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# Parametric Thinking SCAF

Bob Mills

3<sup>rd</sup> February 2015



# Parametric Thinking - Abstract



Automotive New Model Programmes are typically only in their development phase (pre volume production) for between 1½ to 6 yrs. In common across Industry sectors though it is important to recognise if a programme will make a profit and as early as possible in the development process. If it is not profitable on paper, is there anything we can do to steer the programme towards making a profit? When to stop 'CPR' and let the programme die!

Parametric Cost Estimating has rarely, if at all, been applied within the Automotive sector. In this presentation Bob Mills will explore the reasons why it might be appropriate to adopt it's application and hint at the results that Jaguar Land Rover have achieved during a Proof of Concept application.

The basis of the authors on-going PhD will also be explored. This PhD seeks to join the 2 principal schools of Cost Engineering, Parametric Cost Estimating and Should Cost, together in an attempt to uncover the Uncertainties embedded within the output of Parametric Cost Estimating and migrate them into mitigateable Risks and Opportunities. In achieving this some low level tools will also be explored such as the importance of understanding  $R^2$ .

# Bob Mills



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## Brief background.

- Started as an Aeronautical Engineering
- Progressed to Tool Making small batch production
- Converted to Mechanical / Production Engineer
- Became a teacher of 11-18yr olds
- Joined Jaguar as a Cost Estimator 6<sup>th</sup> Aug 1984
- Completed MSc in Manufacturing Systems @ Warwick 1988
- Achieved Snr Cost Engineering Manager 2006
- Appointed Chairman of ACostE (Association of Cost Engineers) Engineering and Manufacturing 2010 and served in that capacity until April 2014.
- Started a PhD in Manufacturing Engineering (Cost Engineering) @ Bath Jan 2014.

# Achieving heightened levels of confidence around New Model Programmes.

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Sometimes we look back at a New Model Programme and only see the effects of the flourish of activity that occurred during the final delivery stages of a New Model Programme or for that matter any project.

But the real point of difficulty occurred right at the beginning – GETTING STARTED!

So what held us back from getting started? Typically the answer will boil down to confidence. Confidence in our ability to achieve, deliver or dare I say it make a profit.

My PhD will look at exploiting the benefits of applying Parametric Cost Engineering and the heightened level of detail already available within Automotive from 'Bottom-up' methodologies.

# Automotive background in Parametric Cost Estimating.



Whilst Aerospace, Defence Civil and Chemical all have an established background in Parametric Cost Estimation, the Automotive sector has largely steered away preferring more analogous methods – it's like this but different so what is the difference worth. The following citations confirm the Automotive Analogous method during early New Model Programme evaluations; [Nunez, \(1993\)](#); [Roy, et al, \(2005\)](#); [Roy, et al; \(2011\)](#).

Parametric Cost Estimation itself is becoming a confused term having 2 definitions. Academic papers can be found supporting the use of both. The following citations correctly recognise Parametric Cost Estimation as a Statistical method based on historical data; [Curran, et al, \(2001\)](#); [Bajaj, et al, \(2002\)](#); [Bao and Weston, \(2002\)](#); [Camargo, et al, \(2003\)](#); [Watson, et al, \(2006\)](#). [Dysert, \(2008\)](#); [Trivailo, et al, \(2012\)](#); [Lunghi, et al, \(2013\)](#).

Others have used the term Parametric to represent Parametised which would be better stated as 'Should Cost' Family of parts; [Roy, \(2003\)](#); [Chougule and Ravi, \(2006\)](#); [Qian and Ben-Arieh, \(2007\)](#). Unfortunately this interpretation has been taken up by the CAD industry and is being proliferated.

# An observable difference.

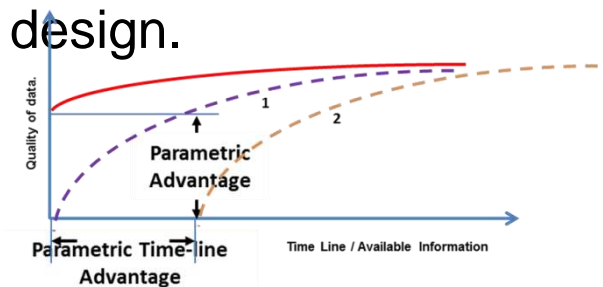


About 30yrs ago there was a split within Cost Engineering circles. Aerospace & Defence went down a top-down approach, whilst Automotive and White goods went down a bottom-up approach.

- Bottom-up Cost Estimating is a detailed costed process plan against a specific design. These days it might be known as a “Should Cost”, the suppliers equivalent is called a QAF (Quotation Analysis Form).
- Top down Cost Estimating is based on understanding your historically incurred costs and through statistical methods called CERs (Cost Estimating Relationships) projecting the cost for something different in the future. It relies on a concept rather than a design.

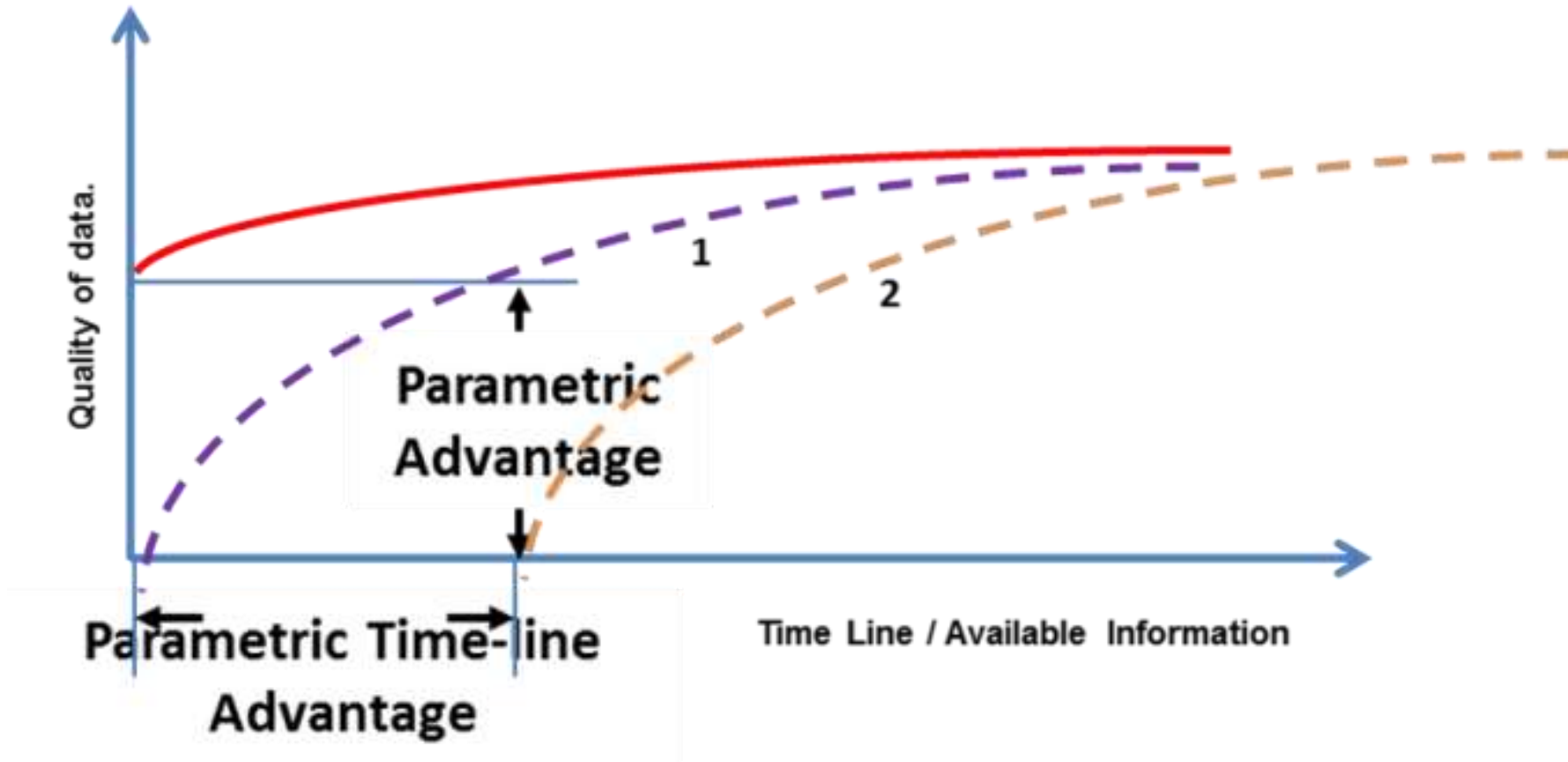
Bottom-Up or ‘Should Cost’ relies upon a design existing.

Top-Down or ‘Parametric Cost’ only needs historical data and a concept!



Based upon Shermon, D., 2009

# An observable difference.



Based upon Shermon, D., 2009

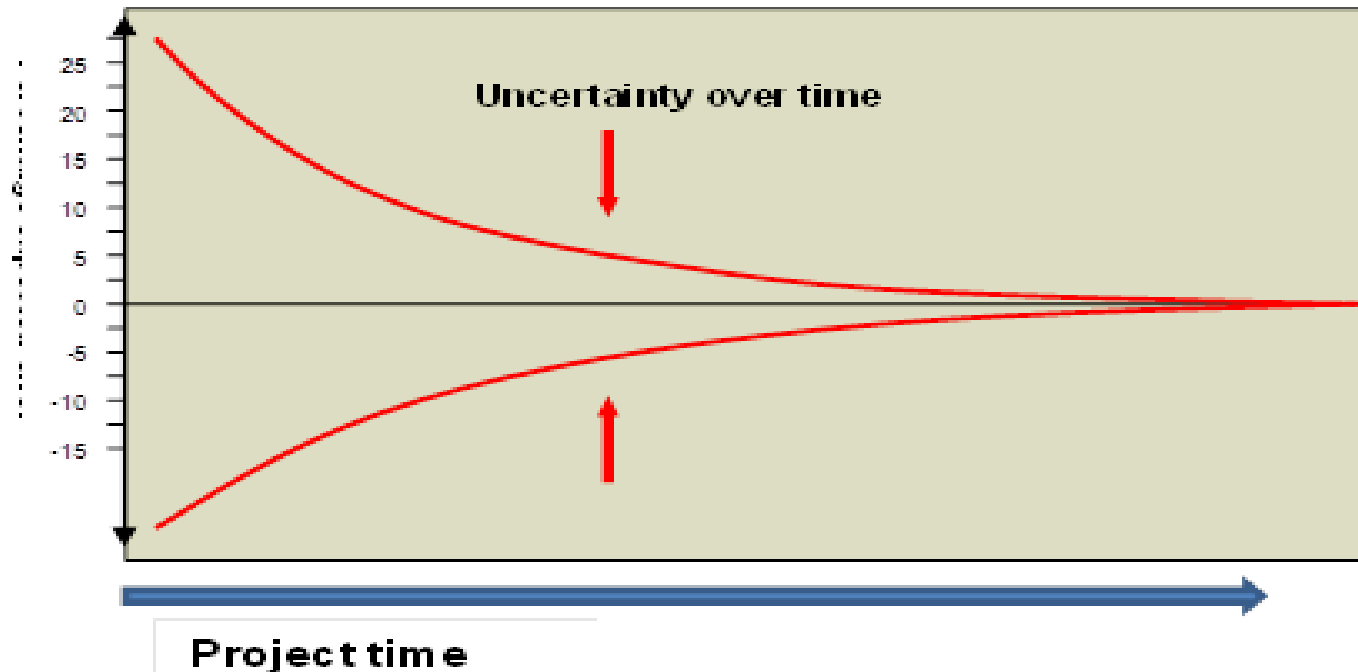


# A basic visual framework



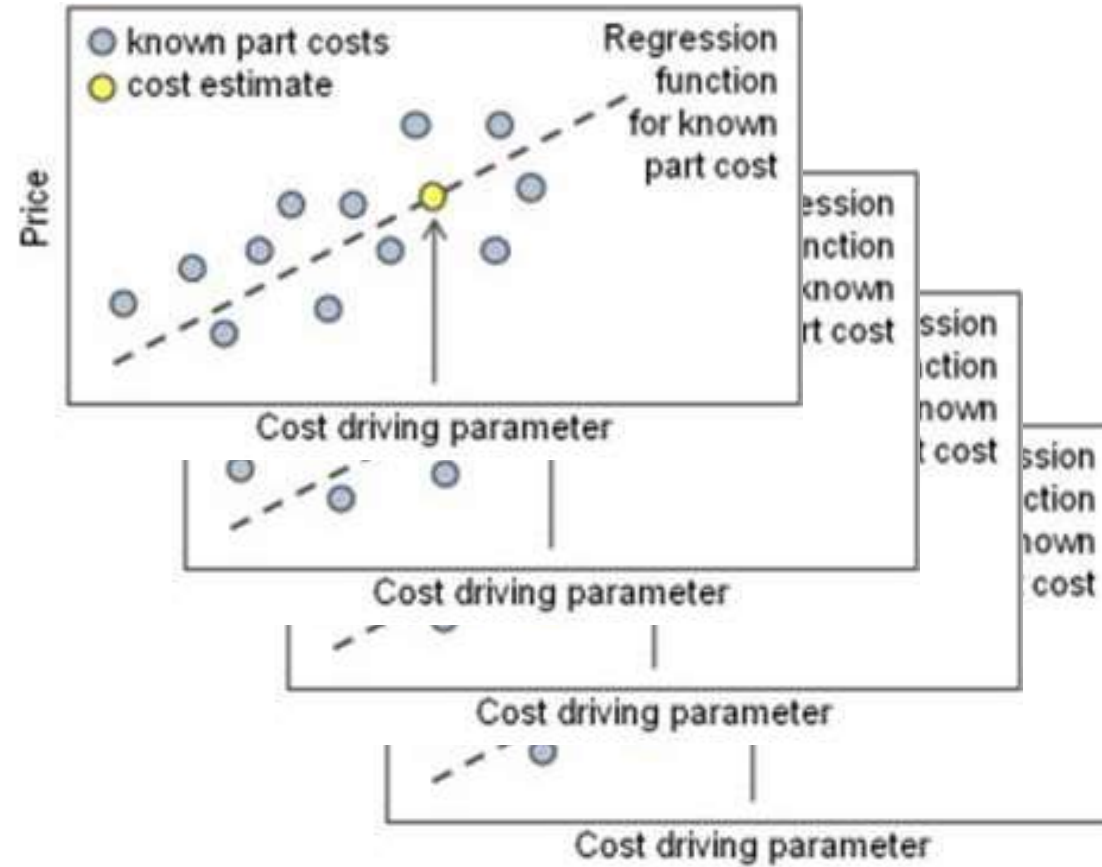
I would propose that whilst we consider our degree of confidence in a project to be our initial concern re getting started, in Cost Engineering and many academic circles this is normally referred to as “Uncertainty”.

Typically we can break Uncertainty down into 2 key components; Risk – Something that we can define and if we are lucky influence or mitigate, and Uncertain Uncertainty, “Unknowables”.



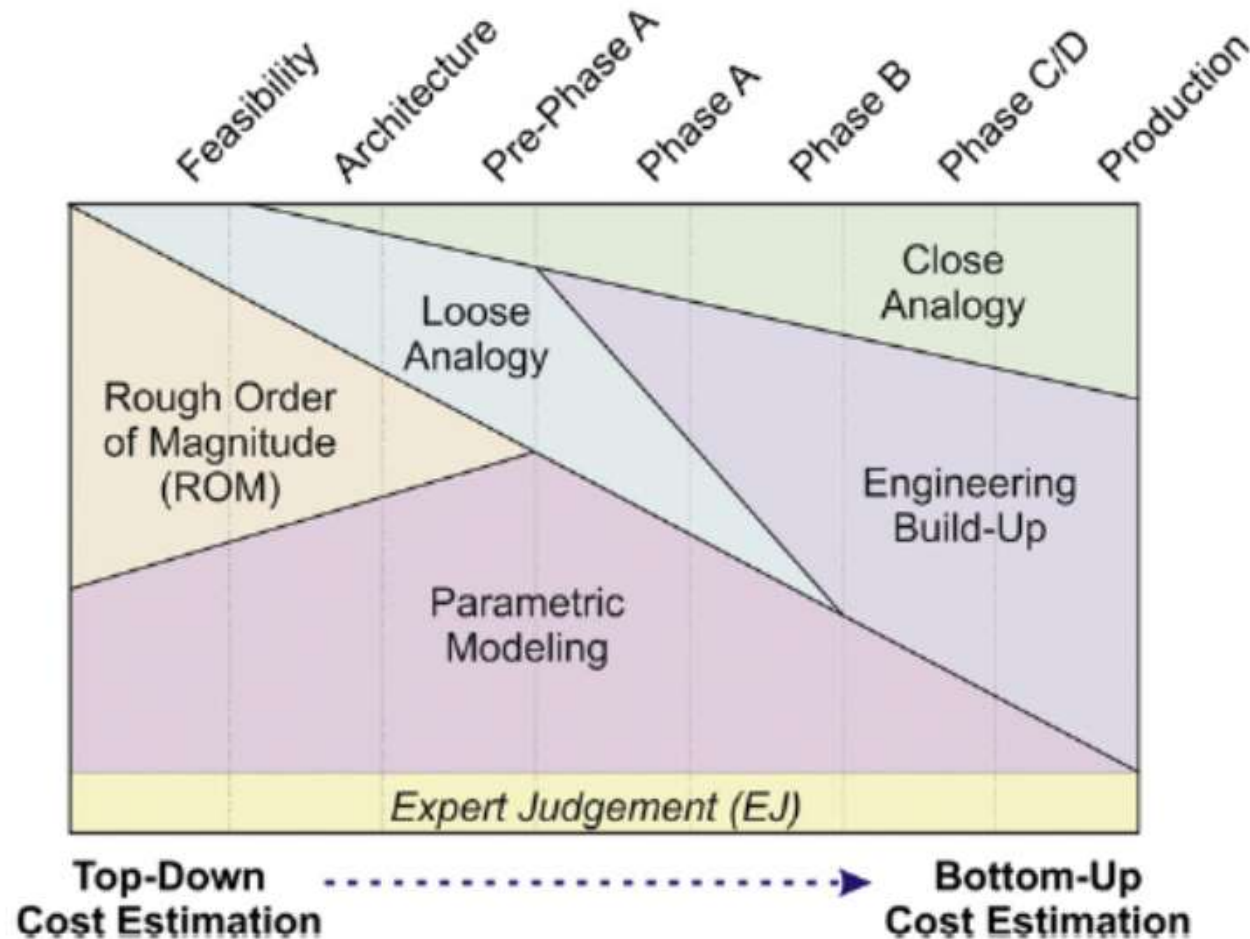
This basic visual now known as the “Cone of Uncertainty” was originally proposed by [Gorey, 1958](#), further developed by [Bauman, 1958](#)

# A simplistic CER



A CER can be developed against almost any independent variable.

# Positioning of various Cost Engineering tools.



Qualitative application of Cost Estimating Methods (CEMs) according to generalised Project Phases. (Trivailo et al, 2012)

# JLR POC and PhD Objective

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The initial POC (Proof of concept when applied to Piece Cost and a limited Vehicle system) has already indicated a very significant advantage simply for applying basic Parametric Cost Engineering principals to an Automotive New Model Programme (NMP).

My PhD objective is to explore methods to identify the Uncertainty and allow it to be converted either to deliverable opportunities or mitigateable risks at the very earliest stages of an NMP.

In Scope is:

- The concurrent analysis of incurred and piece cost 'Should Costs'.
- The understanding of Costs Drivers from within the historical Part data.
  - Does it deliver information on cost drivers to design around?
  - Does it deliver confidence to bulk buy supplier production capacity?

# What might happen if we combined Top-down and Bottom-up?

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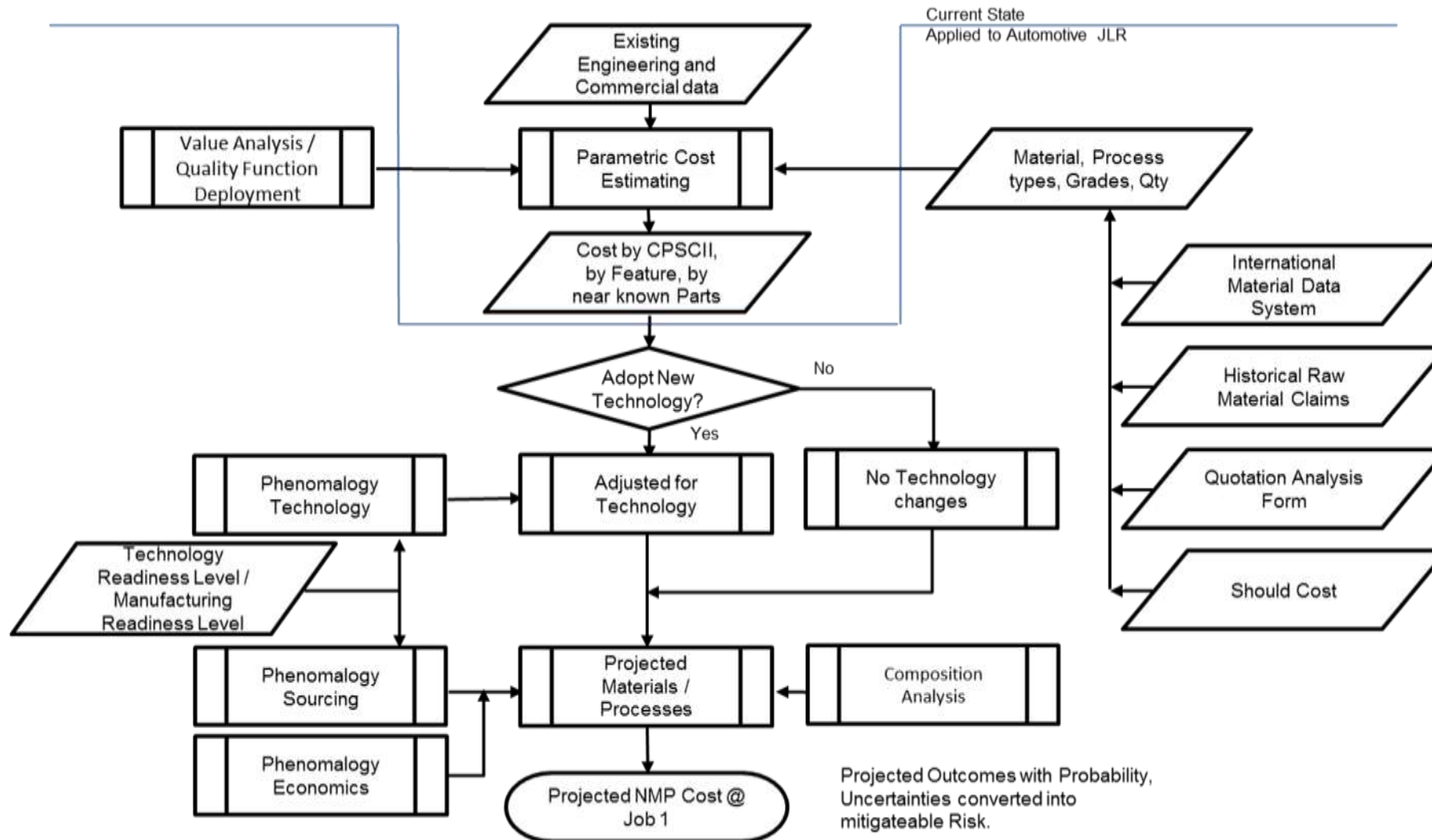


What might happen if we combined Top-down and Bottom-up?

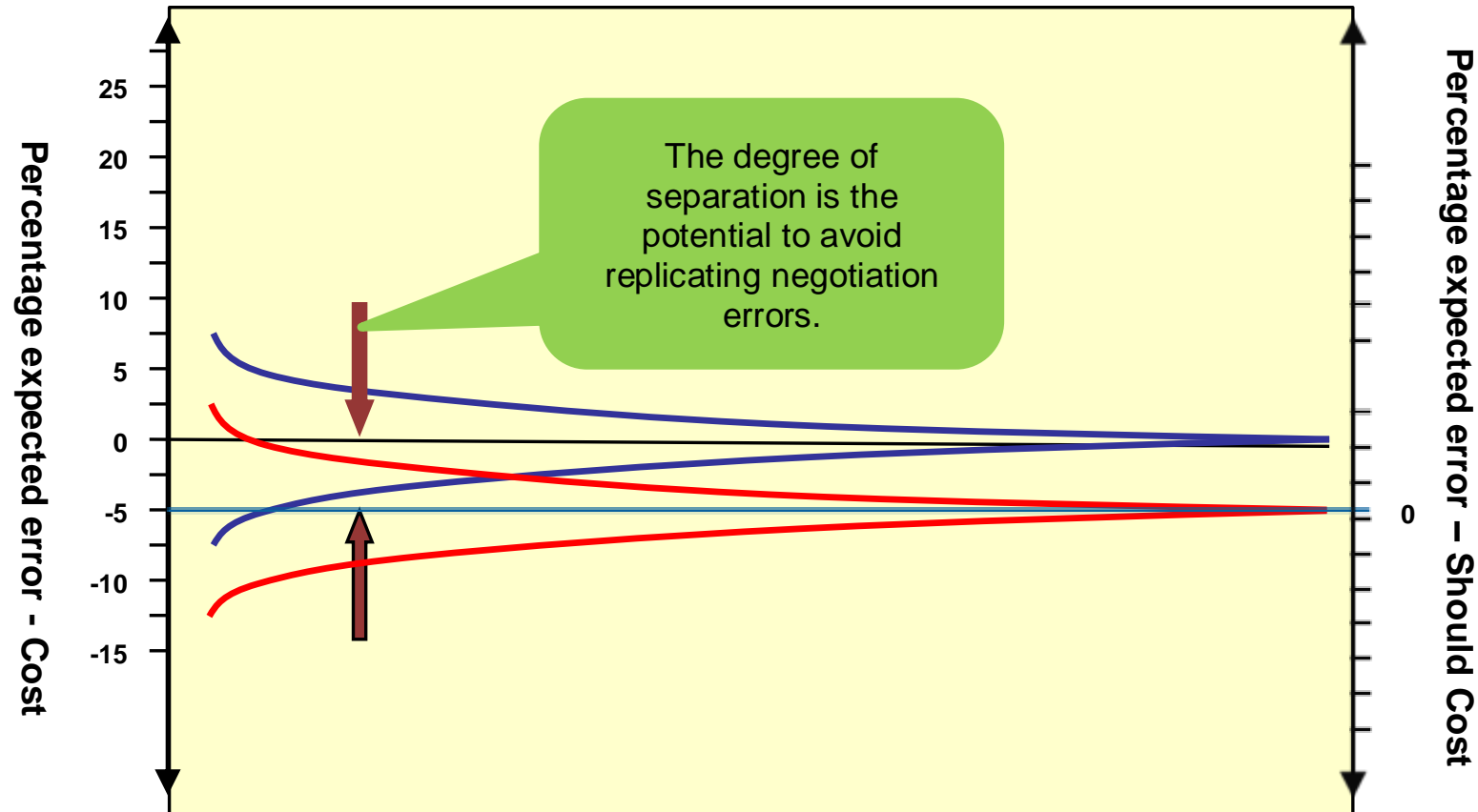
Might we get a similar effect to twisting 2 pieces of fibre together? – A stronger combined effect!

More data at the early stages that we might be able to employ to direct the reduction of Uncertain  
Uncertainty – converting it to a Risk with mitigation, an action plan?

# Next Steps



# Combining views of Historically Incurred Cost and Should Cost.



# Target Balance



| Target        | Business Structure | £k Ave Programme pu |
|---------------|--------------------|---------------------|
| Revenue       | 100%               | 50.000              |
| Material Cost | 48%                | 24.000              |

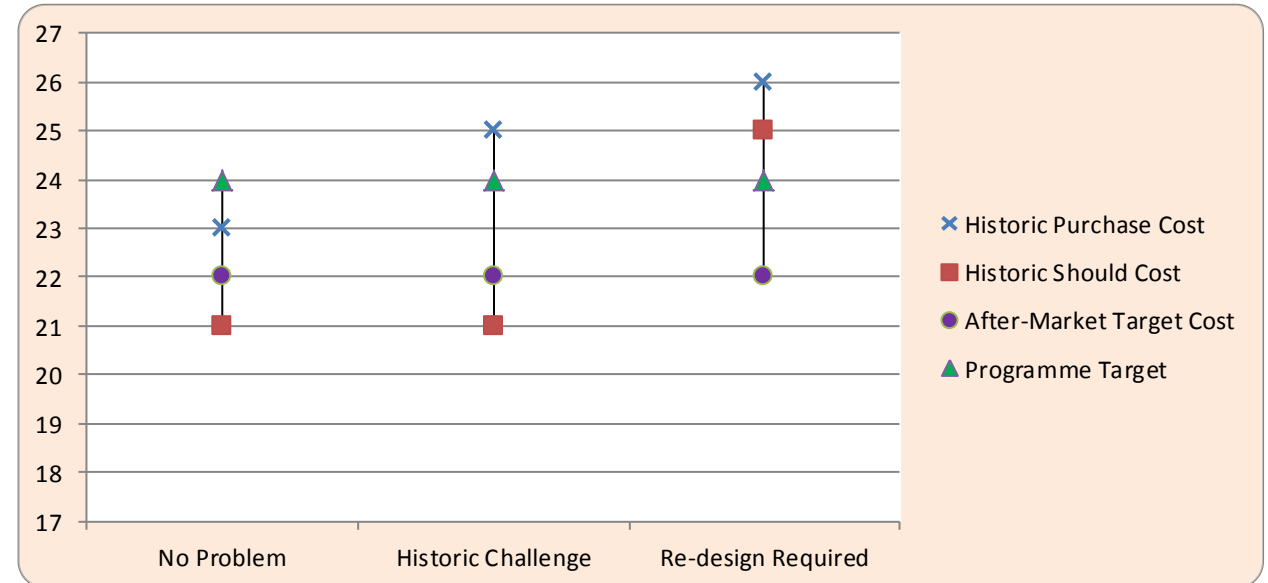
Input value that results from early Market tests. "If we gave you this what could you sell it for and how many could you sell by market?".

Business historic Structure of the 'Income Statement'. This can be used at the total average Business or at the Brand level. JLR does not have a history of using it below this structure.

Resulting Target output value. In this case the Value of Piece Cost which is the Piece Cost associated with the Supplier Parts.

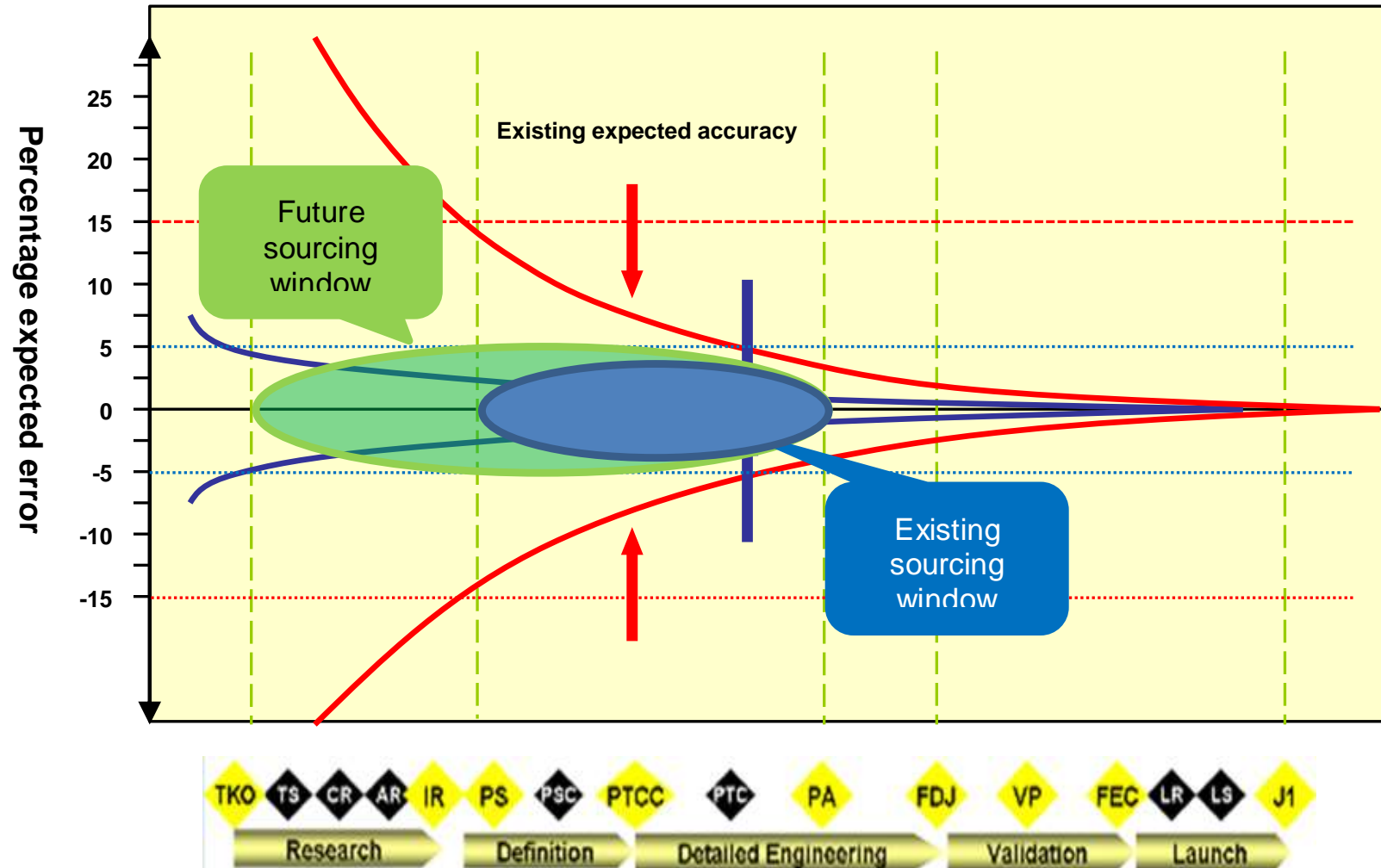
NB: Whilst After-Market Target Cost has been shown this is currently out of scope.

|                          | No Problem | Historic Challenge | Re-design Required |
|--------------------------|------------|--------------------|--------------------|
| Historic Purchase Cost   | 23         | 25                 | 26                 |
| Historic Should Cost     | 21         | 21                 | 25                 |
| After-Market Target Cost | 22         | 22                 | 22                 |
| Programme Target         | 24         | 24                 | 24                 |

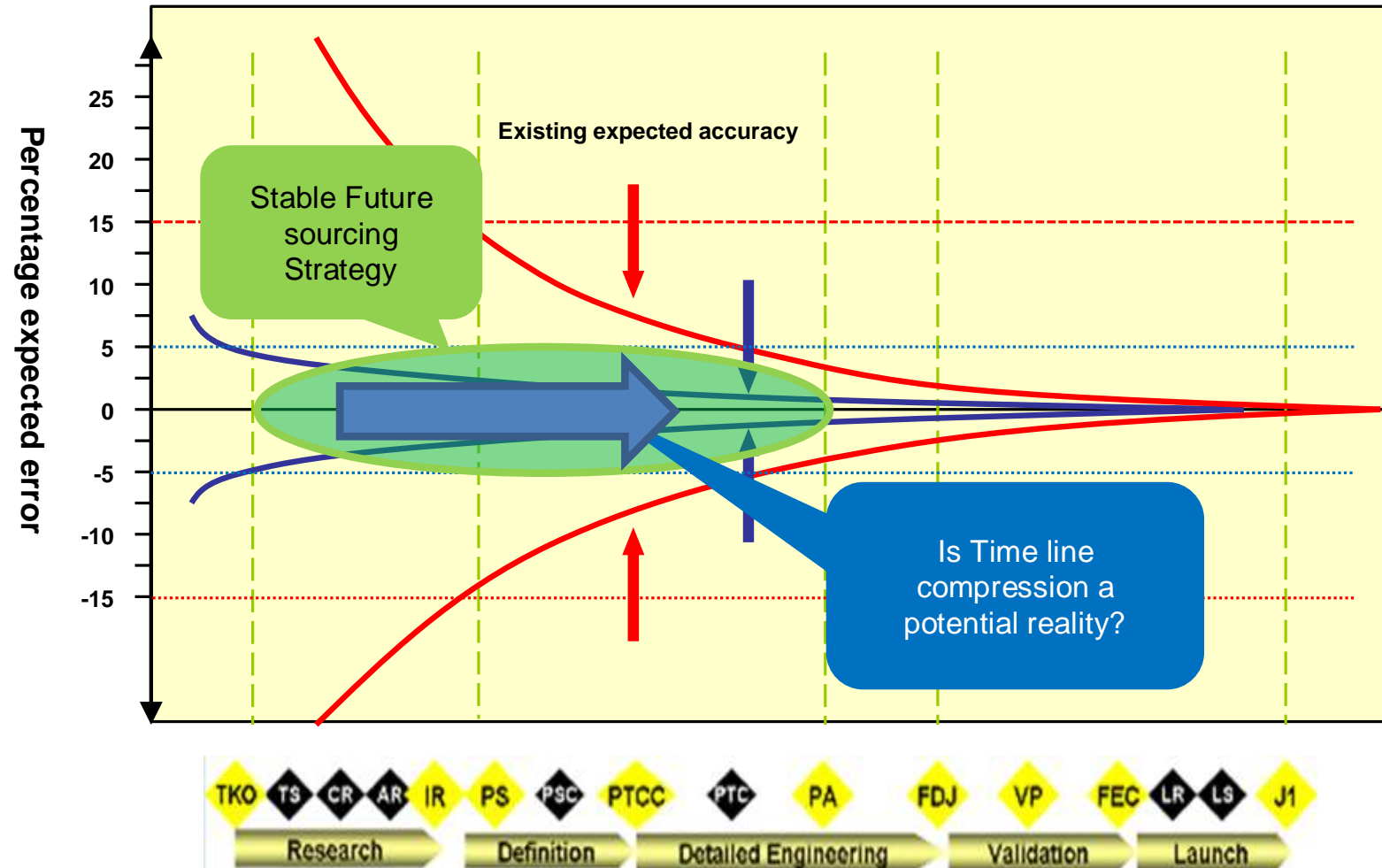




# What the future might hold



# What the future might hold<sub>2</sub>



# Q&A

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Please note: due to 'IPR' constraints I'm am constrained from telling you either – how JLR has managed to achieve success in applying Parametric Methods to the Automotive Sector, the actual POC results – other than they were successful and significant, or the detail that is expected from the next phase.

Perhaps at a later date?

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