,300	£ 201,460

OVERVIEW OF SOME SUPPLY CHAIN OUTPUTS

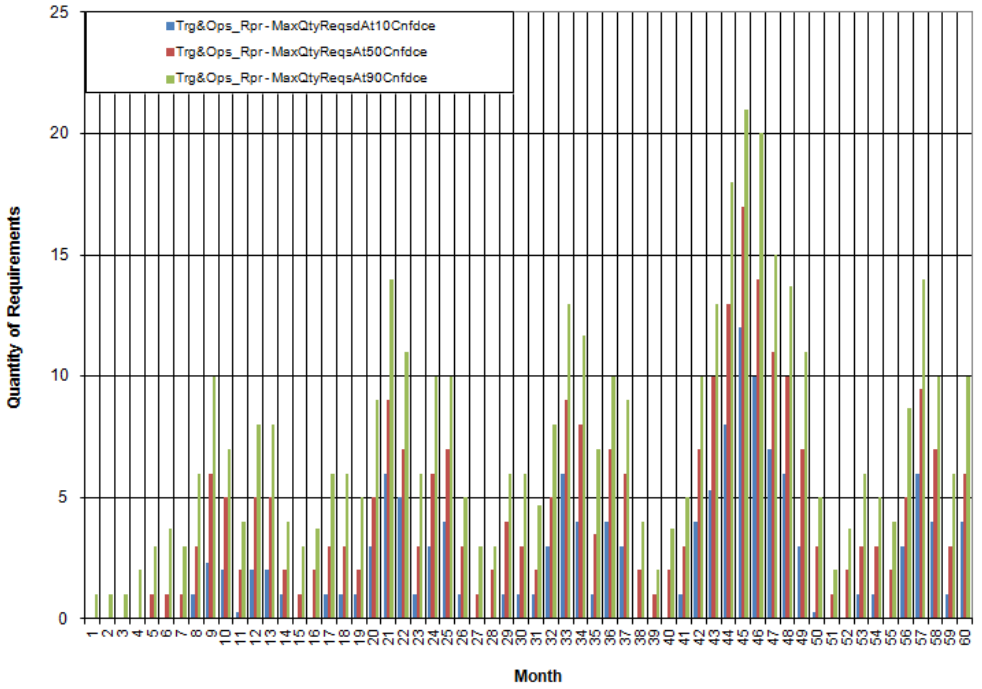
Output8 – Quantity of Back Orders

- Output8 is the maximum quantity of backorders:
  - Backorders outstanding for greater than a user-input duration.
  - User-input confidence limits.

CumMoonth	MaxQBOAt10Cnfdce	MaxQBOAt50Cnfdce	MaxQBOAt90Cnfdce
< 46	0	0	0
46	0	0	1
47	0	0	2
48	0	0	3
49	0	1	5.7
50	0	2	6.7
51	0	2	7
52	0	1	5
53	0	0	4
54	0	0	2
55	0	0	1
56 - 60	0	0	0

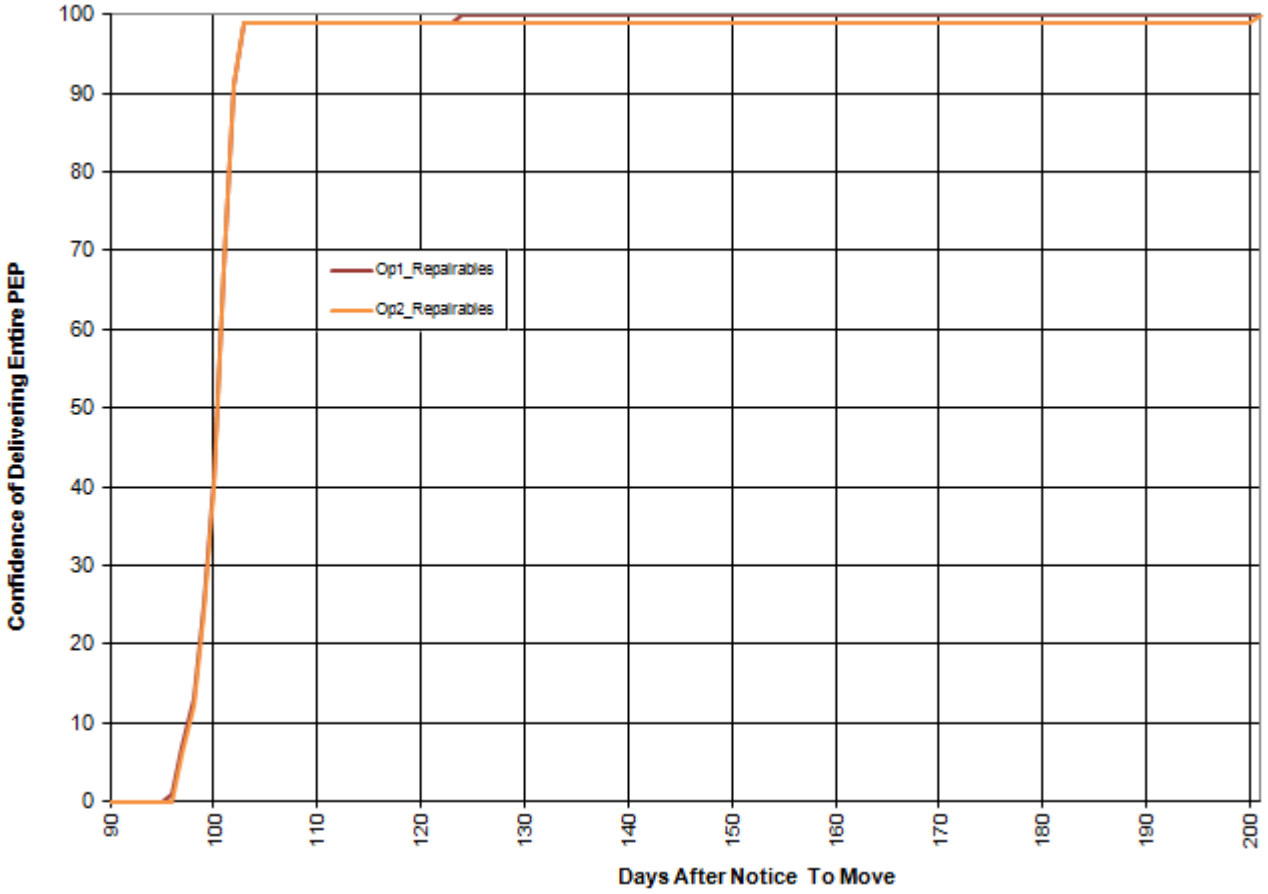
Output14 – Qty of Demands to Suppliers by Month

- Output14 is the maximum quantity of Requirements placed on suppliers each month with user-input confidence:
  - A Requirement is always for one ‘BAE Part Ref’.
  - For Consumables, the quantity demanded per Requirement may be > 1.



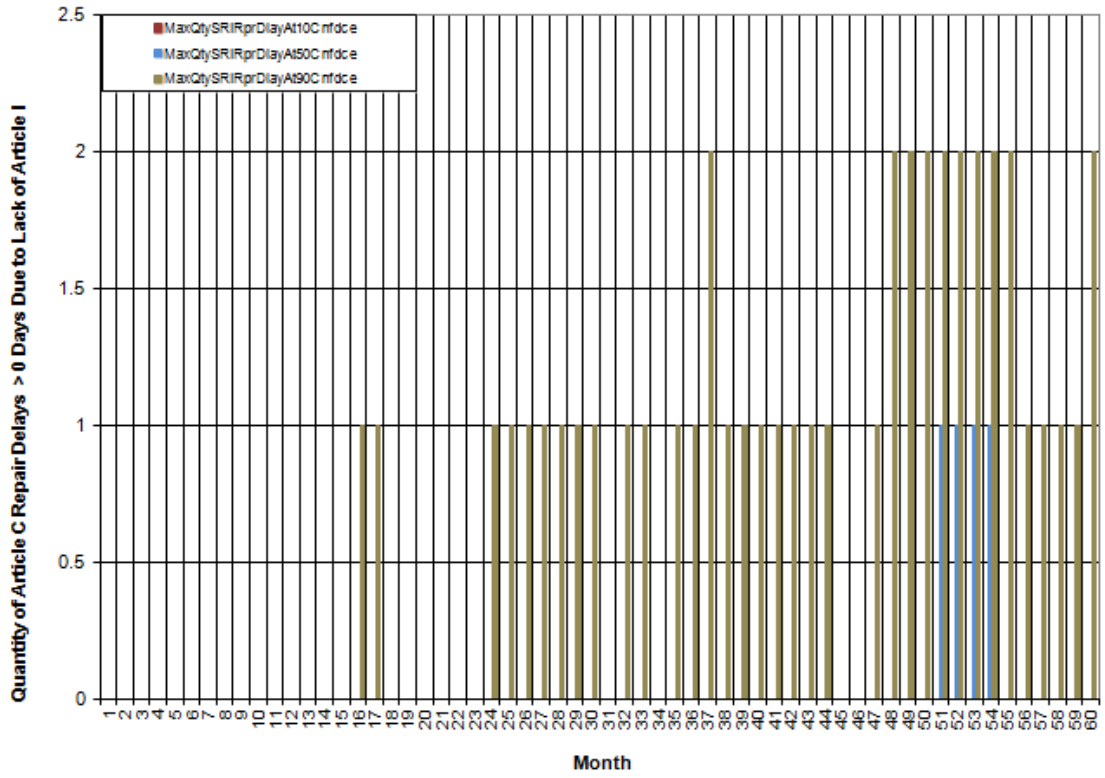
Output10 – Confidence of when Theatre Spares Issued

- Output10 is the confidence of when spares will be delivered to theatre to support Operations.



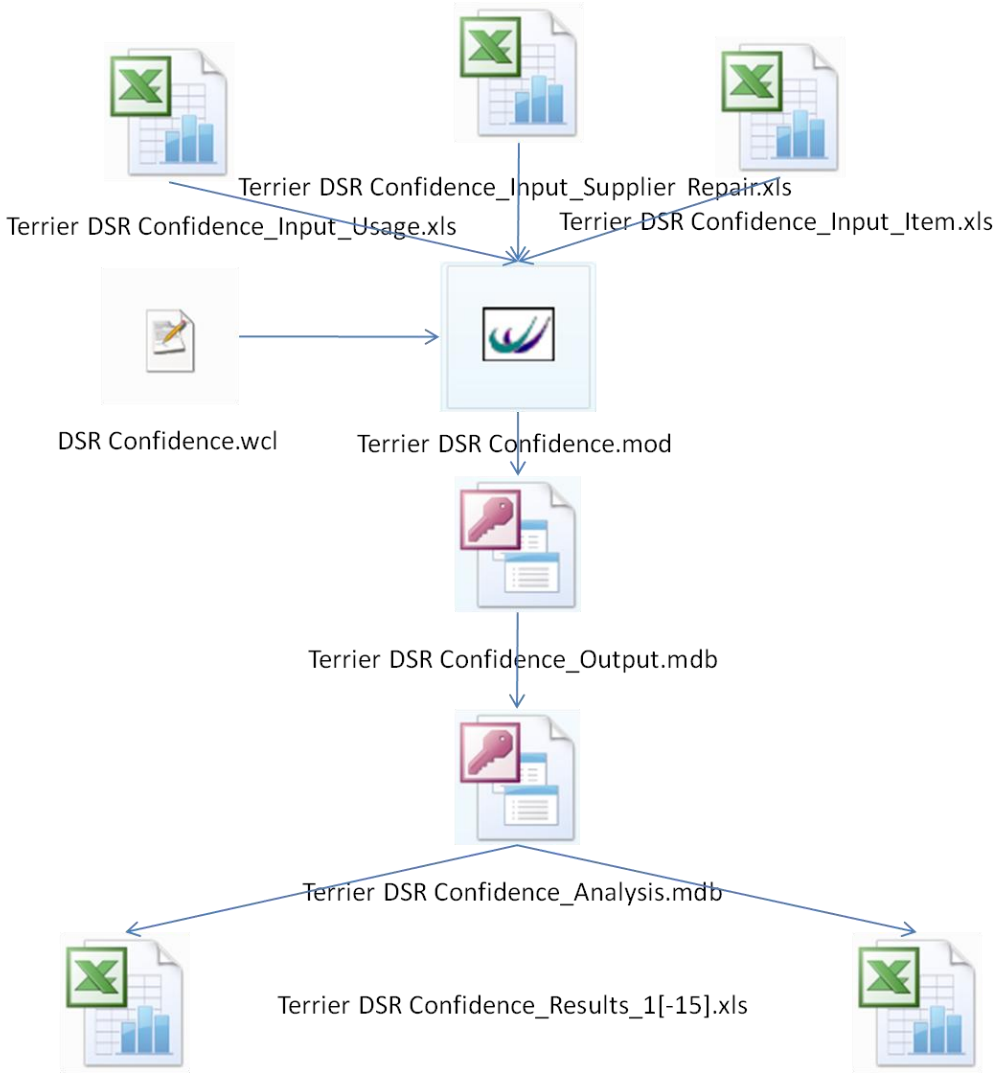
Output9 – Quantity of Supplier Repair Item Delays by Month

- Output9 is the maximum quantity of delays to Supplier Repairs due to lack of spares:
  - User-input confidence.
  - Only specific data-driven items analysed to this level of detail.

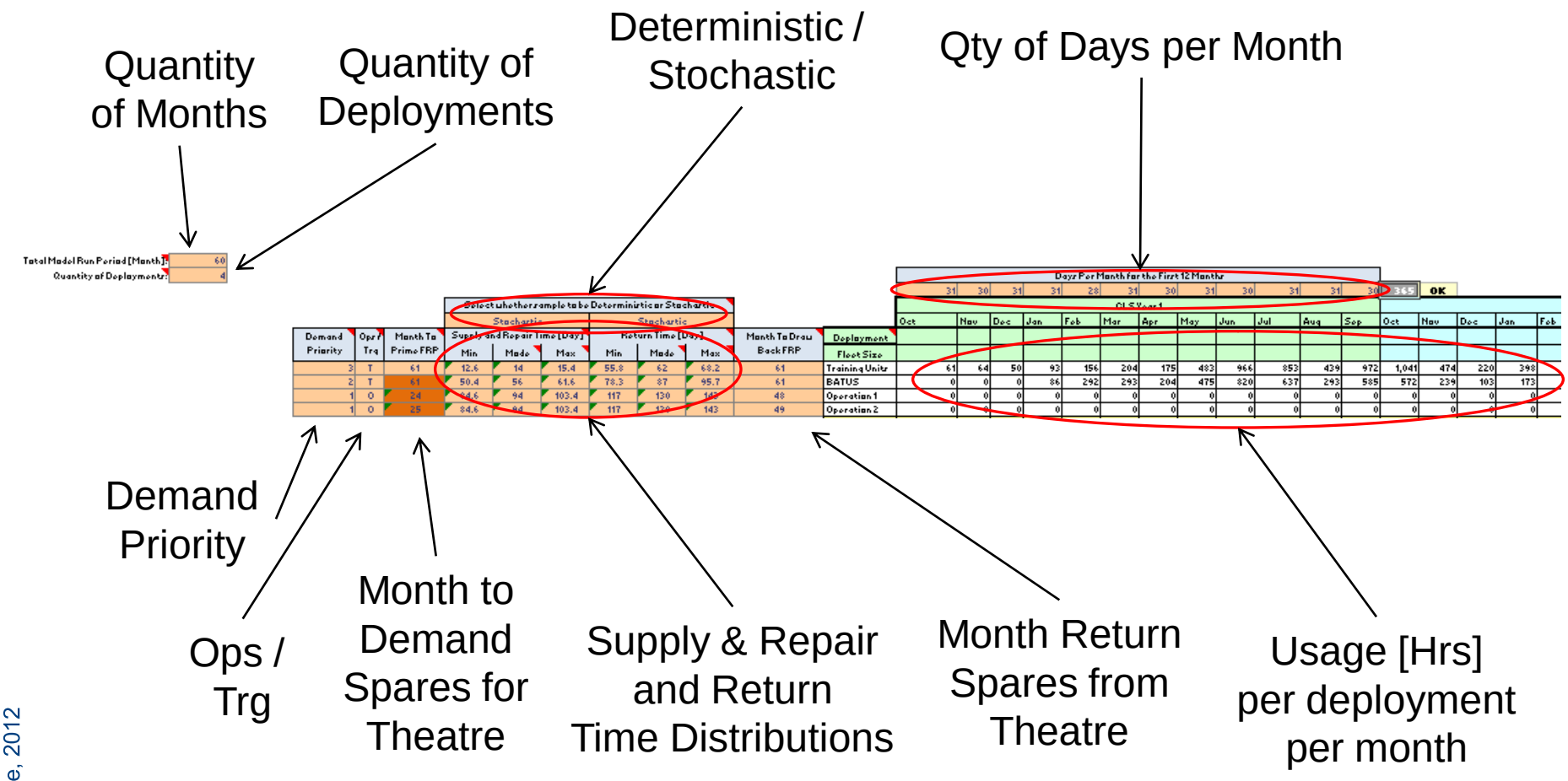


OVERVIEW OF HOW ‘T DSR C’ WORKS

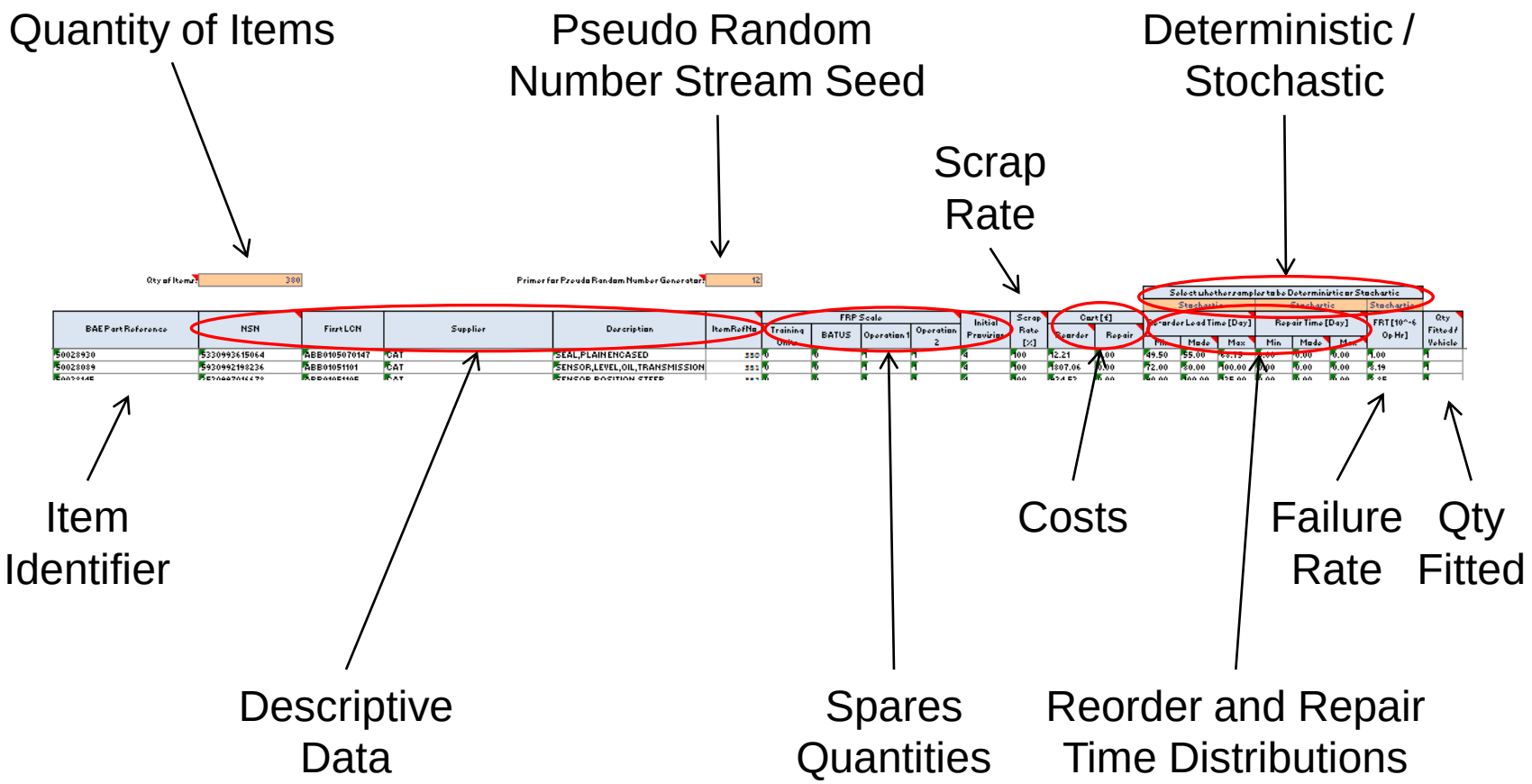
Data Flow Path

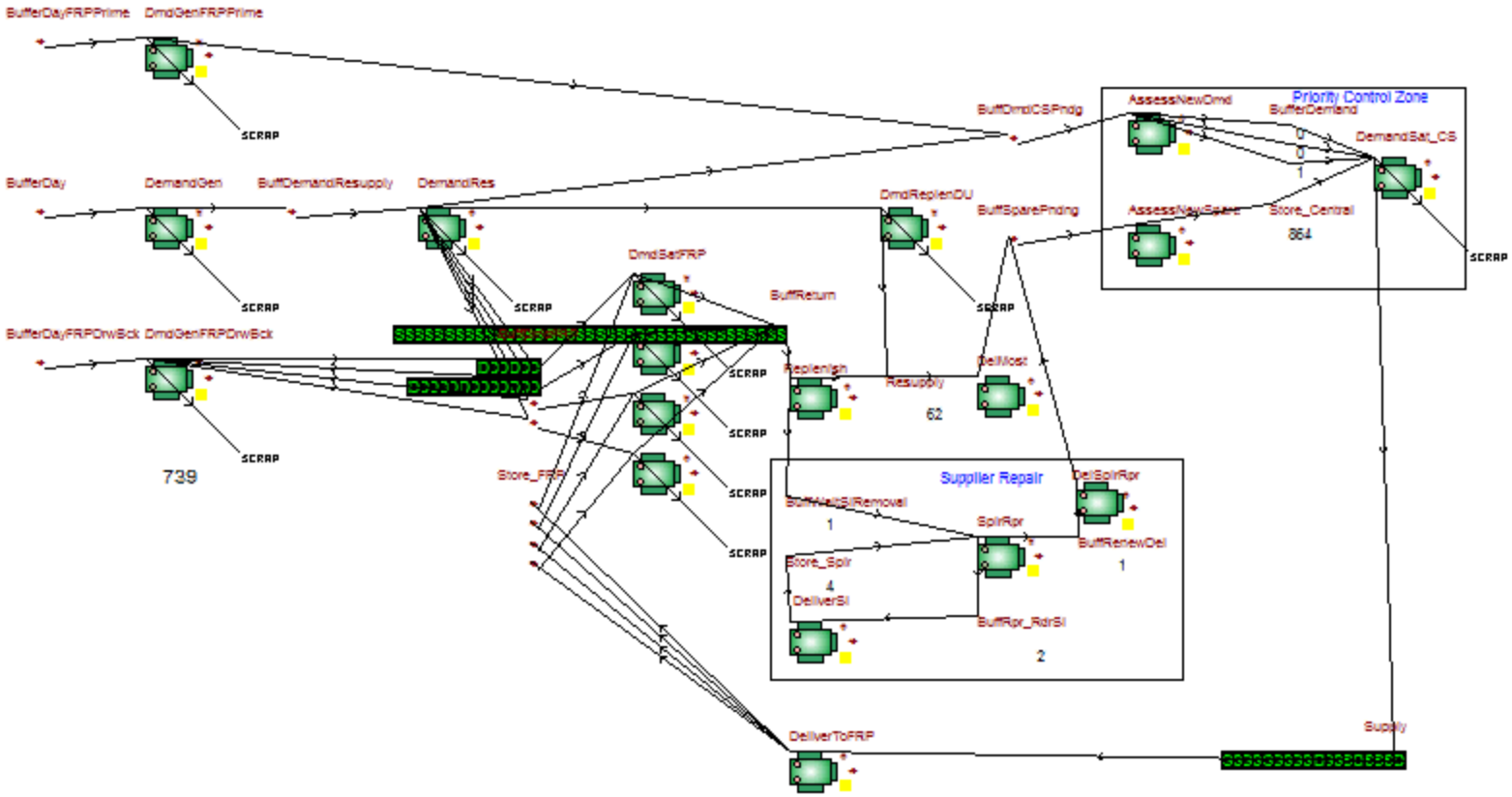


- Usage Input Data



- Item Input Data





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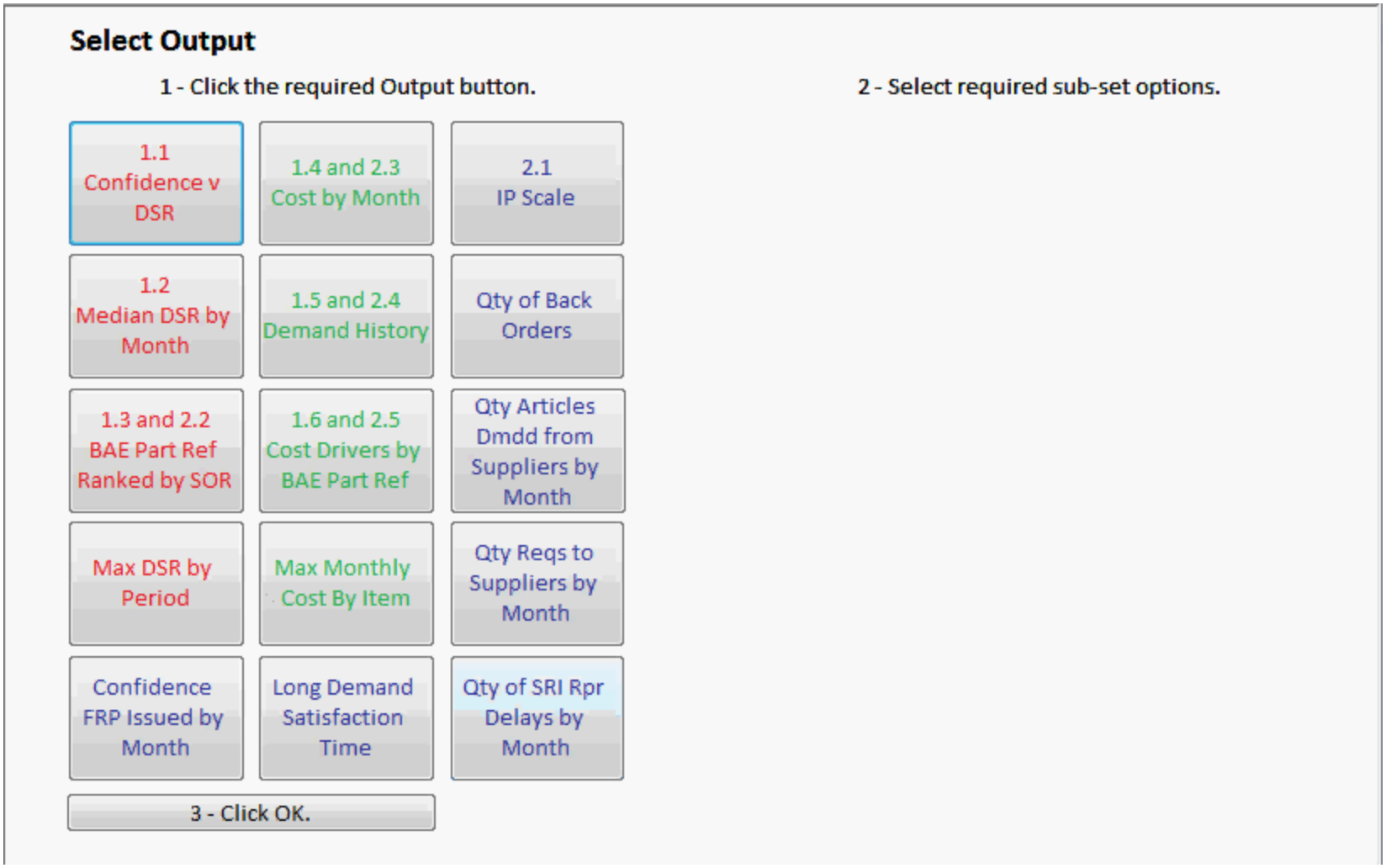
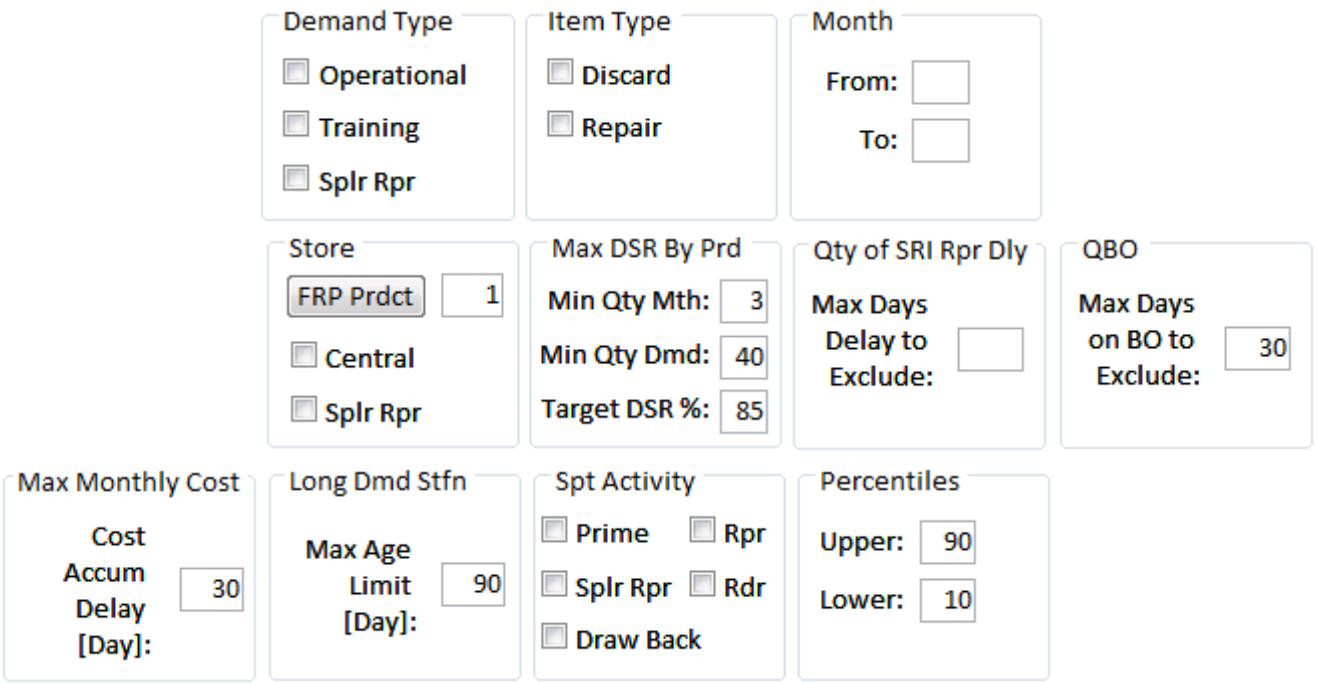
Analyser User Interface



Report Sub-set Options



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Value Added

- MOD KPIs assessed.
- BAES GCS-V commercial / risk concerns assessed.
- Some key areas where value has been added by T DSR C:
  - Generally, T DSR C confirmed and quantified previous gut feelings; this increased confidence in proposed solutions.
  - T DSR C quantified the following types of output at different confidence levels.
    - DSR / SOR.
    - Cost.
    - Supply chain parameters.
  - Identified additional stock to provide improved efficiency of the Power Pack repair agent.
  - Showed the additional stock required to support higher usage and retain baseline KPI values.
  - Focussed effort for improvement by quantifying risks.

Questions