



Aan:	Connekt
Van:	Kelly van Raaij, Gordian Logistics Experts Uitgevoerd in opdracht van Ministerie I&M/ Connekt via TKI Dinalog
Datum:	26 mei 2016
Betreft:	Buitenlandpromotie Project nummer: PTL08.009, Deliverable 4A-1 Service Logistiek Zuid Afrika <i>Verslag spare parts management workshop tijdens SAAMA conferentie, 16 mei 2016, Somerset West, Zuid Afrika</i>

Achtergrond

In 2015 heeft Gordian Logistic Experts in opdracht van de Topsector Logistiek twee Business meets Science seminars georganiseerd in Zuid-Afrika. Deze seminars zijn positief ontvangen in Zuid-Afrika en gaven aanleiding om verder de Zuid-Afrikaanse markt te verkennen binnen het project Buitenlandpromotie-Export. In deze rapportage vindt u de verslaglegging van de 'spare parts management en optimization' workshop tijdens de SAAMA conferentie.

Bijeenkomst

De Southern African Asset Management Association (SAAMA) conferentie wordt één keer per jaar gehouden in Zuid-Afrika. Pragma, de Zuid-Afrikaanse partner van Gordian Logistic Experts, is 'diamond sponsor' en organiseert voor een groot deel deze conferentie. De conferentie bestaat uit verschillende lezingen en workshops, verspreid over 3 dagen. De 'spare parts management & optimization' workshop was onderdeel van het programma. De workshop is samen georganiseerd met Pragma en professor Henk Zijm van Universiteit Twente in opdracht van de Topsector Logistiek.

Voorafgaand aan de workshops konden deelnemers het programma inzien en hun deelname voor de dag bepalen. De 'spare parts management & optimization' workshop was daar uiteraard onderdeel van. In de bijlage 'uitnodiging' staat de aankondiging beschreven.

- Datum: 16 mei 2016
- Tijd: 13 uur - 16:30 uur
- Locatie: NH Cape Town The Lord Charles, Main Rd & Broadway Boulevard, Croydon, Cape Town, 7130
- Onderwerp: Spare parts management & optimization workshop
- Geschatte aantal deelnemers: 20
- Werkelijke aantal deelnemers: gemiddeld 40

Agenda

Part 1: 13.00 – 14.30

1. 13.00 – 13.20 Introduction by Henk Zijm (University of Twente)
2. 13.30 – 13.50 Practical approach to SPO by Gordian and Pragma (Jan Willem Rustenburg (Gordian) and Gerrie Olivier (Pragma))
3. 13.50 – 14.15 Interactive case on practical SPO (Jan Willem Rustenburg (Gordian), Stijn Wouters (Gordian) and Gerrie Olivier (Pragma))

Break: 14.30 – 15.00

Part 2: 15.00 – 16.30

4. 15.00 – 15.20 Advanced SPO by Henk Zijm (University of Twente)
5. 15.20 – 16.00 Interactive case on advanced SPO (by Henk Zijm (University of Twente), Jan Willem Rustenburg (Gordian), Stijn Wouters (Gordian) and Gerrie Olivier (Pragma))
6. 16.00 – 16.30 Interactive discussion on when/how to start with SPO by Henk Zijm (University of Twente) and Jan Willem Rustenburg (Gordian)

Deelnemers

De marketing en uitnodiging van de deelnemers is georganiseerd door de organisatie van SAAMA. Daarnaast waren deelnemers vrij om in en uit te lopen bij workshops en/of lezingen wanneer ze wilden. Mede hierdoor was het niet mogelijk om handtekeningen te verzamelen. Voor de koffiepauze waren er 50 mensen bij de 'spare parts management & optimisation' workshop en na de koffiepauze waren er nog zo'n 35 mensen over. Er waren onder andere deelnemers van de volgende bedrijven, waarmee ook tijdens het evenement verder gesproken is;

- Anglo Thermal Coal
- Rand Water
- Nampower
- Pedro Diamonds
- SA Banknote
- Ethekwini
- PPC
- Distell
- Hulamin

Verslag

Henk Zijm, professor van Universiteit Twente, trapte af met een introductie over de workshop. Hij vertelde globaal wat de rol van spare parts management binnen asset management is. Ook bereidde hij het publiek alvast voor op de twee opdrachten die tijdens de workshop werden gehouden.

Na deze introductie volgden Jan Willem Rustenburg, CEO van Gordian Logistic Experts, en Gerrie Olivier, partner consultant van Pragma. Jan Willem vertelde over de basis principes van 'spare parts optimization' en de relevantie van samenwerking in de keten. Ordening en focus benadrukte hij door middel van een simpele en begrijpelijke classificatie. Op basis van deze classificatie van reserveonderdelen kan vervolgens een 'service level' differentiatie worden gemaakt. Gerrie Olivier completeerde dit verhaal door zaken als informatie uit onderhoudsplanningen en 'criticality' informatie van reserveonderdelen bij te voegen. Deze zaken verbeteren de onderdelenplanning aanzienlijk. Tijdens de presentatie werden er ook vragen gesteld uit het publiek, waardoor er een goede interactie plaatsvond.

Daarna was het tijd voor de eerste opdracht. Stijn Wouters, managing consultant van Gordian Zuid-Afrika, legde uit wat de bedoeling was. Een case van een typisch productiebedrijf betrof een onderdelenassortiment waarvoor de supply chain manager een kostenreductie wilde realiseren met gelijkblijvend service level. De groep die door middel van de SPM studio de laagste voorraadwaarde met een minimale target service level wist te verkrijgen, won de eerste opdracht. Ondanks dat de groepen groot waren, deed iedereen goed mee. Na ongeveer driekwartier was het tijd om de resultaten te analyseren. De groep van Jan Willem had de eerste opdracht gewonnen.

Na een koffie en thee pauze werd de workshop hervat door Henk Zijm. Hij legde uit wat een 'multi-echelon supply chain structure' inhield en wat voor een invloed verschillende parameters hierop hebben. Direct daarna legde hij de volgende opdracht uit. De Chinook helikopter is een militaire helikopter dat gebruikt wordt door de Nederlandse luchtmacht. Het onderhoud vindt plaats op verschillende niveaus (bij de fabrikant, op depot en op verschillende bases). Daarnaast spelen er zaken zoals verschillende reparatietijden, niet iedere component kan overal gerepareerd worden en het aantal helikopters op de verschillende bases varieert. Door middel van een Excel sheet moesten de verschillende groepjes proberen om de 10 belangrijkste componenten van de helikopter op voorraad te leggen in het netwerk, zodanig dat de totale voorraadwaarde in het complete netwerk zo laag mogelijk is en de overall service level ten minste 99 procent bedraagt. De groepjes bleven hetzelfde, zodat er revanche genomen kon worden. Weer had elk groepje ongeveer driekwartier de tijd om tot de beste oplossing te komen. Dit keer won het groepje van Stijn Wouters de opdracht.

Tot slot verzorgden Jan Willem en Henk Zijm de afsluiting van de workshop. Aan de hand van de 'roadmap' van Pragma vertelden zij dat iedereen goed moest nadenken hoe volwassen hun bedrijf is en welke eerste stappen er gezet moeten worden. Pas als de basis van je voorraadbeheer goed is kun je gaan nadenken over optimalisatie. Hierbij benadrukten ze wel dat de basis niet perfect hoeft te zijn, maar grotendeels in orde.

Conclusie

Wederom een uiterst interactieve workshop met deelnemers uit geheel Zuidelijk Afrika (ook Namibië en Botswana waren vertegenwoordigd). Het lijkt erop dat er nu echt een beweging begint te ontstaan. We zijn voornemens in november een nieuwe sessie te organiseren in het Gauteng gebied.

Er begint hiermee ook een basis te ontstaan voor meer kruisbestuiving, bv. door meer bedrijven te laten participeren en universitaire samenwerking (laatste begint al te komen).

We merken – net als bij de business development – dat het realiseren van innovatieve samenwerking een kwestie is van de langere adem. Maar de enorme interesse motiveert ons zeer om door te gaan.

Bijlage 1 - uitnodiging



Prof Henk Zijm
UNIVERSITY OF
TWENTE



Jan Willem
Rustenburg
GORDIAN

WORKSHOP – SPARE PARTS MANAGEMENT AND OPTIMISATION

13:00 – 14:30 continued 15:00 – 16:30

Venue: Somerset 3

During the workshop, we will look at some of the typical challenges companies face with their spare parts management and discuss the elements that should be in place before spare parts optimisation (SPO) is considered. We will discuss a practical approach to SPO and look at aspects such as classification, service level differentiation and adding information on maintenance planning and criticality. Case studies will be presented that focus on advanced tooling and advanced SPO.

Bijlage 2 - Presentaties

Introductie presentatie



Workshop

Spare Parts Inventory Optimization

Part 1



Striving towards Asset Management **Excellence**

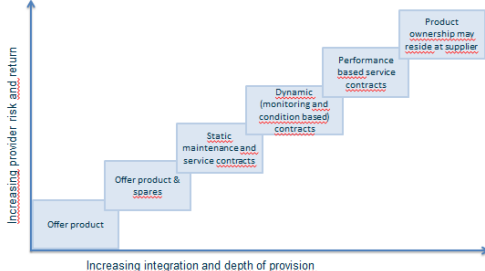
Asset Management and Integrated Logistics Support

- MRO and logistic support during the entire commercial life cycle
- All activities needed to exploit, modify, maintain, upgrade, support and finally discard capital assets



Striving towards Asset Management **Excellence**

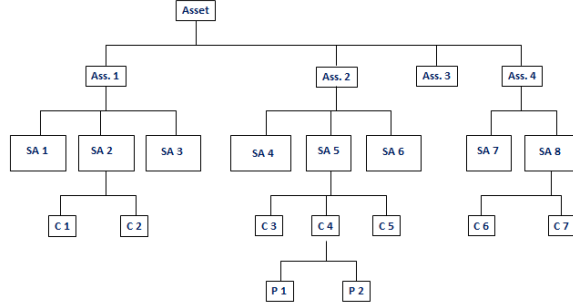
Service Market Developments: from products to functionality



Modified after Andy Neely, Cambridge Service Alliance, 2013

Striving towards Asset Management **Excellence**

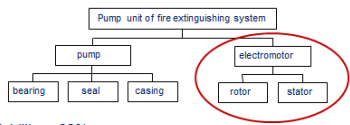
Logistic Support: a multi-indenture structure



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Item-oriented spare parts approach: focuses on item availability

System-oriented spare parts approach: focuses on system availability



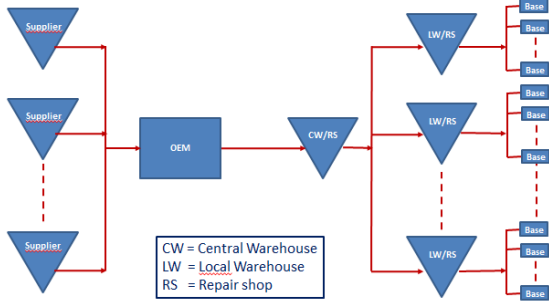
Target availability = 93%

Item	Price	Stock (Item)	Service-level (I)	Stock (System)	Service-level (S)
Elmo	20000	2	95%	1	82%
Rotor	5000	4	95%	4	95%
Stator	1000	6	95%	11	99%

Budget (Item approach): € 66000 Budget (System approach): € 51000

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Logistics Support: a multi-echelon structure



CW = Central Warehouse
LW = Local Warehouse
RS = Repair shop

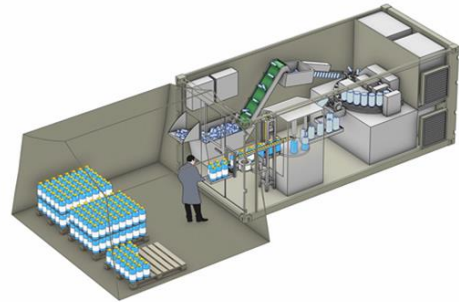
Striving towards Asset Management **Excellence**

Case: Spare part inventory optimization for the Chinook helicopter



Striving towards Asset Management **Excellence**

Case: Spare parts optimization at a manufacturing company



Striving towards Asset Management **Excellence**

Presentatie Spare Parts Management & Optimisation



Spare parts management & optimisation

A practical and staged road towards excellence

Striving towards Asset Management **Excellence**

The spare parts optimisation road

1. Our key challenge
2. Our basic methodology
3. The road to perfection
4. Solution overview
5. Typical results

 Striving towards Asset Management **Excellence**

1. Our key-challenge

We believe that physical assets do not have to be down due to a shortage of spare parts... against reasonable costs!

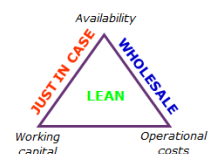
Hence, all our efforts focus on optimising the "triangle"



 Striving towards Asset Management **Excellence**

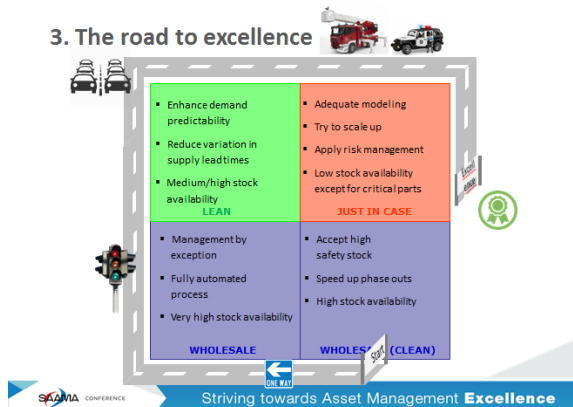
2. Our basic methodology

Unit-price	High	Low
	High Demand frequency	Low Demand frequency
	- Enhance demand predictability - Reduce variation in supply leadtimes - Medium/high stock availability LEAN	- Adequate modeling - Try to scale up - Apply risk management - Low stock availability except for critical parts JUST IN CASE
	- Management by exception - Fully automated process - Very high stock availability WHOLESALE	- Accept high safety stock - Speed up phase outs - High stock availability WHOLESALE (CLEAN)



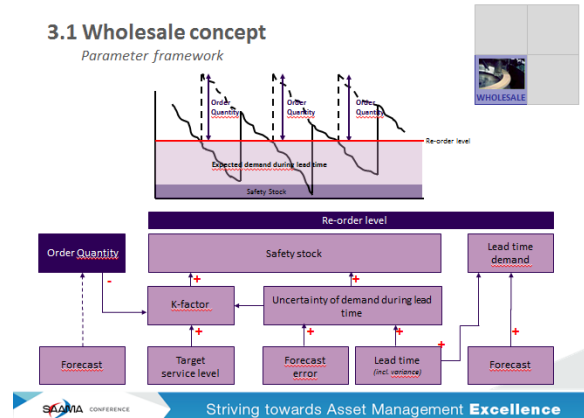
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3. The road to excellence



3.1 Wholesale concept

Parameter framework



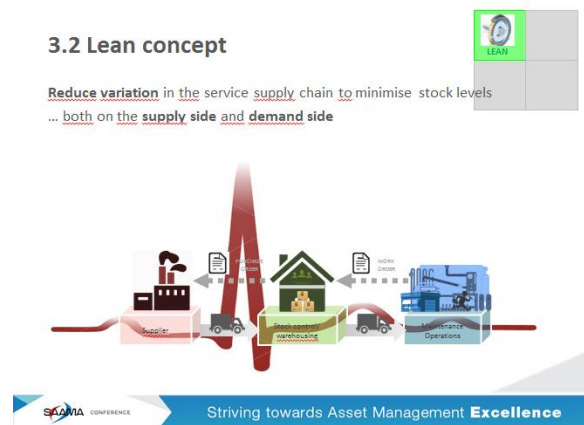
3.1 Wholesale concept

Implement an automated IT system approach
... while introducing management by exception



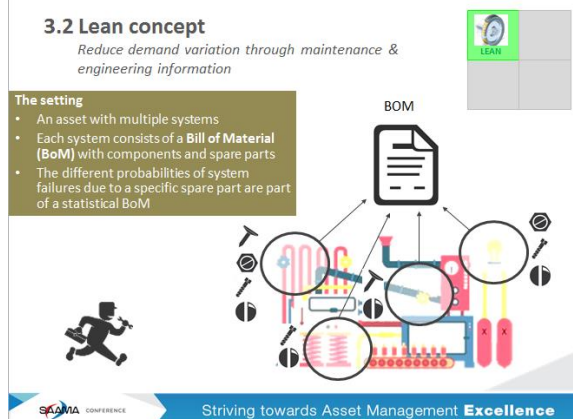
3.2 Lean concept

Reduce variation in the service supply chain to minimise stock levels
... both on the supply side and demand side



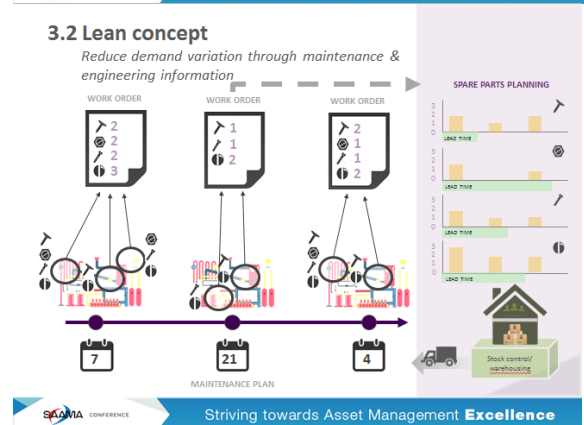
3.2 Lean concept

Reduce demand variation through maintenance & engineering information



3.2 Lean concept

Reduce demand variation through maintenance & engineering information



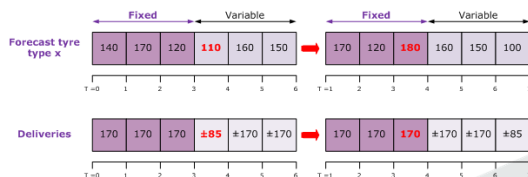
3.2 Lean concept

Reduce supply variation through supplier collaboration

Develop supplier collaborations based on forecast & delivery schedules

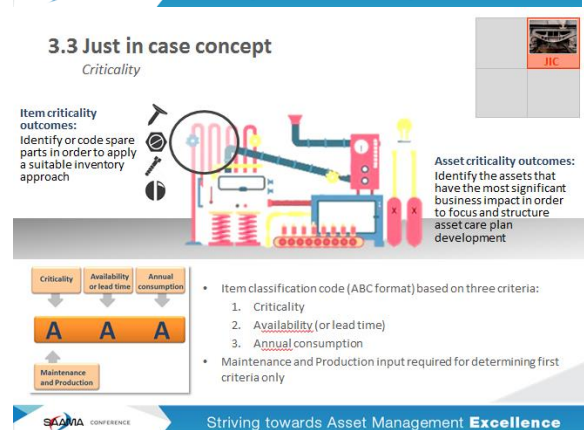
Essentials:

- Proper feed-in from maintenance
- Addressing the soft side of relations



3.3 Just in case concept

Criticality



3.3 Just in case concept

Example



Bogie revision

- Type used in VIRM, designed and built by Bombardier
- In a project, 150 bogies need to be maintained and modified



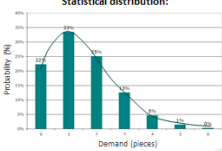
Failure and demand data:

- Failure probability per bogie: 1% per part installed
- Number installed per bogie: 1
- Number of bogies: 150
- Expected demand: $0.01 \times 1 \times 150 = 1.5$

Supply data:

- Price: approx € 25 000
- Lead time: 150 calendar days
- Minimum Order Quantity: 10

Statistical distribution:

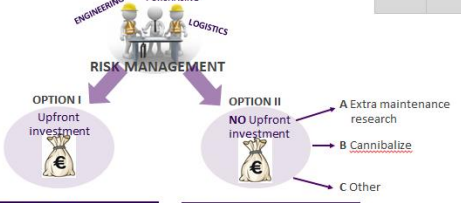




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3.3 Just in case concept

Example



OPTION I
Upfront investment

Investment: 250 K
Surplus: 225 K
Risks: Dead stock
Pro: No stand still

OPTION II
NO Upfront investment

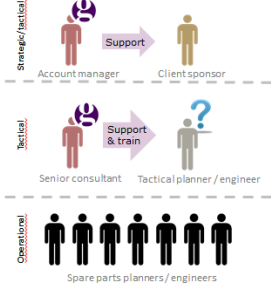
Investment: ?? K
Surplus: ?? K
Risks: Stand still ??
Pro: No/Less dead stock ??



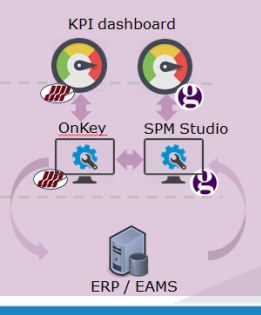
Striving towards Asset Management **Excellence**

4. Solution overview

Organisation



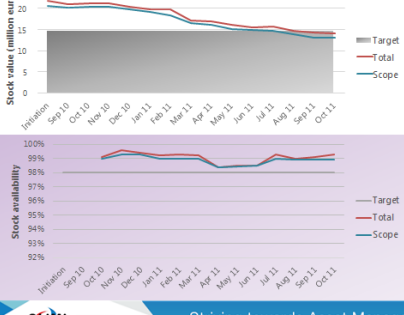
Information Technology





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5. Typical results



RESULTS

- 38% stock reduction
- 99% stock availability sustained
- 20% operational costs reduction
- High customer satisfaction: 7.5



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Presentatie Spare parts optimisation case



Spare parts optimisation case

A real life case in the manufacturing industry





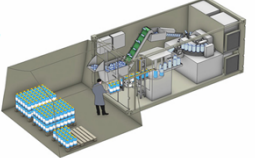

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The case

This manufacturing company is coping with too much downtime due to unavailable spares. At the same time the stores are fully packed and the Finance Director demands for major cost reductions.

Some figures

- Current stock availability: 91.4 %
- Current stock value: R 120.6 m





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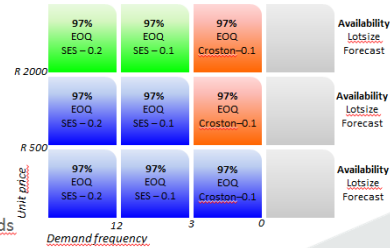
The intervention

First steps

The supply chain manager already started implementing solutions to rationalise stock levels.

For example:

- Classifying the spare parts assortment
- Applying demand forecasting techniques and lotsizing methods

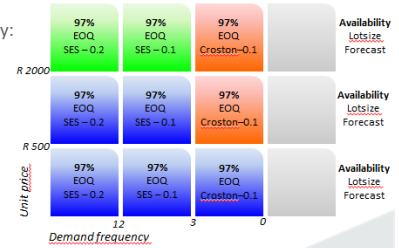


The intervention

Results

These interventions resulted in major cost reductions and availability increase:

- Stock availability: **97.4 % (+6.0 %)**
- Expected stock value: **R 51.6 m** (**-/- R 69.0 m**)



Your job



Unfortunately the Finance Director is still not happy and is convinced that another R 10 k can be saved from the stock value, while maintaining a 97.0 % stock availability.

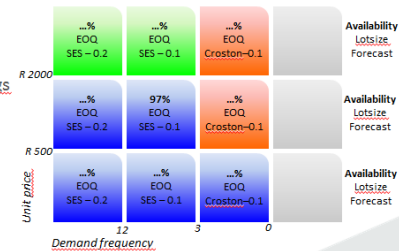
Your job is to get that result!

Your job

The assignment

Assign stock availability settings to each segment such that the overall stock availability is at least 97.0 %, but with minimal stock.

The lotsize and forecasting settings remain intact, as well as the classification thresholds.



Your job

The assignment



Presentatie Spare parts optimisation case 2



Workshop

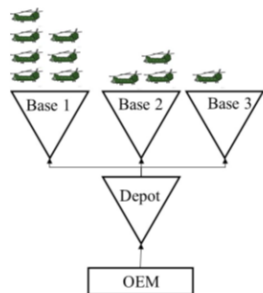
Spare Parts Inventory Optimization

Part 2



Striving towards Asset Management **Excellence**

Multi-echelon supply chain structure



Corrective maintenance by replacement of the failing key module

Failed module is sent to a repair shop for further investigation and possible repair

Repair shops exist at each base, at the depot and at the OEM.

Spare modules can be stored only at the three bases and at the depot, not at the OEM.

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Case: Spare part inventory optimization for the Chinook helicopter



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We're concentrating on 9 different modules (spare parts)



Module	Cost	Multiplicity
Vertical Gyro	\$18.120	2
AFCS Computer	\$104.259	2
Air Data Computer	\$29.155	1
Multifunction Display	\$63.644	4
VHF Receiver/Transmitter	\$15.328	2
Auxiliary Power Unit	\$134.215	1
FWD Rotor Blade	\$300.000	3
Pilot Cockpit Windshield	\$7.470	1
Wheel Assy	\$2.213	4

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Basic module and repair structure characteristics

Module	Cost	Multiplicity	Failure rate / yr
Vertical Gyro	\$18.120	2	0.3727
AFCS Computer	\$104.259	2	0.2279
Air Data Computer	\$29.155	1	0.7127
Multifunction Display	\$63.644	4	0.1555
VHF Receiver/Transmitter	\$15.328	2	0.1818
Auxiliary Power Unit	\$134.215	1	0.1200
FWD Rotor Blade	\$300.000	3	0.3824
Pilot Cockpit Windshield	\$7.470	1	1.3200
Wheel Assy	\$2.213	4	0.1536

Module repair at base	repair time (yr)	repair fraction	order-and-ship time (yr)
Vertical Gyro	0	0	0.019
AFCS Computer	0	0	0.019
Air Data Computer	0	0	0.019
Multifunction Display	0.0038	0.1	0.019
VHF Receiver/Transmitter	0	0	0.019
Auxiliary Power Unit	0.0192	0.5	0.038
FWD Rotor Blade	0.0192	0.2	0.038
Pilot Cockpit Windshield	0	0	0.019
Wheel Assy	0.0385	1	0.019

Module repair at depot	repair time (yr)	repair fraction	order-and-ship time (yr)
Vertical Gyro	0.004	0.004	0.019
AFCS Computer	0.1667	0.60	0.019
Air Data Computer	0.0833	0.20	0.019
Multifunction Display	0.0417	0.58	0.019
VHF Receiver/Transmitter	0.0417	0.20	0.019
Auxiliary Power Unit	0.0385	0.25	0.038
FWD Rotor Blade	0.0377	0.88	0.038
Pilot Cockpit Windshield	0.004	0.004	0.019
Wheel Assy	0.004	0.019	

Module repair at OEM	repair time (yr)	repair fraction	resupply lead time (yr)
Vertical Gyro	0.2300	1.00	
AFCS Computer	0.4167	1.00	
Air Data Computer	0.3333	1.00	
Multifunction Display	0.2300	1.00	
VHF Receiver/Transmitter	0.2300	1.00	
Auxiliary Power Unit	0.4167	1.00	
FWD Rotor Blade	0.5000	1.00	
Pilot Cockpit Windshield	0.004	0.004	0.125
Wheel Assy	1.00	1.00	

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Basic elements needed for any spare parts inventory optimisation

- Number of systems at base:** Number of Chinooks stationed at the base under consideration.
- Cost:** the price per module, used to assess the inventory investment.
- Failure rate:** The average number of times per year that a single module fails. Note that any failure of a module generates a demand for a ready-for-use module.
- Multiplicity:** The number of the same module in a single Chinook; for example, a Chinook has two vertical gyros.
- Repair time:** the average throughput time in the repair shop; this may be different at bases, depot and OEM; typically, more complex repairs are performed upstream in the supply chain, and so the corresponding repair lead times can be significantly higher.
- Repair fraction:** Fraction of failed modules arriving at the location that can be repaired over there. The rest is sent upstream in the supply chain for further investigation (from base to depot, or from depot to OEM)
- Order-and-ship time:** Time needed to move a ready-for-use module to the location from its supplier (to each base from the depot, and to the depot from the OEM). The time to return a failed module upstream in the supply chain is included in the repair throughput time.
- Resupply lead time (only for the Pilot Cockpit Windshield at the OEM):** Time to order a new module from an external supplier if the module cannot be repaired anymore.

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1. For expensive modules, one tends to hold some items at the central depot, less at the bases.
2. Modules with a high failure rate are generally held at the bases, less at the depot.
3. If budgets are limited, cheap modules are favored over more expensive modules when deciding on how many of each module to hold in stock.
4. Long repair times for a certain module tend to lead to higher inventory for that particular module.
5. Longer order-and-ship times (from depot to base, or from OEM to depot) tend to increase inventories.
6. Overall system availability depends on target inventory levels but also on the pipeline stock.

Base inventories	\$0
Depot inventories	\$0
OCM inventories	\$0
Total inventories	\$0
Weighted average availability	31.60%

Sheet1

Systems		Part	
demand	price	stock	profit
0.82	0.52	87.00%	87.00%
0.82	0.53	87.00%	87.00%
0.82	0.54	87.00%	87.00%
0.82	0.55	87.00%	87.00%
0.82	0.56	87.00%	87.00%
0.82	0.57	87.00%	87.00%
0.82	0.58	87.00%	87.00%
0.82	0.59	87.00%	87.00%
0.82	0.60	87.00%	87.00%
0.82	0.61	87.00%	87.00%
0.82	0.62	87.00%	87.00%
0.82	0.63	87.00%	87.00%
0.82	0.64	87.00%	87.00%
0.82	0.65	87.00%	87.00%
0.82	0.66	87.00%	87.00%
0.82	0.67	87.00%	87.00%
0.82	0.68	87.00%	87.00%
0.82	0.69	87.00%	87.00%
0.82	0.70	87.00%	87.00%
0.82	0.71	87.00%	87.00%
0.82	0.72	87.00%	87.00%
0.82	0.73	87.00%	87.00%
0.82	0.74	87.00%	87.00%
0.82	0.75	87.00%	87.00%
0.82	0.76	87.00%	87.00%
0.82	0.77	87.00%	87.00%
0.82	0.78	87.00%	87.00%
0.82	0.79	87.00%	87.00%
0.82	0.80	87.00%	87.00%
0.82	0.81	87.00%	87.00%
0.82	0.82	87.00%	87.00%
0.82	0.83	87.00%	87.00%
0.82	0.84	87.00%	87.00%
0.82	0.85	87.00%	87.00%
0.82	0.86	87.00%	87.00%
0.82	0.87	87.00%	87.00%
0.82	0.88	87.00%	87.00%
0.82	0.89	87.00%	87.00%
0.82	0.90	87.00%	87.00%
0.82	0.91	87.00%	87.00%
0.82	0.92	87.00%	87.00%
0.82	0.93	87.00%	87.00%
0.82	0.94	87.00%	87.00%
0.82	0.95	87.00%	87.00%
0.82	0.96	87.00%	87.00%
0.82	0.97	87.00%	87.00%
0.82	0.98	87.00%	87.00%
0.82	0.99	87.00%	87.00%
0.82	1.00	87.00%	87.00%
0.82	1.01	87.00%	87.00%
0.82	1.02	87.00%	87.00%
0.82	1.03	87.00%	87.00%
0.82	1.04	87.00%	87.00%
0.82	1.05	87.00%	87.00%
0.82	1.06	87.00%	87.00%
0.82	1.07	87.00%	87.00%
0.82	1.08	87.00%	87.00%
0.82	1.09	87.00%	87.00%
0.82	1.10	87.00%	87.00%
0.82	1.11	87.00%	87.00%
0.82	1.12	87.00%	87.00%
0.82	1.13	87.00%	87.00%
0.82	1.14	87.00%	87.00%
0.82	1.15	87.00%	87.00%
0.82	1.16	87.00%	87.00%
0.82	1.17	87.00%	87.00%
0.82	1.18	87.00%	87.00%
0.82	1.19	87.00%	87.00%
0.82	1.20	87.00%	87.00%
0.82	1.21	87.00%	87.00%
0.82	1.22	87.00%	87.00%
0.82	1.23	87.00%	87.00%
0.82	1.24	87.00%	87.00%
0.82	1.25	87.00%	87.00%
0.82	1.26	87.00%	87.00%
0.82	1.27	87.00%	87.00%
0.82	1.28	87.00%	87.00%
0.82	1.29	87.00%	87.00%
0.82	1.30	87.00%	87.00%
0.82	1.31	87.00%	87.00%
0.82	1.32	87	

demand	pipeline	stock
6.00	1.6134	0
5.00	1.5718	0
7.84	2.5429	0
6.18	0.8791	0
4.00	0.8949	0
0.92	0.3105	0
7.68	0.8792	0
14.52	2.0962	0
0.00	0.0000	0

demand	pipeline	regime / propagation time (μ s)
6.00	1.5000	0.2500
2.00	0.8333	0.4167
6.27	2.0857	0.3333
2.74	0.6660	0.2500
3.29	0.8000	0.2500
0.64	0.2750	0.4167
0.93	0.6660	0.5000
14.52	1.8120	0.1250
0.00	0.0000	

Striving towards Asset Management **Excellence**

9. **Pipeline:** Modules already ordered but not yet received (at base or depot).

- **Total inventories:** try to minimize this value
- **Weighted average availability:** this should be at least 0.99

Striving towards Asset Management **Excellence**

Are you sufficiently mature?

OPERATE AT YOUR OPTIMUM

However, some kind of maturity already enables spares optimisation:

SUSTAIN **WELLBEING**

Optimisation and maintenance
Business Partner Relationship
Environmental Management
Asset Life Cycle Management

Sustainable Enterprise Asset Management

Zero unplanned downtime
Asset Performance Index

"Good" material planners available
ERP system good in place & used
Management says: "Let's do it!"

Spares optimisations have low probability of success

OPTIMISE **IMPROVE**

Compliance and Safety
Performance Excellence
Asset Reliability and Maintenance
Asset Efficiency
Customer Value and Satisfaction
Asset Profitability

Company is still very busy with getting the basics in place

DIAGNOSE **STRATEGISE** **COMPLY** **STABILISE**

ENTERPRISE ASSET MANAGEMENT ROAD MAP

PRAGMA

Bijlage 3 – foto's

