Abstract

- At the pre-concept and concept phases of a project the nature of the solution is varied and the number of options numerous. There are many ways to satisfy the capability need. At this point the estimating accuracy is such that the output tolerance is broad.
- As the project moves into the concept and assessment phases the feasibility studies begin to produce more information for the purpose of estimating and the number of options starts to reduce. Now the estimating tolerance starts to reduce.
- In a hybrid cost estimating framework solution it is possible to migrate from a macro cost model to a micro cost model without need for training or skills. The framework is able to accommodate a change in estimating model without amendment.
- If necessary it is possible to apply both macro and micro-parametrics together to estimate the project solutions.

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Dale Shermon

- QinetiQ Fellow | Management Consultant - Cost
- BA Degree in Technology, Open University
- ACCA Diploma in Accounting and Finance (C Dip (A&F))
- ICEAA Certified Cost Estimator / Analyst with the Parametric Specialism (CCEA-P)
- Chartered Engineer with Institution of Engineering and Technology (IET)
- Council member and Fellow of the Association of Cost Engineers (FACostE)
- Chairman and member of the board of the Society for Cost Analysis and Forecasting (SCAF)
- Life member of International Cost Estimating and Analysis Association (ICEAA) and recipient of the Frank Freiman award
- Member of Association of Project Managers (MAPM)
- Co-author of "*Cost Engineering Health Check: How good are those numbers?*", 2017, ISBN: 978-1-4724-8407-9
- Contributor to "*Aspects of Complexity: Managing Projects in a Complex World*", as author of Chapter six "*The Impact of Complexity on Project Cost and Schedule Estimates*", 2011, ISBN: 978-1-935589-30-3
- Editor and major contributor of "*Systems Cost Engineering*" , July 2009. ISBN: 978-0-566-08861-2

QINETIQ

Hybrid cost estimating: the union of macro and micro-parametrics

Dale Shermon – QinetiQ Fellow
Managing Consultant

International Cost Estimating and Analysis Association (ICEAA)
Tampa, 14th to 17th May 2019
QINETIQ/19/00553

QINETIQ

Agenda

Caveat – all figures and analysis are for presentation purposes only!

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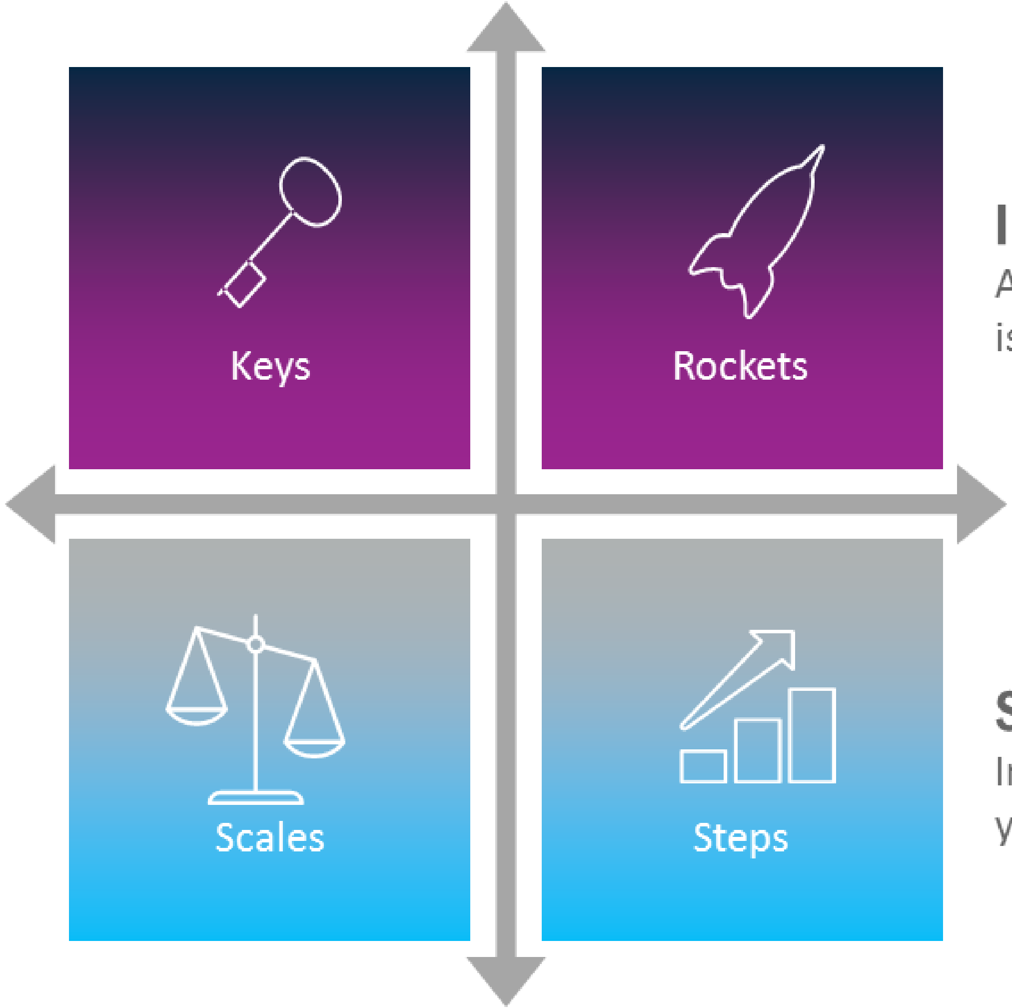
Advisory Services

Business change

Transformational consulting
Unlocking the potential in your organization

Innovative consulting
Assessing technology change is not rocket science



Technology change

Business as Usual
Deciding on the option to take in these times of change

Strategic consulting
Incremental process change in your organization

QinetiQ Advisory services

Introduction of parametric modelling

- CFO introduction of parametric cost estimating to enable high level review of budgets and generate independent cost estimates (ICE)

Strategic Consulting

Canada Treasury Board Secretariat cost maturity assessment

- Workshop for four government departments to benchmark their cost estimating maturity and make improvement recommendations

Transformation Consulting

CCG Fleet Review

- Created a robust audit trail and evidence for a revised Fleet Renewal Plan (FRP) 2017 across 119 vessels in 43 home ports of the Canadian Coast Guard (CCG)

Complex Decisions

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Macro versus micro parametrics

Macro versus Micro

[QinetiQ Proprietary]

Future characteristics of cost estimating models

- **Data**
  - Social media
  - Knowledge Managers
- **Tools**
  - COTS versus Bespoke
  - Visualisation
  - Macro-parametrics versus Micro-parametrics
  - Portable
- **People**
  - Professionalism
  - Emerging markets
  - Training
  - Fun
- **Process**
  - Independent Cost Estimating (ICE)
  - Learn from other disciplines
  - Proactive not Reactive

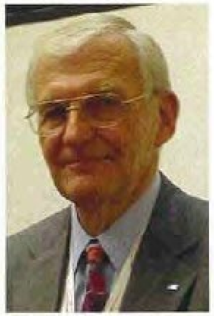
QinetiQ ispa SCEA The Society of Cost Estimating and Analysis

2012 CONFERENCE

(All Photos by Hank Apgar, except as noted)

Modeling Vision Panel

'Modeling Vision Panel' Developers — Hans Vonk, Herbert Spix, Dale Shermon, Doug Howarth, Dan Galorath, Tony Demarco



Hank Apgar, moderator for 'Modeling Vision Panel'

Panelists Herbert Spix, Dale Shermon

'Modeling Vision Panel' Users — Arno Rol, Marcel Smit, Michel van Pelt, Don MacKenzie

Source: ISPA SCEA conference Belgium, Modelling Vision Panel, Page 9, Parametric World, Summer 2012

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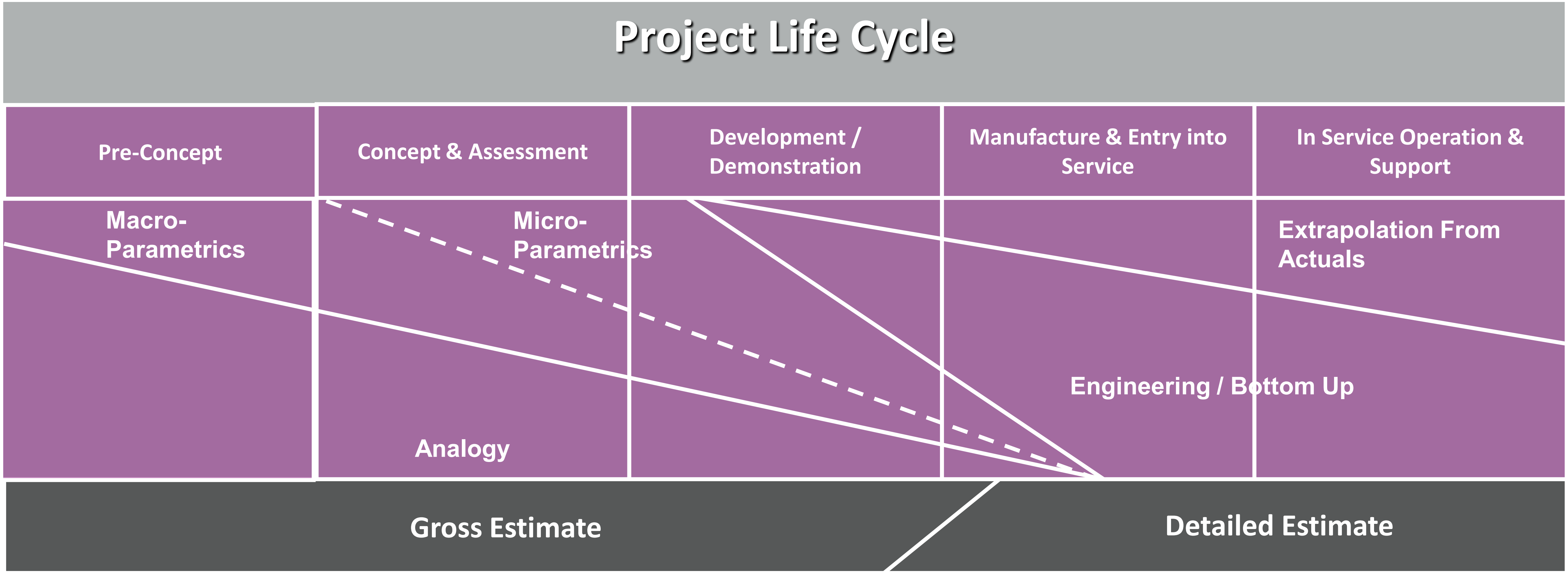
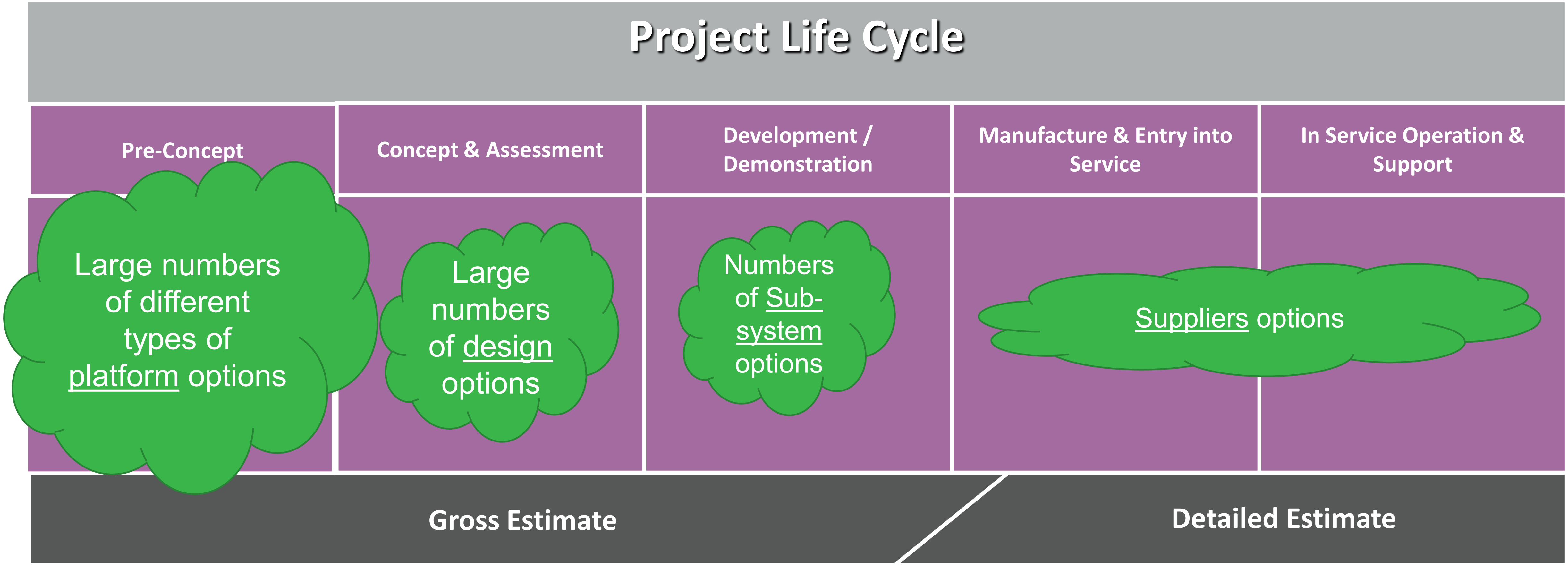
Cost Modelling Capability



Options process



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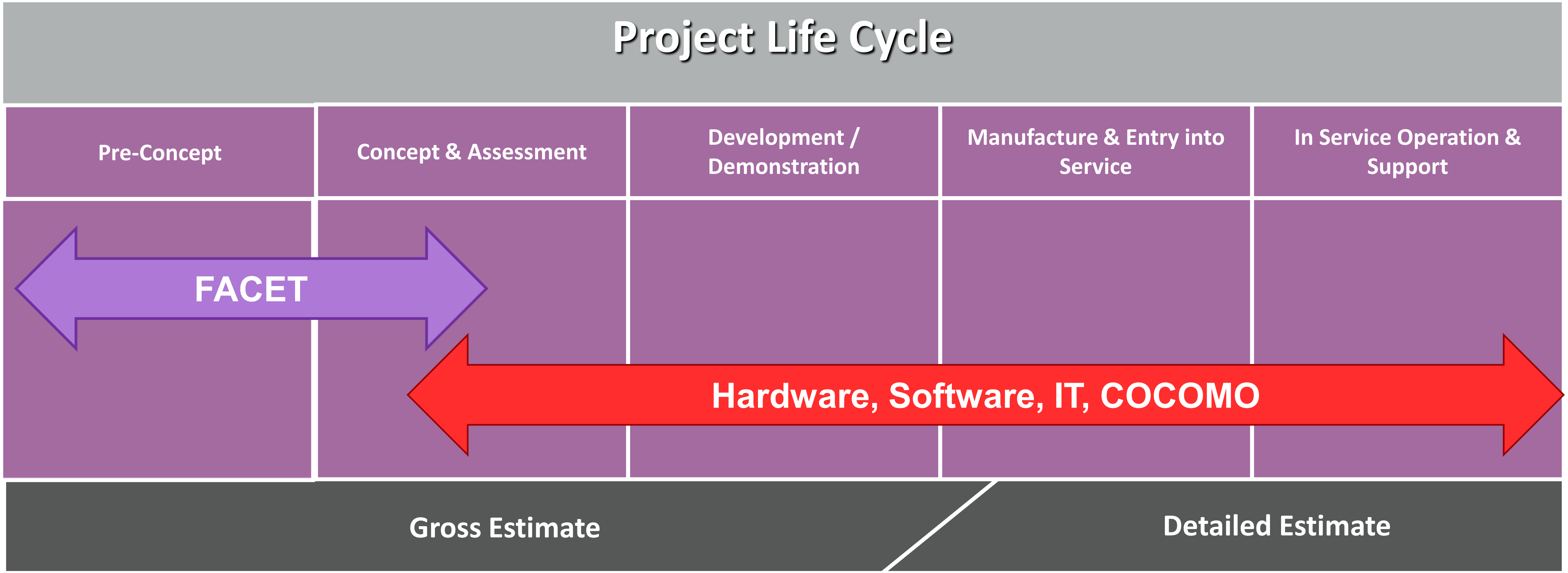
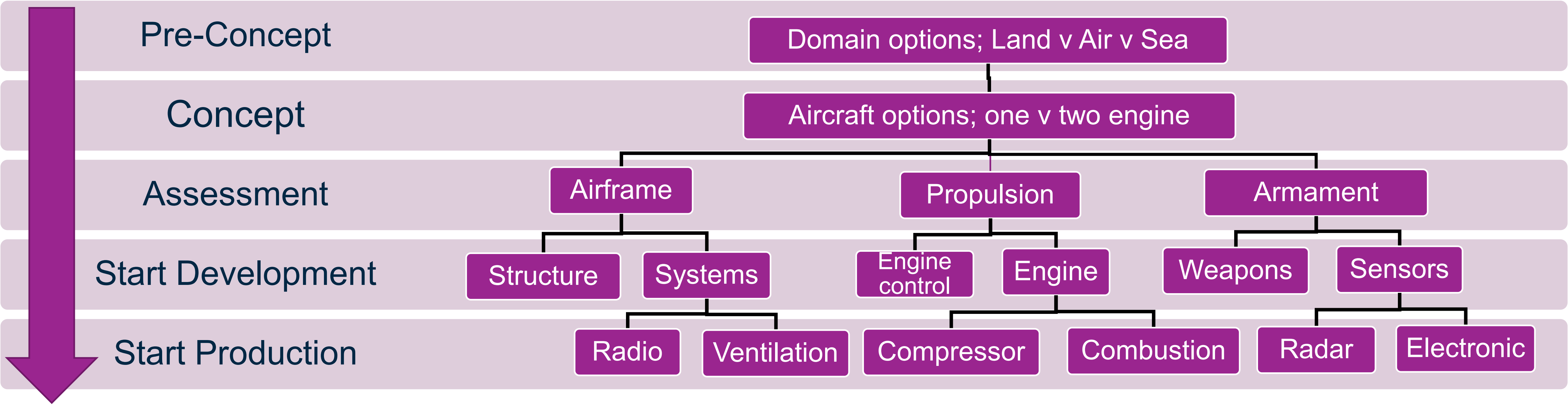
Cost Modelling Capability: complementary



Development of a capability breakdown



- As a project progresses in time and maturity the level of definition of the platform increases.
- Initially, there are multiple concepts which are competing to fill the gap
- Ultimately, there is a detailed Bill of Material which defines the complete system

Hybrid cost estimating

International Society of Parametric Analysts

Parametric Estimating Handbook©

Fourth Edition – April 2008

Benefits of Using Parametrics

The benefits of using parametrics are well documented. It is estimated that the savings to proposal preparation is between 40 percent and 80 percent as compared to the "normal" bottoms-up approach. Parametric tools and techniques have much more versatility than other estimating approaches. There are numerous reasons for this. Here are a few:

- Better estimates are provided, often in a matter of minutes;
- There exists a high-quality link between the technical and cost proposals;
- The data is well understood through the calibration and validation activities;
- It is much easier to estimate conceptual designs;
- Early costing cannot be done effectively any other way;
- No bill of material (BOM) is required;
- It is much easier to handle scope, technical, and performance changes.

Parametrics in Support of CMMI Certification

One of the emerging benefits of parametric estimating is in the Software Engineering Institute's (SEI's) Capability Maturity Model Integration (CMMI®) certification. CMMI is a process by which contractor organizations are evaluated against a standard set of process and business measures established by an Industry steering committee working through the auspices of Carnegie Mellon University. The intent is for contractor organizations to certify themselves against a selected CMMI model. There are many models to choose from depending on the type of organization and the type of products that they develop.

Obtaining a CMMI maturity level (1 to 5, with 5 being the highest) through the audit process provides the organization a measure of how mature and effective their processes and business practices are against the CMMI standards. The certifications are sought-after as discriminators in competing for new business opportunities. Chapter 6 discusses the application of CMMI principles to the software estimating environment.

The CMMI standards apply to the estimating process as well and highlight areas of the process where specific characteristics must be present to achieve certification. The higher the certification, the more rigorous the estimating process must be. Some of these characteristics are interpreted differently at different levels of certification, and by different auditors, but in general CMMI addresses the following estimating characteristics:

1. An estimating process must identify and employ a documented method for estimating software, hardware, and so forth including the use of work products and task attributes.

"the savings to proposal preparation is between 40% and 80% as compared to the "normal" bottom-up approach."

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American Association of Cost Engineers (AACE) - Cost Estimate Classification System

Primary Characteristic		Secondary Characteristic		
Estimate Class	Degree of Project Definition Expressed as % of complete definition	End Usage Typical purpose of estimate	Methodology Typical estimating method	Expected accuracy range Typical variation in low and high ranges
Class 5	0% to 2%	Concept, screening or feasibility	Capability factored, parametric models, judgement or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Concept study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorisation or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 70%	Control or bid / tender	Detailed unit cost with forced detailed take-off	L: - 5% to -15% H: +10% to +20%
Class 1	50% to 100%	Check estimate or bid / tender	Detailed unit cost with detailed take-off	L: -3% to -10% H +3% to +15%

Sources: AACE 96R-18, 18R-97, 17R-97

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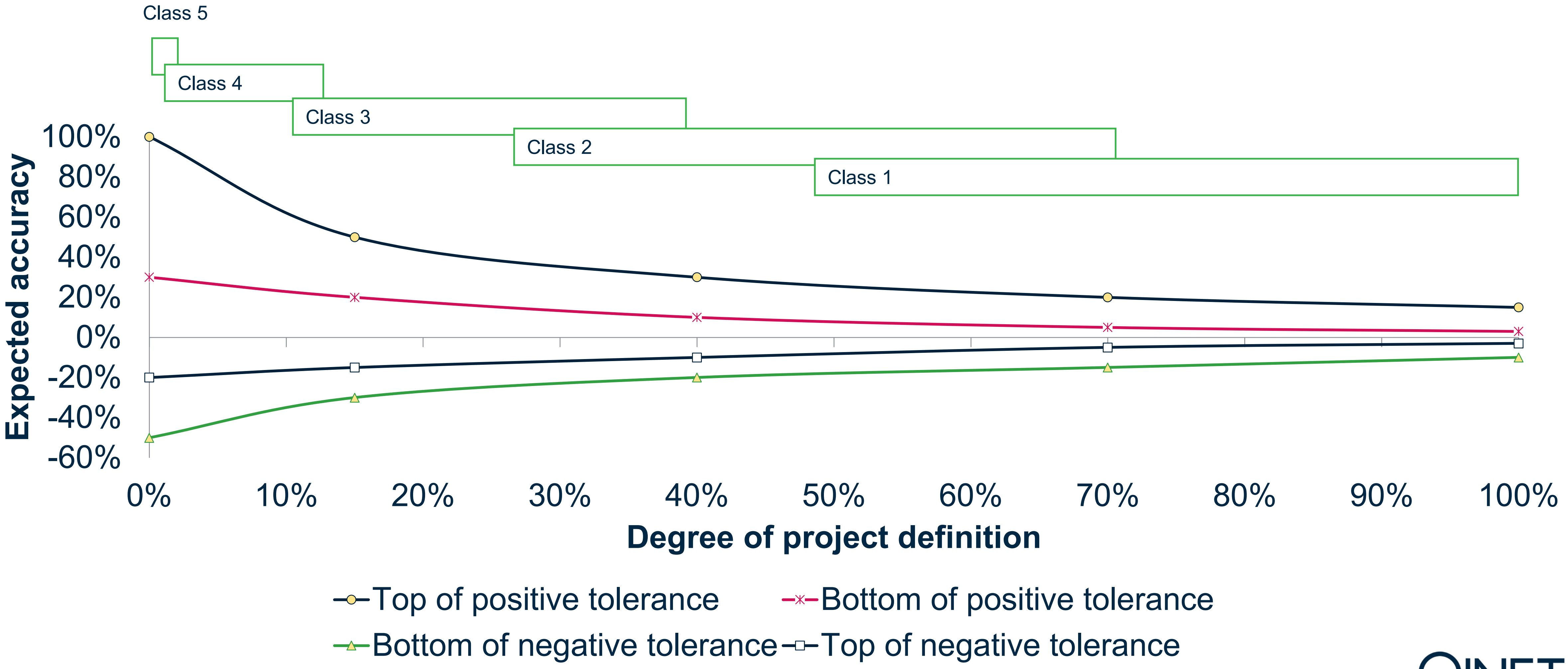
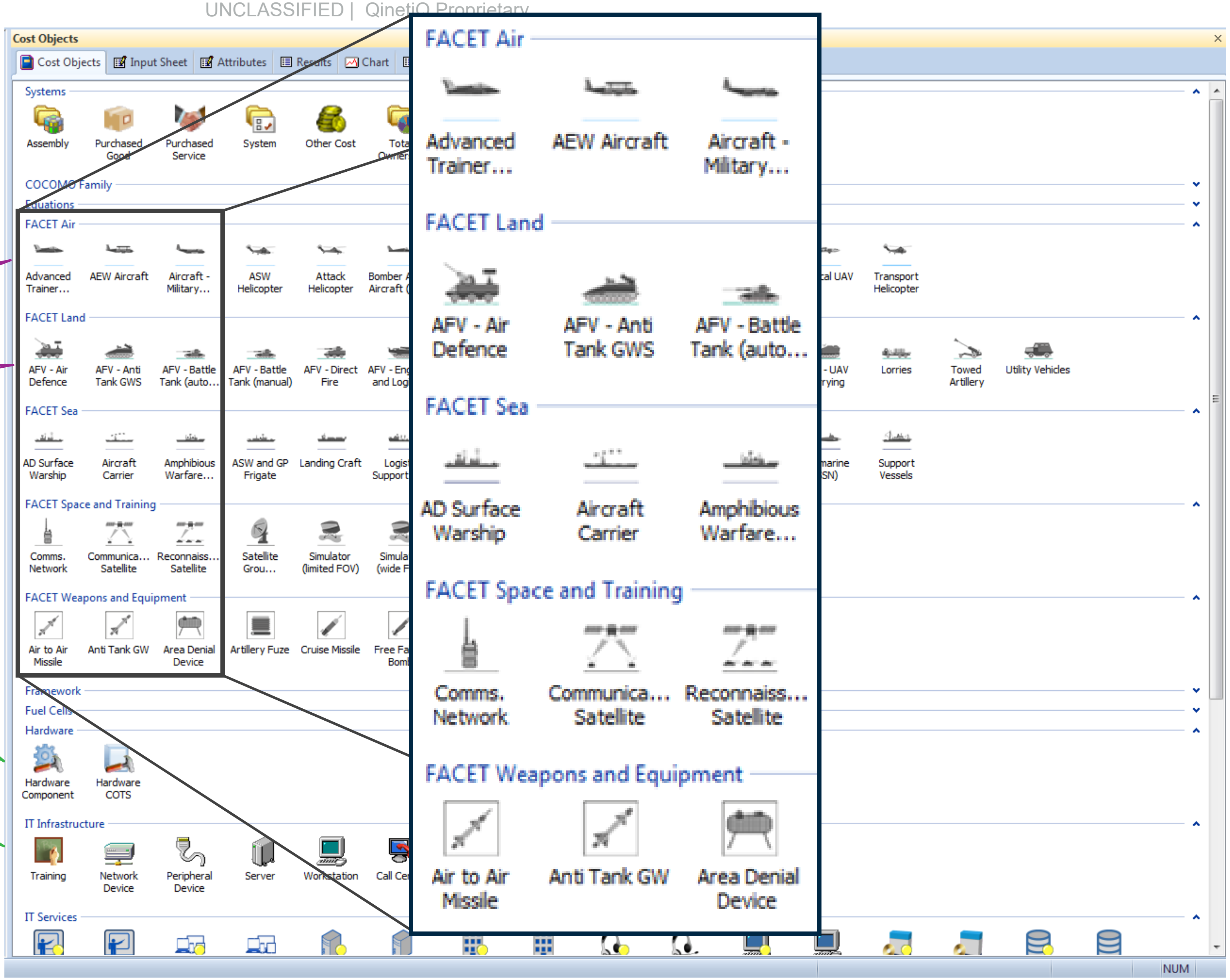
Cone or funnel of uncertainty



Hybrid cost estimating

Macro-parametrics – FACET

Micro-parametrics – Hardware, Software, IT



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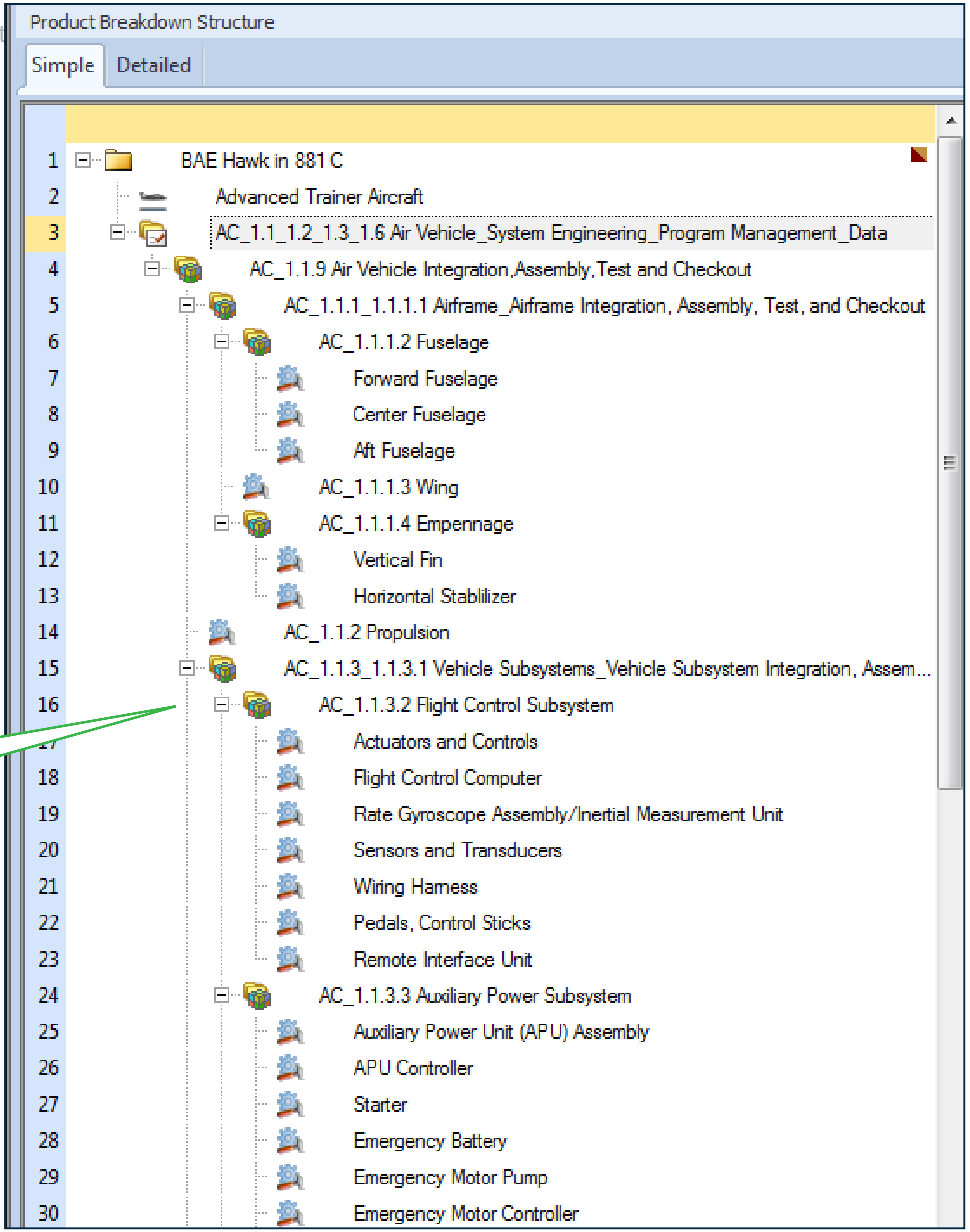
Case study - Advanced Trainer

Macro-parametric versus Micro-parametric Product Breakdown Structure (PBS)

One Platform specific item

Multiple hardware, software and IT items in a PBS



QINETIQ

Macro-parametric versus Micro-parametric
Input parameters

		Value	Pessimistic	Optimistic	Units
1	Start Date				
2	**Performance Data**				
3	Training Load	**3,484.00**	3,484.00	3,484.00	kg
4	Maximum Speed	**990.00**	990.00	990.00	km/hr
5	**Design Data**				
6	Basic Mass Empty	**4,481.00**	4,481.00	4,481.00	kg
7	Syllabus Code, SC	**2.00**	2.00	2.00	
8	**Technology Standard**				
9	Year	1990	1990	1990	
10	**Programme Data**				
11	Number of Participating Nations	1.00			
12	Percentage to be included in the estimate of Development	100.00%			%
13	Percentage to be included in estimate of Production Invest...	100.00%			%
14	Number of additional variants to be developed	0			
15	Development Status	New Design			
16	Production Quantity (including all variants)	**1,020**			
17	Production Rate	**20.00**			Units Per Year
18	**Crew Data**				
19	Number of Instructor Pilots	0	0	0	
20	Instructor Pay	0.00	0.00	0.00	£
21	Number of Student Pilots	0	0	0	
22	Student Pay	0.00	0.00	0.00	£
23	Crew Overhead	00%			%
24	**Operations Data**				
25	Hours Flown per year		0.00	0.00	hours per year
26	Service Life				years
27	**Number of Units**				
28	Units in Active Fleet				
29	Units as Rotable Spares				
30	Units in Reserve				

23 input parameters for platform

		Value	Units
1	Start Date	01/01/2008	
2	Quantity Per Next Higher Level	1.00	
3	**Additional Units**		
4	Number of Additional Production Units	0.00	
5	Number of Additional Prototypes	0.00	
6	**Cost Sharing Units**		
7	Total Number of Production Units Produced	0	
8	Total Number of Prototypes Produced	0.00	
9	**Technical Description**		
10	Equipment Type	None	
11	Operating Specification	**1.800**	
12	Weight of Structure	**707.0000**	kg
13	Weight of Electronics	0.0000	kg
14	Volume	**707.000**	l
15	Manufacturing Complexity for Structure	**5.580**	
16	Percent of New Structure	100.00%	
17	Percent of Design Repeat for Structure	0.00%	
18	Manufacturing Complexity for Electronics	7.000	
19	Percent of New Electronics	100.00%	
20	Percent of Design Repeat for Electronics	0.00%	
21	Engineering Complexity	1.000	
22	Electronic Density	**1.0000**	**lbs/**
23	Labor Learning Curve	0.00%	
24	Material Learning Curve	0.00%	
25	Beginning Production Unit (for Learning Curve)	1	
26	B Factor	0.00%	
27	Manufacturing Process Index for Labor	0.000	
28	Manufacturing Process Index for Material	0.000	
29	Technology Improvement Control	**0.0**	
30	Technology Obsolescence Control	0.0	
31	Year of Technology		
32	External Integration Complexity for Structure	3.00	

More than 48 input parameters plus life cycle inputs for equipment

QINETIQ

Macro-parametric versus Micro-parametric Outputs

	Costs : Advanced Trainer Aircraft - [Advanced Trainer Aircraft] Currency in USD ($) (as spent)	Total	Development	Production	Operation & Support
1	Research, Development, Test and Evaluation	100,219,752	100,219,752		
2	Production Investment	89,143,152	89,143,152		
3	Production	10,909,305,845		10,909,305,845	
4	In Service Crew	0			0
5	In Service - Non Crew	0			0
6	**Total**	**11,098,668,750**	**189,362,905**	**10,909,305,845**	**0**

Limited cost fidelity across the life cycle

	Costs : AC_1.1_1.2_1.3_1.6 Air Vehicle_System Engineering_Program Management_Data - [System] Currency in USD ($) (as spent)	Total	Development	Production	Operation & Support
1	Project Initiation and Planning for Development	2,215,751	2,215,751		
2	Project Management and Control for Development	12,790,040	12,790,040		
3	Quality Assurance Management for Development	7,808,288	7,808,288		
4	Configuration Management for Development	7,149,090	7,149,090		
5	Vendor Management for Development	0	0		
6	Documentation for Development	8,526,979	8,526,979		
7	Project Initiation and Planning for Production	111,345,190		111,345,190	
8	Project Management and Control for Production	560,365,284		560,365,284	
9	Quality Assurance Management for Production	329,805,386		329,805,386	
10	Configuration Management for Production	272,577,493		272,577,493	
11	Vendor Management for Production	0		0	
12	Documentation for Production	406,607,319		406,607,319	
13	Project Initiation and Planning for Operation and S...	0			0
14	Project Management and Control for Operation an...	0			0
15	Quality Assurance Management for Operation and...	0			0
16	Configuration Management for Operation and Sup...	0			0
17	Vendor Management for Operation and Support	0			0
18	Documentation for Operation and Support	0			0
19	Requirements Definition and Analysis	19,099,477	19,099,477		
20	System Design	10,428,909	10,428,909		
21	Development Engineering	47,737,490	47,737,490		
22	Development Manufacturing	35,679,341	35,679,341		
23	Development Tooling and Test	6,274,779	6,274,779		
24	Producti[illegible]gineering	52,407,994		52,407,994	
25	[illegible]ction Manufacturing	8,698,809,063		8,698,809,063	
[illegible]	Production Tooling and Test	957,289,638		957,289,638	
27	Software Integration and Test	5,239,408	5,239,408		
28	Hardware Software Integration and Test	3,035,138	3,035,138		
29	Operational Test and Evaluation	32,110,918	32,110,918		
30	Assembly Operation and Support	0			0

54 costed activities across the life cycle split into resources and PBS elements

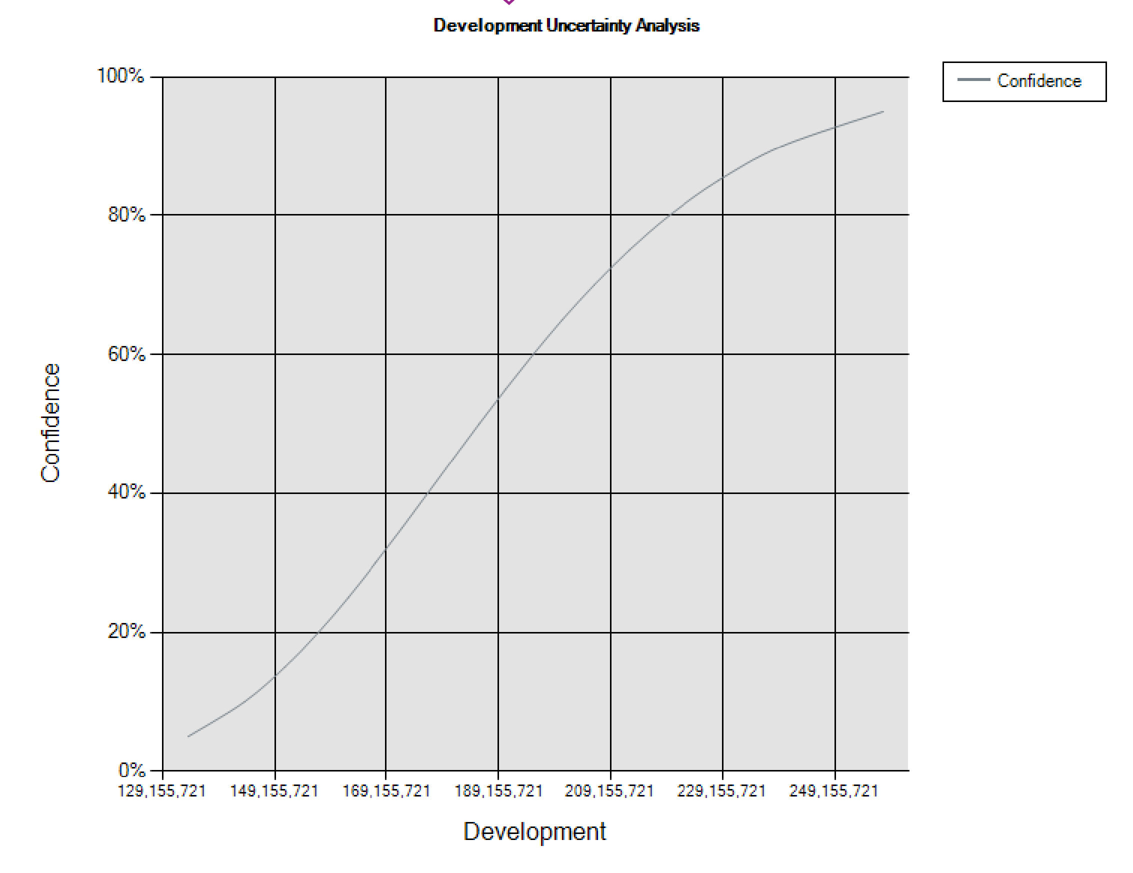
Macro-parametric versus Micro-parametric Outputs

Early non-recurring estimate with broad uncertainty

- An Advanced trainer aircraft uncertainty estimate for the macro-parametric cost model.
- The result of the same platform from the micro-parametric cost modelling

5% Uncertainty Report : Advanced Trainer Aircraft - [Advanced Trainer Aircraft]
Currency in USD ($) (as spent)

	Confidence	Development
1	5%	133,713,759
2	10%	143,768,538
3	15%	150,958,488
4	20%	156,968,492
5	25%	162,277,681
6	30%	167,199,324
7	35%	171,927,439
8	40%	176,507,771
9	45%	181,065,809
10	50%	185,667,572
11	55%	190,386,288
12	60%	195,302,717
13	65%	200,505,792
14	70%	206,175,757
		212,428,765
16	80%	219,613,802
17	85%	228,357,130
18	90%	239,777,408
19	95%	257,807,780
20	**Standard D...**	**37,227,173**
21	**Mode**	**178,445,506**
22	**Mean**	**189,362,905**
23	**Coefficient ...**	**20%**



NUM

$210m (as spent) detailed estimate within the uncertainty range

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Macro-parametric versus Micro-parametric Outputs

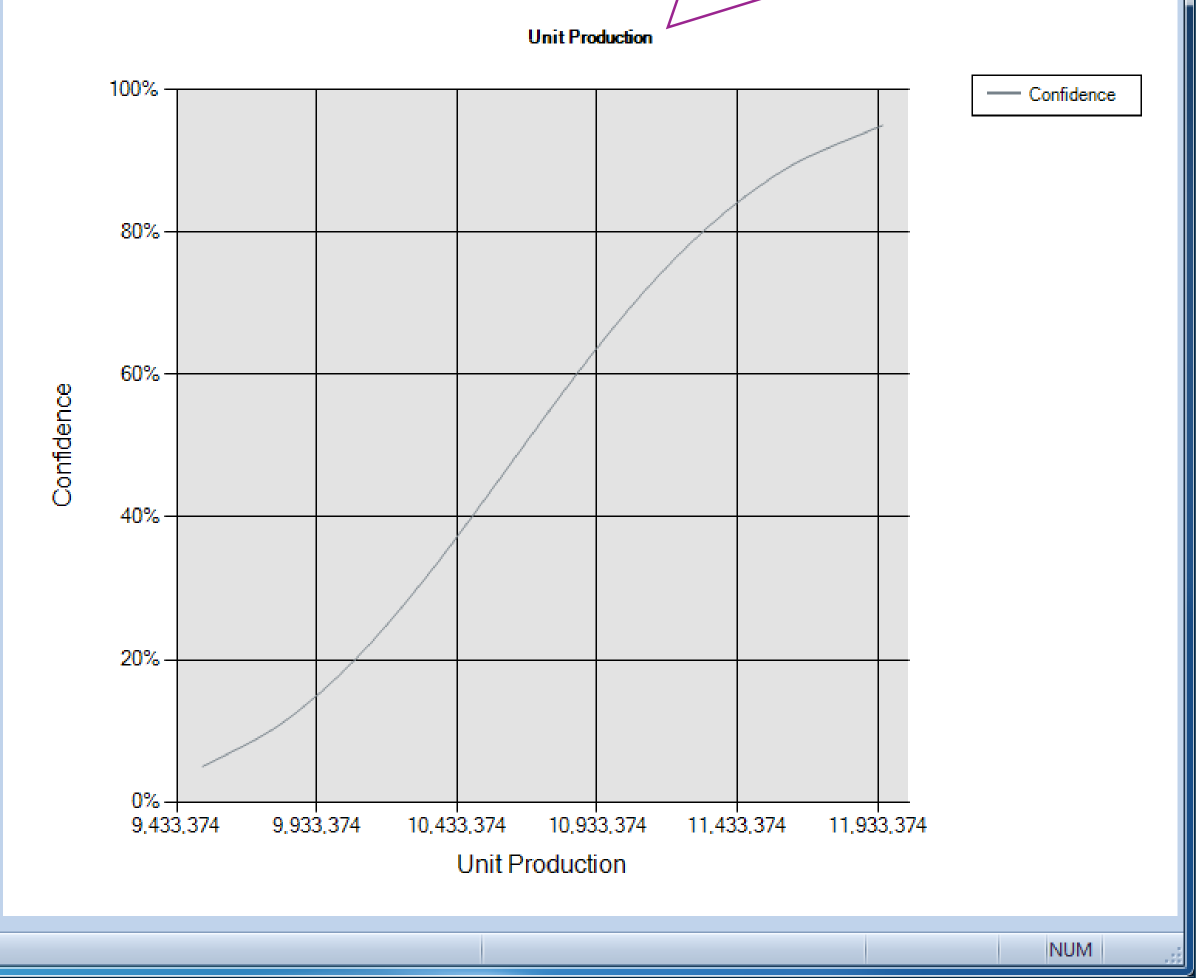
Early UPC estimate with broad uncertainty

- An advanced trainer aircraft uncertainty estimate for the macro-parametric cost model.
- The result of the same platform from the micro-parametric cost modelling

$11.1m (as spent) detailed estimate within the uncertainty range

5% Uncertainty Report : Advanced Trainer Aircraft - [Advanced Trainer Aircraft]
Currency in USD ($) (as spent)

	Confidence	Unit Production
1	5%	9,525,541
2	10%	9,767,288
3	15%	9,933,448
4	20%	10,068,409
5	25%	10,184,847
6	30%	10,290,579
7	35%	10,390,253
8	40%	10,485,115
9	45%	10,577,930
10	50%	10,670,096
11	55%	10,763,066
12	60%	10,858,341
13	65%	10,957,477
14	70%	11,063,610
[illegible]	[illegible]	11,178,465
16	80%	11,307,741
17	85%	11,461,373
18	90%	11,656,353
19	95%	11,952,178
20	**Standard D...**	**735,240**
21	**Mode**	**10,619,633**
22	**Mean**	**10,695,398**
23	**Coefficient ...**	**7%**



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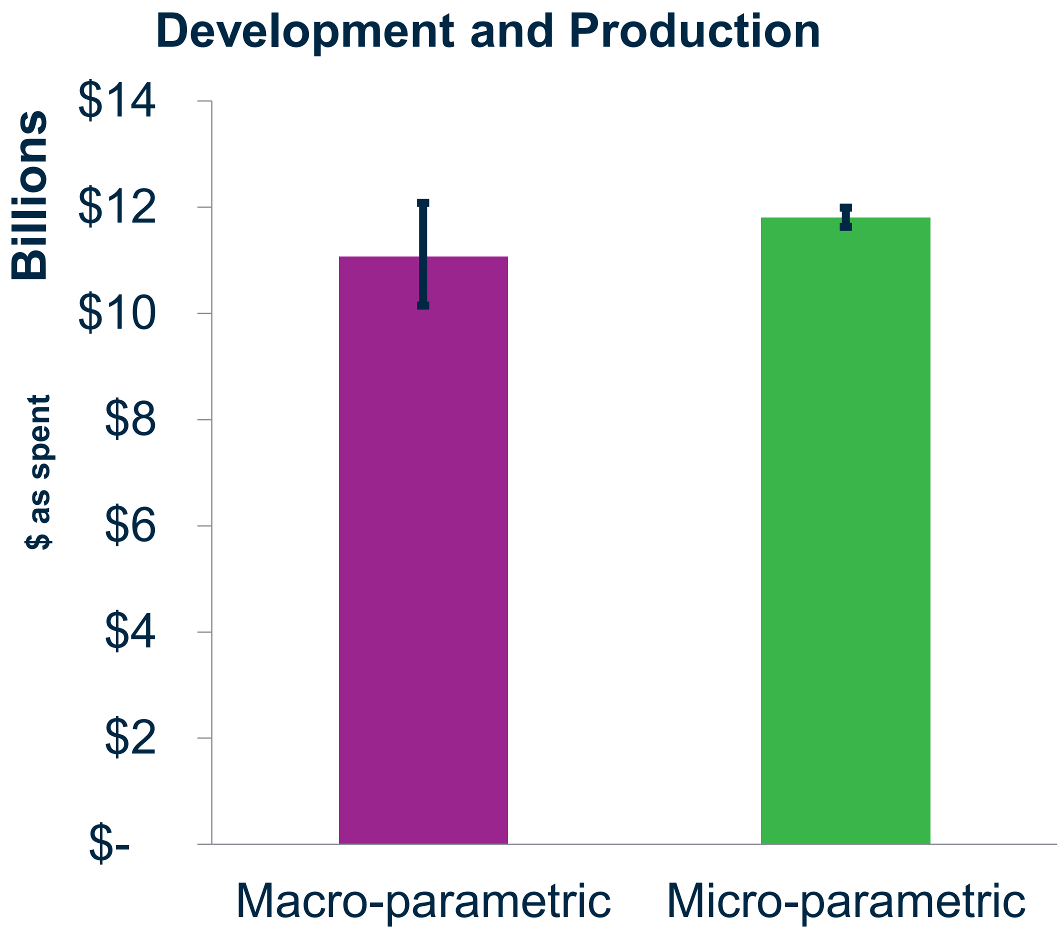
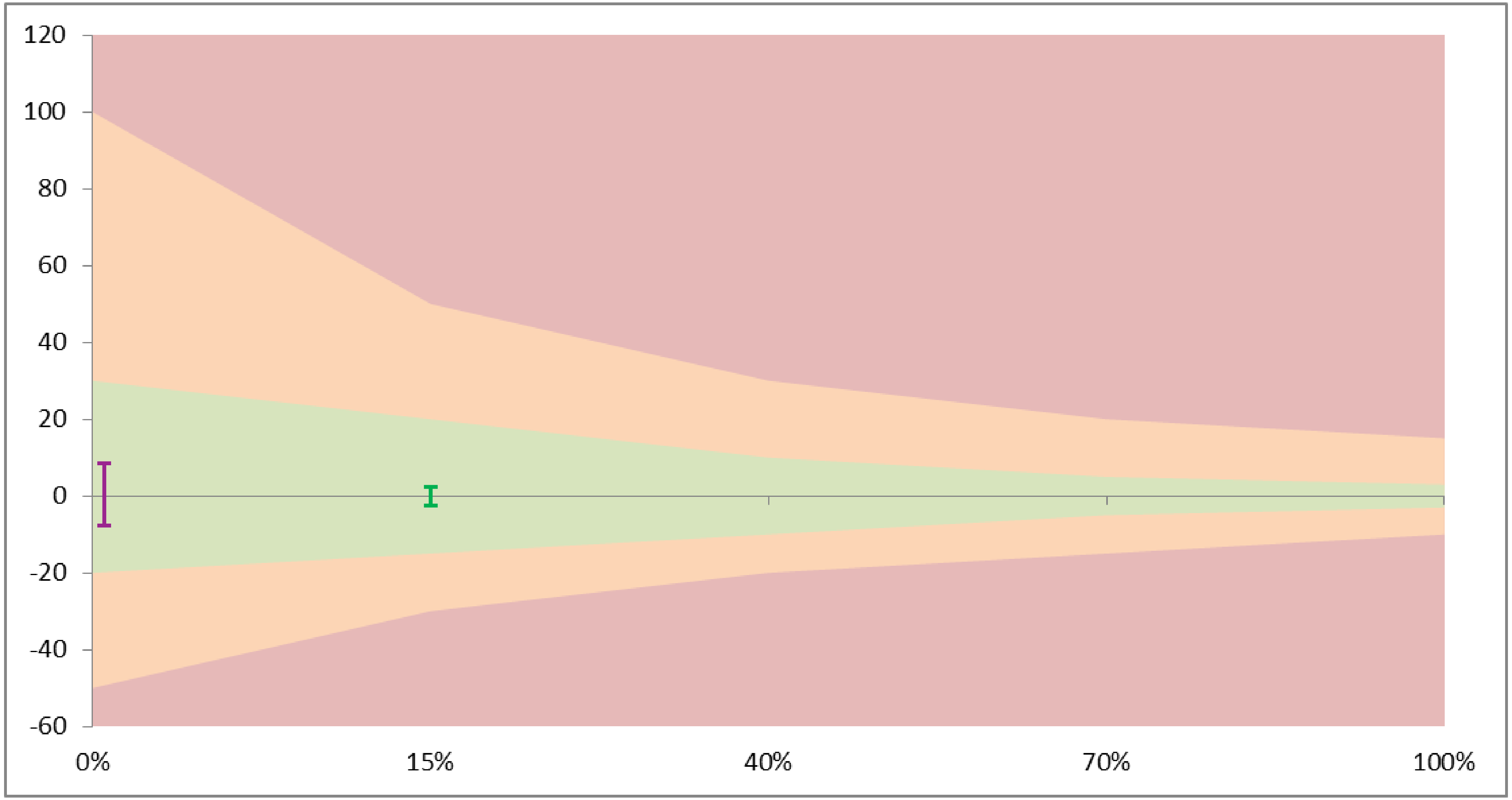
Macro-parametric versus Micro-parametric Outputs



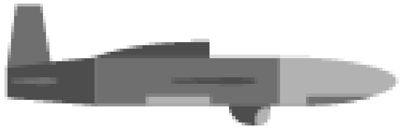
- Macro-parametric cost model provides a broad (10% - 90% percentile) tolerance around the deterministic estimate
- Micro-parametric estimate within the range of the macro-parametric model
- Micro-parametric cost model has a narrower (10% - 90% percentile) tolerance

Macro-parametric versus Micro-parametric



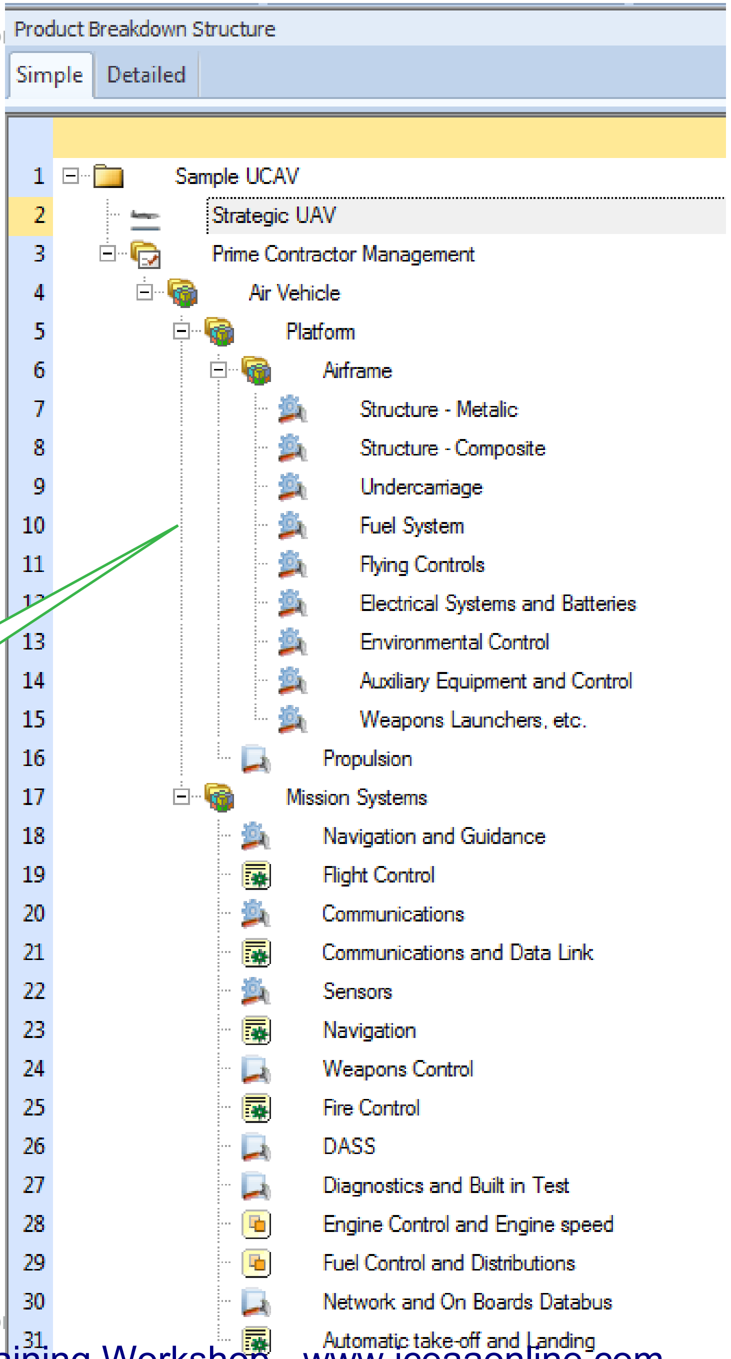
Case study - UAV

Macro-parametric versus Micro-parametric Product Breakdown Structure (PBS)



One Platform specific item

Multiple hardware, software and IT items in a PBS



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Macro-parametric versus Micro-parametric
Input parameters

		Value	Pessimistic	Optimistic	Units
1	Start Date				
2	**Performance Data**				
3	Endurance	**12.00**	20.00	10.00	hours
4	Transit Speed	**635.00**	700.00	500.00	km/hr
5	**Design Data**				
6	Launch Mass	**5,611.00**	5,611.00	5,611.00	kg
7	**Technology Standard**				
8	Year	**2000**	2000	2000	
9	**Programme Data**				
10	Number of Participating Nations	1.00			
11	Percentage to be included in the estimate of Development	100.00%			%
12	Percentage to be included in estimate of Production Invest...	100.00%			%
13	Number of additional variants to be developed	0			
14	Development Status	New Design			
15	Production Quantity (including all variants)	**55**			
16	Production Rate	**25.00**			Units Per Year
17	**Operations Data**				
18	Hours Flown per year	0.00	0.00	0.00	hours per year
19	Service Life	0.00			years
20	**Number of Units**				
21	Units in Active Fleet	**55.00**			
22	Units as Rotable Spares				
23	Units in Reserve				

16 input parameters

		Value	Units
1	Start Date	01/01/2008	
2	Quantity Per Next Higher Level	1.00	
3	**Additional Units**		
4	Number of Additional Production Units	0.00	
5	Number of Additional Prototypes	0.00	
6	**Cost Sharing Units**		
7	Total Number of Production Units Produced	0	
8	Total Number of Prototypes Produced	0.00	
9	**Technical Description**		
10	Equipment Type	None	
11	Operating Specification	**1.800**	
12	Weight of Structure	**707.0000**	kg
13	Weight of Electronics	0.0000	kg
14	Volume	**707.000**	l
15	Manufacturing Complexity for Structure	**5.580**	
16	Percent of New Structure	100.00%	%
17	Percent of Design Repeat for Structure	0.00%	%
18	Manufacturing Complexity for Electronics	7.000	
19	Percent of New Electronics	100.00%	
20	Percent of Design Repeat for Electronics	0.00%	
21	Engineering Complexity	1.000	
22	Electronic Density	**1.0000**	lbs/
23	Labor Learning Curve	0.00%	
24	Material Learning Curve	0.00%	
25	Beginning Production Unit (for Learning Curve)	1	
26	B Factor	0.00%	
27	Manufacturing Process Index for Labor	0.000	
28	Manufacturing Process Index for Material	0.000	
29	Technology Improvement Control	**0.0**	
30	Technology Obsolescence Control	0.0	
31	Year of Technology		
32	External Integration Complexity for Structure	3.00	

More than 48 input parameters plus life cycle inputs

QINETIQ

Macro-parametric versus Micro-parametric Outputs

Phase Set: A <Inherited> Worksheet Set: A <Inherited>

	Costs : Strategic UAV - [Strategic UAV] Currency in GBP (£) (in March, 2018)	Total	Development	Production	Operation & Support
1	Research, Development, Test and Evaluation	728,954,747	728,954,747		
2	Production Investment	50,213,057	50,213,057		
3	Production	634,135,510		634,135,510	
4	In Service - Non Crew	301,721,676			301,721,676
5	Total	1,715,024,990	779,167,805	634,135,510	301,721,676

Limited cost fidelity across the life cycle

Phase Set: A <Inherited> Worksheet Set: A <Inherited>

	Costs : Prime Contractor Management - [System] Currency in GBP (£) (in March, 2018)	Total	Development	Production	Operation & Support
1	Project Initiation and Planning for Development	5,185,309	5,185,309		
2	Project Management and Control for Development	23,623,028	23,623,028		
3	Quality Assurance Management for Development	17,354,840	17,354,840		
4	Configuration Management for Development	15,831,473	15,831,473		
5	Vendor Management for Development	0	0		
6	Documentation for Development	22,422,220	22,422,220		
7	Project Initiation and Planning for Production	3,793,884		3,793,884	
8	Project Management and Control for Production	13,915,349		13,915,349	
9	Quality Assurance Management for Production	10,358,568		10,358,568	
10	Configuration Management for Production	8,561,055		8,561,055	
11	Vendor Management for Production	0		0	
12	Documentation for Production	15,272,368		15,272,368	
13	Project Initiation and Planning for Operation and S...	0			0
14	Project Management and Control for Operation an...	0			0
15	Quality Assurance Management for Operation and...	0			0
16	Configuration Management for Operation and Sup...	0			0
17	Vendor Management for Operation and Support	0			0
18	Documentation for Operation and Support	0			0
19	Requirements Definition and Analysis	24,156,027	24,156,027		
20	System Design	13,189,957	13,189,957		
21	Development Engineering	57,552,912	57,552,912		
22	Development Manufacturing	25,809,753	25,809,753		
23	Development Tooling and Test	3,097,184	3,097,184		
24	Production Engineering	5,813,598		5,813,598	
25	Production Manufacturing	304,995,872		304,995,872	
26	Production Tooling and Test	20,420,364		20,420,364	
27	Software Integration and Test	60,261,569	60,261,569		
28	Hardware Software Integration and Test	6,948,064	6,948,064		
29	Operational Test and Evaluation	28,427,887	28,427,887		
30	Assembly Operation and Support	0			0
31	Support Equipment Procurement	0		0	
32	Support Equipment Maintenance	0			0
33	...al Spares Procurement	0		0	
34	Replenishment Spares Procurement	0			0
35	Contractor Support	0			0

57 costed activities across the life cycle split into resources and PBS elements

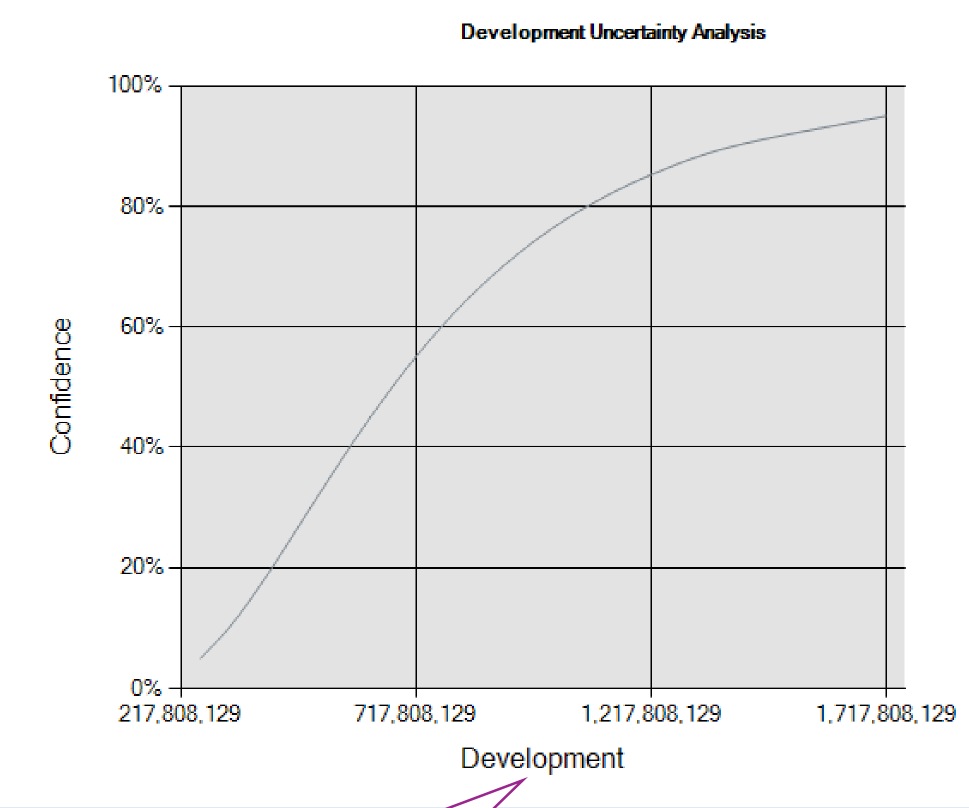
Macro-parametric versus Micro-parametric Outputs

- An Unmanned air vehicle uncertainty estimate for the macro-parametric cost model.
- The result of the same platform from the micro-parametric cost modelling

Phase Set: A <Inherited> Worksheet Set: A <Inherited>

5% Uncertainty Report : Strategic UAV - [Strategic UAV] Currency in GBP (£) (in March, 2018)

	Confidence	Development
1	5%	258,466,905
2	10%	318,584,306
3	15%	366,735,408
4	20%	410,445,611
5	25%	451,775,603
6	30%	492,434,379
7	35%	533,677,530
8	40%	575,722,812
9	45%	619,654,977
10	50%	666,173,632
11	[illegible]	716,184,530
[illegible]	60%	770,835,026
13	65%	831,564,538
14	70%	901,211,059
15	75%	982,318,003
16	80%	1,081,232,925
17	85%	1,210,102,155
18	90%	[illegible]



£591.4m @ March 2018 ec detailed estimate within the uncertainty range

Early non-recurring estimate with broad uncertainty

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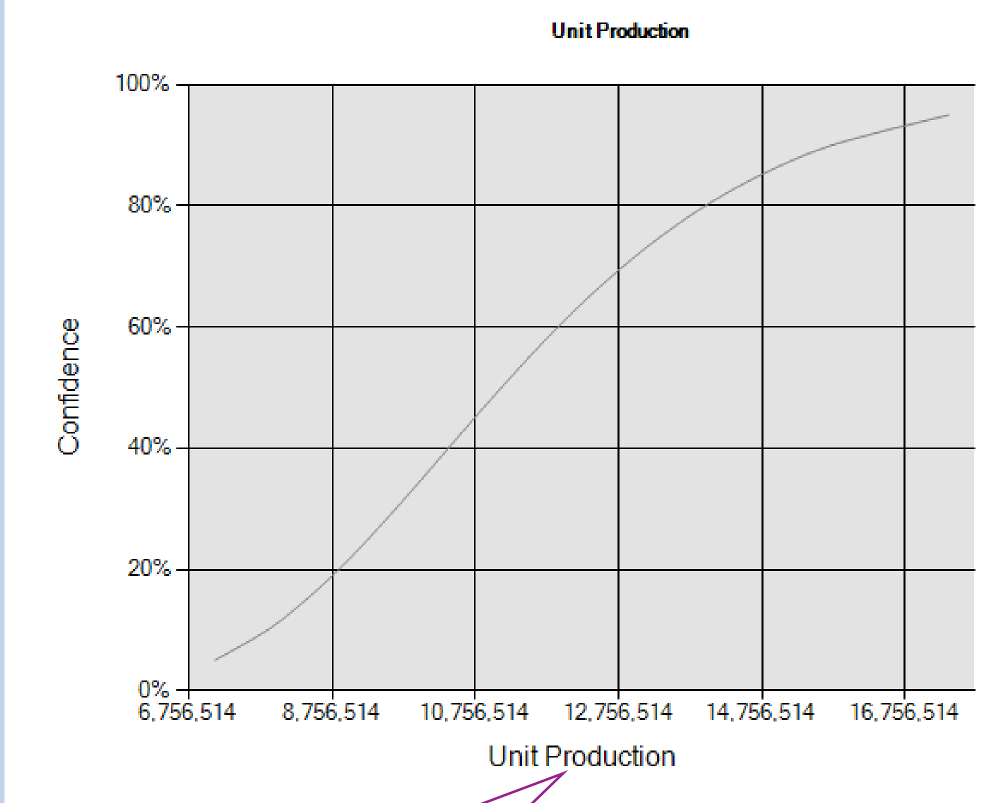
Macro-parametric versus Micro-parametric Outputs

- An Unmanned air vehicle uncertainty estimate for the macro-parametric cost model.
- The result of the same platform from the micro-parametric cost modelling

	5% Uncertainty Report : Strategic UAV - [Strategic UAV] Currency in GBP (£) (in March, 2018)	
	Confidence	Unit Production
1	5%	7,120,672
2	10%	7,857,460
3	15%	8,395,831
4	20%	8,852,969
5	25%	9,262,056
6	30%	9,645,589
7	35%	10,017,869
8	40%	10,382,027
9	45%	10,747,787
10	50%	11,120,415
11	55%	11,505,962
12	60%	11,911,318
13	65%	12,344,304
14	70%	12,820,743
[illegible]	[illegible]	13,351,638
16	80%	13,968,604
17	85%	14,729,169
18	90%	[illegible]



£13.3m @ March 2018 ec detailed estimate within the uncertainty range

Early UPC estimate with broad uncertainty

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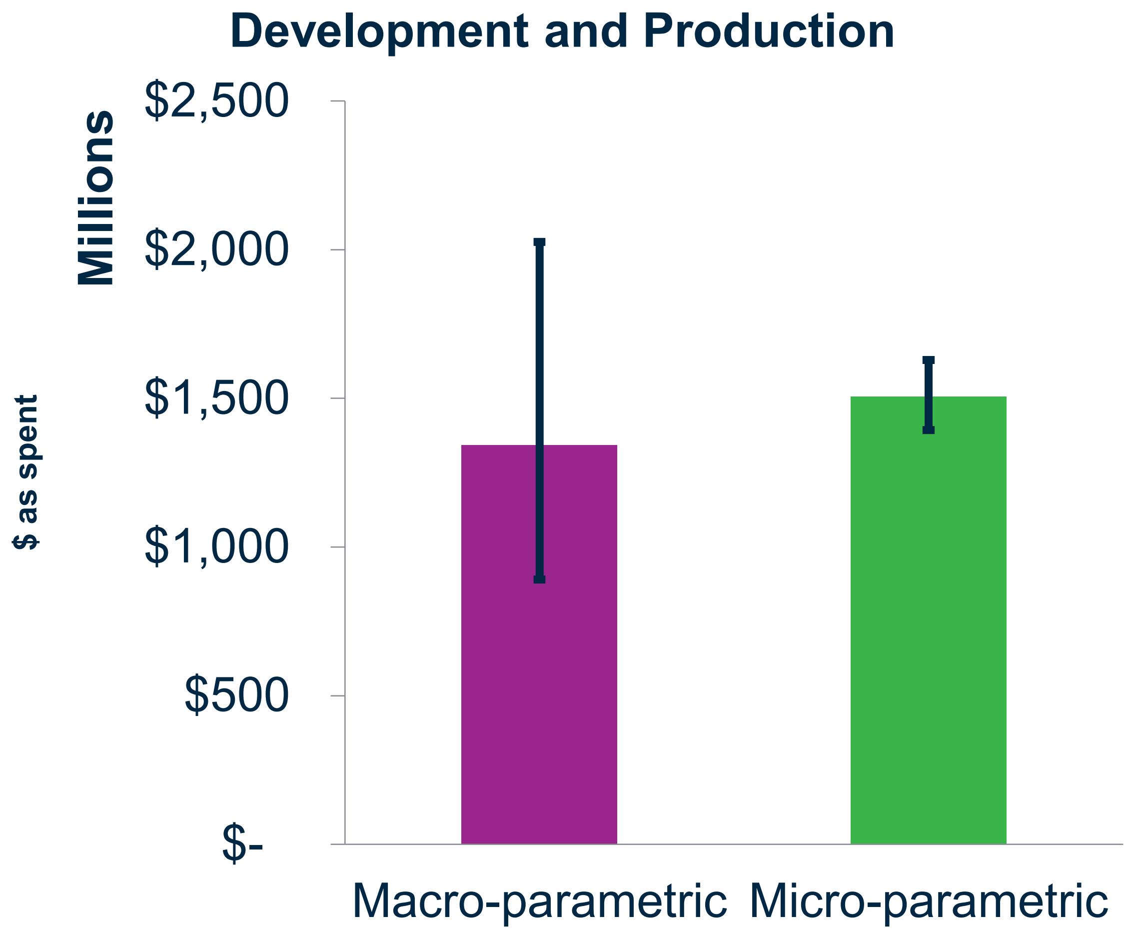
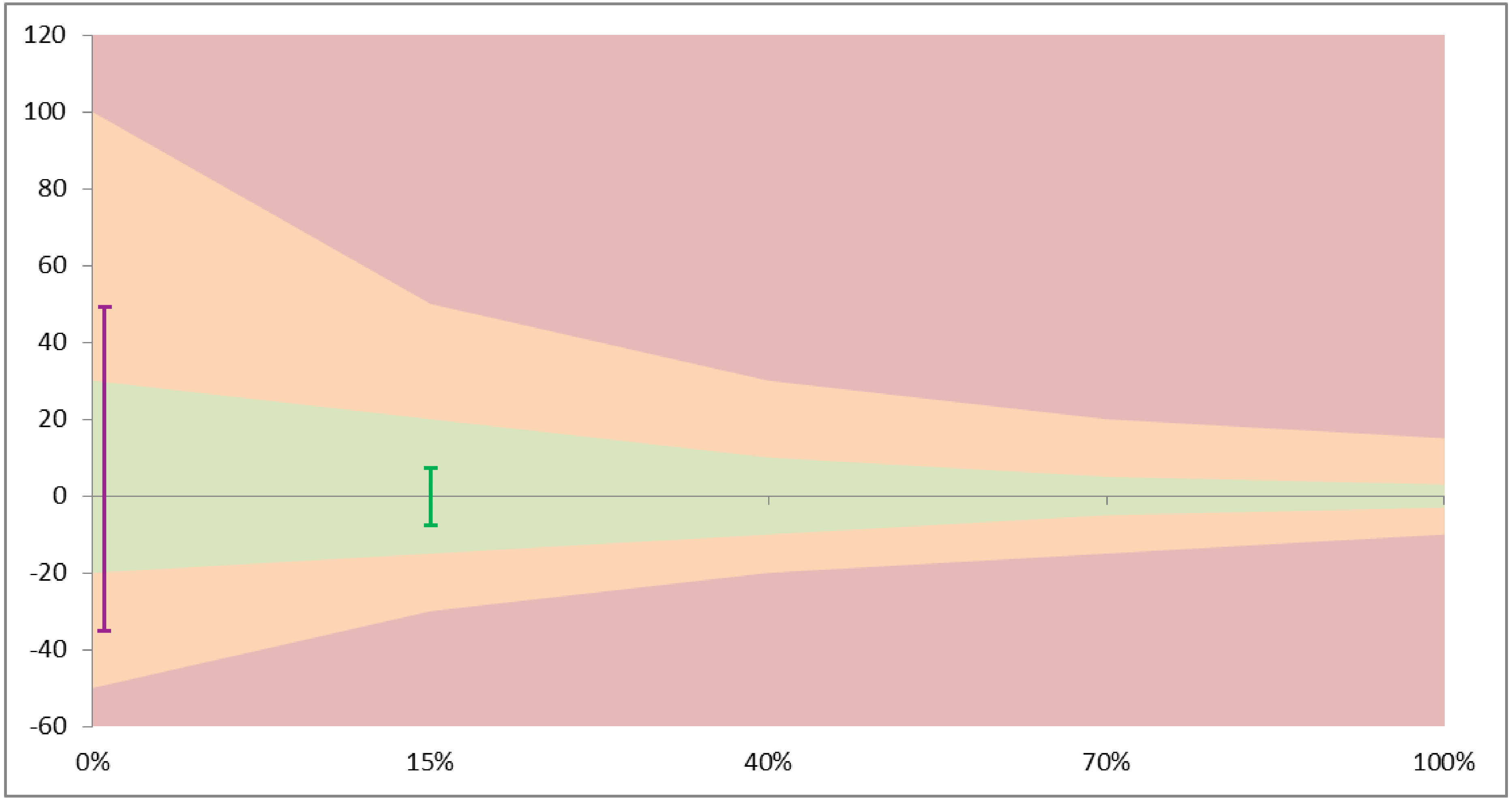
Macro-parametric versus Micro-parametric Outputs



- Macro-parametric cost model provides a broad (10% - 90% percentile) tolerance around the deterministic estimate
- Micro-parametric estimate within the range of the macro-parametric model
- Micro-parametric cost model has a narrower (10% - 90% percentile) tolerance

Macro-parametric versus Micro-parametric



Analysis observations

- ✗ Only one micro level solution was considered, when there could be a number of technical solutions;
- ✗ No consideration of project- specific risks;
- ✗ No application of both micro and macro models was considered.

- ✓ Cost modelling capability to match the phase of the project;
- ✓ Both macro and micro parametric cost models accommodated within one framework;
- ✓ First level ROM analysis of multiple capability solutions can avoid claims of project or solution bias;
- ✓ Saving of time (and cost) for training by utilising the same hybrid cost framework;
- ✓ Demonstration of the cone (or funnel) of uncertainty;
- ✓ Reduced license fees by adopting one universal cost framework;
- ✓ Detailed cost analysis can support the design phase when appropriate;
- ✓ The analysis assumptions and input parameters are recorded for future scrutiny and debate.

Summary

- At the pre-concept and concept phases of a project the nature of the solution is varied and the number of options numerous. There are many ways to satisfy the capability need. At this point the estimating accuracy is such that the output tolerance is broad. Macro-parametric are applicable to quickly establish the WLC of multiple solutions.
- As the project moves into the definition and assessment phases the feasibility studies begin to produce more information for the purpose of estimating and the number of options starts to reduce. Micro-parametrics are applicable to refine the cost modelling with more information.
- In a hybrid cost estimating framework solution it is possible to migrate from a macro to a micro modelling solution without the need for re-training saving time and cost.
- Application of the correct estimating approach at the correct project phase provides decisions makers with quality, appropriate information on time.

Any questions?

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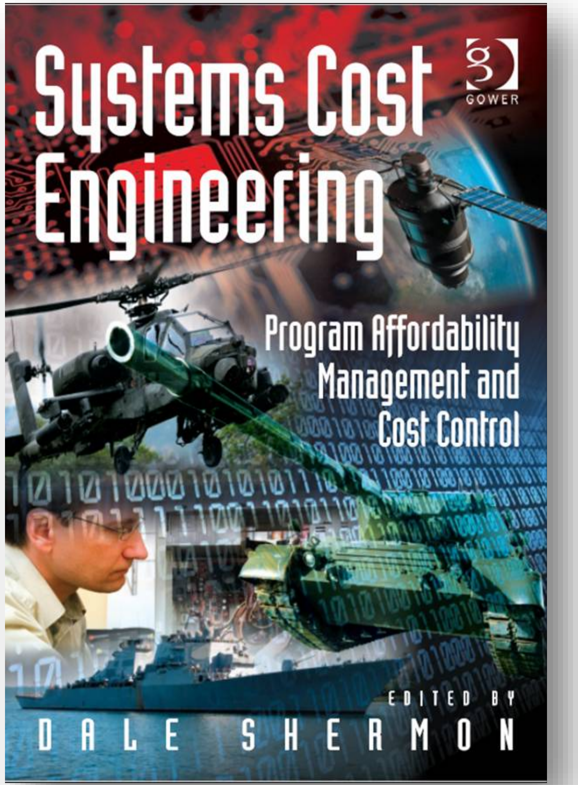

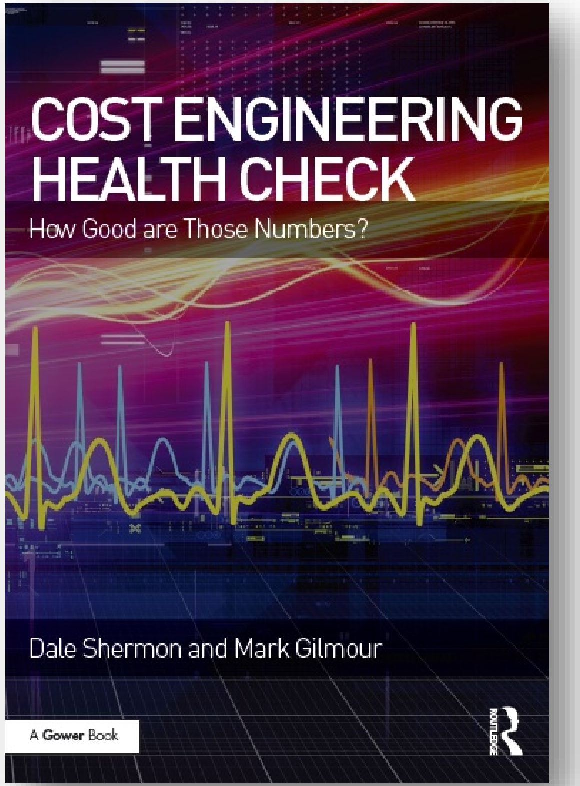

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