The Opus_Suite for System concept phase sustainment metrics modeling

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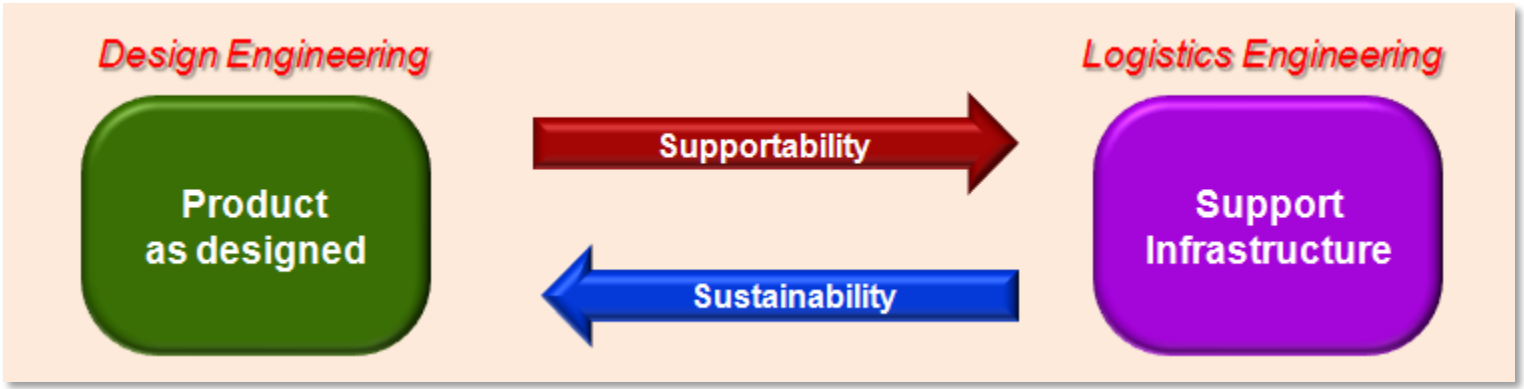
Support : ***The physical act of providing for the existence or subsistence of an item at a desired level (Operational, Sustainment, Logistics).***



Source of requirements

- The System ***Concept of Operations*** (***ConOps)*** is a user-oriented document that describes system characteristics for a proposed system from the users' viewpoint. It is used to communicate overall quantitative and qualitative system characteristics objectives.

- *Requirements development* is a process that consists of a set of activities that produce requirements for a product.

- Requirements involve two main areas:
  - ***Functional requirements***: ***Does the system do WHAT it is supposed to do?***
  - ***Performance requirements***: ***How well does the system do its functions?***

Scope of the sustainment concept phase

Define the support infrastructure and management guidelines given a new product top level supportability parameters to optimize total system performance and total ownership costs, while ensuring that the system is designed, operated and maintained consistent with mission requirements.

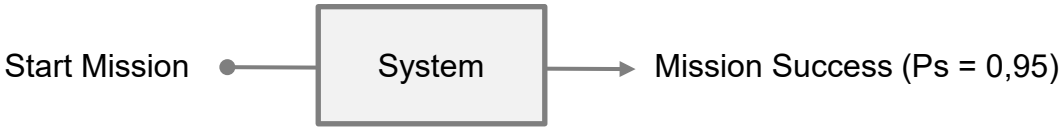
Case 1 for Opus Suite Modeling

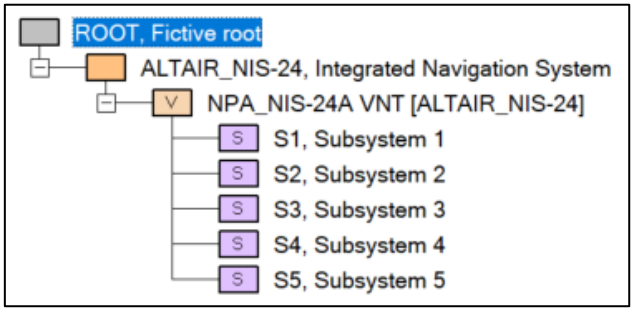
- **Electronic System Concept Phase Design Metrics**

Example of system top level specification requirement

- A new version of a Naval Navigation System is required and consists of five (5) integrated equipment to perform the major system tasks. *"System Survivability"* is requested as a critical KPP attribute to evaluate the effective system capability.

- *The System shall require maintenance with average interval of not less than 3 days during one month mission period (i.e.: for system maximum capability operational mode) with 95% confidence level.*
- *Market projection cost analysis suggests to adopt the feasibility cost threshold of 1.6 M Euro.*





- Above requirement can be also translated as "Sustainment KPP": *System probability of operation (system reliability) shall be at least 0,95 after 72 hours of operation with maximum functional configuration*

Concept requirements analysis

- The system concept is translated into the main system requirement as: the *Probability Of Survivability (Ps)* shall be 0,95 after 72 hours of operation. This can also be defined as the *Reliability of the System (Rs)* which is, in general, given through the Weibull form:

$$R(t) = e^{-(\frac{t}{\alpha})^{\beta}} = \exp[-(t/\alpha)^{\beta}$$

  - *α = characteristic life, or scale factor. Requirement implies that **1/α = 72 hours.***
  - *β = shape parameter, assumption made is **β = 1** since subsystems are mainly made with electronic components.*

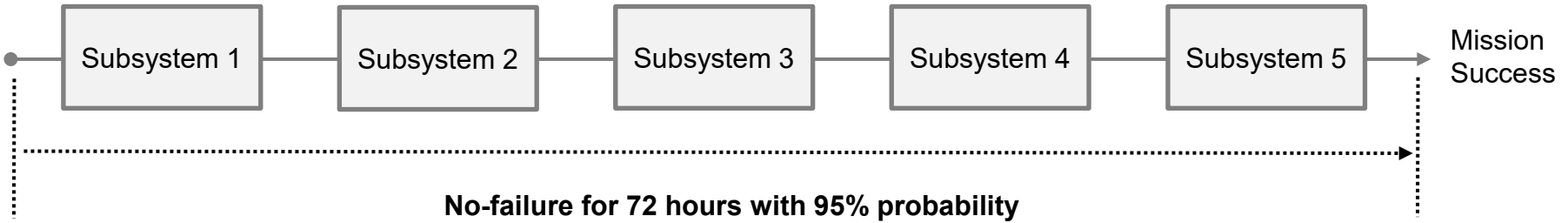
- Above implies: $$Ps = Rs = e^{-\lambda_s \bullet 72}$$

- Solving for the system failure rate: $$\lambda_s = -\frac{1}{72} \bullet \log_e 0.95 = 0.000712406\, fph = 712.406\, fpmh$$

- MTBF requirement ≥ 1'403,694 hours, assuming initially no critical PM so that MTBF = MTBM.

Concept requirement apportionment (1)

- The System consists of five equipment (Subsystems), the maximum configuration FBD is for the series diagram (logistics reliability model).



- Assuming *"Probability of Survivability" (Pi)* of each subsystem it is possible to state that:

$$P_s = \prod_{1}^{5} e^{-\lambda_i \bullet T}$$

$$\lambda_s = \lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 + \lambda_5 = 712.406\, fpmh$$

Concept requirement apportionment (2)

- In the concept definition phase, scope and tasks assigned to the composing Subsystems are defined, or can be estimated. Concept of functionality allocated to each main component shall allow to determine the relative complexity figure, for example: assuming Subsystem 1 as a reference it is conceptually possible to allocate a complexity weight to all the other Subsystems.

- Assuming relative complexity indexes, it is possible, for example, to state that:

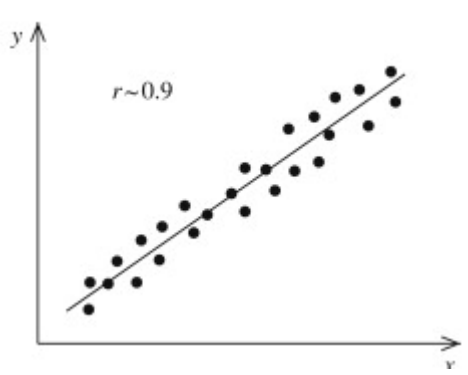
$$\lambda_s = (1+1{,}8+2{,}2+1{,}5+3) \bullet \lambda_1 = 9{,}5 \bullet \lambda_1 = 712.406\, fpmh$$

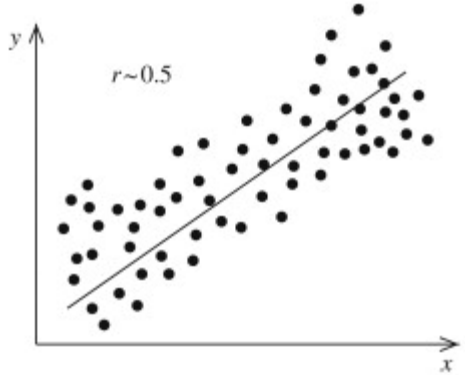
- Thus the failure rate (λ) of the reference Subsystem is :

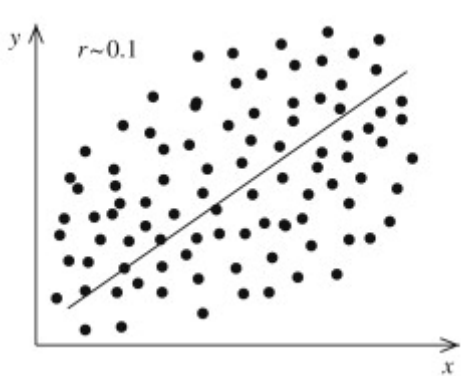
$$\lambda_1 = \frac{712.406}{9.5}\, fpmh = 74.9901\, fpmh$$

Parameters distribution and correlation index

- The adopted criteria is to correlate item complexity with the cost, assuming that cost of an item increases with the complexity of the item itself and complexity is measured by the item failure rate. Monotonic gradient of FRT/Cost relationship can be positive, as illustrated, or negative if cost increases because of complexity due to item redundancy, thus increasing the availability.







- To use OPUS10 to generate the list of items composing each Subsystem, it is necessary to estimate from the design experience adopted for other similar projects, the *logarithmic correlation index* between failure rate and price.

Concept requirement allocation (1)

- Using the complexity index it is possible to allocate the concept failure rate to all the other subsystems as in the following summary table. The calculated failure rate is nominal, it is useful also to estimate reasonable standard deviation (σ) of each Subsystem components data set (failure rate and cost) as an indication of the spread likelihood.

Main component	Complexity Index	Allocated FRT (λ)	Std Dev /Mean (σ/μ)
Subsystem_1	1	74,9901	0,10
Subsystem _2	1,8	134,9822	0,10
Subsystem_3	2,2	164,9782	0,20
Subsystem_4	1,5	112,4851	0,25
Subsystem_5	3	227,9703	0,20

- The FRT uncertainty ***(Standard Deviation)/Mean*** depends on the technology adopted for the equipment (Subsystems) and the design experience.

- Statistical distribution of complexity weight of the composing items for allocating the individual FRT calculation requires the ratio **σ/μ.** Different values can be adopted for FRT and Cost distributions, however in this example the same σ/μ data is assumed.

Concept requirement allocation (2)

- Next step requires a definition of the engineering concept for each Subsystem to allocate the *number of composing items* and the *estimate of the cost of each Subsystem* that is derived from the experience of previous projects and/or economic targets.

- The feasibility economic target is that the System acquisition cost shall not exceed ***1.6 Millions of Euro.*** This requirement shall be apportioned to the composing Subsystems proportioned to the related complexity index. Summary of FRT and cost apportionments is provided in the following table.

Main component	Complexity Index	Allocated FRT (λ)	Std Dev/Mean (σ/μ)	Number of Items	Preliminary Cost
Subsystem_1	1	74,9902	0,10	6	168’421 Euro
Subsystem _2	1,8	134,9823	0,10	11	303’158 Euro
Subsystem_3	2,2	164,9785	0,20	16	370’526 Euro
Subsystem_4	1,5	112,4853	0,25	8	252’631 Euro
Subsystem_5	3	227,9706	0,20	21	505’263 Euro

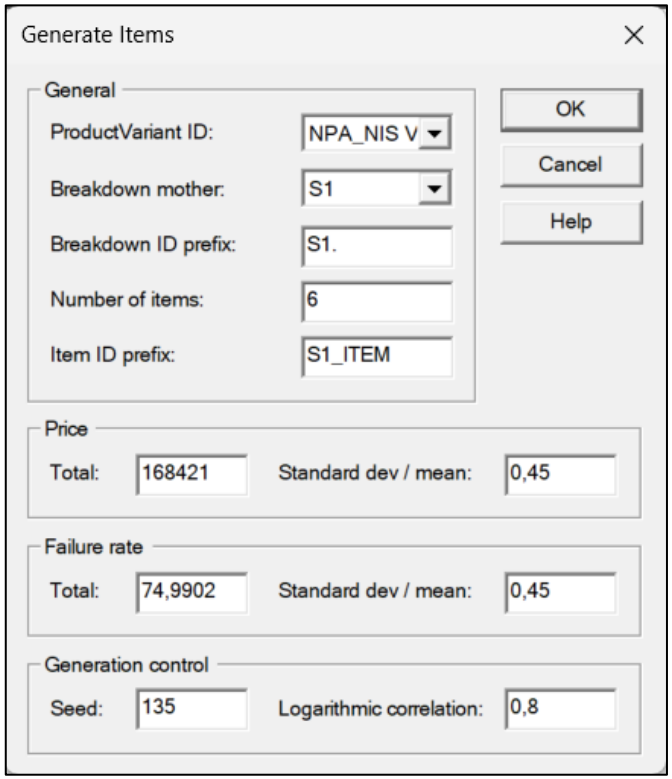
Concept requirement allocation (3)

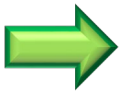
- Items FRT-to-Cost *Correlation Index* adopted for System breakdown definition depends on the subsystem characteristics. The estimated values are added to complete the summary table.

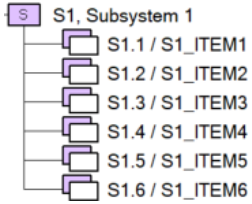
Main component	Complexity Index	Allocated FRT (λ)	Std Dev/Mean (σ/μ)	Number of Items	Preliminary Cost	Correlation Index
Subsystem_1	1	74,9902	0,45	6	168'421 Euro	0,80
Subsystem _2	1,8	134,9823	0,10	11	303'158 Euro	0,70
Subsystem_3	2,2	164,9785	0,20	16	370'526 Euro	0,70
Subsystem_4	1,5	112,4853	0,25	8	252'631 Euro	0,50
Subsystem_5	3	227,9706	0,20	21	505'263 Euro	0,80

- Opus Suite model is implemented in the file *"Nav_Sys Concept.opi"*

Example: Subsystem_1 breakdown data apportionment







Item

	IID Item identifier	DESCR Description	PRICE Price	TLLEN Technical life length [Years]
1	S1_ITEM1		22384,673	
2	S1_ITEM2		21556,526	
3	S1_ITEM3		21184,915	
4	S1_ITEM4		23531,092	
5	S1_ITEM5		21864,246	
6	S1_ITEM6		57899,547	

Failure

	FRID Failure identifier	DESCR Description	BDEID Breakdown element identifier	IID Item identifier	REPAB Repairable <Y>	PSEI Probability for system effectiveness impact <1,00>	NOTE User note
1	FAILURE_S1_ITEM1		S1.1				
2	FAILURE_S1_ITEM2		S1.2				
3	FAILURE_S1_ITEM3		S1.3				
4	FAILURE_S1_ITEM4		S1.4				
5	FAILURE_S1_ITEM5		S1.5				
6	FAILURE_S1_ITEM6		S1.6				

FailureRate

	FRID Failure identifier	OPID Operation parameter identifier	FRT Failure rate [1/MOPIDs]	NOTE User note
1	FAILURE_S1_ITEM1	<OPHOURS>	10,32	
2	FAILURE_S1_ITEM2	<OPHOURS>	9,39	
3	FAILURE_S1_ITEM3	<OPHOURS>	5,23	
4	FAILURE_S1_ITEM4	<OPHOURS>	13,03	
5	FAILURE_S1_ITEM5	<OPHOURS>	12,48	
6	FAILURE_S1_ITEM6	<OPHOURS>	24,53	

System steady-state modeling finalization

- To run the System concept model through OPUS10 it is necessary to enter basic corrective maintenance information, support organization, and system deployment.

MaintenanceLevel

	LEVLID	DESCR	LEVLNO	NOTE
	Maintenance level identifier	Description	Level number	User note
1	OLM	Items replace	1	
2	DLM	Items repair	2	

MaintenanceCapability

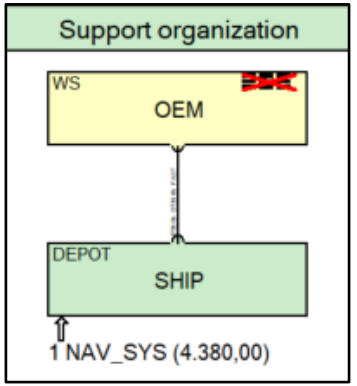
	COGID	SGID	LEVLID	ENDBL	NOTE
	Component group identifier	Station group identifier	Maintenance level identifier (inclusive)	Endurance blocked (inclusive) <Y>	User note
1	VARIANT	SHIP	OLM		
2	ITEMS	OEM	DLM		

UtilizationProfile

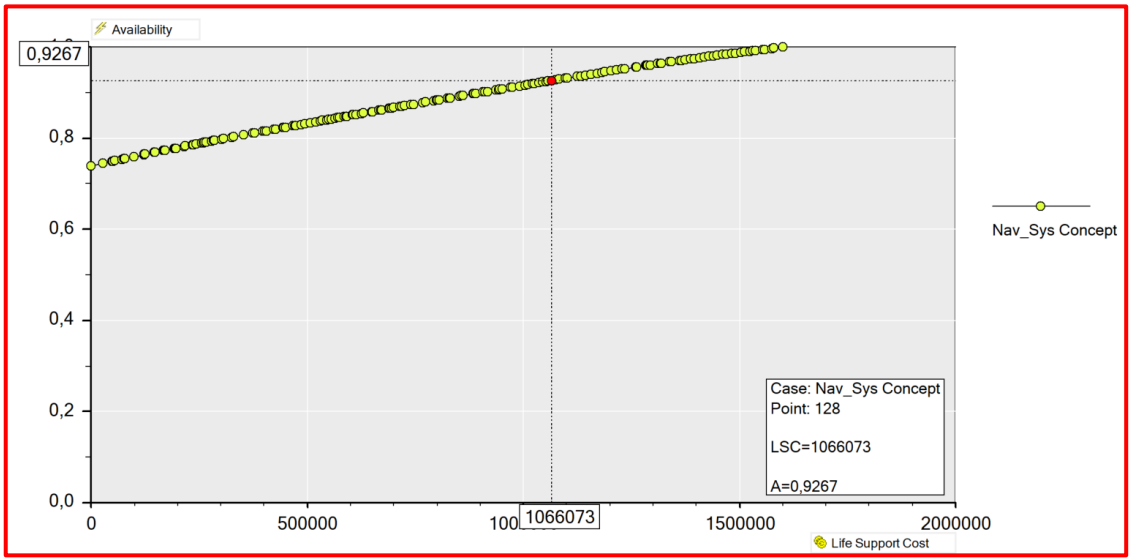
	UTLID	UTIL	MRT	IDISP	NOTE
	Utilization profile identifier	Utilization per calendar time [1/Year] <8760,00>	Missions per calendar time [1/Year]	Initiation distribution pattern <EQUIDIST>	User note
1	NPA_OP_PROF	730,00	1,00	EQUIDIST	

Task

	TID	DESCR	TYPE	COST	LEVLID	DURN	NOTE
	Task identifier	Description	Task type <RECTIFY>	Direct cost per task <0,00>	Maintenance level identifier	Duration [Hours]	User note
1	ITEM_REPLACE		REPLACE		OLM	0,5	
2	ITEM_REPAIR		RECTIFY		DLM	2920,0	



System steady-state calculation results

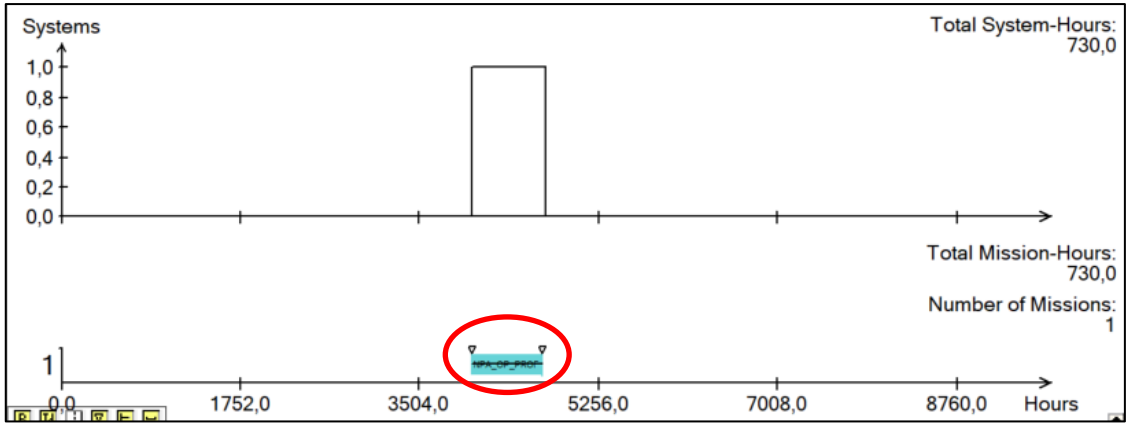


Reliability_System

	SID	MTBF	MIDRT	RPAPY	AINHE	MUTIL
	System identifier	Mean op time between failure [Hours]	Mean item demand rate [1/MHour]	Repair actions per year	In-herent avail-ability	Mean util-ization factor
1	NAV_SYS	1397,61	59,63	0,522	1,0000	0,083

- Concept design model provides: **MTBF = 1397,61 h** (715,56 fpmh) < 1403,69 h
- The predicted MTBF attribute is very close the requirement, however a small refinement of the allocated failure rates is necessary (- 3 fpmh).

SIMLOX simulation assuming no-spares (1)

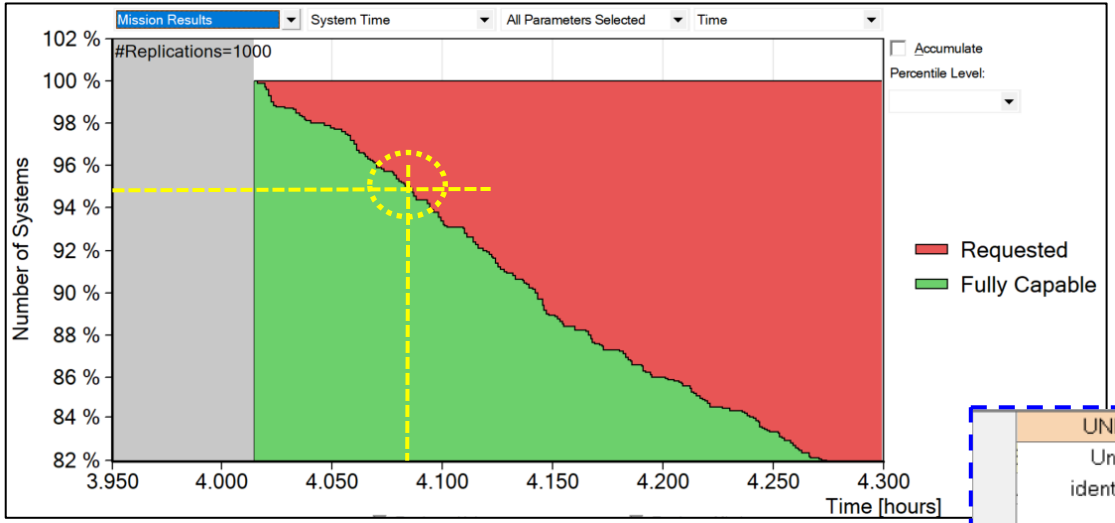


Control				
NREPS	Number of replications		<1>	1000
SIMPE	Simulation period	[Hours]		8760,0
RSEED	Random seed			16807
APID	Allocation point identifier			
RCINT	Result collection interval	[Hours]	<24,0>	1,0
RCSTA	Result collection start time	[Hours]	<0,0>	4014,0
RCEND	Result collection end time	[Hours]		4745,0

- SIMLOX *"Operation Profile View"* sets the shown default window for the one month mission time.

- Let's set the *"Control"* table to collect simulation results with 1 hour interval during the whole mission period of 730 consecutive hours to verify at which time limit the simulation confims fraction of mission fully capable before statistical value decreases below 0,95.

SIMLOX simulation assuming no-spares (2)



- Detailed result collection shows that MTF = 0,95 is achieved after 70 hours, thus confirming that a small adjustment of the allocated failure rates is necessary to satisfy the requirements.

	UNID Unit identifier	MTID Mission identifier	STINT Start Time interval [Hours]	ETINT End Time interval [Hours]	MTREQ Mission time requested [Hours]	MTFC Mission time fully capable [Hours]	MTF Mission time fraction
68	Total over all Units	Total over all Missions	4081,00	4082,00	1,00	0,95	0,952
69	Total over all Units	Total over all Missions	4082,00	4083,00	1,00	0,95	0,951
70	Total over all Units	Total over all Missions	4083,00	4084,00	1,00	0,95	0,950
71	Total over all Units	Total over all Missions	4084,00	4085,00	1,00	0,95	0,950
72	Total over all Units	Total over all Missions	4085,00	4086,00	1,00	0,95	0,949
73	Total over all Units	Total over all Missions	4086,00	4087,00	1,00	0,95	0,947

Further evaluations by means of SIMLOX (1)

- More detailed results collection model is adopted to analyze results about the first segment of three days of the nominal mission defined as *"Mission Type = Operation_Phase_1"*

OperationProfile

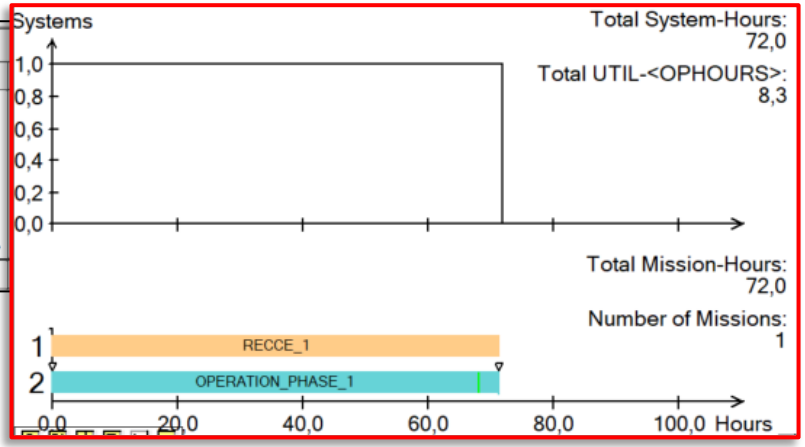
	PRID	SPRID	STIM	DURN	DURND	ITYPE	IQTY	IQTYD	IPER	IDISP	DTIM	NOTE
	Profile identifier	Subprofile identifier	Start time [Hours]	Mission duration [Hours]	Mission duration distribution	Initiation type <SCHEDULED>	Initiation quantity <1>	Initiation quantity distr	Initiation period [Hours] <0,0>	Initiation distribution pattern <EQUIDIST>	Deferment time [Hours] <0,0>	User note
1	RECCE_1	OPERATION_PHASE_1	0,0	72,0					2000,0			

MissionType

	MTID	DESCR	NOS	MNOS	MNOSA	MSUCPT	TFOUT	TFRET
	Mission type identifier	Description	Nominal number of systems	Minimum number of systems	Minimum number of systems abort	Mission success point <1,0>	Mission out time fraction <0,000>	Mission return time fraction <0,000>
1	OPERATION_PHASE_1		1	1				

Operations

	USTID	PRID	NOTE
	Unit, station or group identifier	Profile identifier	User note
1	SHIP	RECCE_1	



Detailed results collection settings

ResultCollection

	RTYPE	RCINT	RCSTA	RCEND	RCPID	NOTE
	Result type	Result collection interval [Hours]	Result collection start time [Hours]	Result collection end time [Hours]	Result collection profile identifier	User note
1	MISSION				DAY_3_RC_PROF	
2	SYSTEM				DAY_3_RC_PROF	

- Further analysis of the new system concept can be performed by checking detailed results with 1 hour step for the 3 days mission phase which is demanding the system requirement.

ReplicationResultControlMission

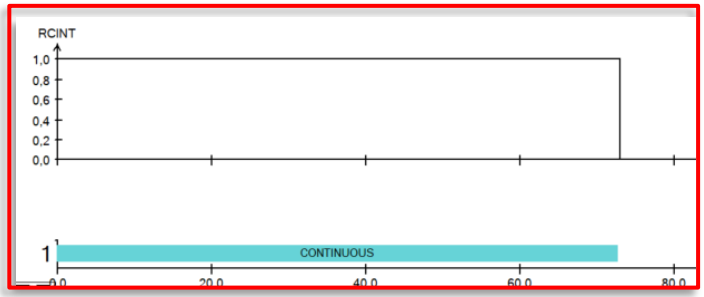
	MTID	USTID	TOTAL	TIME	SNAPS	NOTE
	Mission type identifier	Unit or station identifier	Store total <N>	Store time <N>	Store snapshots <N>	User note
1	OPERATION_PHASE_1	SHIP		Y		

ReplicationResultControlSystem

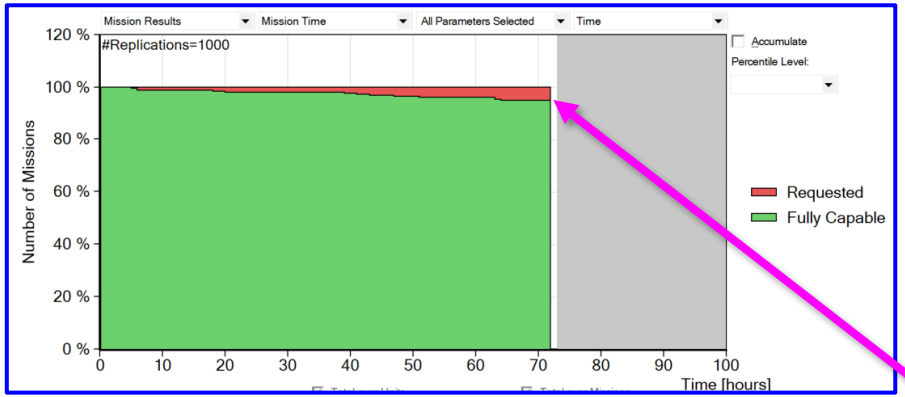
	SID	USTID	TOTAL	TIME	SNAPS	NOTE
	System identifier	Unit or station identifier	Store total <N>	Store time <N>	Store snapshots <N>	User note
1	NAV_SYS	SHIP		Y		

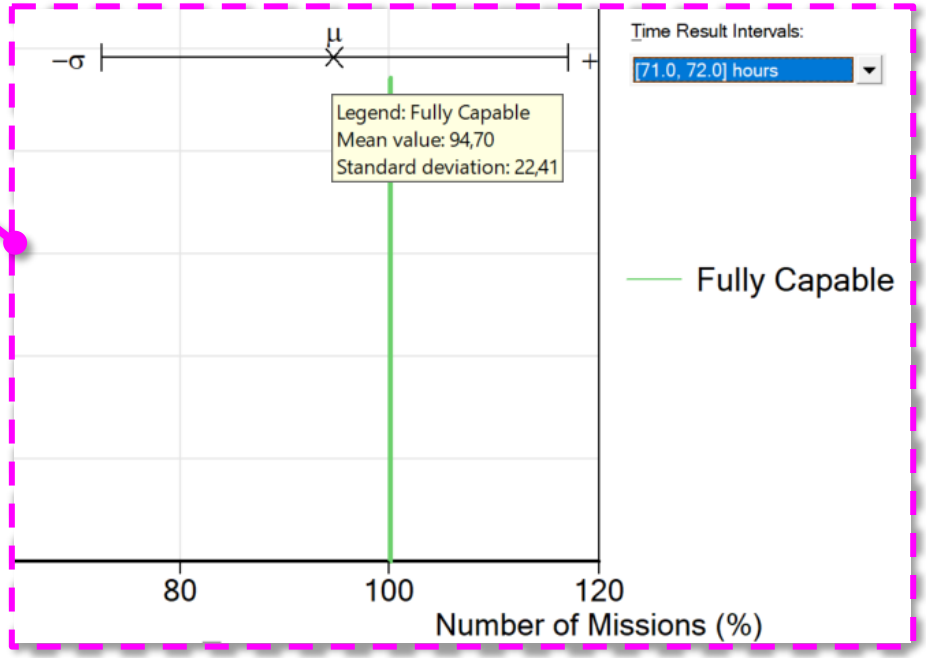
ResultCollectionProfile

	RCPID	SRCPID	STIM	IQTY	IINT	RCINT	DURN	NOTE
	Result collection profile identifier	Sub result collection profile identifier	Start time [Hours]	Initiation quantity <1>	Initiation interval [Hours]	Result collection interval [Hours]	Duration of collection period [Hours]	User note
1	DAY_3_RC_PROF	CONTINUOUS	0,0			1,0	73,0	



Detailed results collection view for a 72 h limited mission





- Watching the results in the last hour of the ″Operation_Phase_1″ (namely time interval 71,0 to 72,0) over a simulation of 1000 missions, the average mean result of 94,70% is confirmed.

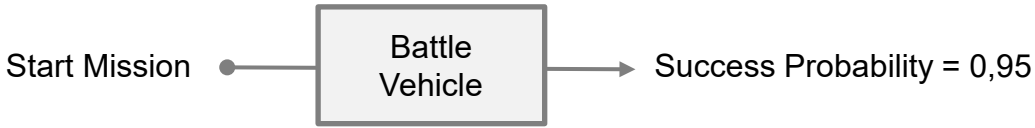
- Above result confirms that for 947 out of 1000 replications, the requirement is achieved,

Case 2 for Opus Suite Modeling

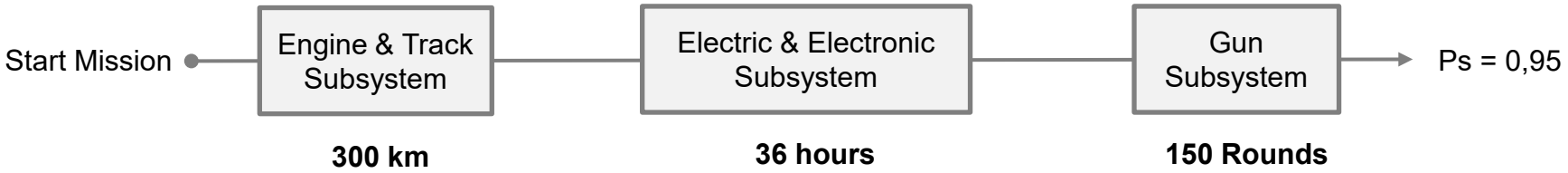
- **Army Battle Vehicle Concept Phase Design Metrics**

Example of system top level specification requirement

- *A new **Battle Vehicle** is required with "Probability of 95%" of not having failures for **36** hours of continuous operation.*
- *Operational concept analysis indicates that during 36 hours of operation the **Battle Vehicle** runs 300 km and fires 150 Rounds with the "Gun Subsystem".*



- The basic model of the ***Battle Vehicle*** to satisfy concept requirements is as illustrated. Each major Subsubsystem has a proper operation parameter (OPID) as identified in the Opus_Suite modeling:



Concept requirements analysis and subsystems apportionment (1)

- System requirement implies that equivalent failure rate (λs) to achieve the required probability of success of the ***Battle Vehicle*** is, assuming the shape factor = 1:

$$P_s = e^{-\lambda_s \bullet 36} \Rightarrow \lambda_s = 0{,}00142481373$$

- Above implies that *System Key Sustainment Attribute (KSA)* is achieved with:

MTBF = 701,85 hours and ***FRT = 1424,81377 fpmh.***

- The three Subsystems are different, it is not possible to determine relative weight from concept point of view as for the Case 1, therefore the best preliminary solution is to assume that they have the same weight in three different technology areas and the probability of success is equally allocated so that the following relationships applies:

$$P_1 = P_2 = P_3 = \sqrt[3]{0{,}95} = 0{,}98305$$

Concept requirements analysis and subsystems apportionment (2)

- Definition of system failure rates KSA vs the individual subsystems parameters identifiers are as follows:

$$P_1 = 0{,}98305 = e^{-\lambda_1 \bullet 300}$$

Required distance run between failure = $1/\lambda_1$ = 5,7133E-5

$$P_2 = 0{,}98305 = e^{-\lambda_2 \bullet 36}$$

Required interval between failure = $1/\lambda_2$ = 0,00047627

$$P_3 = 0{,}98305 = e^{-\lambda_3 \bullet 150}$$

Required rounds between failure = $1/\lambda_3$ = 0,000114306

Concept requirements analysis and subsystems apportionment (3)

- Summary parameters values apportioned to the three subsystems are as follows:

Subsystem	OPID (OPUS10)	Probability of Success (Pi)	Logarithm, natural, of Pi	Utilization Profile	Failure Rate (λ)	Required KSA	MOPID (OPUS10)
Engine & Track	km	0,98305	0,017146	300 km	5,6984E-5	MDBF = 17’548,7 km	56,9843
Electric & Electronic	OPHOURS	0,98305	0,017146	36 hours	0,000474869	MTBF = 2’105,84 h	474,870
Gun	Rounds	0,98305	0,017146	150 rounds	0,000113968	MRBF = 8’774,344	113,968

- MDBF = Mean Distance-run Between Failures
- MTBF = Mean Time Between Failures
- MRBF = Mean Rounds Between Failures

Assumptions for cost breakdown

- Assuming that the new Battle Vehicle shall be competitive on the market, a single unit price shall be not more than 3,5 millions of Euro. Typical price apportionment among the main subsystems for that type of vehicles is assumed as follows:

	Engine & Track	Electric & Electronic	Gun
Relative Cost percentage	**61%**	**18%**	**21%**
Price apportionment	**2'135'000 Euro**	**630'000 Euro**	**735'000**

- Technical evaluations suggest that *"Engine & Track"* components parameters values spread is high compared to the *"Electric & Electronic"* subsystem.

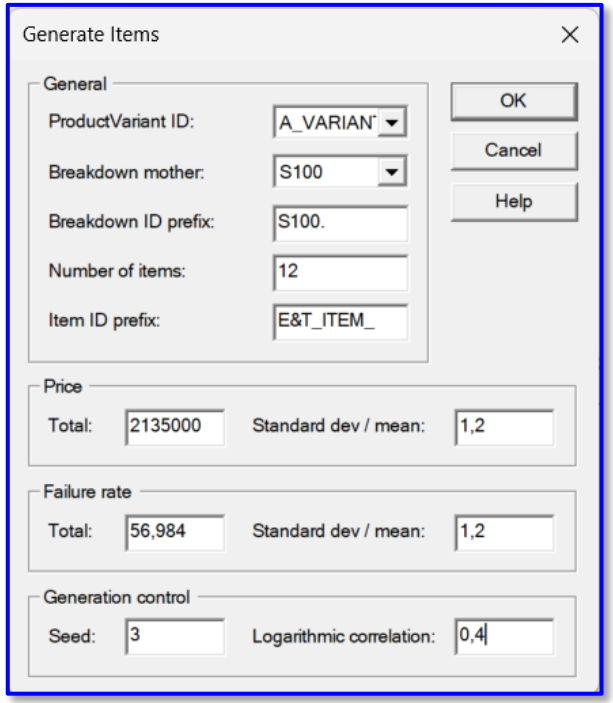
Summary of parameters for items generation by means of OPUS10

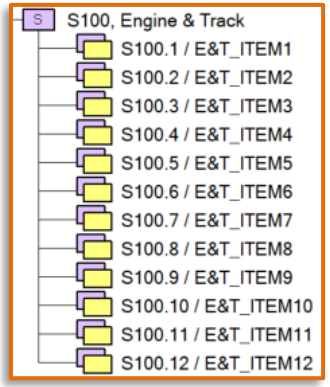
- Summary of supportability parameters and cost values related with the related statistical profiles is:

Subsystem	OPID (OPUS10)	Failure Rate (λe-6)	MOPID (OPUS10)	Number of Items	FRT Std Dev/Mean (σ/μ)	Subsystem Cost (Euro)	Cost Std Dev/Mean (σ/μ)	Correlation Index
Engine & Track	km	56,984 fpmkm	56,9843	12	1,2	2'135'000	1,2	0,4
Electric & Electronic	OPHOURS	474,869 fpmh	474,870	7	0,7	630'000	0,7	0,8
Gun	Rounds	113,968 fpmr	113,968	5	0,8	735'000	1,2	0,6

- Model is implemented in the file *"Combat_Vehicle.opi"*

“Engine & Truck” subsystem requirements breakdown allocated by OPUS10





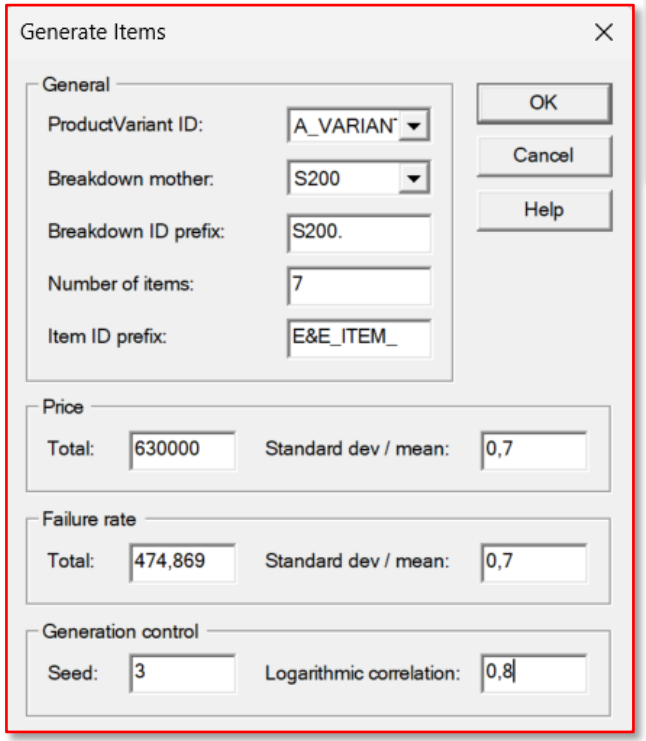
Item

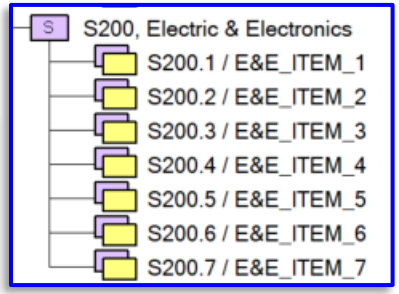
	IID Item identifier	DESCR Description	PRICE Price	TLLEN Technical life length [Years]	UTXT User define text
1	E&T_ITEM1		147435,955		
2	E&T_ITEM2		79044,916		
3	E&T_ITEM3		59039,451		
4	E&T_ITEM4		223838,499		
5	E&T_ITEM5		418841,110		
6	E&T_ITEM6		134817,835		
7	E&T_ITEM7		382644,112		
8	E&T_ITEM8		24021,408		
9	E&T_ITEM9		250741,614		
10	E&T_ITEM10		106967,902		
11	E&T_ITEM11		156151,137		
12	E&T_ITEM12		151456,062		

FailureRate

	FRID Failure identifier	OPID Operation parameter identifier	FRT Failure rate [1/MOPIDs]	NOTE User note
1	FAILURE_E&T_ITEM1	KM	2,27	
2	FAILURE_E&T_ITEM2	KM	8,43	
3	FAILURE_E&T_ITEM3	KM	4,43	
4	FAILURE_E&T_ITEM4	KM	0,92	
5	FAILURE_E&T_ITEM5	KM	4,32	
6	FAILURE_E&T_ITEM6	KM	9,49	
7	URE_E&T_ITEM7	KM	4,75	
8	URE_E&T_ITEM8	KM	1,28	
9	URE_E&T_ITEM9	KM	1,42	
10	URE_E&T_ITEM10	KM	9,42	
11	URE_E&T_ITEM11	KM	2,70	
12	URE_E&T_ITEM12	KM	7,54	

“Electric & Electronic” subsystem requirements breakdown allocated by OPUS10





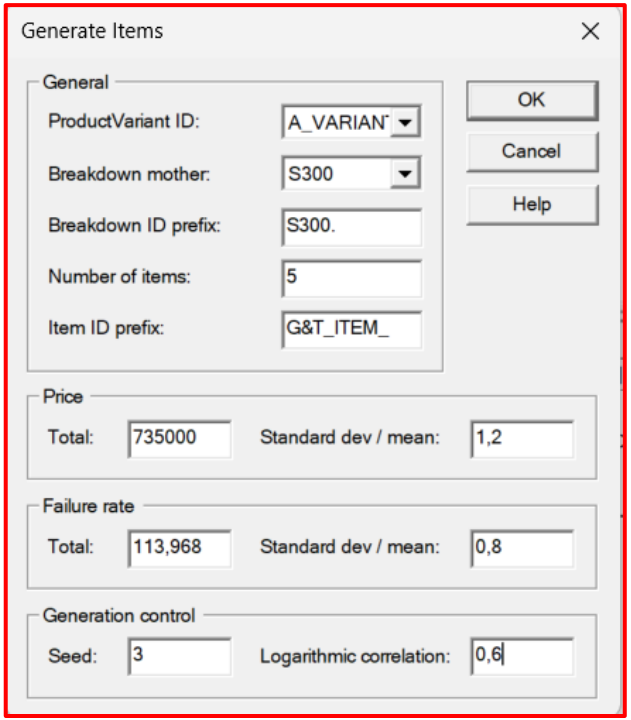
Item

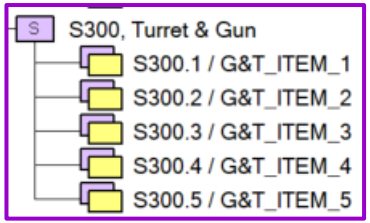
	IID Item identifier	DESCR Description	PRICE Price	TLLEN Technical life length [Years]	UTX User defi te
13	E&E_ITEM_1		75291,728		
14	E&E_ITEM_2		49628,456		
15	E&E_ITEM_3		40831,452		
16	E&E_ITEM_4		99538,240		
17	E&E_ITEM_5		151332,613		
18	E&E_ITEM_6		70919,739		
19	E&E_ITEM_7		142457,771		

FailureRate

	FRID Failure identifier	OPID Operation parameter identifier	FRT Failure rate [1/MOPIDs]	NOTE User note
13	FAILURE_E&E_ITEM_1	<OPHOURS>	48,23	
14	FAILURE_E&E_ITEM_2	<OPHOURS>	68,40	
15	FAILURE_E&E_ITEM_3	<OPHOURS>	46,44	
16	FAILURE_E&E_ITEM_4	<OPHOURS>	37,73	
17	FAILURE_E&E_ITEM_5	<OPHOURS>	92,97	
18	FAILURE_E&E_ITEM_6	<OPHOURS>	87,26	
19	FAILURE_E&E_ITEM_7	<OPHOURS>	93,84	

“Gun & Turret” subsystem requirements breakdown allocated by OPUS10





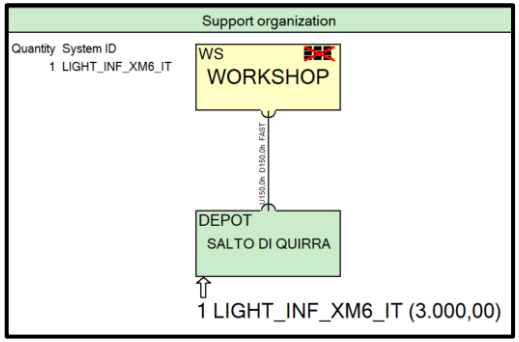
Item

	IID Item identifier	DESCR Description	PRICE Price	TLLEN Technical life length [Years]	UTX Use defin tex
20	G&T_ITEM_1		116747,937		
21	G&T_ITEM_2		62592,132		
22	G&T_ITEM_3		46750,700		
23	G&T_ITEM_4		177247,693		
24	G&T_ITEM_5		331661,537		

FailureRate

	FRID Failure identifier	OPID Operation parameter identifier	FRT Failure rate [1/MOPIDs]	NOTE User note
20	FAILURE_G&T_ITEM_1	FIRE ROUNDS	16,69	
21	FAILURE_G&T_ITEM_2	FIRE ROUNDS	34,81	
22	FAILURE_G&T_ITEM_3	FIRE ROUNDS	21,68	
23	FAILURE_G&T_ITEM_4	FIRE ROUNDS	10,02	
24	FAILURE_G&T_ITEM_5	FIRE ROUNDS	30,76	

Operative and maintenance scenario



Task

	TID Task identifier	DESCR Description	TYPE Task type <RECTIFY>	COST Direct cost per task <0,00>	LEVLID Maintenance level identifier	DURN Duration [Hours]	NOTE User note
1	S100_REPLACE		REPLACE		LEVEL_1	2,0	
2	S100_REPAIR		RECTIFY		LEVEL_3	1500,0	
3	S200_REPLACE		REPLACE		LEVEL_1	2,0	
4	S200_REPAIR		RECTIFY		LEVEL_3	1500,0	
5	S300_REPLACE		REPLACE		LEVEL_1	2,0	
6	S300_REPAIR		RECTIFY		LEVEL_3	1500,0	

UtilizationRate

	UTLID Utilization profile identifier	OPID Operation parameter identifier	UTIL Utilization per calendar time [1/Month]	NOTE User note
1	BATTLE VEHICLE OP_PROF	FIRE ROUNDS	750,00	
2	BATTLE VEHICLE OP_PROF	KM	1500,00	

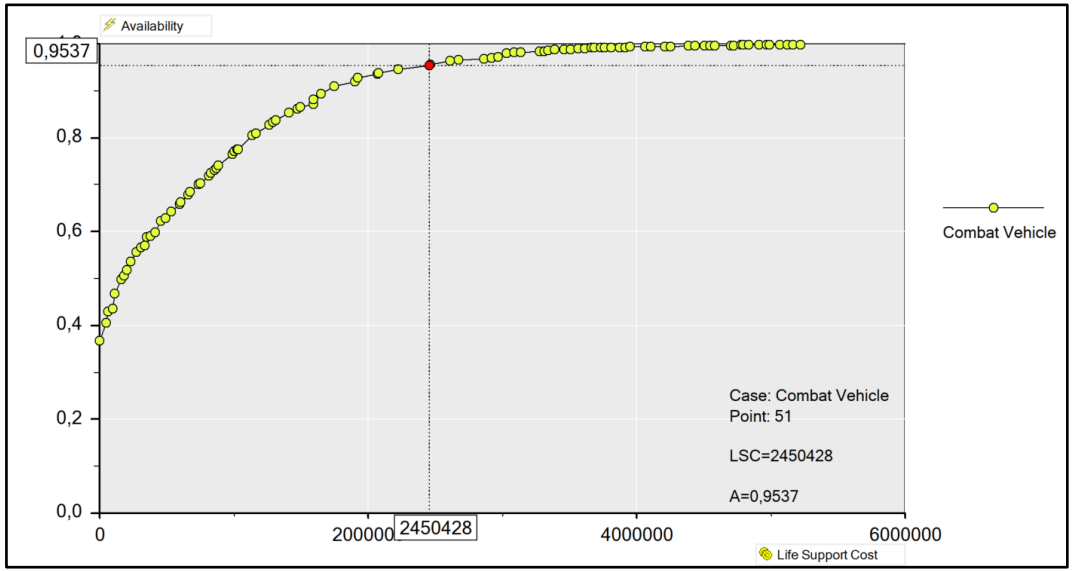
MaintenanceCapability

	COGID Component group identifier	SGID Station group identifier	LEVLID Maintenance level identifier (inclusive)	ENDBL Endurance blocked (inclusive) <Y>	NOTE User note
1	VARIANTS	SALTO DI QUIRRA	LEVEL_1		
2	S100_ITEM_GROUP	WORKSHOP	LEVEL_3		
3	S200_ITEM_GROUP	WORKSHOP	LEVEL_3		
4	S300_ITEM_GROUP	WORKSHOP	LEVEL_3		

UtilizationProfile

	UTLID Utilization profile identifier	UTIL Utilization per calendar time [1/Month] <730,00>	MRT Missions per calendar time [1/Month]	IDISP Initiation distribution pattern <EQUIDIST>	NOTE User note
1	BATTLE VEHICLE OP_PROF	250,00	5,00	EQUIDIST	

Design concept verification by OPUS10 to ascertain feasibility



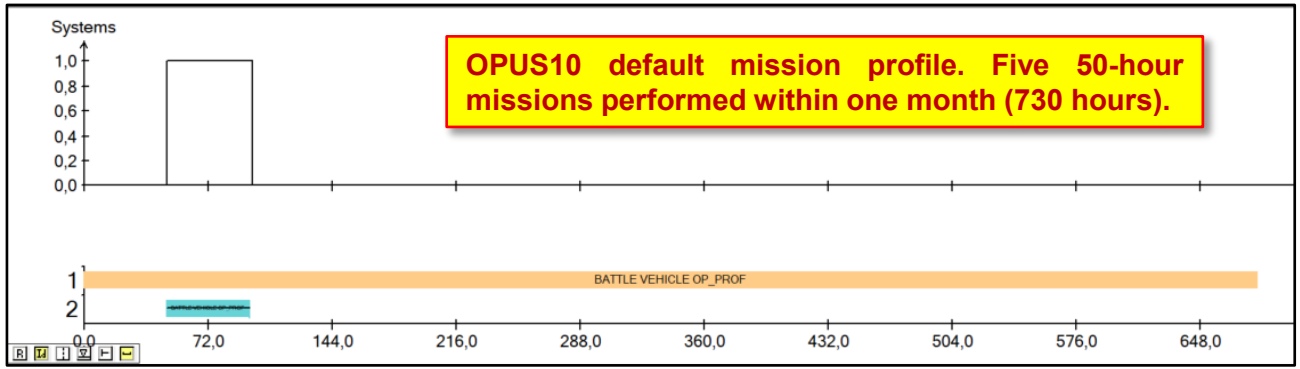
	SID System identifier	MTBF Mean op time between failure [Hours]	MIDRT Mean item demand rate [1/MHour]	AINHE In-herent avail-ability	MUTIL Mean util-ization factor
1	LIGHT_INF_XM6_IT	701,95	351,27	0,9993	0,247

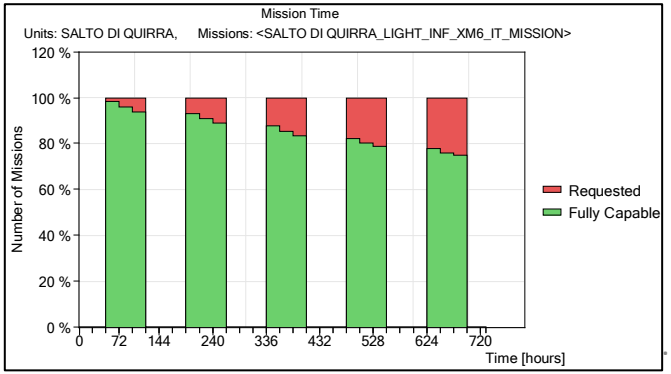
Basic requirements was Probability of Success (Ps ≥ 0,95 after 36 hours of mission) which implies MTBF = 701,85 hours.

OPUS10 model calculation has verified that the subsequent allocated R&M requirements and Costs are balanced for a feasible project.

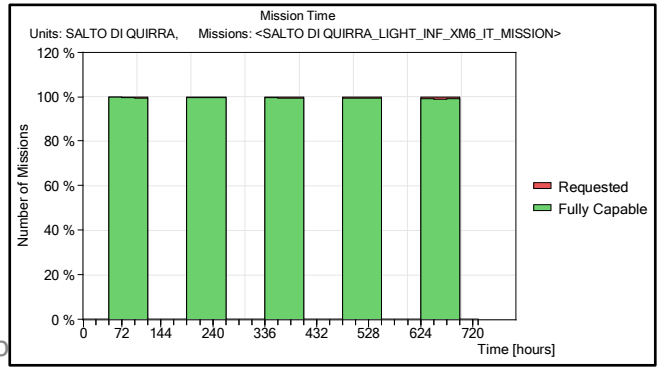
Model verification using SIMLOX

- Model is tested by using SIMLOX by assuming the utilization profile adopted for OPUS10 analysis for one month of operation consisting of five missions of 50 hours each, no replacement is allowed, therefore degradations are not restored.





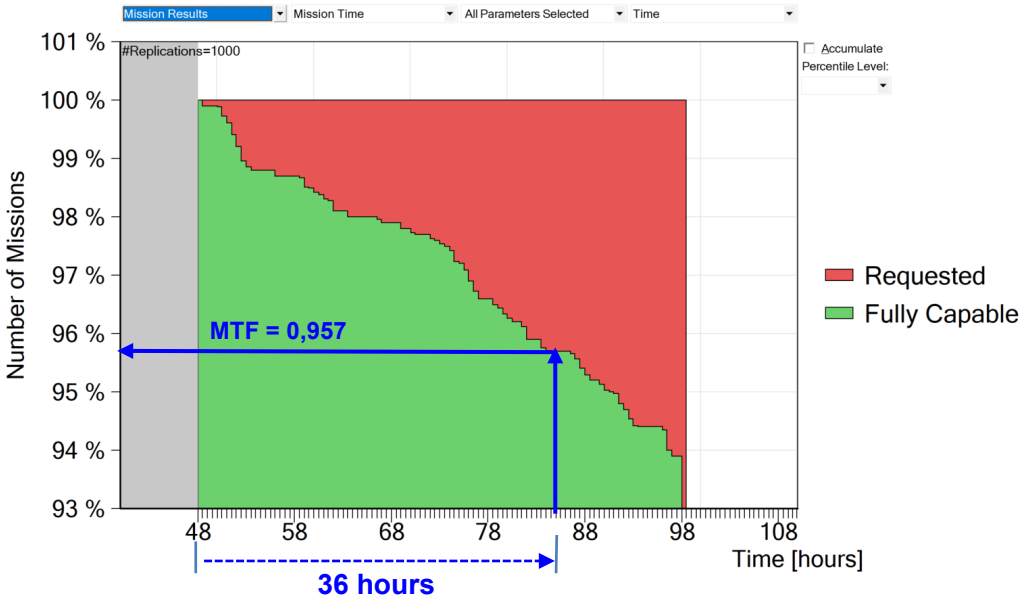
Mission result No spares mission result.



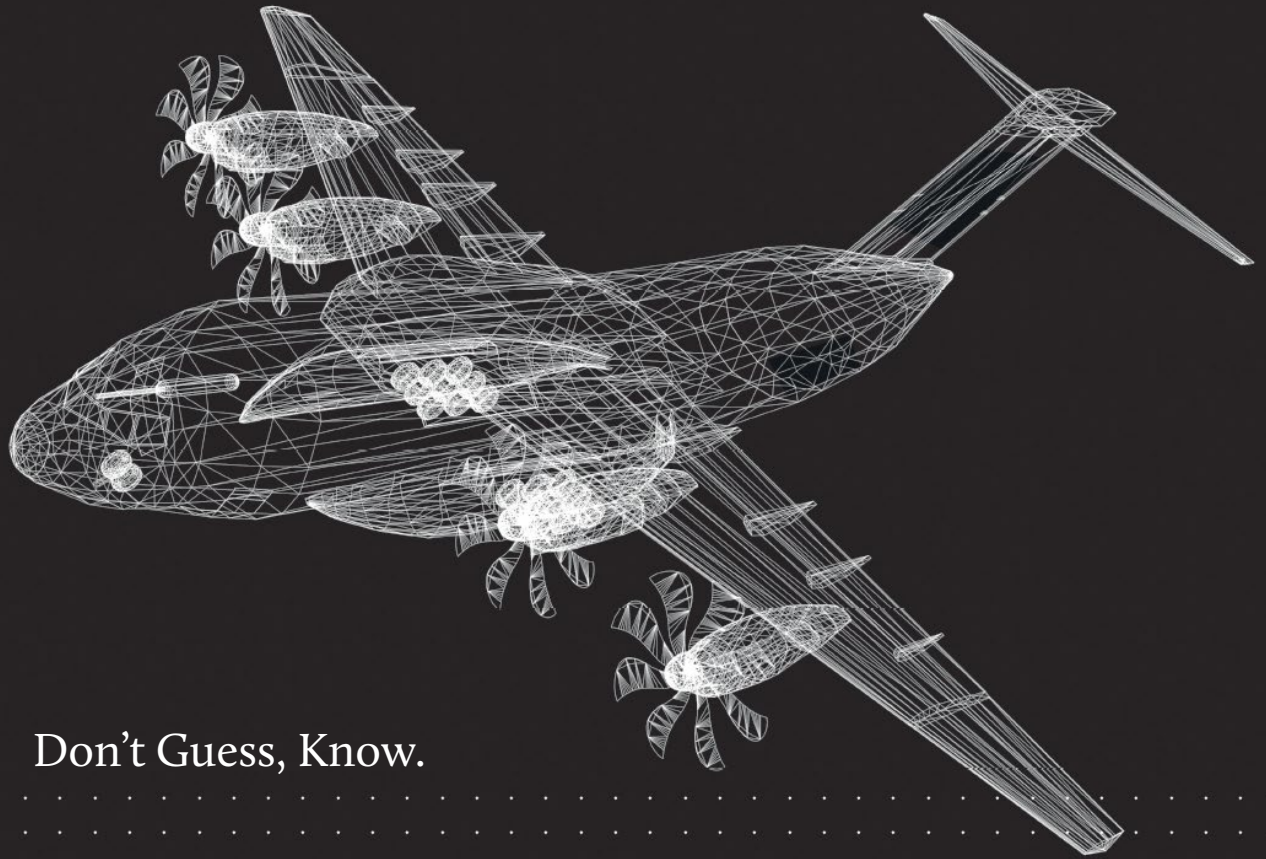
Mission result if spares are available to repair system failures.

Model verification using SIMLOX

- Monte Carlo simulation over 1000 iterations provides statistical average mission time fraction accomplishment as illustrated: *apportioned configuration of the Combat Vehicle satisfies the requirements*



Thank You
for
Your Attention



Don’t Guess, Know.