26th annual INCOSE international symposium
Edinburgh, UK
July 18 - 21, 2016

A Case for Product Lines

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INCOSE
presents

"THE THREE ± 1 ESTIMATEERS"

Starring

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Andy "Porthos" Pickard
Steve "Athos" Fisher
Andy "Aramis" Nolan

An introduction

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This presentation is an appetiser.

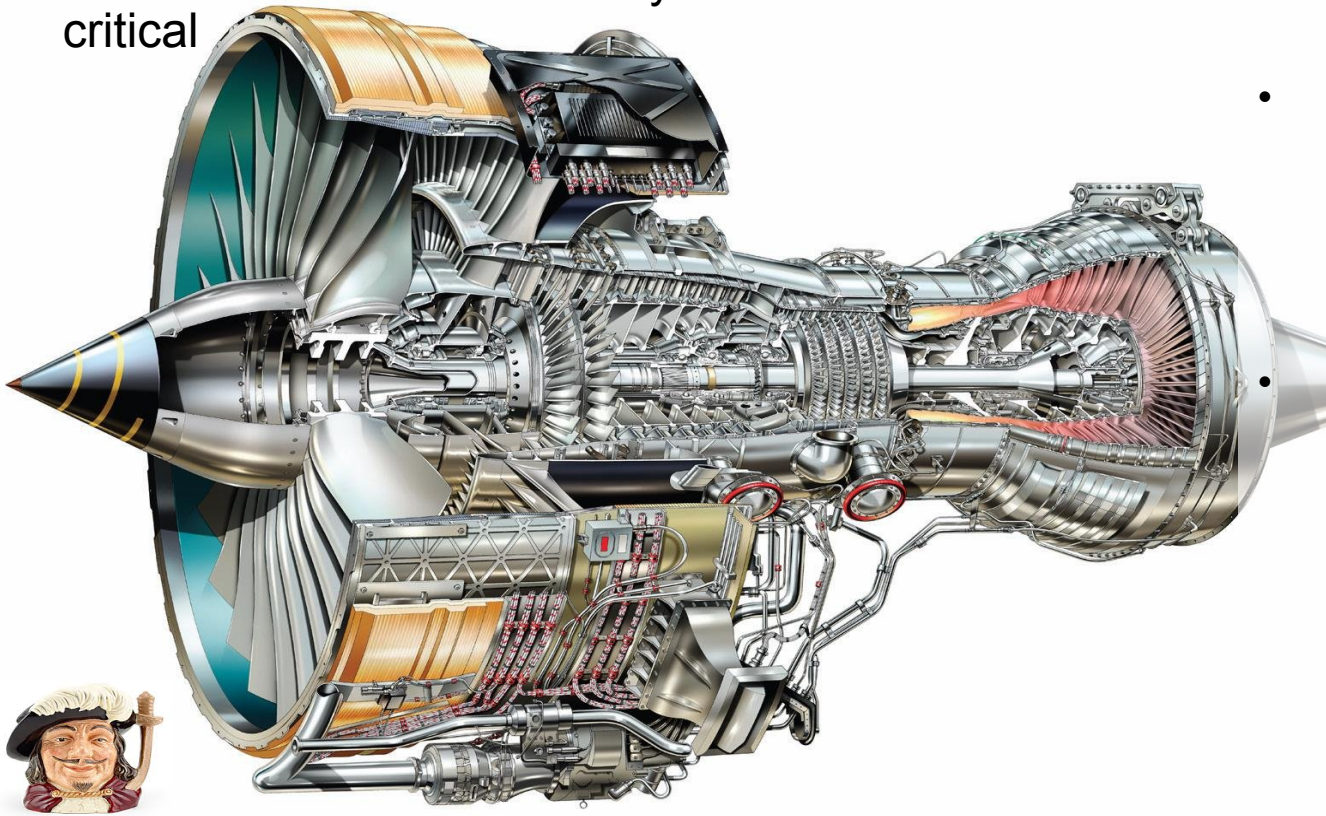
We encourage you to read the paper.

Part 1

The need for Product Lines

Engine Controllers

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



- 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.

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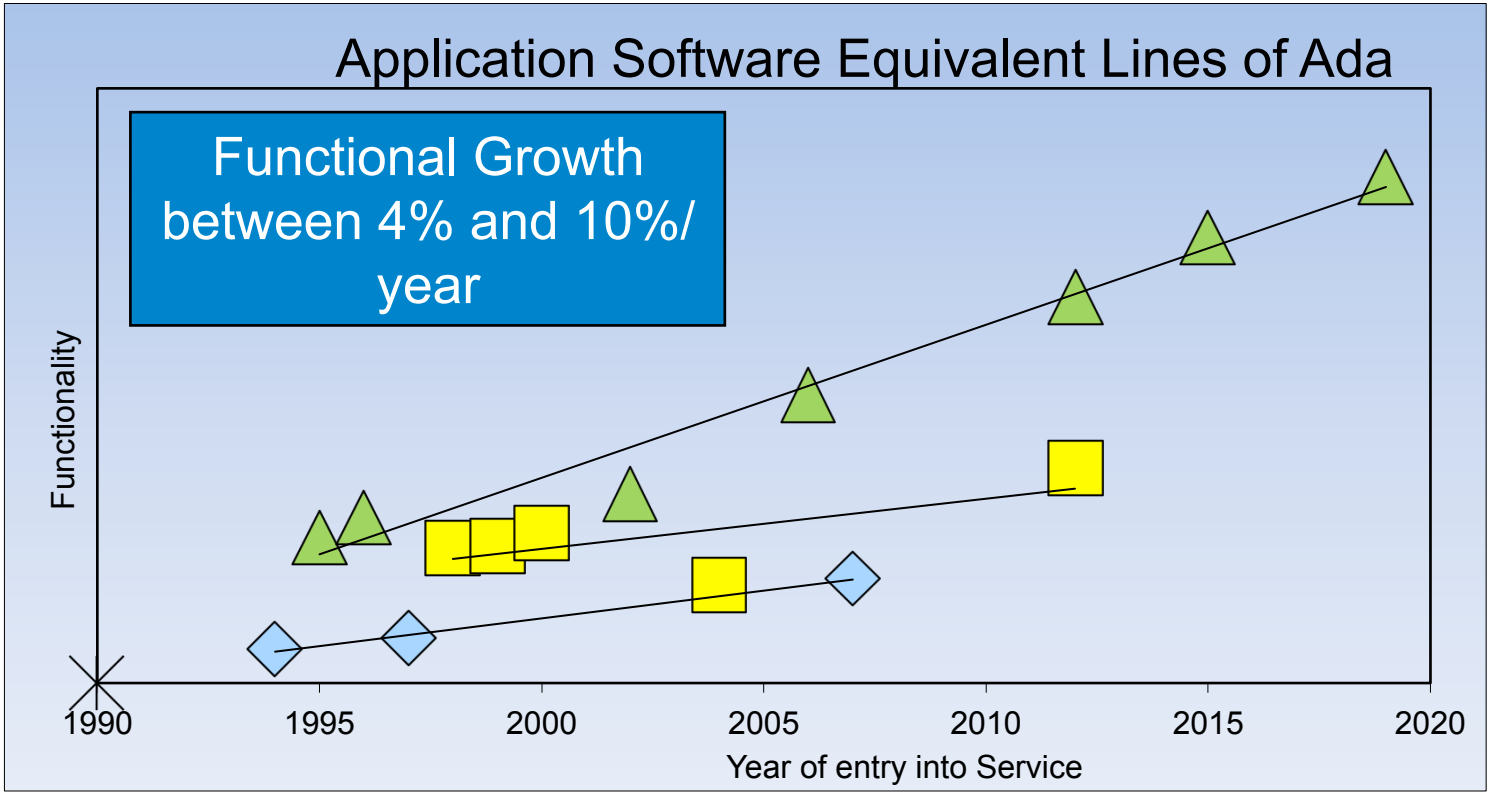
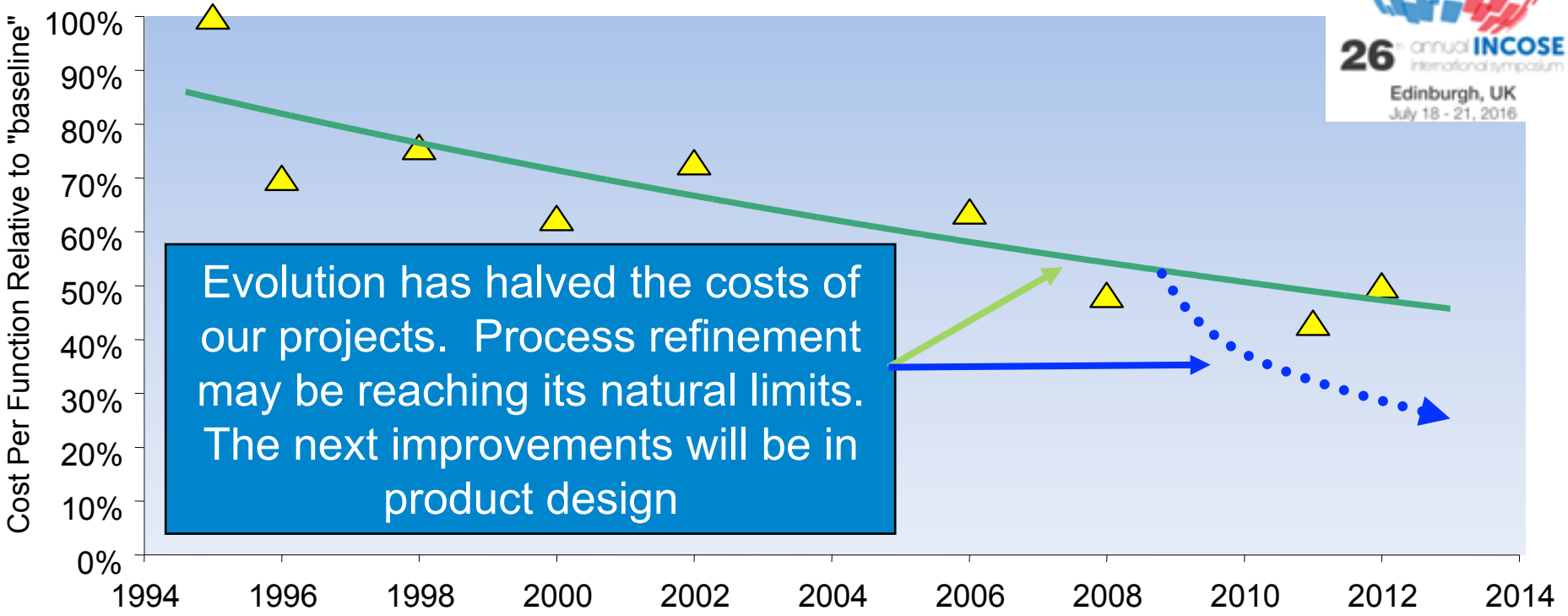
The demand for software functionality is growing



Process Improvement will soon end



Reactive

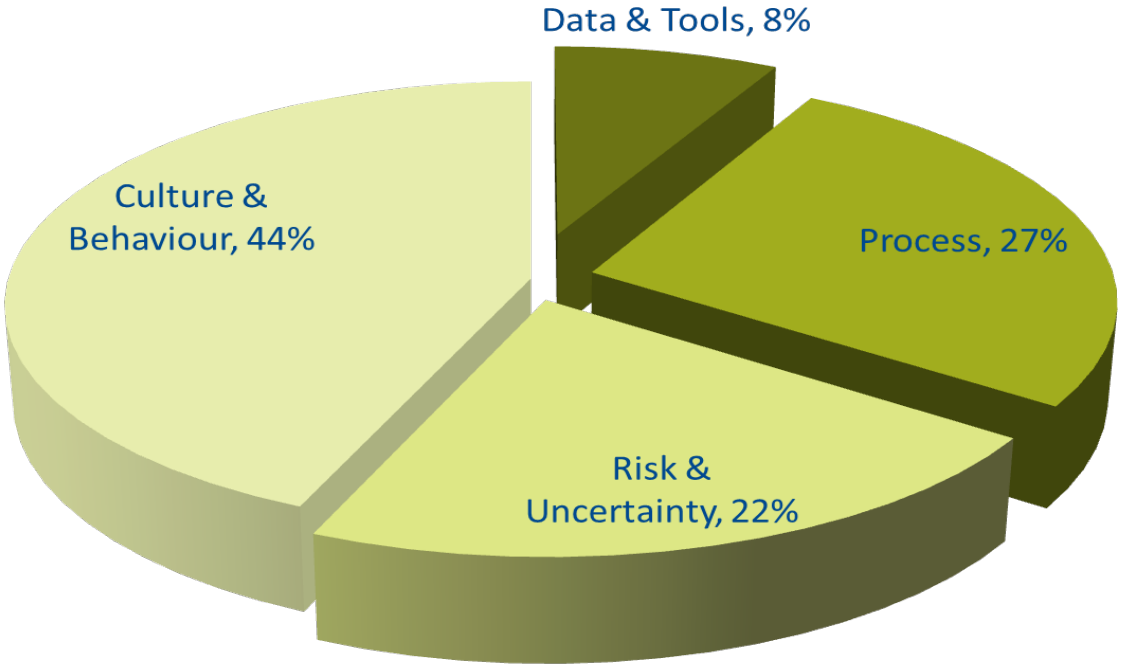
Proactive

Product lines refers to engineering methods, tools and techniques for creating a collection of similar systems from a shared set of assets using a common means of production.

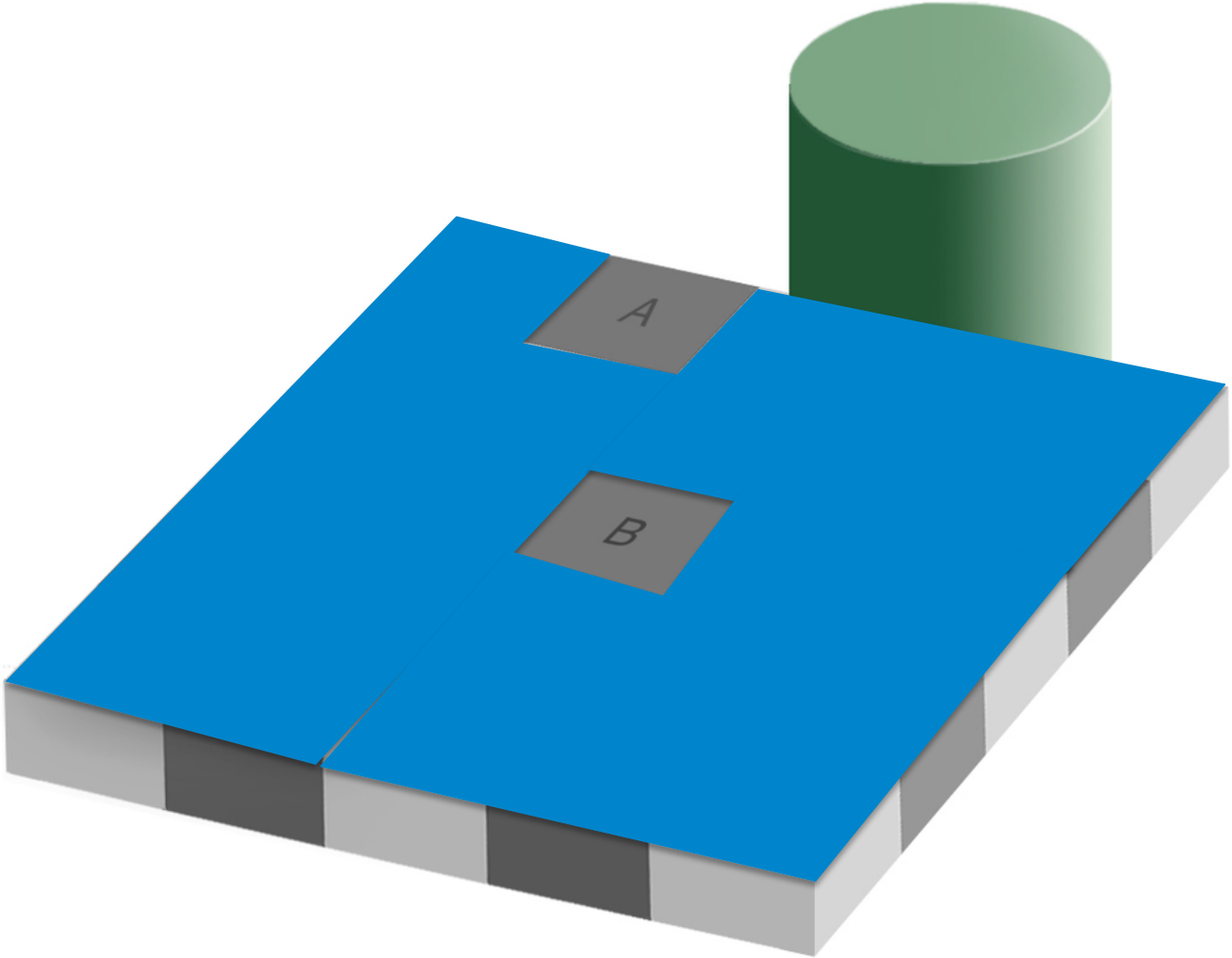
Part 2

The need for Product Lines

Causes of Estimation Inaccuracy



A fool with a tool is still a fool!



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Optimism

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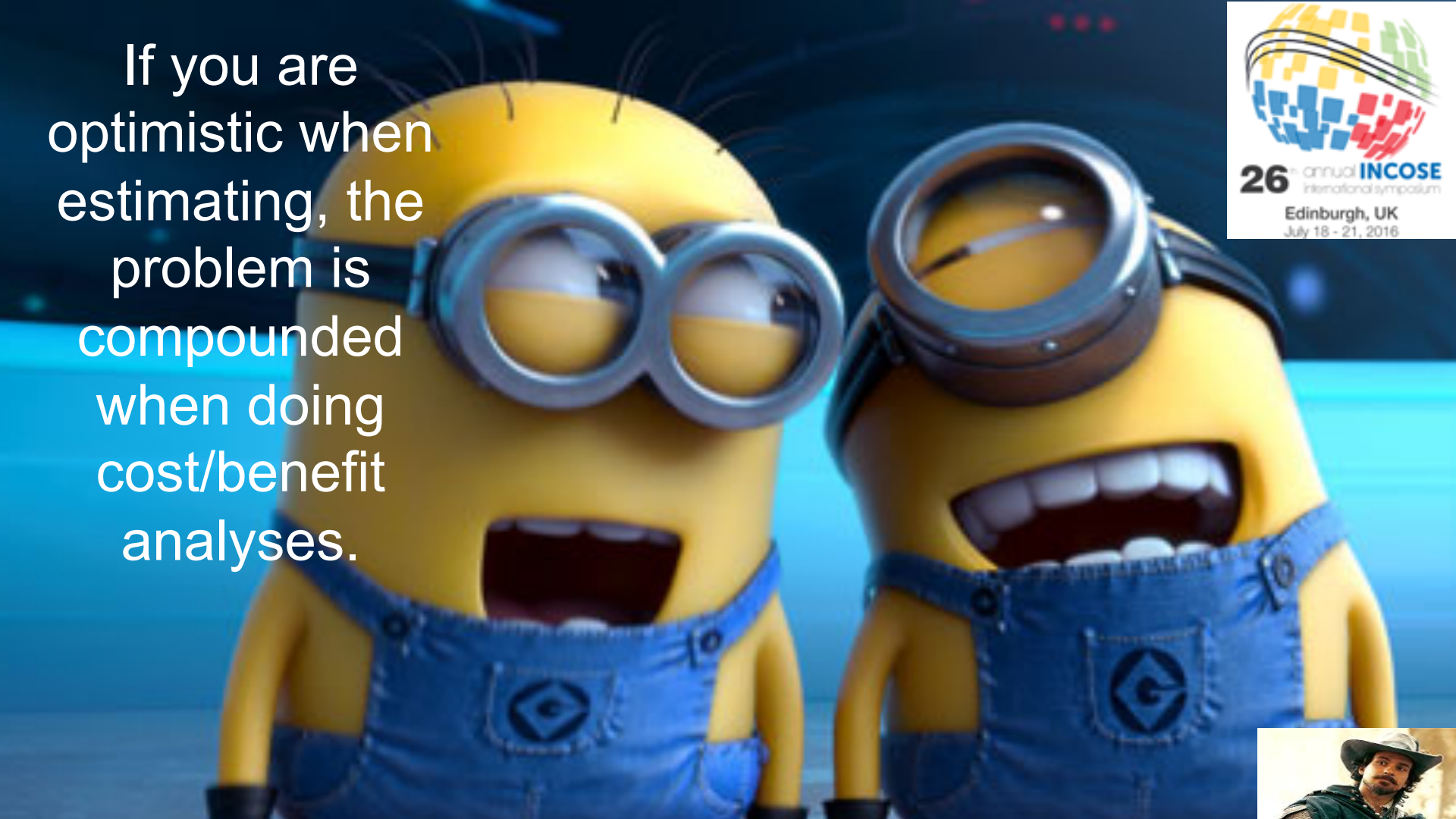
80% of people are optimistic!

If you are optimistic when estimating, the problem is compounded when doing cost/benefit analyses.



Only 13% of “good ideas” are good ideas!

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Your biggest risk is you!

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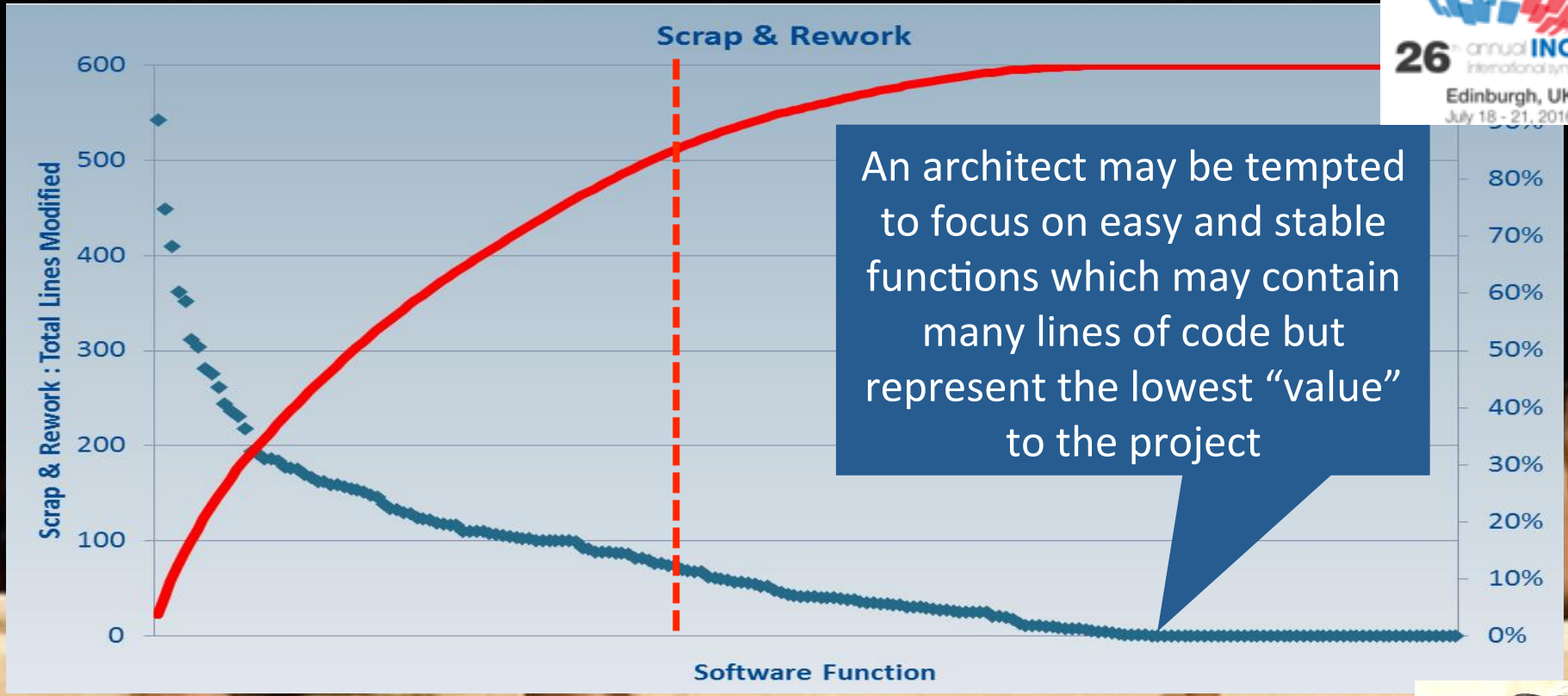
We need estimation tools to:

- Minimise biases
- Understand complex situations
- Make informed trades
- Convince Leaders

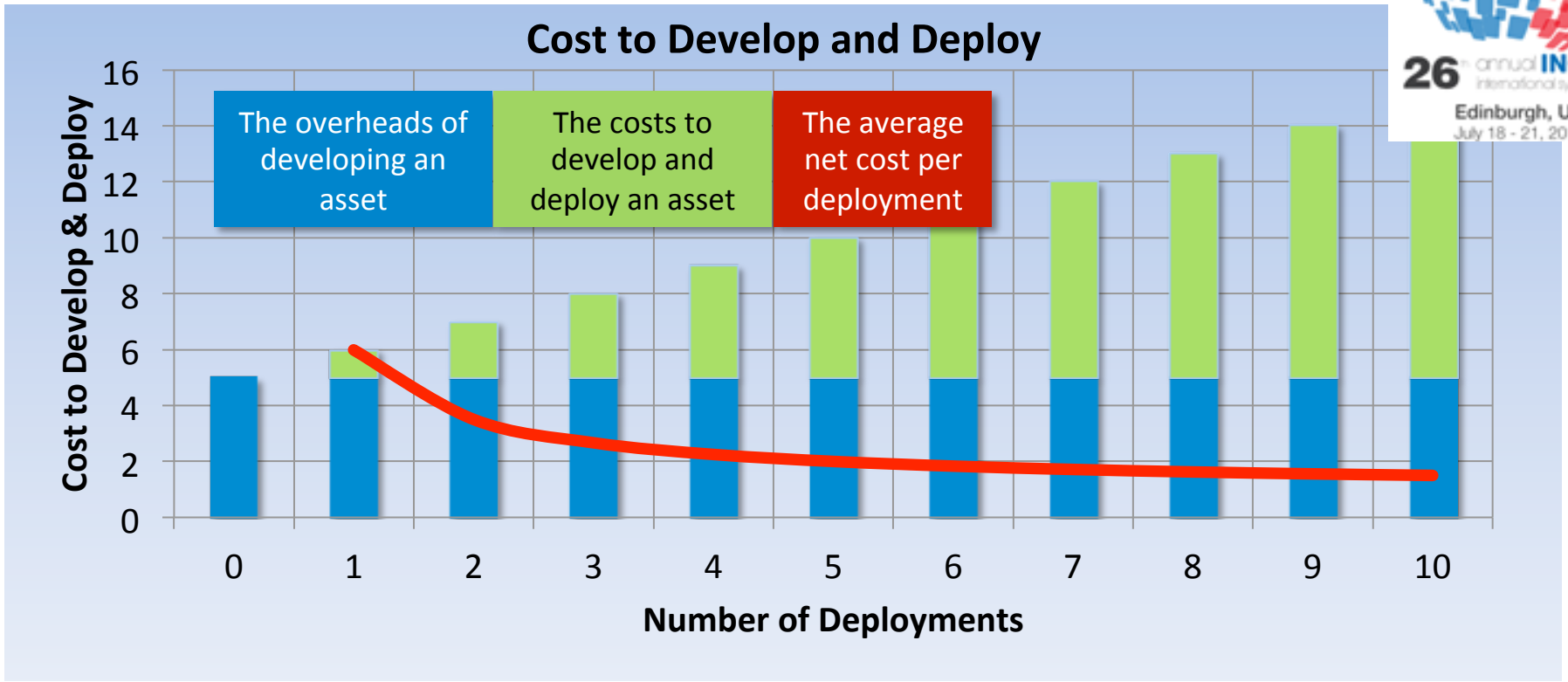
Part 3

Philosophy

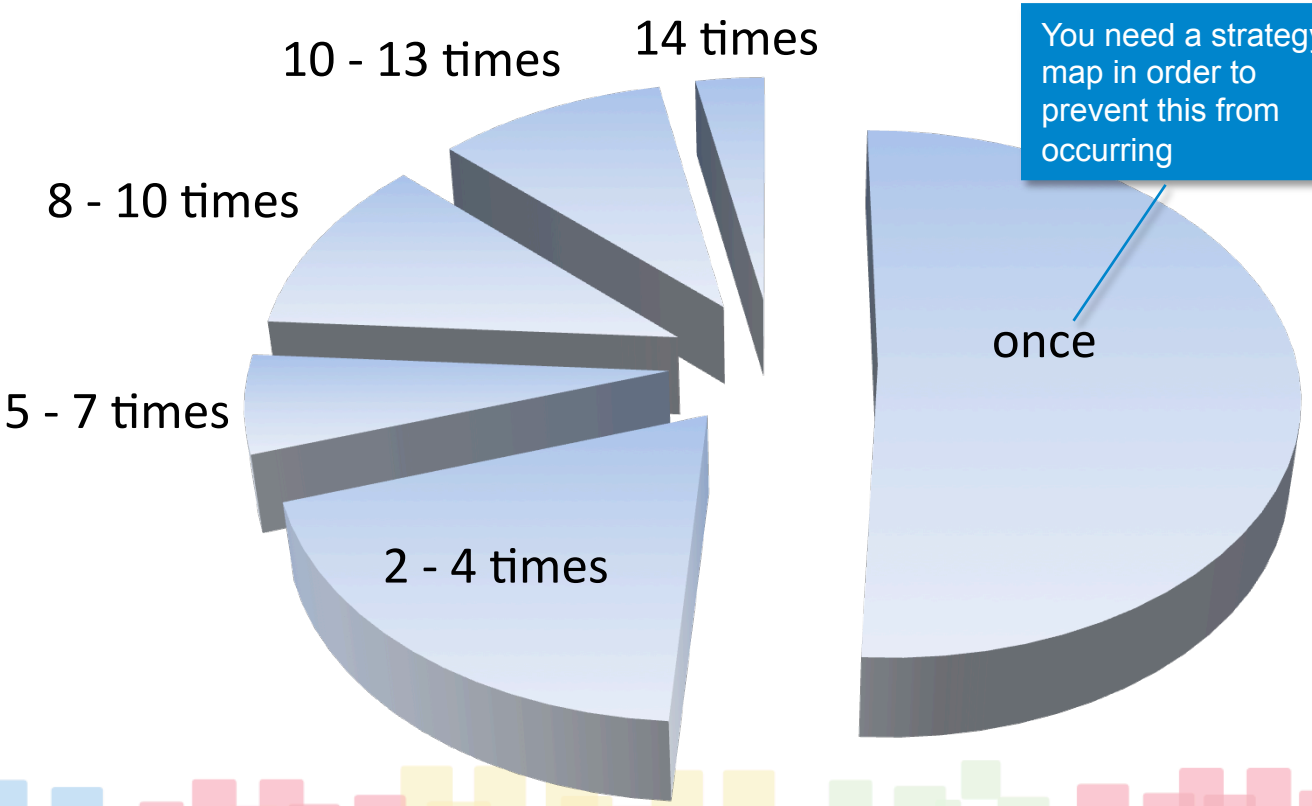
Its not the size that matters!



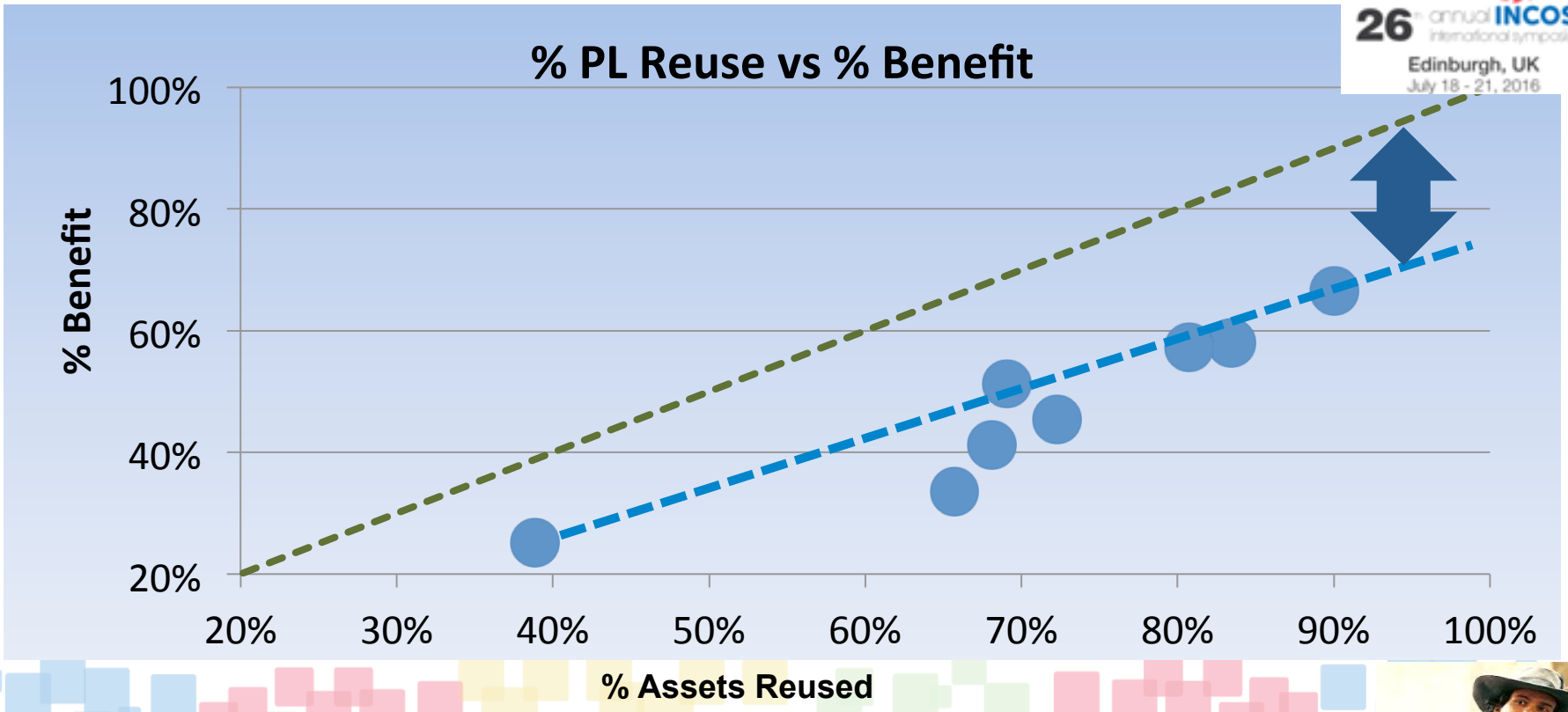
Its all about deployment!



Number of Deployments



Reuse is Not Free!



Free Stuff

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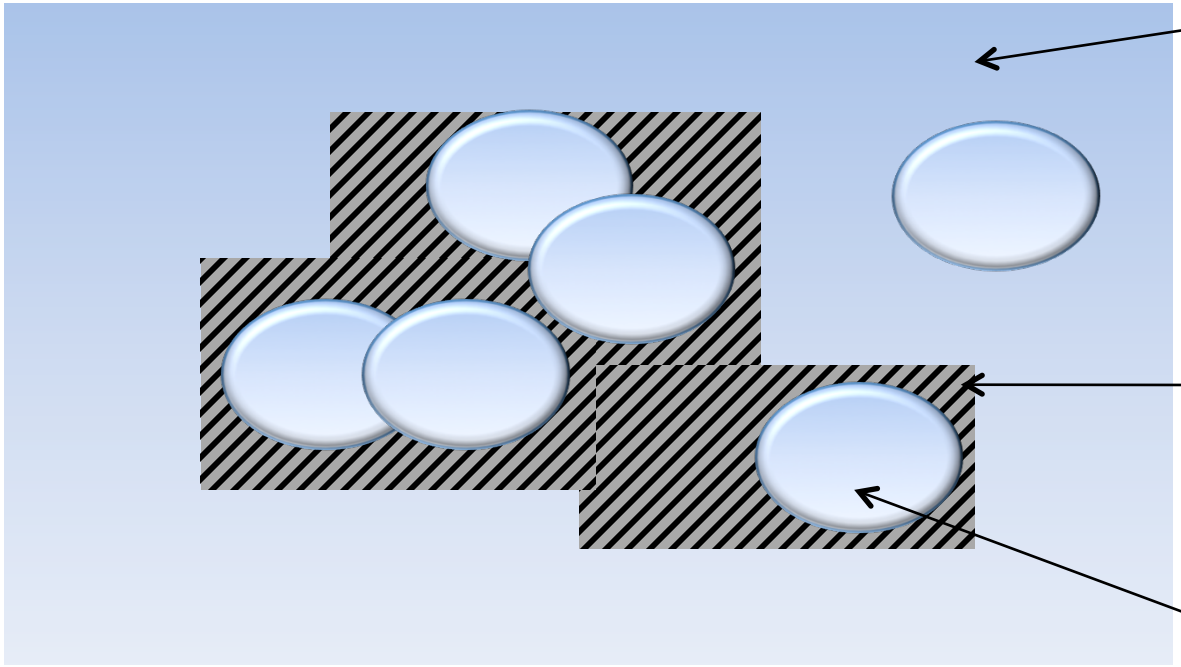
Free things are very expensive!

Goldilocks and Product Lines

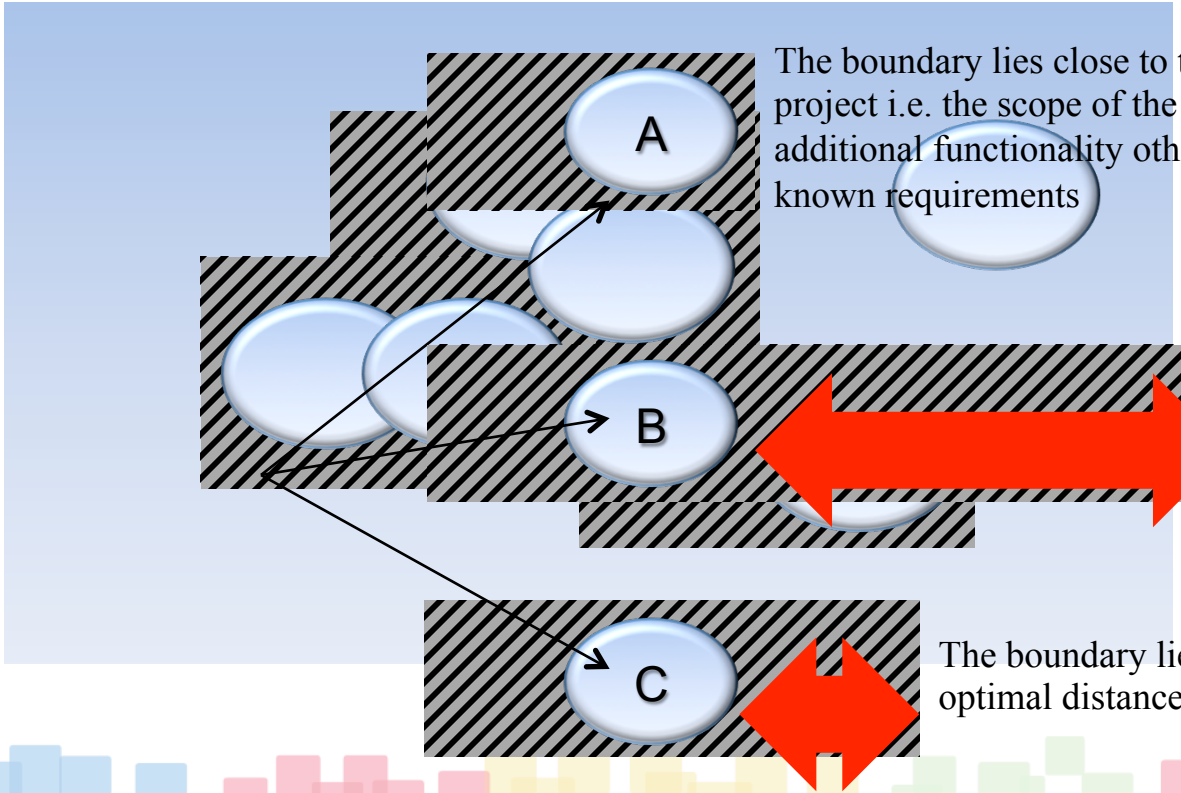


Full range of functionality across the domain

Scope of the asset functionality

Projects needs within the design space

Goldilocks and Product Lines

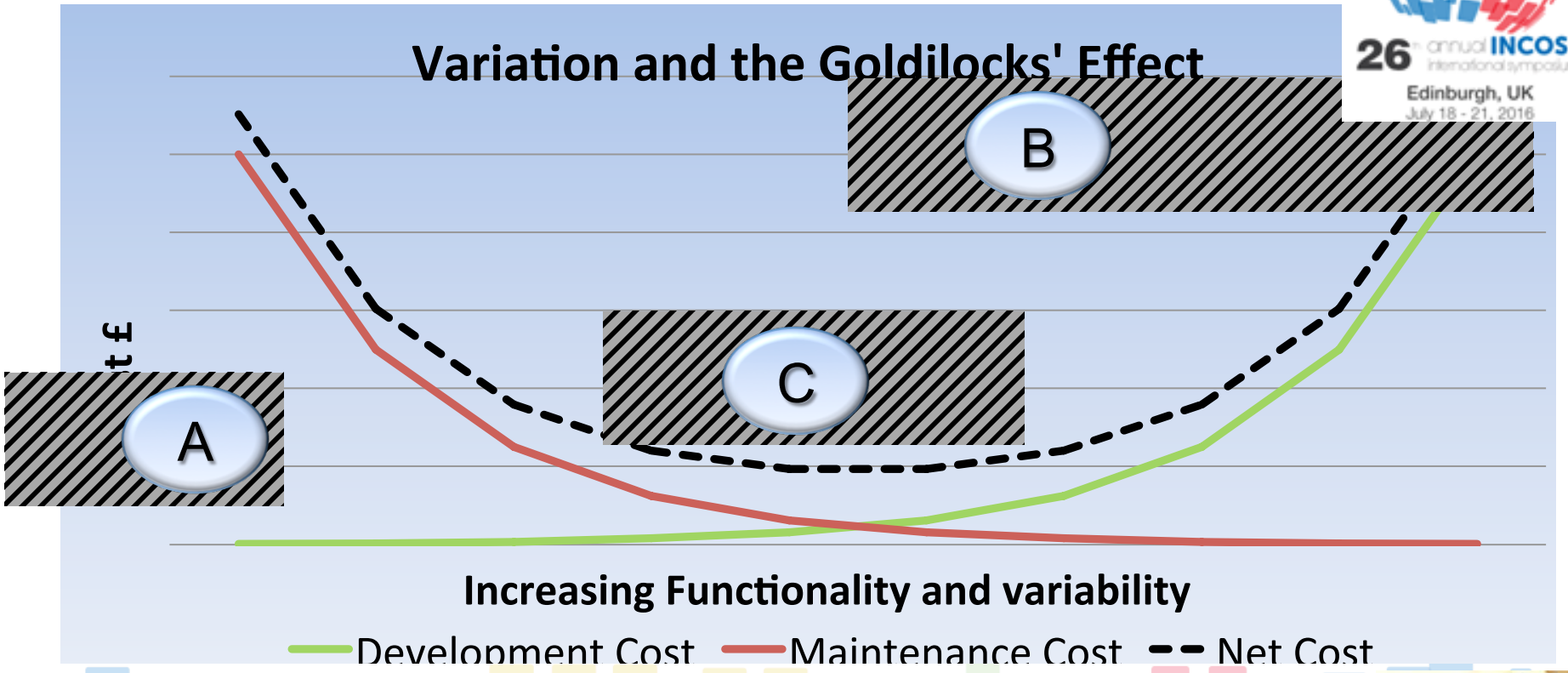


The boundary lies close to the known project i.e. the scope of the PL contains no additional functionality other than the known requirements

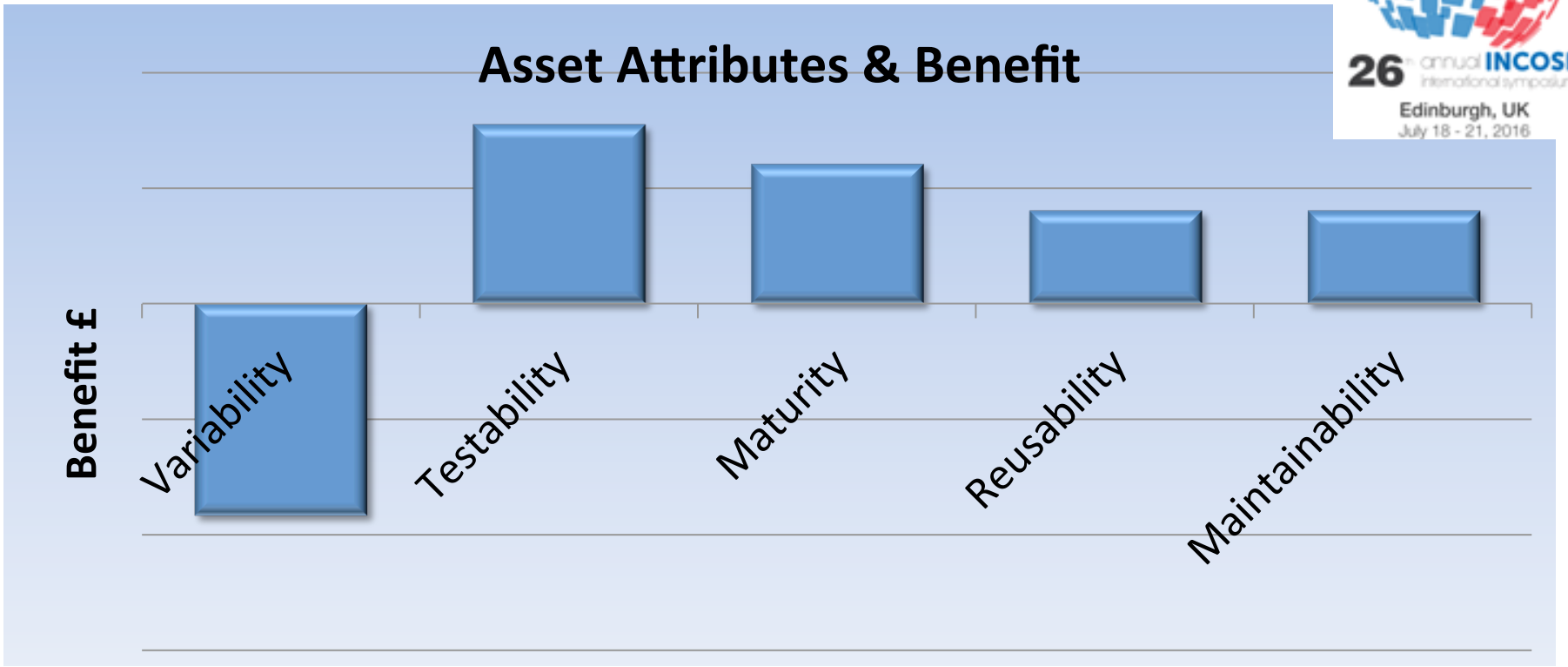
The boundary lies far away from any known project i.e. the scope of the asset contains significantly more functionality than is known about

The boundary lies at an optimal distance

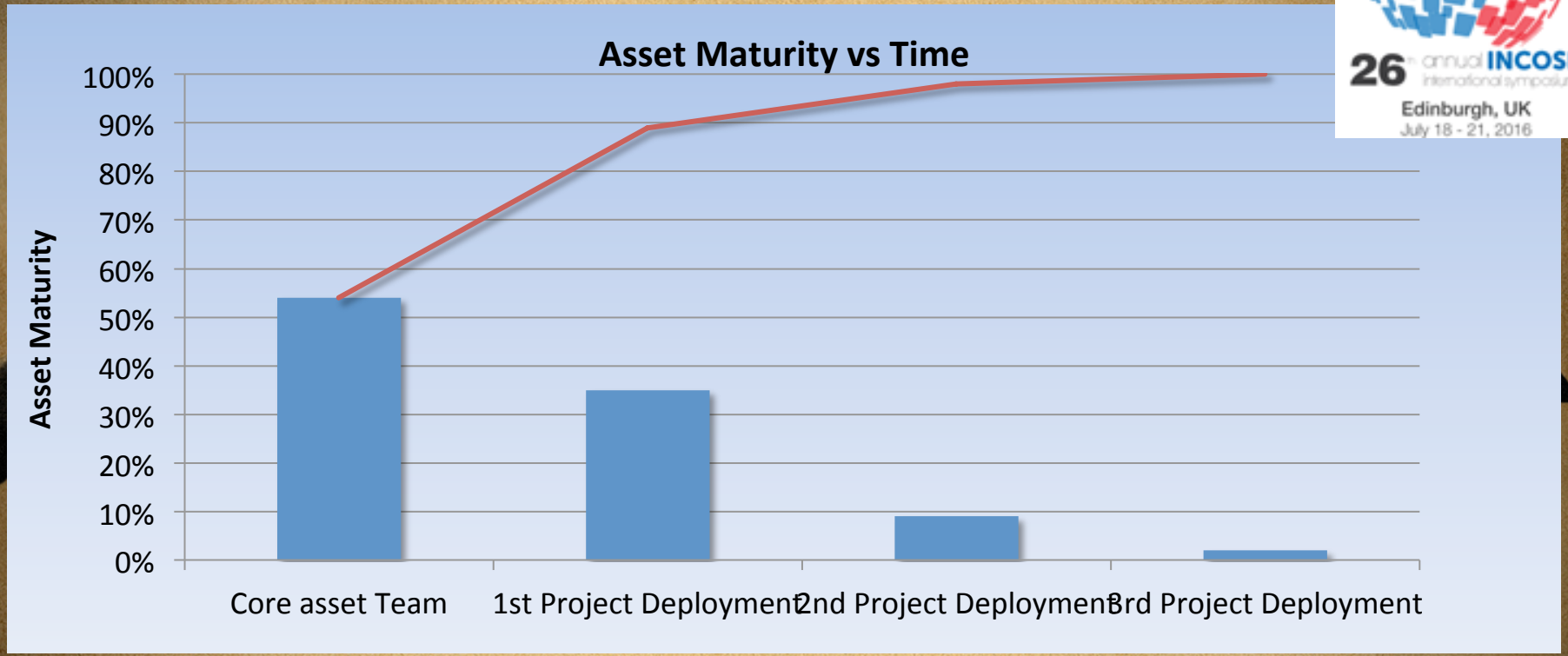
Goldilocks and Product Lines



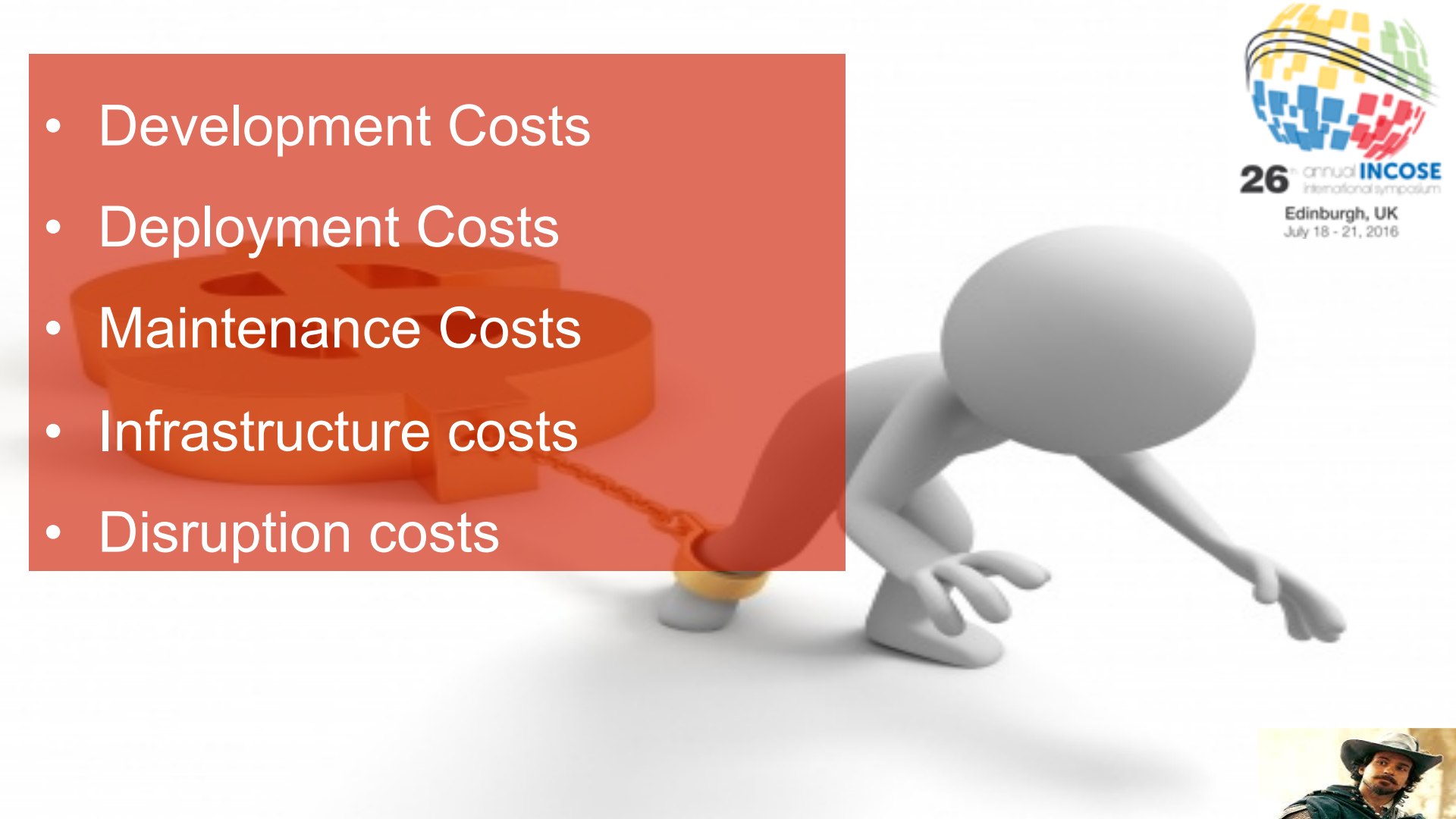
The attributes that affect £benefit



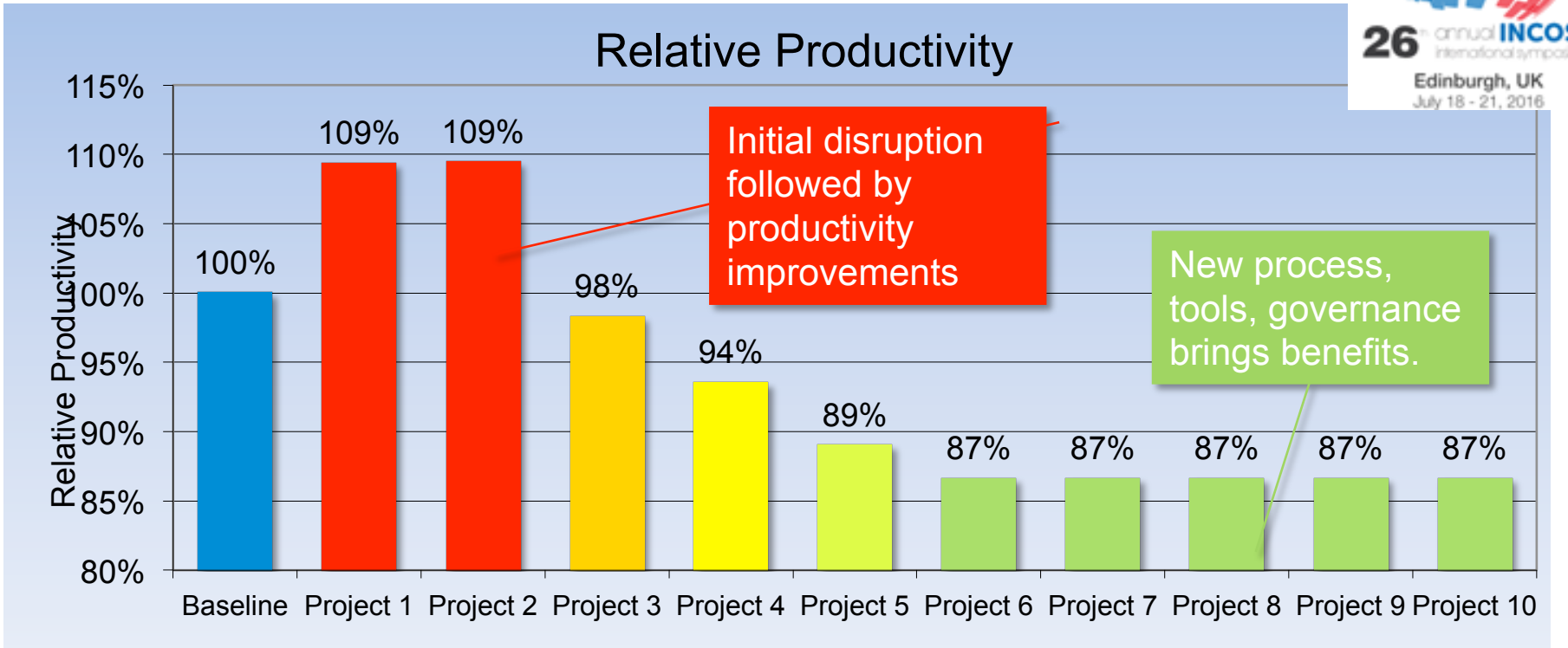
Evolving Maturity

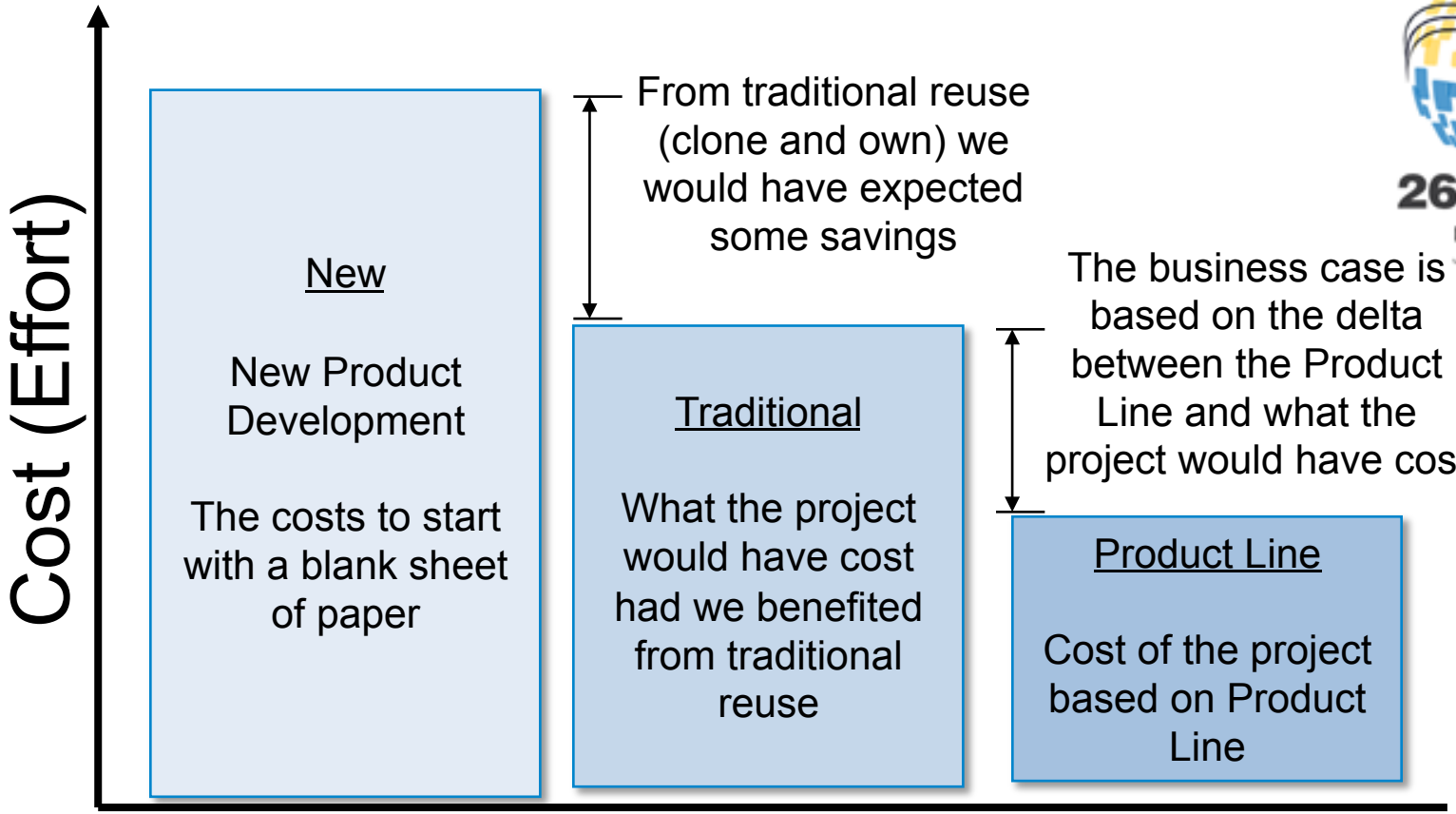


- Development Costs
- Deployment Costs
- Maintenance Costs
- Infrastructure costs
- Disruption costs



“Disruption” Costs




Cost (Effort)
New
New Product Development
The costs to start with a blank sheet of paper
From traditional reuse (clone and own) we would have expected some savings
Traditional
What the project would have cost had we benefited from traditional reuse
The business case is based on the delta between the Product Line and what the project would have cost
Product Line
Cost of the project based on Product Line

Part 4

Tool Outputs

Benefit Per Asset

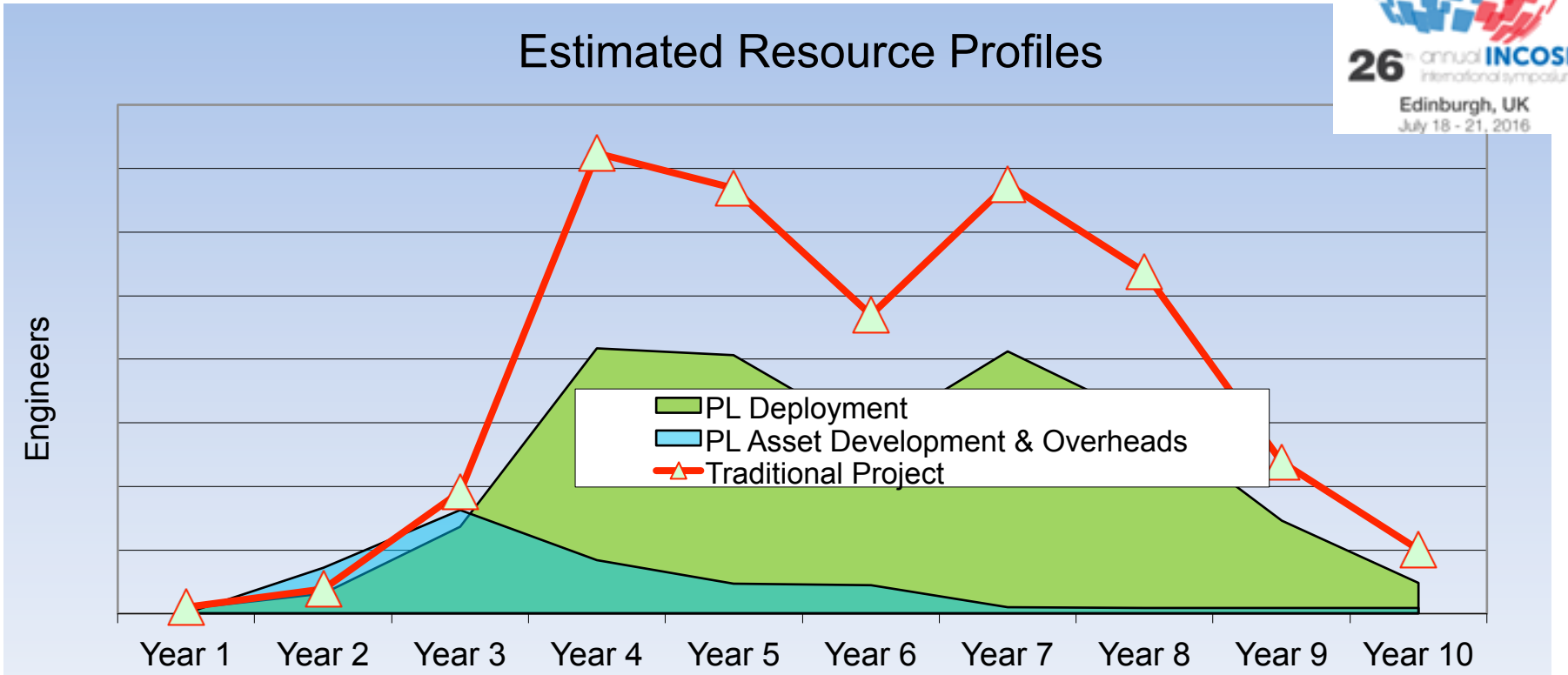
Function (Step 1)	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Project 7	Project 8	Project 9	Gross Benefit - excluding development costs	Net Benefit Including development costs
Function 1	69%			69%	69%	69%	69%	69%	69%	69%	49%
Function 2	63%	54%	54%	54%	54%	54%	54%	63%	-50%	52%	37%
Function 3		0%	0%	57%	57%	57%	57%	65%		43%	14%
Function 4	16%				-175%			16%	-175%	-29%	-33%
Function 5	0%	0%	0%	57%	-42%	-42%	57%	57%	-42%	21%	-14%
Function 6	57%	57%	57%	57%	57%	57%	57%	57%	44%	55%	27%
Function 7	57%	57%	57%	-42%	-42%	57%	57%	65%	-42%	48%	7%
Function 8	57%	57%	70%	57%	57%	57%	65%	57%	-42%	57%	32%
Function 9	53%	53%	68%	53%	53%	53%	62%	53%	-55%	51%	39%
Function 10	57%	57%	57%	57%	-42%	57%	57%	-42%	-42%	43%	10%

In some cases, it may be more economical to clone and own an asset rather than use a Product Line option

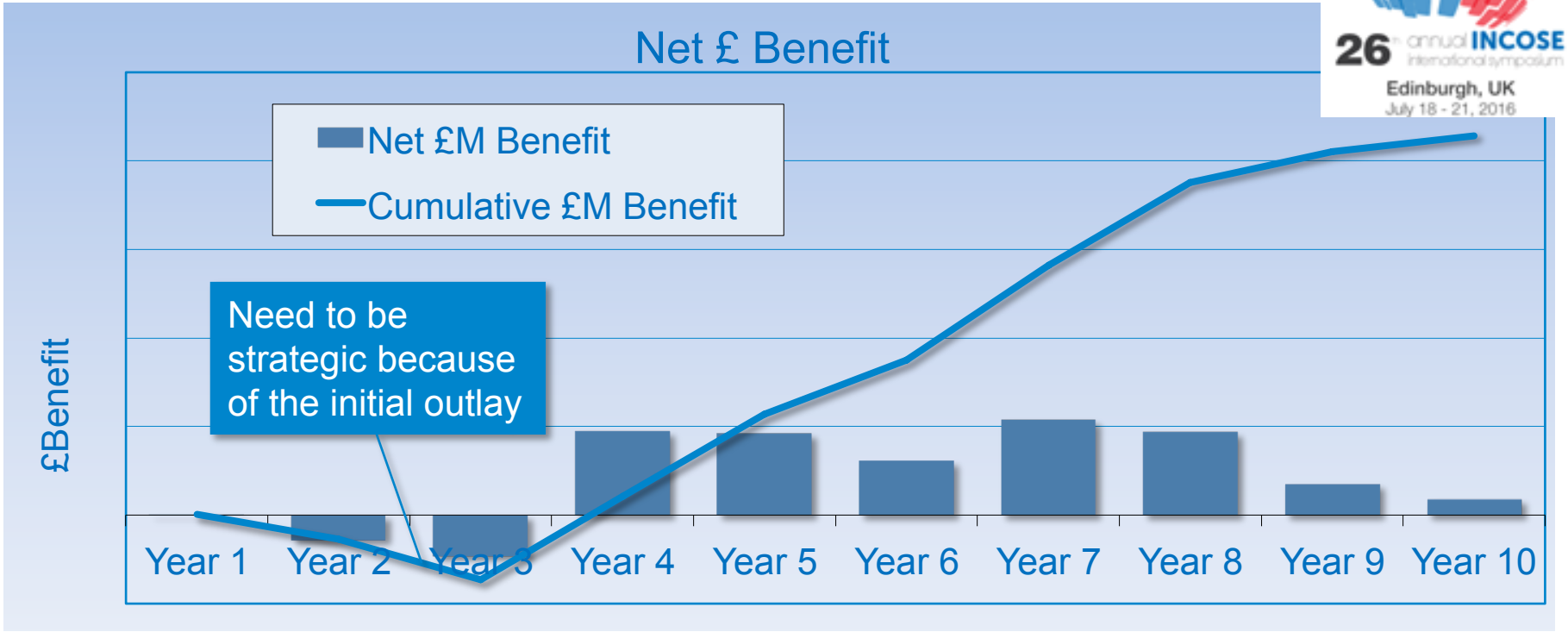
In some cases, there is no overall benefit from developing a Product Line Asset

In some cases, there is a gross benefit BUT when factoring for development costs, there is no net benefit

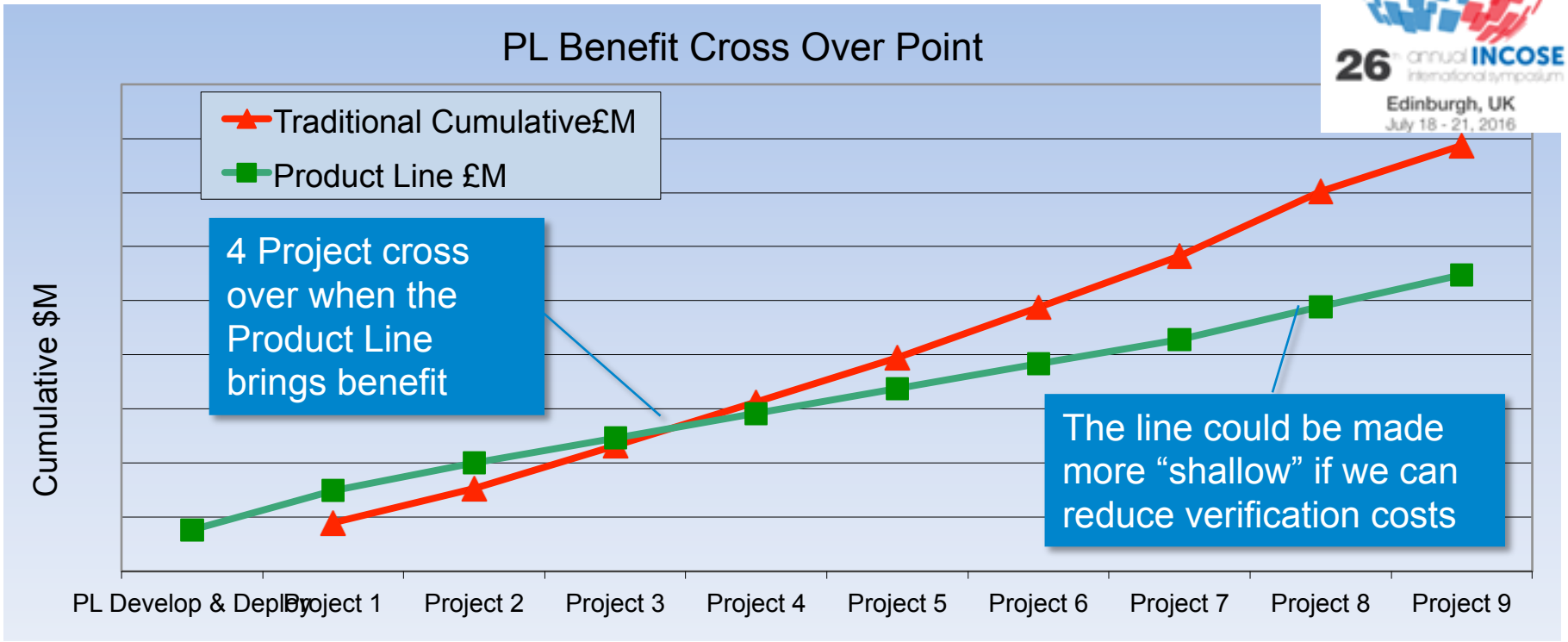
Resource Loads



Cash Flow


Net £ Benefit
Net £M Benefit
Cumulative £M Benefit
Need to be strategic because of the initial outlay
£Benefit
Year 1
Year 2
Year 3
Year 4
Year 5
Year 6
Year 7
Year 8
Year 9
Year 10

Benefits X-Point



Part 5

Conclusions

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Conclusions

- Select assets based on their value rather than size.
- The value of a Product Line asset is determined by the extent of deployment
- If a function already had good (traditional) reuse then investing in the Product Line asset may not add value.
- Doing nothing is still expensive in a safety critical world.
- You must choose the right variation mechanism.
- Introducing a Product Line "disturbs" the organization
- Not all assets should be developed into Product Line assets – it's not always beneficial
- Keep the product line team and deployment team is separate entities, funded separately