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CMM future demands – measurement at the edge

Nick Orchard

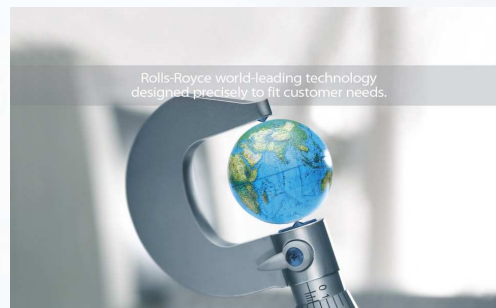
Manufacturing Process Owner – Dimensional Measurement

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Content

- About Rolls-Royce
- The cost of measurement
- Future development needs



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What does Rolls-Royce Make?

- Engines for –
 - Civil Aircraft
 - Military Aircraft
 - Ships
 - Power generation plant
 - Nuclear submarines
- Power Systems

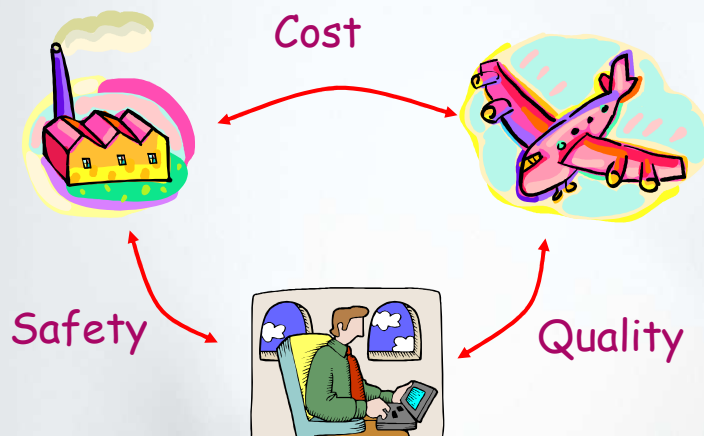


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Key drivers in engine manufacture



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Manufacturing objective - make things the right size!

- You don't have to make another one
- You don't have to correct it
- It fits properly
- It works as the designer intended it to
- It doesn't break or fall apart

But it's not as simple as that!

- It has to be done at minimum cost
- How do we really know if it's the right size?



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Measurement's role in manufacture

- Protect the customer
 - We cannot afford to deliver non-conforming parts
- Provide key information to enable the machining processes to operate to their full potential
 - Be the eyes of the process
- Don't get in the way – try to be invisible.



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The headline objective for measurement:

“100% customer protection at zero cost”

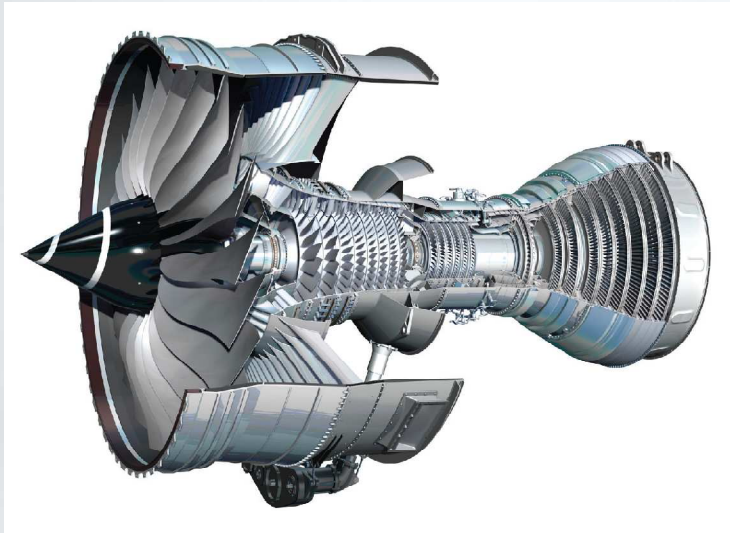
Dr Hamid Mughal

EVP Manufacturing Engineering and Technology for Rolls-Royce



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Trent XWB



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'Every part of this ship was built by the low bidder' – Alan Shepard



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The stages of Process Improvement

Stage 1 – Where we start – the status quo

Stage 2 – Investment in new equipment

Stage 3 – Process development

Stage 4 – Continuous improvement

Stage 5 – Where we end – the target state



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What happens when we invest in new measurement technology?

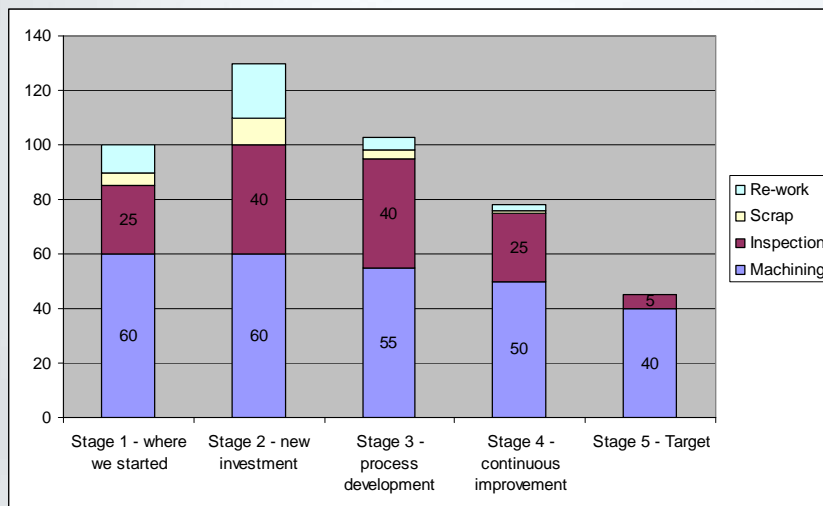
Following investment in new measurement capability, would you expect the overall process capability to:

- a) Go up?
- b) Go down?
- c) Stay the same?
- d) Don't know?
- e) Don't care?



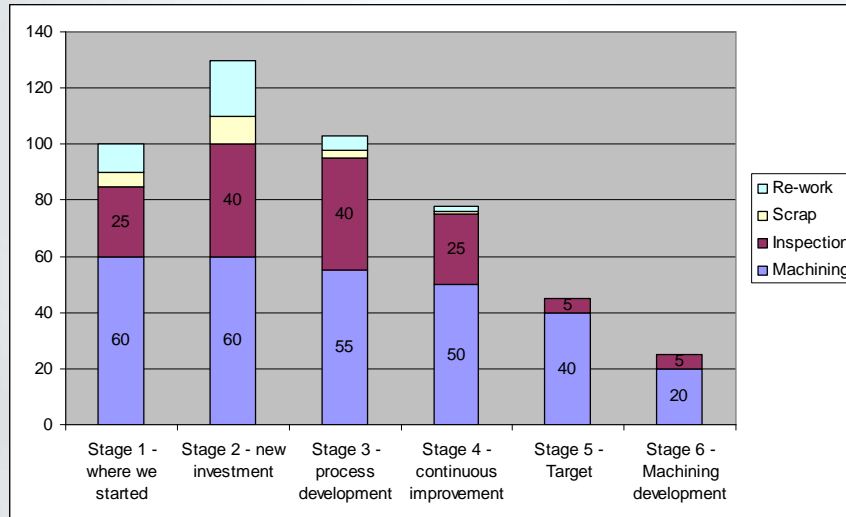
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Process cost



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Effect of machining development



Choices – is it...?



Or



..or more realistically is it ...?

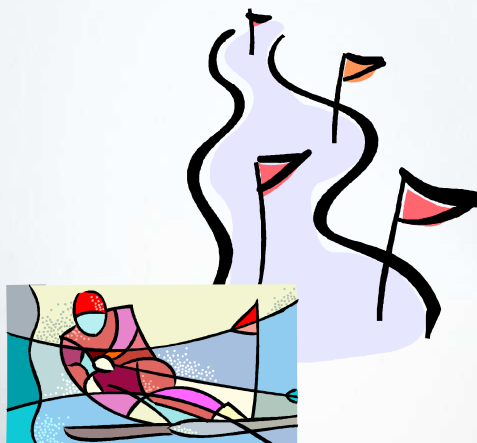


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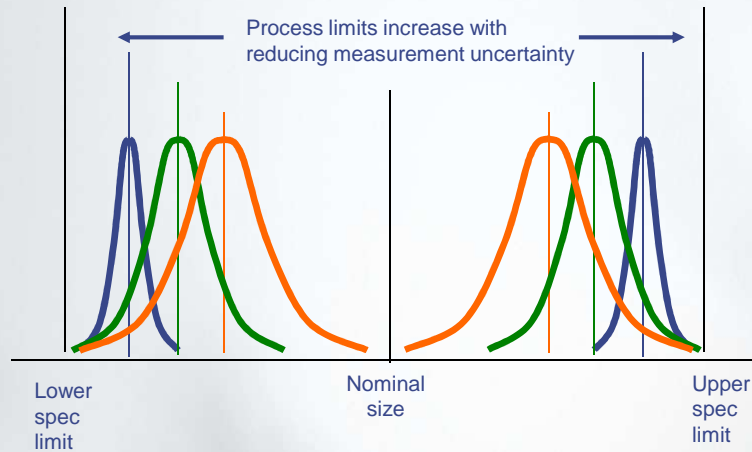
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Cutting it fine..



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Measurement Capability v tolerance



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The cost/capability trade-off

- Would using a lower capability (cost) measuring instrument compromise the overall process cost?
- We want to use the 'worst possible' measurement system!



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...but..

- How confident are we that we know where the limits of capability lie?
- Can we be sure that the measurement system will perform to expectations?



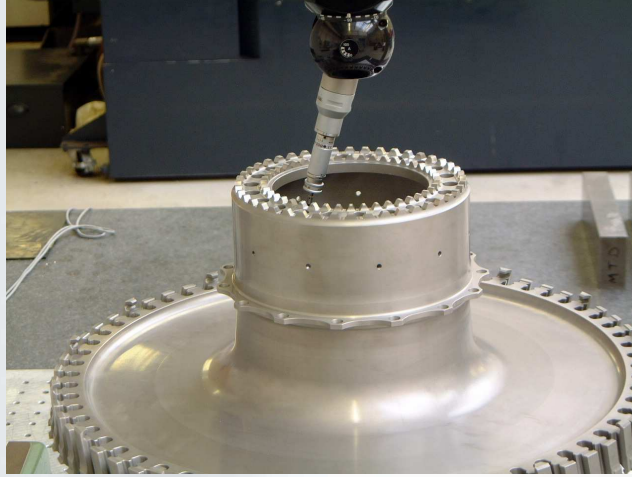
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ISO 10360 Test set up



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Real world – we need to measure a hidden bore



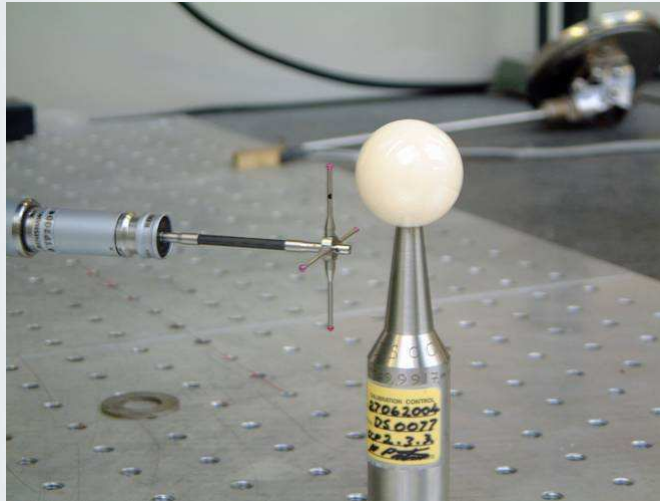
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Is this better than... ..this?



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...or this?



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Our current problems...solutions please

- We need a much better understanding of task-specific measurement uncertainty
- How do we verify CMM programs?
- How do we compare measurements on two CMMs and decide if they correlate?
- How can we make very high precision measurement on small features but then relate them to distant datum features?
- Do we know enough about machine tool measurement uncertainty to be able to dispense with any further measurement?



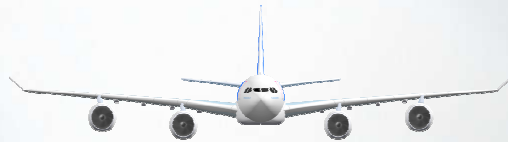
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Thank you for your attention
Any questions?

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