



Rolls-Royce

Size isn't everything!

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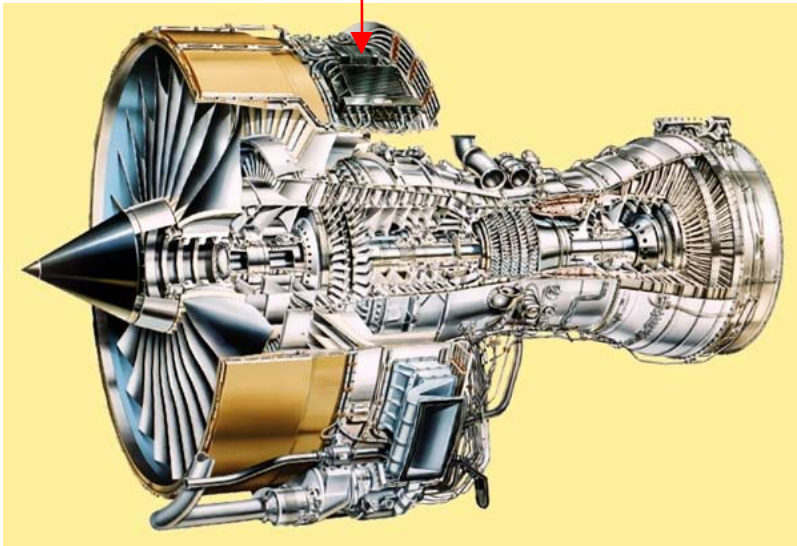
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Developing Control Systems since 1990

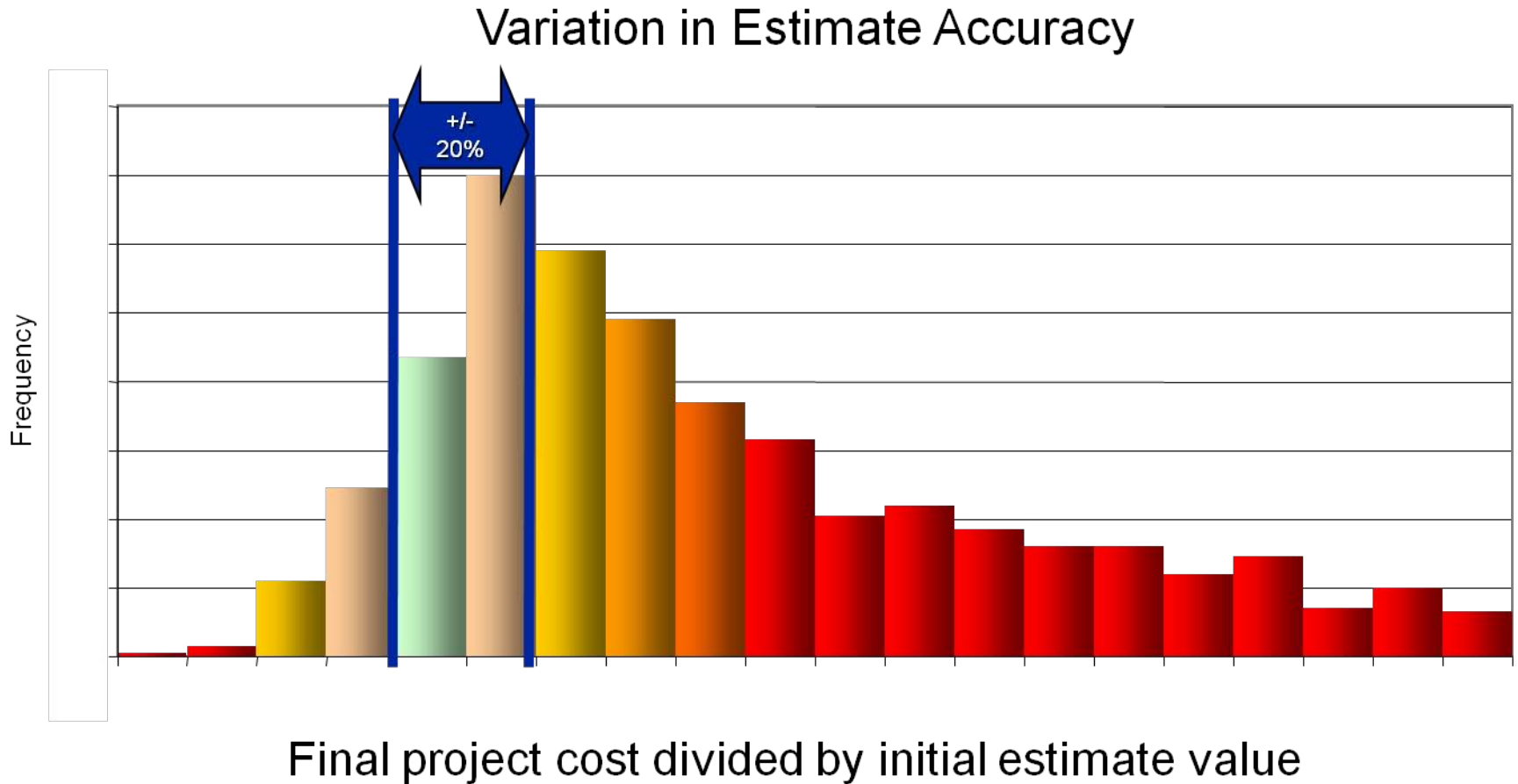
- The control system is fundamental to the certification of the engine and airframe. The Control System software is classed as safety critical.

Electronic Engine Controller

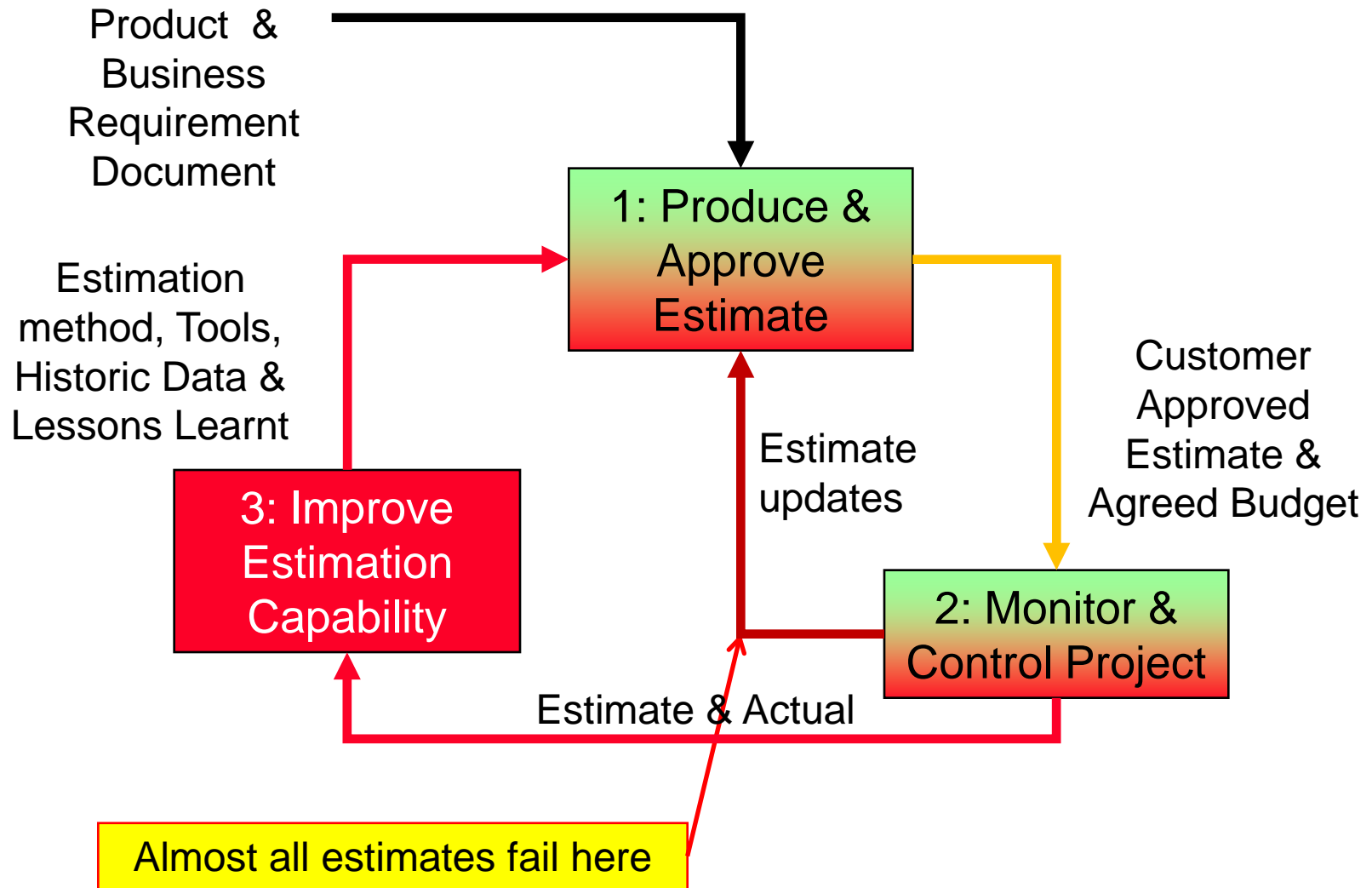


- Certification evidence cannot be easily generated centrally but must be gathered on each project instance, during system integration and integration with the hardware.
- Gathering this evidence, which can be over 50% of the Control Systems project's total cost, has to be incurred on each configured project instance.
- Projects are typically low volume and are individually configured for their application.

The accuracy of our estimates in 2004

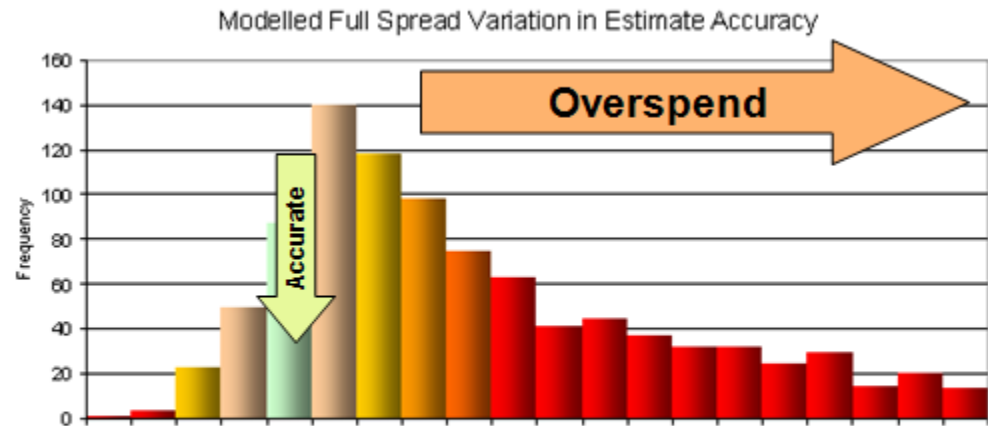


2004: The estimation life-cycle



Causes of Estimation Inaccuracy

- 1. Scope creep*
- 2. Requirements Uncertainty*
- 3. Poorly defined scope* (we did not know what we had to do)
- 4. Unrealistic expectations (internal & external to Controls)
- 5. Risks Management*
- 6. Missing peer review of estimate
- 7. Estimation experience

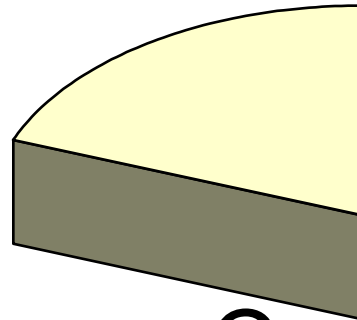


- 8. Lack of historic data
- 9. Lack of estimation process
- 10. Estimation Tool/process failed
- 11. Environmental factors not tracked (e.g. people, process, tools etc)
- 12. Unable to validate supplier quotes

2004: The root cause for estimation inaccuracy

Estimation Tools – 19%

E.g.
COCOMO II

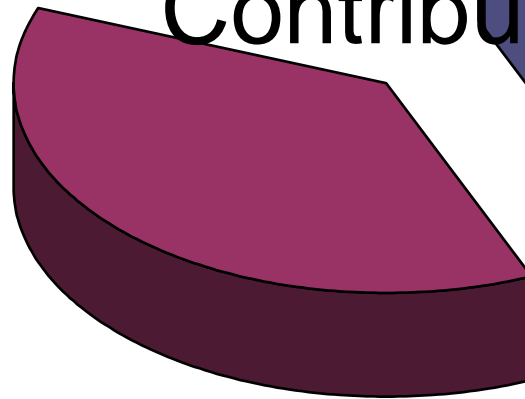


Behaviour 44%

Not complying to the process. Over zealous estimates, bullying into low estimates, rushing estimates, low respect for estimates, not managing change, not monitoring key assumptions....

Estimation Process 37%

Producing, reviewing and approving estimates. Monitoring and managing estimates. Managing change.



%

Contribution

2005

Benchmarking the business



Estimation & eliciting key assumptions & negotiation



Challenging our supplier costs



Using the model to identify and quantify risk

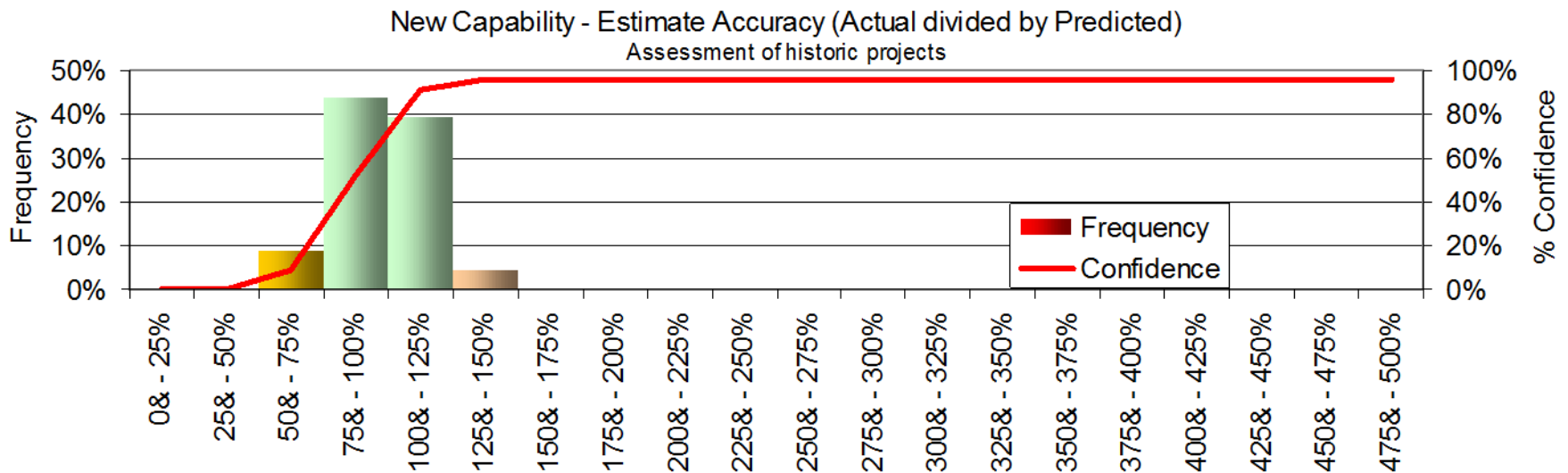
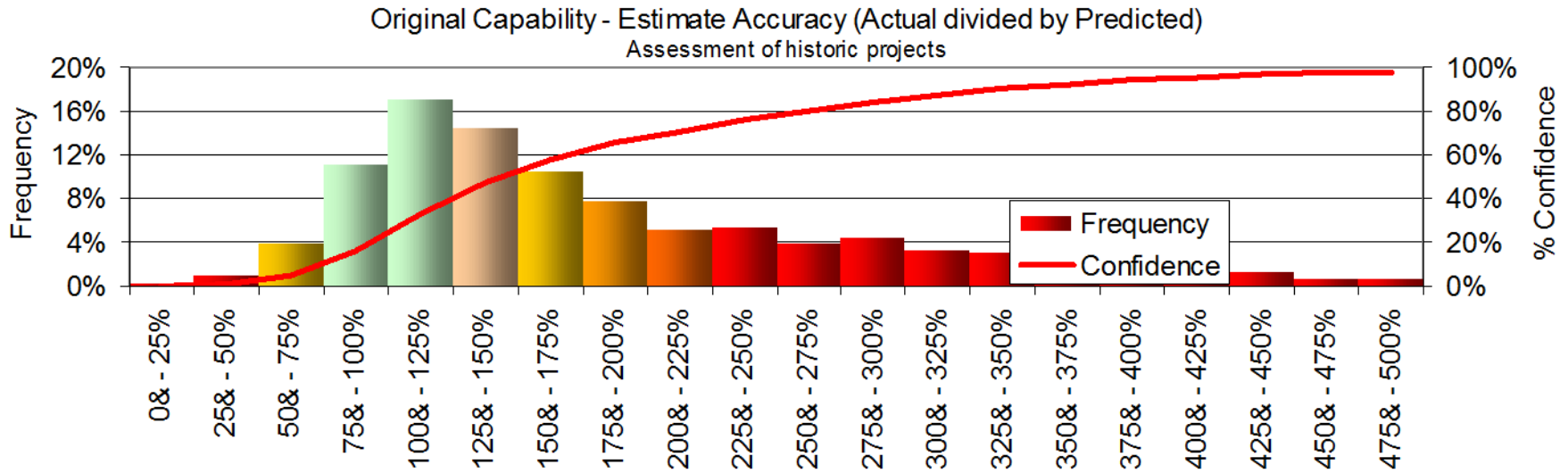


Using the model to identify & validate improvements



Using many of the same factors to estimate hardware engineering costs

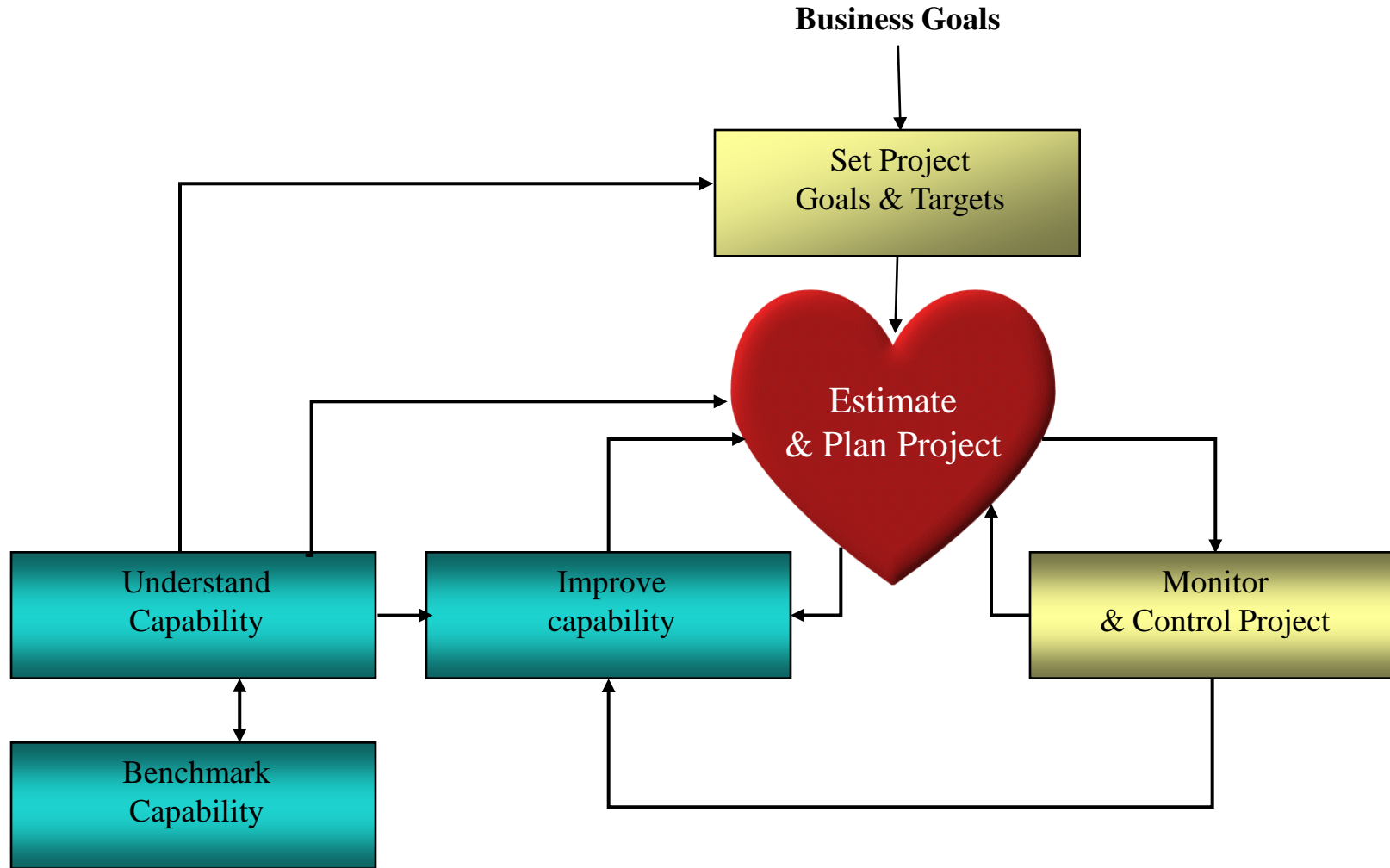
2005: before and after



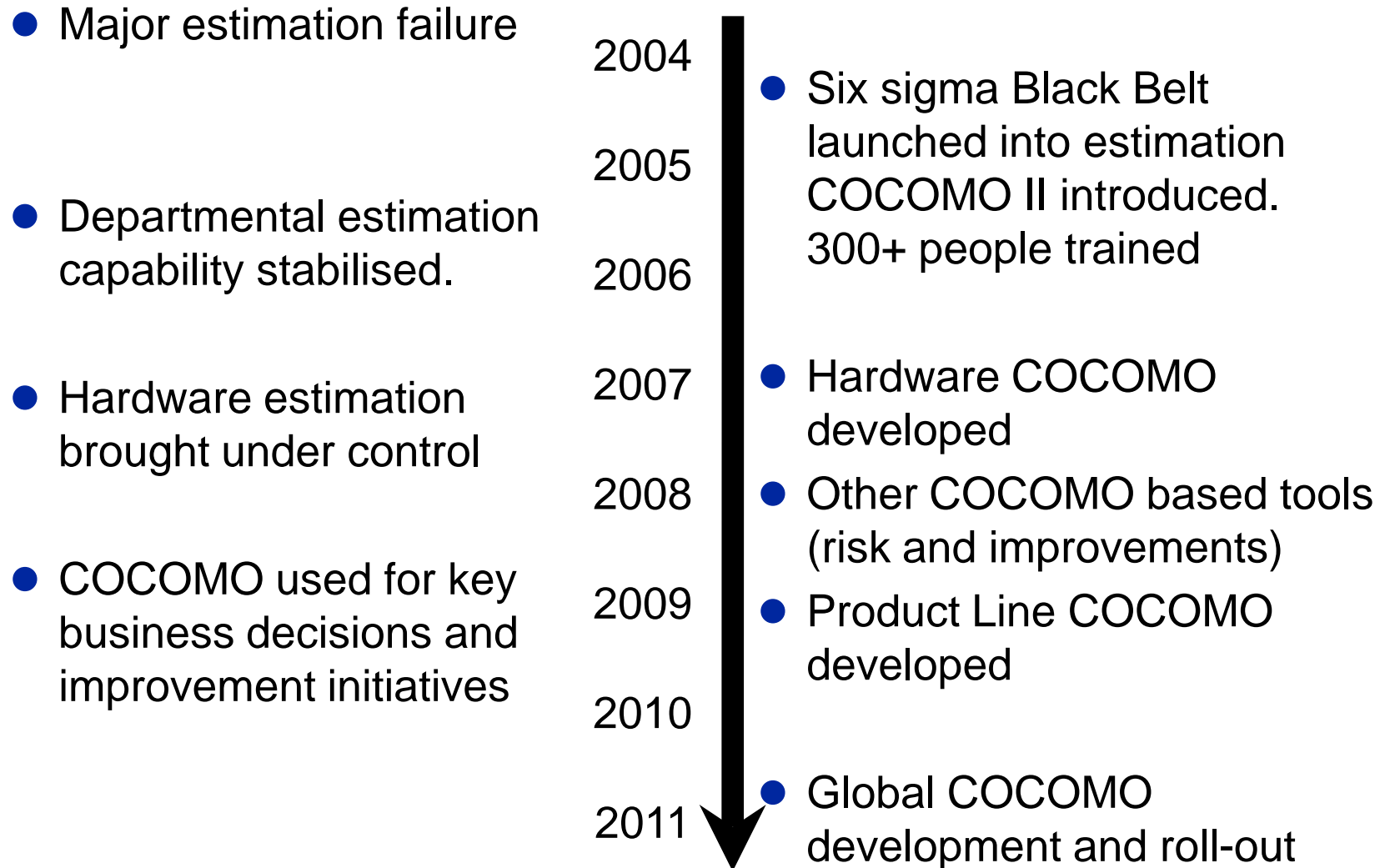
2011: The benefits from improved estimation



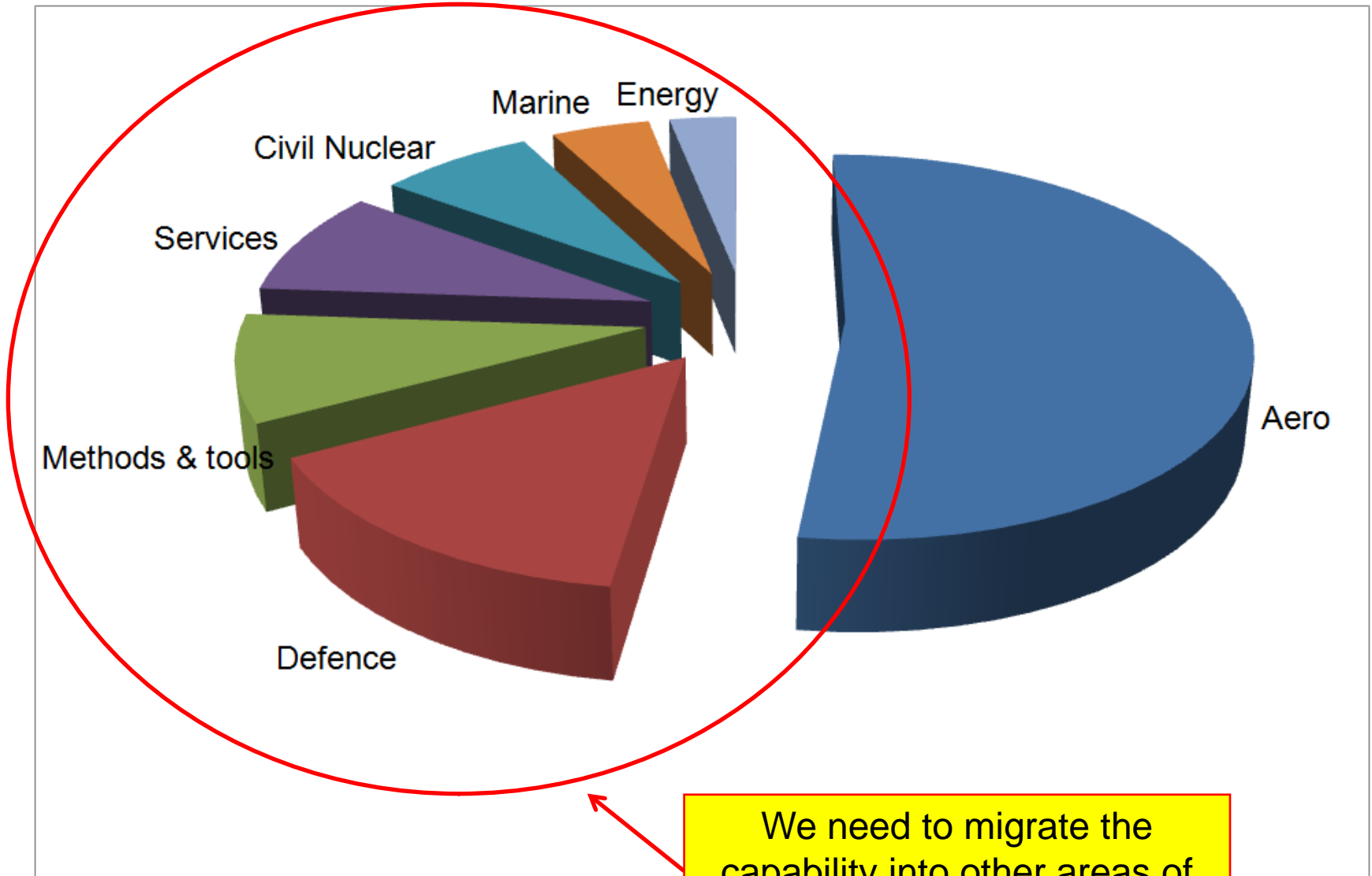
COCOMO is at the heart of our business



History



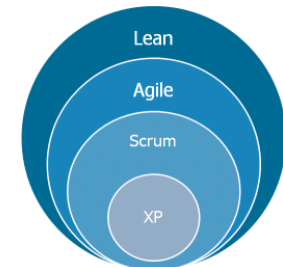
We have reached only half of the business so far



Global Estimation Capability

- Aim is to replicate the benefits gained by Aerospace. Applying the same principles **Globally** i.e. The deployment of proven...
 - Estimation process
 - Guidelines
 - Training
 - Tools

- Tools need to meet the needs of a far wider range of developers e.g.
 - Methodologies: Agile, Waterfall, Formal Methods
 - Standards: DO-178, Non-safety critical
 - Domains: Aero, Nuclear, Defence, Marine



Further Opportunities from tools

- Tools that can help us benchmark ourselves e.g.
 - Process: Cost for testing, architecture...
 - Products: Number of requirements, test cases....
- Other
 - Through life cost models (including maintenance and refresh)
 - Hardware and Electronics engineering
 - Schedule estimation and life-cycle phases
 - Multi user estimation
 - Cost of product features



Some benefits

- There are few things more compelling to the business than a well constructed business case and a rational defendable estimate
- The tool taught the business what was important, what to manage, what to monitor, where the risks lay and where opportunities would come from
- Despite initial reservations, the tool was calibrated and in use in only 1 month. The benefits have been on 10,000 times this effort
- Since we introduced COCOMO II we have seen improvements in both project stability and performance (11% cost saving on average)