

Why Invest in Systems Engineering?

Manage Complexity Reduce your Risk, High Return on Investment

- > Unclear or confused about what the system is supposed to do?
SE improves the quality and management of Requirements.
- > Inadequate costing and time-scale estimation?
SE results in better Work Breakdown Structures and Plans.
- > Weak control of suppliers/sub-contractors?
SE delivers better Specifications.
- > Integration problems?
SE defines the System Parts and how they fit together correctly.
- > Non-existent or inadequate test and acceptance strategy?
SE provides Test and Acceptance Criteria linked to Requirements.

These problems erode profit margins and damage reputations. If the organisation takes SE seriously, the business benefits will follow.

6 Steps to Success:

- > **Understand the problem**
- > **Investigate alternative solutions**
- > **Agree and manage the requirements**
- > **Agree and manage the interfaces**
- > **Prepare the test and support systems**
- > **Track progress against a plan**

For more explanation on the 6 steps, see the INCOSE 1-page guide :

Z1 "What is Systems Engineering?"

Return on Investment

INCOSE data shows that a spend of 8% of project budget on effective Systems Engineering - much less than you typically spend on fixing errors - reduces the average cost of projects by >20%, and increases your likelihood of delivering on time by 50%.

Systems engineering is:

"Big Picture thinking, and the application of Common Sense to projects;"
"a structured and auditable approach to identifying requirements, managing interfaces and controlling risks throughout the project lifecycle."

This leaflet is intended to explain and demonstrate the business benefits and return on investment of adopting a Systems Engineering approach.

For further information, advice and links to helpful websites, go to:
www.incoseonline.org.uk.

Download copies of this leaflet and other systems engineering resources online at:
www.incoseonline.org.uk

For more information about the worldwide systems engineering professional community, go to:
www.incose.org

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How Systems Engineering Can Save your Business Money

The Value of SE

Do any of these Problems sound familiar?

- > Your Engineers arrive at project reviews reporting unforeseen problems, and needing more time and budget.
- > Your Directors are called in by irate customers or partners, late in the project, to resolve escalated problems due to disagreements over requirements and interfaces.
- > You have looked on helplessly as your competition beats you to market, at lower cost.

Is your programme running late?

Are your costs mounting?

Systems Engineering (SE) can help!

Research indicates that effective use of systems engineering can save over 20% of the project budget.

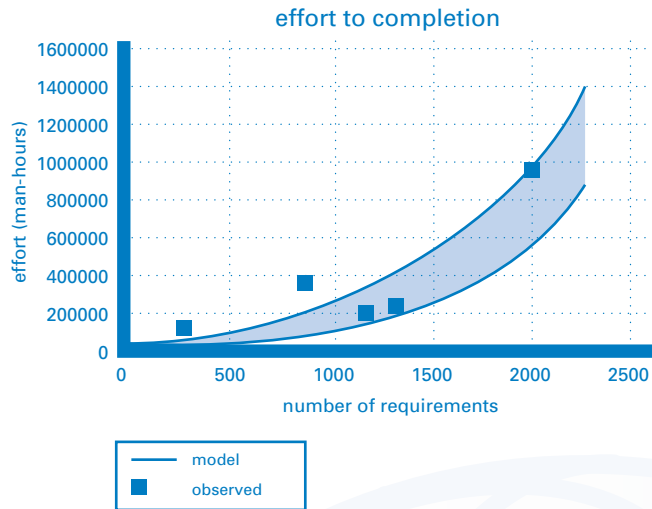
It is not hard to know when system engineering fails, because when something important goes wrong it usually makes the news fast. People get killed, buildings fall down, companies go bust, the law becomes involved.

But when system engineering goes right, no one notices - which is just how it should be. The computer works when you switch it on, trains run on time, your flight lands on time and no one gets mad.



SE Can Predict Complexity

The size of a project in manhours is proportional to the *cube* of the number of requirements (implicit or explicit). Do you know how big your next project is? What is the size of your uncertainty margin?

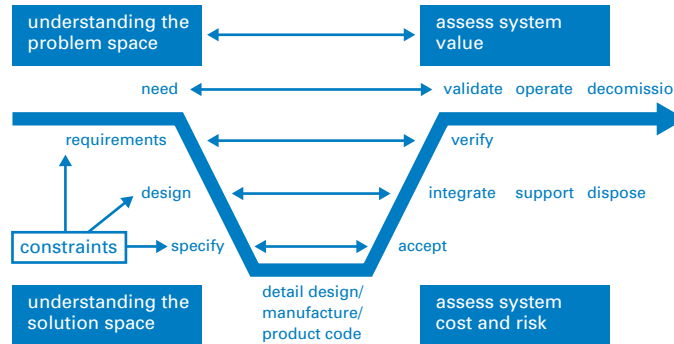


Cost of Fixing Errors in Your Project

	systems cost factors
requirements	x1 (reference)
design	x5
build	x12
test	x40
operations	x250

The SE Lifecycle

The Vee lifecycle model shows the relationship between the different systems engineering activities or 'processes' in a typical project.



Sources of Data

SE Lifecycle Vee model:

INCOSE SE Handbook.

Complexity vs Requirements:

Fred Brooks.

Cost of Errors versus phase:

INCOSE paper by Haskins et al, 2004.

Committed costs / Rayleigh Model:

"Measures of Effectiveness" book by Putnam and Myers.

Return on Investment figures:

based on NASA study and further INCOSE work led by Eric Honour.

Leaflet prepared and published by the UK Chapter of the International Council on Systems Engineering.

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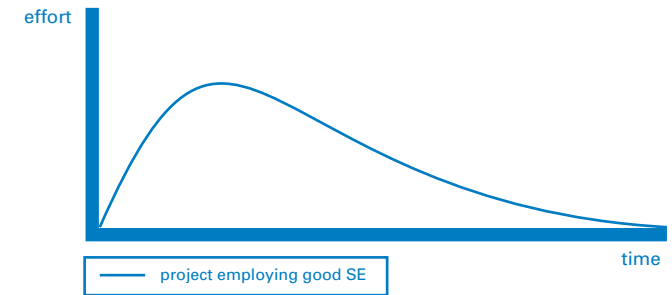
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Committed Costs

All well-run projects have the same shaped (Rayleigh) curve of manpower hours versus time. Departures from the curve are indicators that something is amiss. There are calibrated databases of thousands of projects; which show that you cannot improve on the 'characteristic' profile after 15% of the project timescale has elapsed. 60% of your final costs are already committed by this point.



Benefits of Systems Engineering

- > Project Management (PM) and Systems Engineering have the same ultimate project goals. PM defines them; SE knows how to deliver them.
- > The cost of fixing errors rises exponentially with the phase of discovery, as in the table in the Panel opposite. Would you rather fix a problem at the concept stage or the manufacturing stage?
- > SE covers the entire project life-cycle, but has particularly strong leverage in the early stages.
- > SE can help any organisation involved with complex projects – not just aerospace and defence. Talk to other sectors, e.g. Transportation and Telecoms.
- > SE brings people benefits as well. Their work will become less chaotic and stressful. Quality of work benefits from this.