



Cost and Schedule Growth Through Life

SCAF 7th February 2012

Version 1,
Tom Tiner CAAS



MINISTRY OF DEFENCE

AGENDA

- **Introduction**
 - Overview of the analysis carried out
 - Executive summary
- **Caveats**
 - Statistically valid samples
 - Rubbish in Rubbish out!
- **The Analysis**
 - The process that was undertaken
 - The validation and agreement of the results
- **The different Outputs**
 - Views by Category
 - Views by SMART Approvals
 - Views by OC
- **How it is used**
 - The EPP simulator
 - Graphical results
- **Why have projects grown**
 - Reasons for change analysis
- **Summary**

Introduction – Overview of Analysis

The analysis would focus in on the key metrics presented in the 2009 Gray report and look to refresh the views that were put forward.

A refresh of the data found in the DE&S Corporate Management Information System (CMIS).

Comparison work with L.E.K Consulting Limited to reach a common view on project Cost and Schedule Growth thorough time.

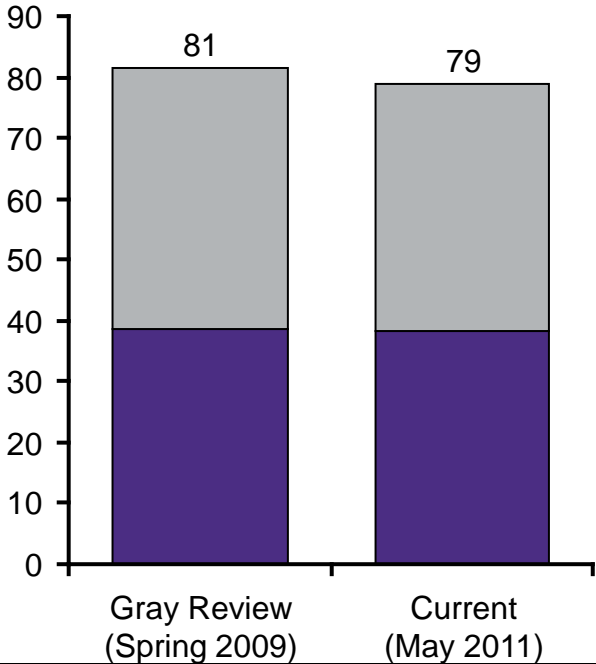
Thanks to:



Introduction - Executive Summary (1)

Average growth in project duration (time to “in service”) for ‘mature’ projects*

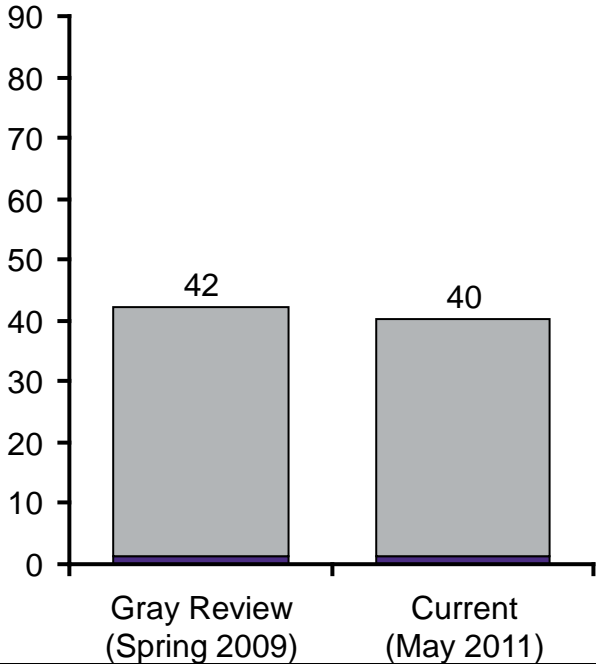
Project duration overrun
(Forecast at Initial Gate₅₀ = 0)



Number of projects sampled	Gray Review (Spring 2009)	Current (May 2011)
	45-91**	52-129**

Average growth in project cost for ‘mature’ projects*

Project adjusted unit cost increase
(Forecast at Initial Gate₅₀ = 0)

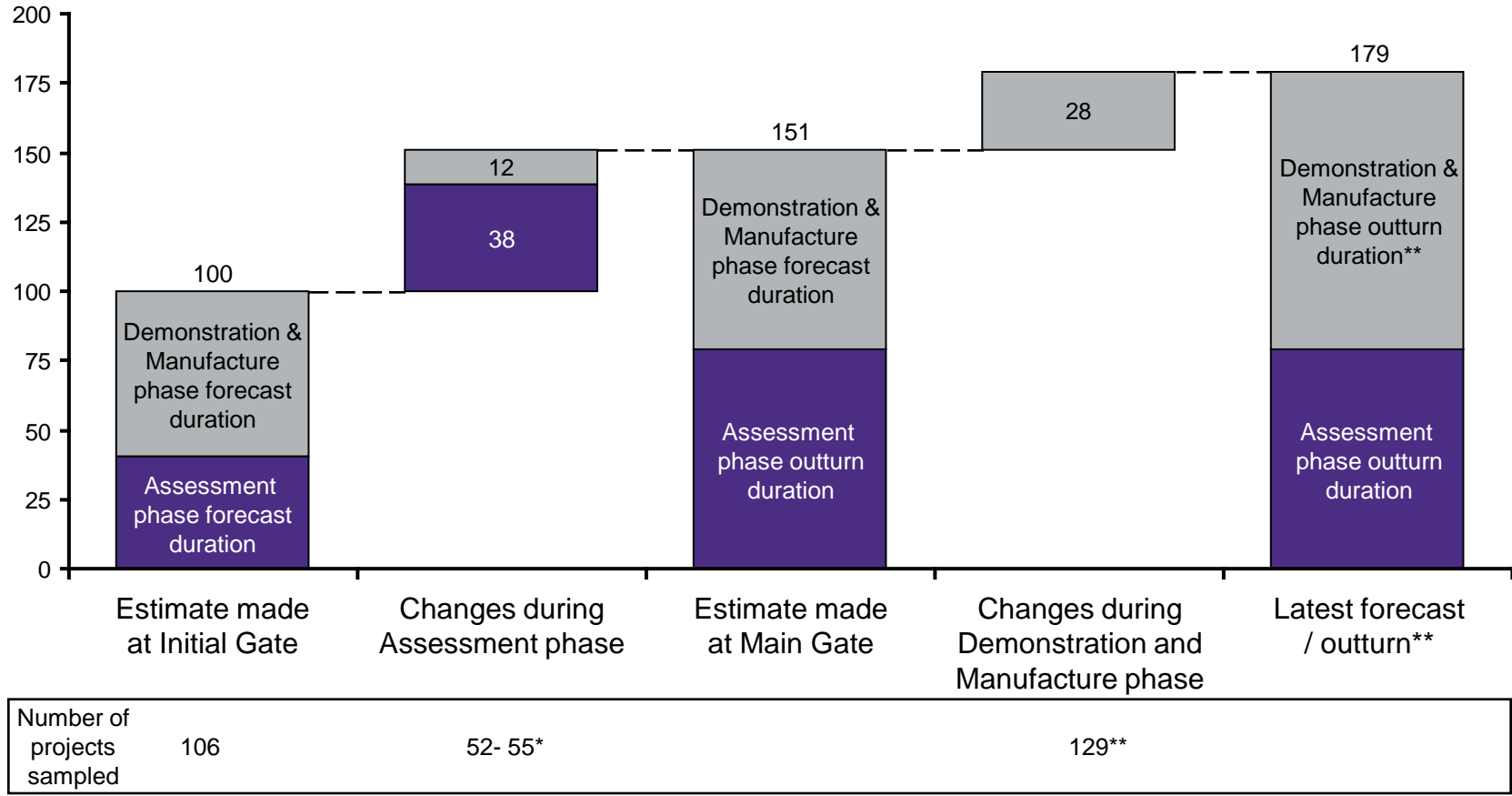


Number of projects sampled	Gray Review (Spring 2009)	Current (May 2011)
	45-49**	53-73**

Introduction - Executive Summary (2)

Average growth in project duration (time to “in service”) for ‘mature’ projects**

Index of project duration (Forecast at Initial Gate₅₀ = 100)

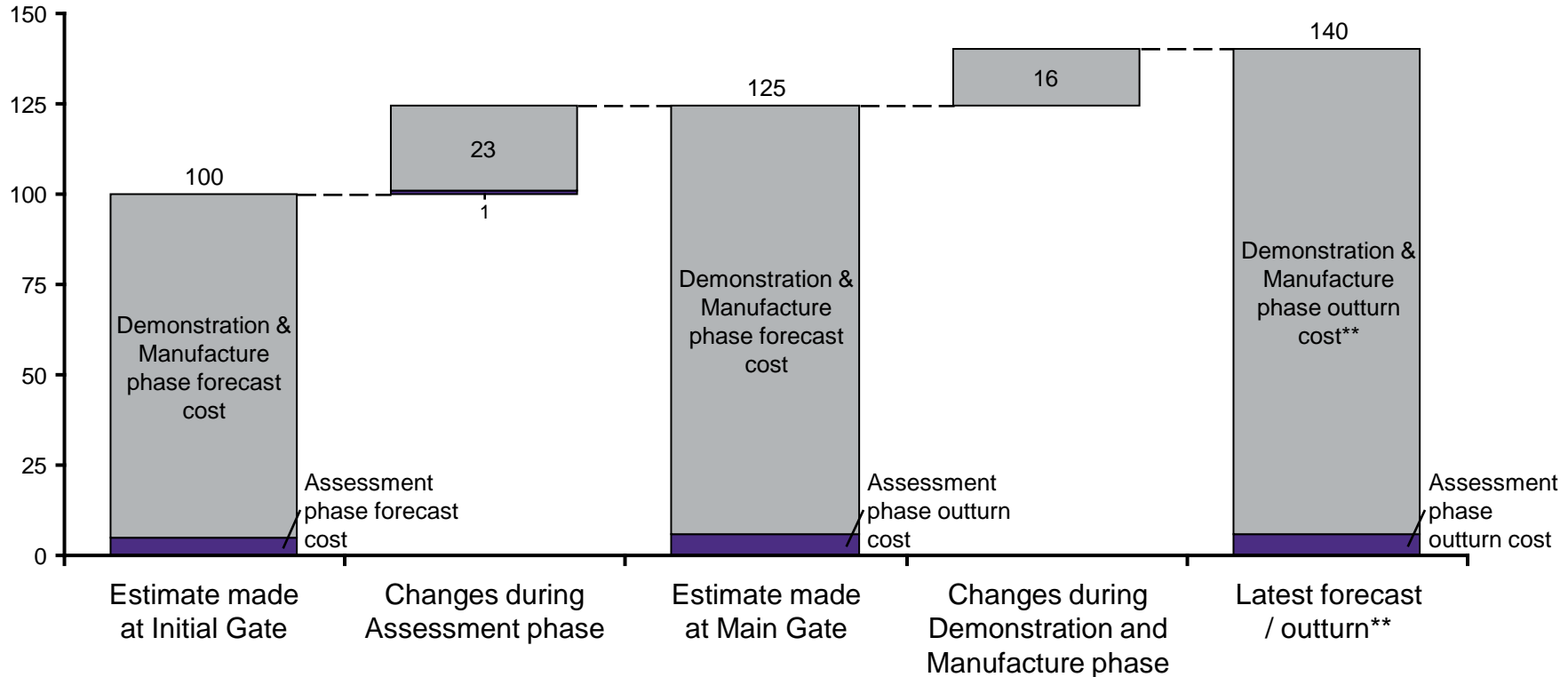


Note: * Sample of 52 for Initial to Main Gate forecast and 55 projects for Main Gate to In Service Date;
 ** Projects over 75% complete and in-service
 Source: CMIS (May 2011); CAAS analysis

Introduction - Executive Summary (3)

Average growth in project cost for 'mature' projects**

Index of adjusted unit cost^ (Forecast at Initial Gate₅₀ = 100)



Number of projects sampled	28	38-53*	73**
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Note: * Sample of 38 in the Assessment Phase and 53 in the Demonstration & Manufacture Phase;
 ** Projects more than 75% complete at latest forecast
 Source: CMIS (May 2011); CAAS analysis



RUBBISH IN RUBBISH OUT

- CMIS data not complete
- Of the 482 projects available on 73 points for cost and 129 for schedule

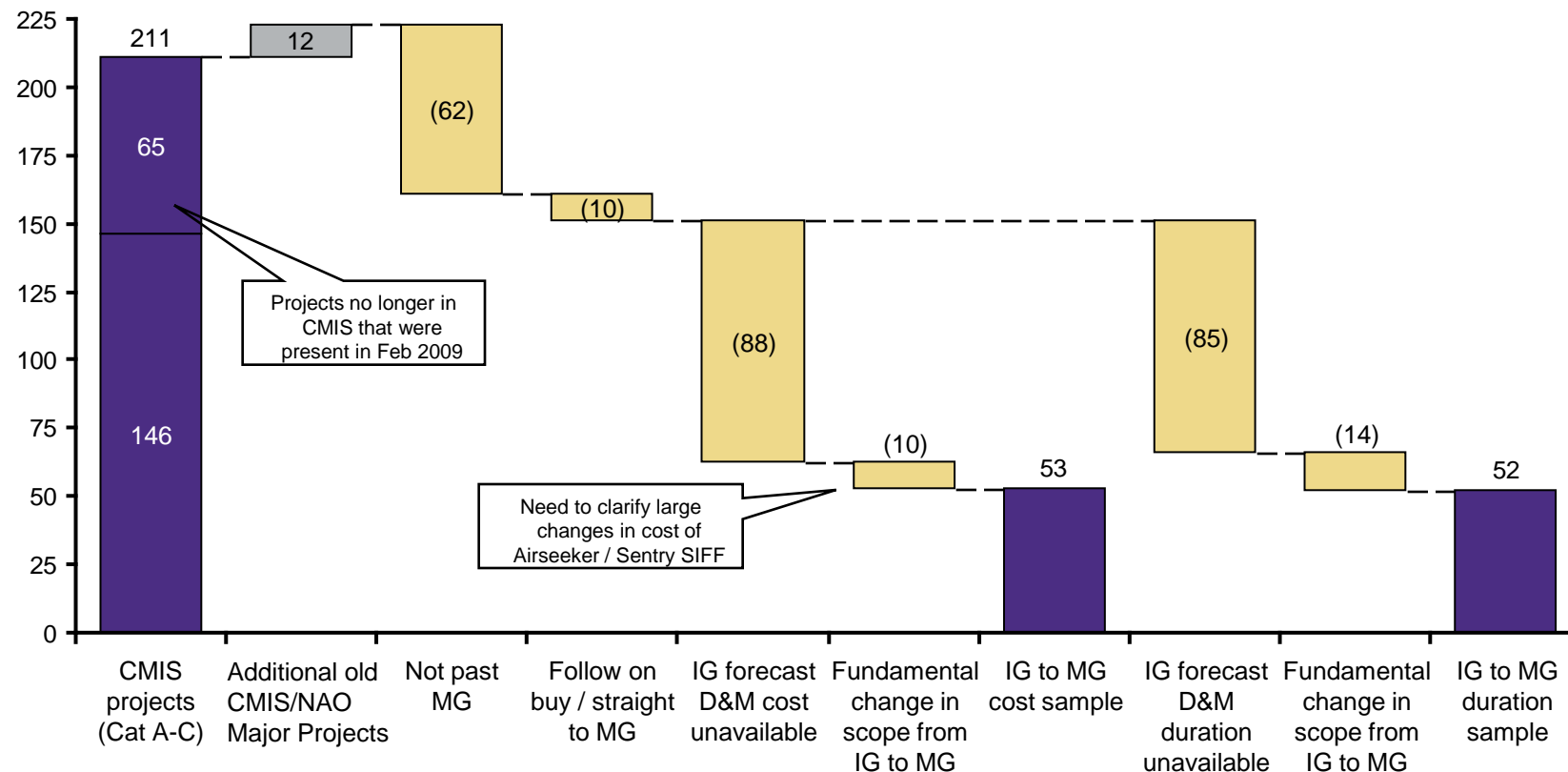
STATISTICALLY VALID SAMPLES

- Number of data points for particular sample sets only 2 or 3 points. NOT VALID.
- Outliers need to be included as they are valid points in the MoD work.

Caveats – Rubbish in Rubbish out (1)

Sample sizes used for Initial Gate to Main Gate analysis

Number of projects



Projects no longer in CMIS that were present in Feb 2009

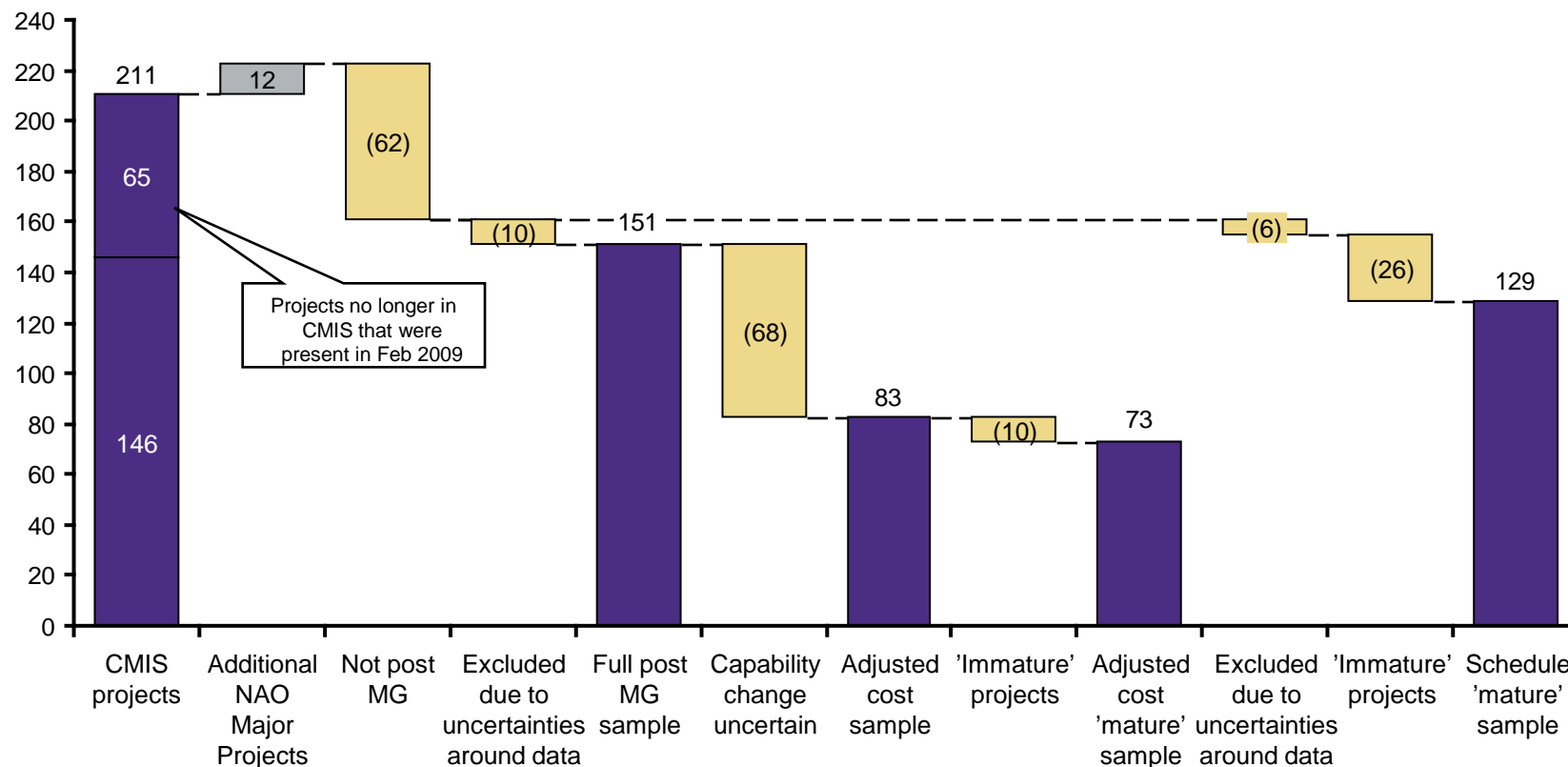
Need to clarify large changes in cost of Airseeker / Sentry SIFF

"n" for Gray review	165	+12	(48)	(10)	(67)	(7)	45	(68)	(6)	45
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Caveats – Rubbish in Rubbish out (2)

Sample sizes used for post Main Gate analysis

Number of projects



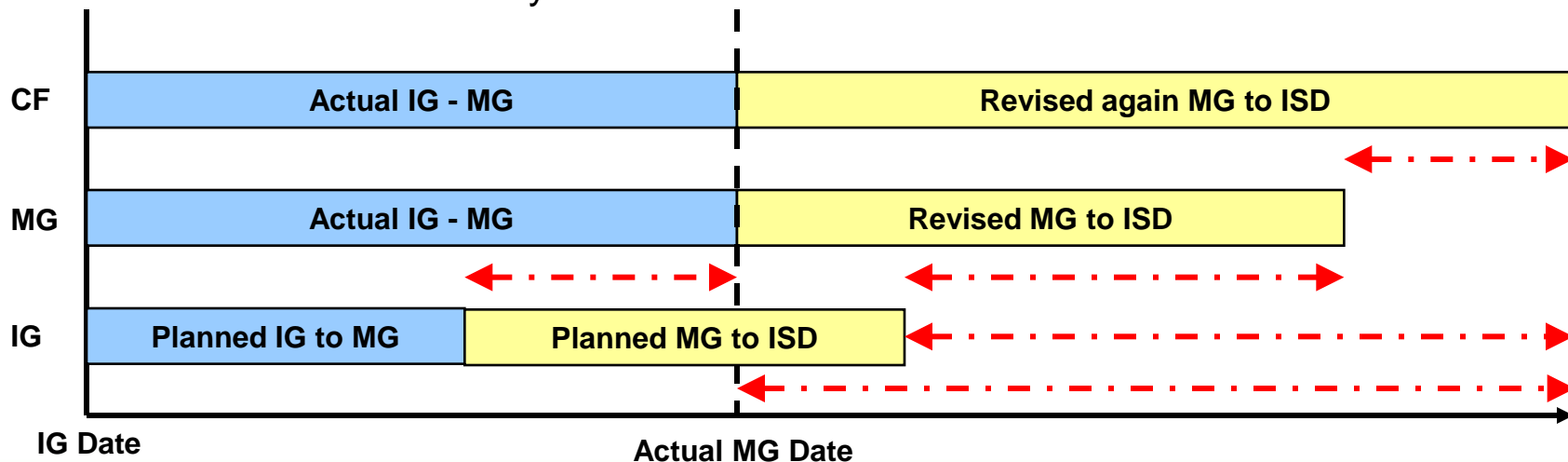
"n" for Gray review	165	+12	(48)	(6)	123	(44)	79	(30)	49	(6)	(32)	91
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The Analysis – The Process Undertaken (1)

- The first step was to understand what data was available and where the gaps were and if these could be filled.

IG MG App Date 10% (CMIS)	IG MG App Date 50% (CMIS)	IG MG App Date 90% (CMIS)	IG MG App Date 10% (Other)	IG MG App Date 50% (Other)	IG MG App Date 90% (Other)	IG MG App Date 10% (Chosen)	IG MG App Date 50% (Chosen)	IG MG App Date 90% (Chosen)
(FEED)	(FEED)	(FEED)	(FEED)	(FEED)	(FEED)	(CALC)	(CALC)	(CALC)
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	Jan-98	n/a	n/a	Jan-98	n/a
n/a	n/a	n/a	Feb-14	Mar-14	Jun-14	Feb-14	Mar-14	Jun-14
Dec-03	Dec-03	Dec-03	n/a	n/a	n/a	Dec-03	Dec-03	Dec-03
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	Dec-04	Dec-04	n/a	n/a	n/a	n/a	Dec-04	Dec-04
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	Nov-00	Feb-02	Feb-02	Nov-00	Feb-02	Feb-02
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

- Next was to calculate all the appropriate ratios that we could then use to perform different cuts of the analysis



The Analysis – The Process Undertaken (2)

- Ratios were calculated for all projects so that a view could be provided for all projects but this is not relevant or a valid view.
- The next stage therefore was to sort out which projects we would actually use in our analysis.

Cat A-C only <small>(CALC)</small>	Mature D&M (>= 75%) <small>(CALC)</small>	Follow on buy / straight to MG <small>(INPUT)</small>	IG Duration Manual Exclusions <small>(CALC)</small>	MG Cost Manual Exclusions <small>(CALC)</small>	Notes on exclusions <small>(NOTE)</small>	IG Duration sample <small>(CALC)</small>	IG-MG AP Durati on sample <small>(CALC)</small>	IG-MG D&M Duration sample <small>(CALC)</small>	MG Duration sample <small>(CALC)</small>	IG Cost sample <small>(CALC)</small>	IG-MG APCost sample <small>(CALC)</small>	IG-MG D&M Cost sample <small>(CALC)</small>	MG Cost sample <small>(CALC)</small>
1	-	-	-	-		1	-	-	-	1	-	-	-
1	1	-	-	-	Removed in Gray Report becaus	1	-	-	1	1	-	-	1
1	1	-	-	-		1	1	1	1	-	-	1	1
1	1	-	-	-		-	-	-	1	-	1	-	1
1	1	-	-	-		1	1	1	1	-	1	-	1
-	-	-	-	-		-	-	-	-	-	-	-	-
-	1	-	-	-		-	-	-	-	-	-	-	-
1	-	-	-	-	Removed as no proper date; no p	-	-	-	-	-	1	-	-
1	-	-	1	-		1	-	-	-	1	-	-	-
-	-	-	-	-		-	-	-	-	-	-	-	-
1	-	-	-	-	To confirm	1	1	1	-	-	-	-	-
1	-	-	-	-		1	1	1	-	1	-	1	-
1	-	-	-	-	- LEK: Need to confirm scope has	1	1	1	-	1	-	-	-
-	1	-	-	-		-	-	-	-	-	-	-	-

The Analysis – The Validation and Agreement of Results

- As all of this work was completed in conjunction with L.E.K.
- The validation proved more tricky and complex as the work progressed. Other CAAS team members were briefed to ensure correct process was followed during this exercise.
- Once completed this work was published on the 16th of May and were used to inform the MoD's 3 month exercise and the CAAS Planning Round support.



The Different Outputs – Views by Category

By Category		IG-ISD index	Sample size	Growth indices MG-ISD	
				Straight	Weighted (by MG D&M cost50)
Schedule	A	175	38	134%	141%
Schedule	B	169	37	126%	126%
Schedule	C	188	54	152%	139%
Schedule	All	179	129	139%	140%
Cost	A	153	31	125%	152%
Cost	B	131	24	106%	108%
Cost	C	128	24	103%	101%
Cost	All	139	79	112%	147%

Cat A projects – Have the highest cost growth across the different categories. This could be for a number of reasons and may be due to the complexity of the projects and technical factors / challenges / requirements.

Cat C projects – Whilst having the least cost growth, these projects generally have the highest schedule slippage. This could be put down to the make up of the project. Rather than having a whole team, it may be a “one man and his dog” and therefore open to more schedule risk eg if the main member of the PT is on leave or ill.

The Different Outputs – Views by SMART Approvals

CF D&M Cost50 (£m)	n		Latest Cost50 vs. MG50		Significance	Avg D&M cost (£m)	
	Pre-Smart	Smart	Pre-Smart	Smart		Pre-Smart	Smart
0-100	8	18	119%	96%	70%	59	31
100-500	14	13	106%	100%	95%	246	237
500-1000	9	-	136%	n/a	n/a	804	n/a
1000-5000	9	-	140%	n/a	n/a	2,667	n/a
5000+	2	-	155%	n/a	n/a	13,377	n/a
	42	31	125%	98%	n/a	1,474	118

Whilst unable to give any statistical validity to a Smart v non Smart project, we can say with reasonable confidence that for projects that have a D&M phase of between £100M and £500M, there is a significant improvement following the introduction of SMART approvals

A next step for this piece of work is to improve the data set but unfortunately as Smart approvals was only introduced in 200, it will take time for some of the big projects to reach a level of maturity that we can analyse.

The Different Outputs – Views by OC (2)

		Growth	Number of projects
Schedule	X	168	4
	X	173	7
	X	161	12
	X	162	16
	X	161	12
	X	195	18
	X	234	16
	X	166	23
	X	174	21
Cost	X	140	3
	X	168	5
	X	191	4
	X	149	9
	X	146	10
	X	129	9
	X	123	10
	X	128	13
	X	130	16

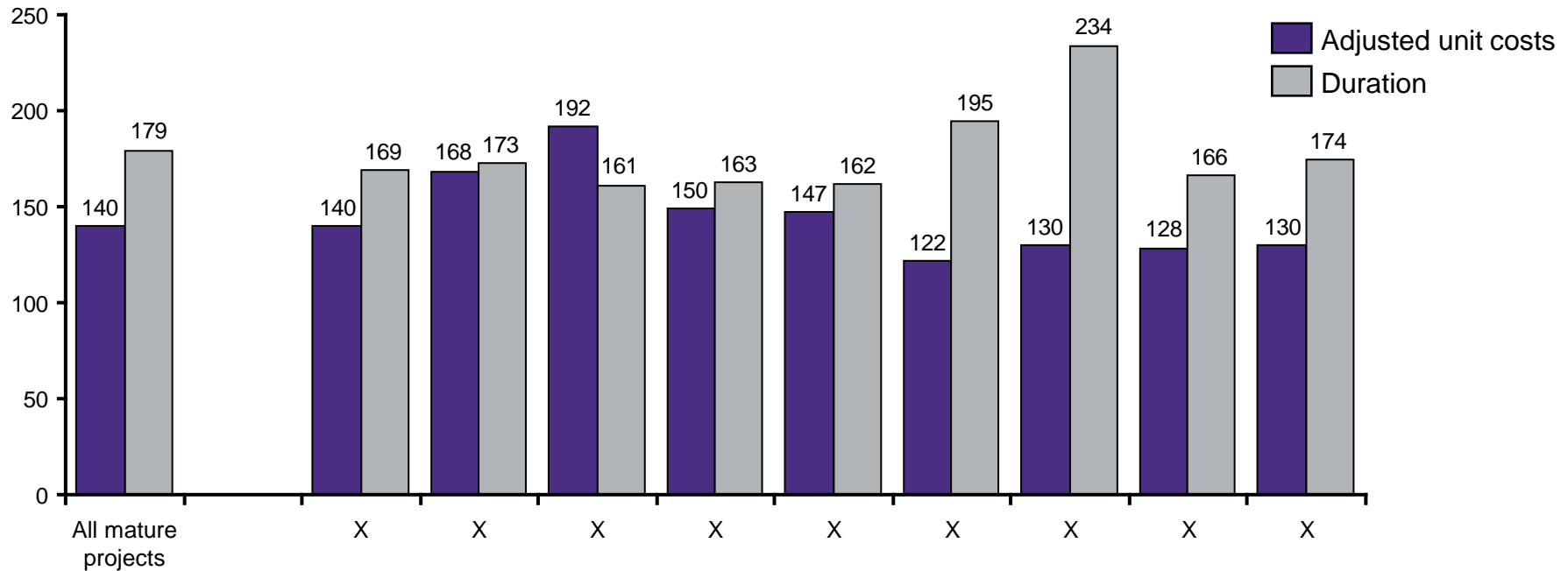
This can provide some good insight, unfortunately in specific sectors there is not enough data to make a valid statement.

There are some very large schedule growth figures particularly. This may be a slightly warped view as some of these projects are short “flash to bang” and therefore a delay of schedule appears to have a bigger impact.

The Different Outputs – Views by OC (2)

Average growth in project cost / time for 'mature' projects*

Index of adjusted unit cost / duration (forecast at Initial Gate₅₀=100)



Number of projects sampled										
73	3	5	4	9	10	6	7	13	16	Cost
126	4	7	12	16	12	18	16	23	21	Duration



Note: * Projects more than 75% complete at latest forecast
Source: CMIS (May 2011); CAAS analysis



How it is used – The EPP Simulator (1)

Selected project: Number:

Global health check

Assumptions

Current spend plans

Apply uniform schedule / cost growth assumptions

Schedule growth

Inputs		Historical Avg	Smart	Non-Smart	MG	Expected	Sensitivity	Selected
Slippage of MG date from IG forecast	<input type="button" value="Expected"/>	194	194	194	194	100	194	100
Forecast duration to ISD slippage @ MG	<input type="button" value="Expected"/>	150	150	150	150	100	150	100
Forecast duration to ISD slippage @ ISD	<input type="button" value="Expected"/>	179	176	182	150	100	179	100

Apply schedule slip n.b., Overrides above settings

Cost growth

Inputs		Historical Avg	Smart	Non-Smart	MG	Expected	Sensitivity	Selected
Forecast cost @ MG vs. IG	<input type="button" value="Historical Avg"/>	124	124	124	124	124	124	124
Forecast cost @ ISD vs. IG	<input type="button" value="Historical Avg"/>	139	121	154	124	139	130	139

MG-ISD growth curves (cost & schedule)

Use project specific input assumptions

First day of Plan

Override cost growth for CAAS ICE (set to 100%) TRUE = 100%; FALSE is Selected (e.g., 140)

The EPP Simulator dashboard allows the user to apply different growth percentages to a cost curve to allow it to be re profiled accordingly

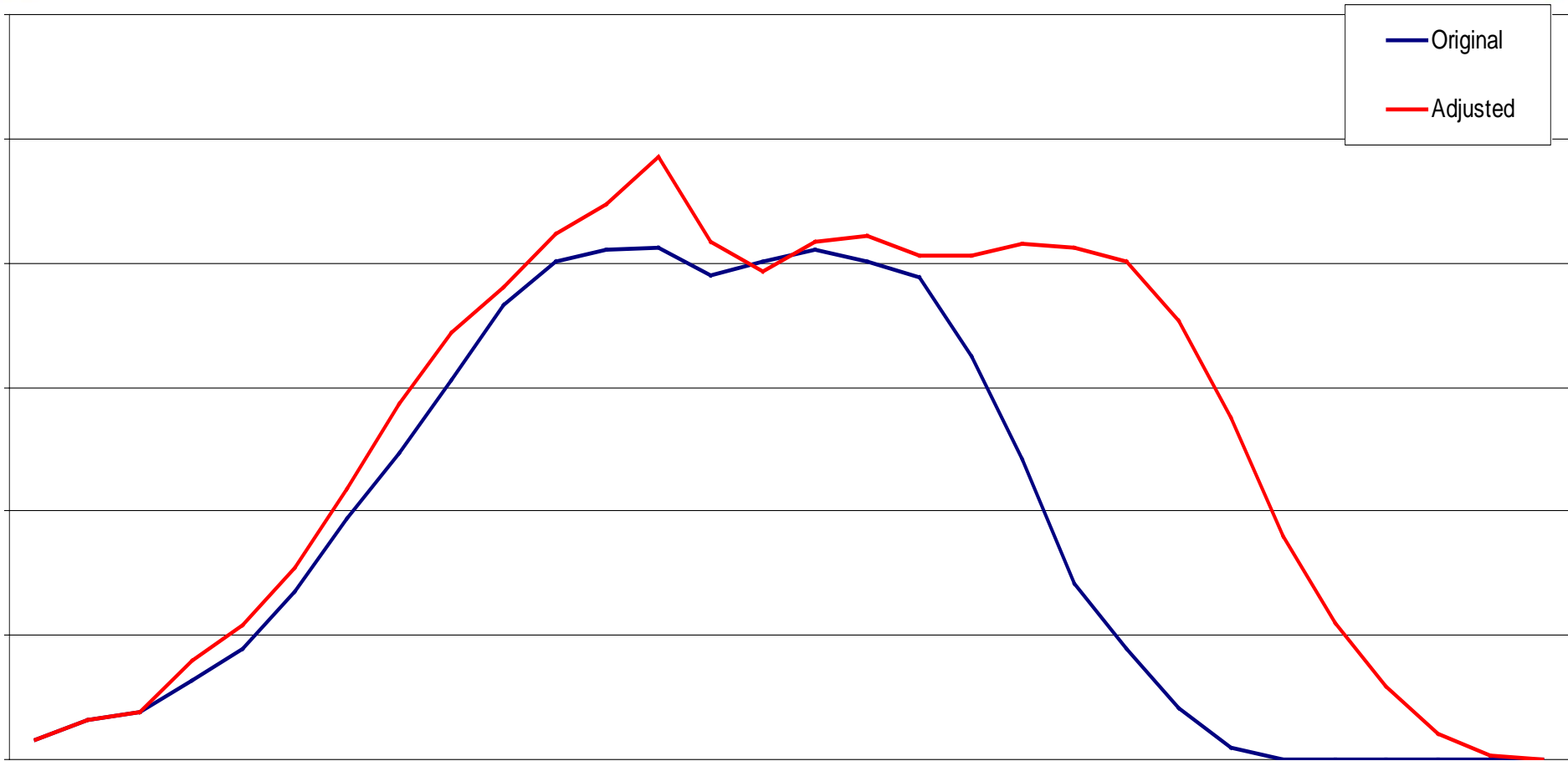
How it is used – The EPP Simulator (2)

	Outturn spend (£m)													
	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25
	33	63	77	158	217	308	436	571	687	760	846	894	969	833
10	0	0	0	0	0	0	0	-	-	-	-	-	-	-
11	5	3	1	0	3	2	7	1	-	0	1	4	6	
12	3	1	-	-	0	5	2	0	-	0	2	2	-	
13	21	5	24	33	31	75	12	-	-	-	-	-	-	
14	-	-	-	-	-	-	-	-	-	-	-	-	-	
15	4	-	-	-	-	-	-	-	-	-	-	-	-	
16	3	1	6	11	2	-	-	-	-	-	5	2	2	
17	-	-	0	0	3	-	-	0	1	3	1	-	0	
18	-	-	-	-	-	(0)	-	-	-	-	-	-	-	
19	-	-	-	1	1	5	5	4	38	95	179	175	179	153
20	4	-	-	-	-	-	-	-	-	-	-	-	-	
21	1	18	25	8	-	-	-	-	-	-	-	-	-	
22	2	0	-	0	1	-	-	-	-	-	-	-	-	
23	21	54	30	76	58	12	12	14	1	-	-	0	0	
24	-	-	-	-	-	-	-	-	-	-	-	-	-	
25	3	1	0	0	4	4	5	2	-	-	-	-	-	

The simulator tool re-calculates each of the cost lines and then places them in to a table so that further macro analysis can be done to help inform the overall affordability of the EPP.

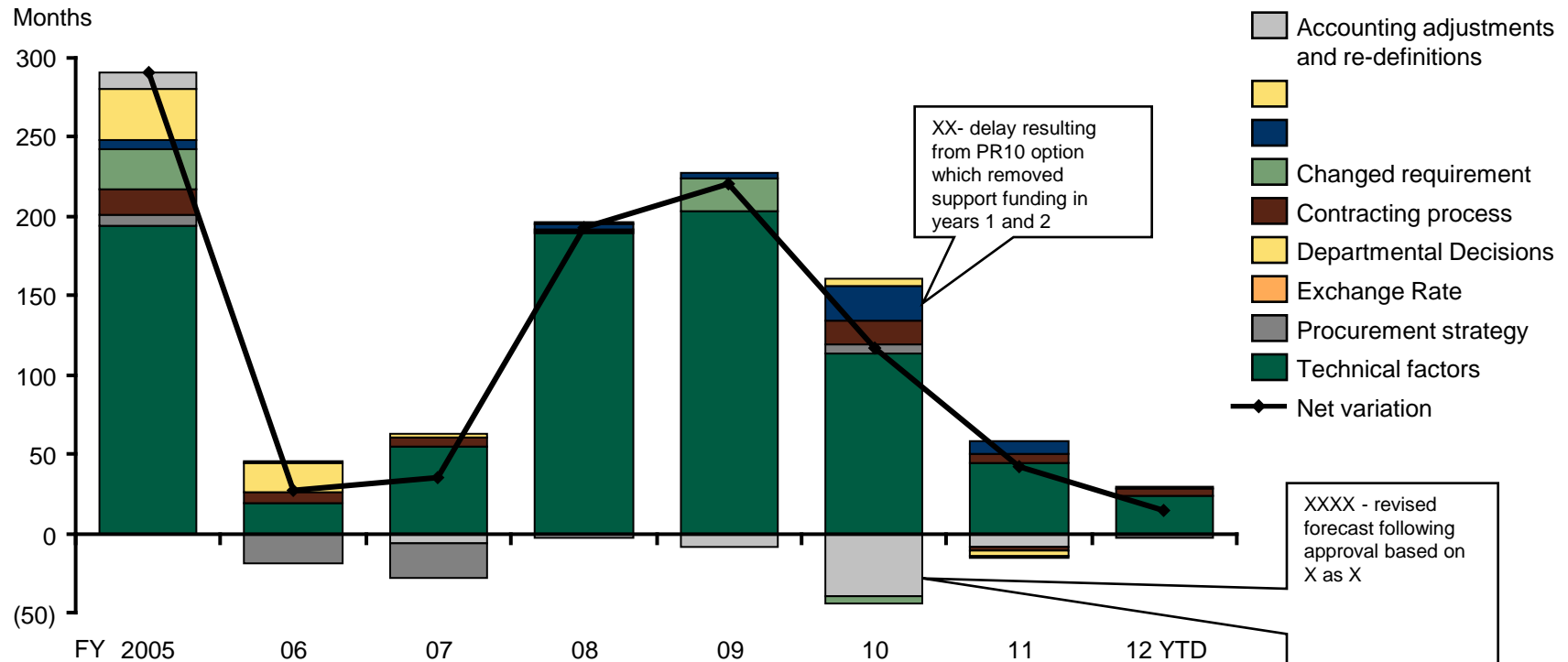
This is then called the Historical Performance Comparator (HPC)

How it is used – Graphical Results



Why projects have grown – Reasons for change analysis (1)

Total duration to ISD₅₀ variation for all projects past Main Gate*

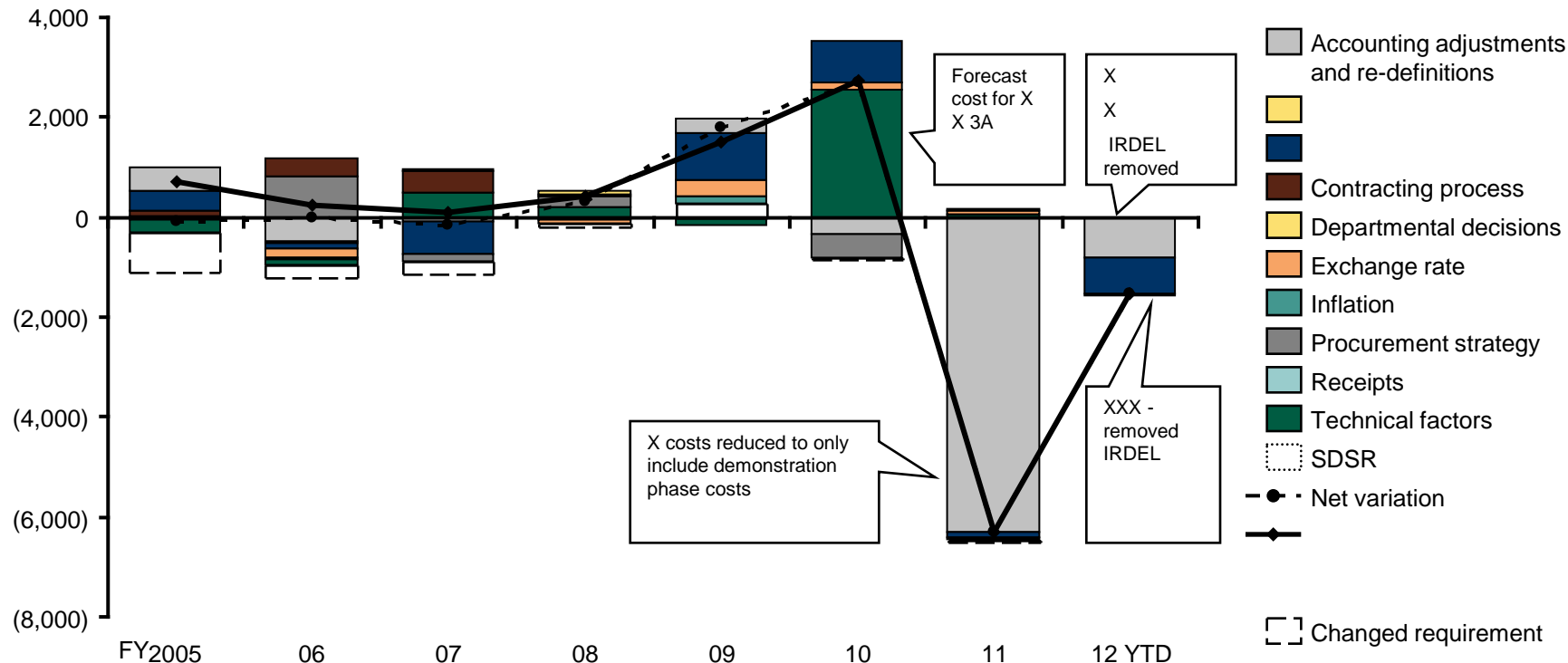


2,737	2,123	2,080	1,826	1,232	1,592	1,058	176	Total forecast D&MP duration of projects (months)
44	28	33	34	37	33	32	5	Number of projects

Why projects have grown – Reasons for change analysis (2)

Total cost₅₀ variation for all projects past Main Gate*

Millions of pounds



52.8	56.9	59.5	49.3	52.1	51.2	53.4	1.1	Total D&M cost of projects
51	53	58	48	45	40	39	6	Number of projects

Summary – Next steps

- First and foremost we need better data and more of it!
- Projects grow so should we really be setting budgets and schedules at 50% or should we be more conservative?
- Do projects grow differently in different sectors?
- Other elements coming in to play on a project and what analysis can be done round these?

ANY QUESTIONS?