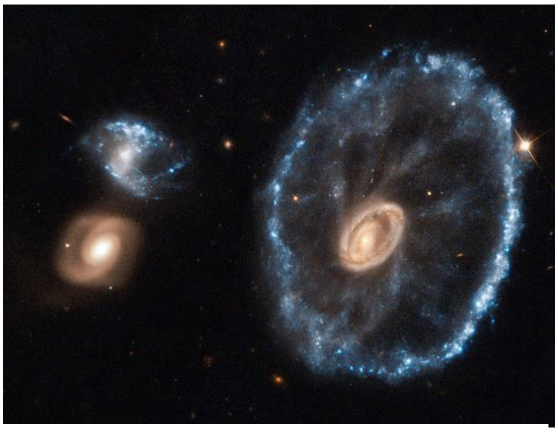
Get it Right First Time with Collaborative Engineering Management

Get your Products and Services Right First Time and Avoid Costly Re-Work

No-one can doubt the ultimate success of the Hubble Space Telescope from which came incredible pictures such as that of the Cartwheel Galaxy show in the figure to the right.



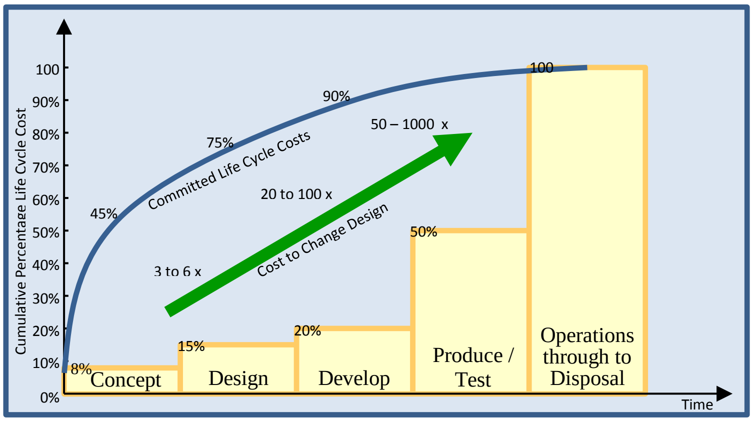
The Cartwheel Galaxy is about 500 million light years away. Its strange shape is the result of a collision with another galaxy. Picture from NASA.

But many people may not recall its troubled beginnings: when it first came into operation in 1990, at a cost of about US $4.7 billion, the images were not nearly as clear and detailed as they were intended to be. Fortunately for us all, NASA rectified the problem in late 1993 with replacement systems and corrective optics at a reported cost of about US $73.9M [1], not counting the cost of the repair space mission itself. The ultimate cause of the problem was found to be an incorrectly-assembled testing device, for which the manufacturers were criticised for not reviewing or supervising the mirror construction adequately and NASA was criticised for not picking up on quality control shortcomings [2].

This is one very famous example where failure to apply proper practices during the design and development of a system has caused huge costs for corrective re-work. Another, more recent, example is the London Millennium Footbridge. Built at a cost of £18.2M, it opened on 10 June 2000, only to be closed two days later because it suffered from resonant vibrations caused by people walking across it. (Similar phenomena were already well-known, troops being required to break step when crossing a suspension bridge, for example.) After correction of the problem, the bridge was re-opened on 22 February 2002 at a further cost of £5M [3].

Another more recent example is the power plant of the UK's Type 45 destroyers. The six destroyers, costing £6.46 billion, had experienced problems with the reliability and resilience of their all-electric propulsion system since the first was commissioned into service in 2009. The manufacturers admitted that, although the system had undergone over 8000 hours of testing, there was a change in the design after about 5000 hours, which resulted in only about 3000 hours testing of the new design. In retrospect, it is conceded that the amount of testing was insufficient [4]. The solution is a major diesel generator upgrade at a further cost of £280M [5].

The results of oft-quoted statistical analysis performed on US Department of Defense (DOD) projects and reported by the Defense Acquisition University (DAU) is illustrated in the figure to the right. This shows that the life cycle costs of a project are determined by the early concepts and designs and that fixes to problems cost significantly more later in the life cycle. Although old research now, it is still cited as valid, for example, in the NASA Systems Engineering Handbook [7], and the real-life situations given at the beginning of this article support its tenets.



Committed Life Cycle Cost against Time.
Based on a paper from the Defence Acquisition University [6].

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SyntheSys SYSTEMS ENGINEERING

The lesson to be learned from this is that implemented and applied systems engineering processes help to ensure that the decisions taken early in the system life cycle are effective, enabling developers to get their products and services right first time and to avoid costly re-work later.

References:

[1] "How NASA fixed Hubble's flawed vision – and reputation", http://www.cbsnews.com/news.an-ingenious-fix-for-hubbles-famously-flawed-vision

[2] "Hubble Space Telescope", Wikipedia.

[3] "Millennium Bridge, London", Wikipedia.

[4] "Type 45 to get third diesel generator to overcome problems", https://www.rina.org.uk/Type_45_to_get_thirds_diesel_generator_to _overcome_problems.html

[5] "Cost of Type 45 Destroyer fix revealed", https://ukdefencejournal.org.uk/cost-type-45-destroyer-fix-revealed

[6] "Committed Life Cycle Cost Against Time", Fort Belvoir VA, Defense Acquisition University.

[7] "Systems Engineering Handbook", NASA SP-2016-6105 Rev 2, NASA, 2016.

[8] "Systems and Software Engineering – System Life Cycle Processes", ISO/IEC/IEEE 15288, 15 May 2015.

[9] "The Logic of Social Systems: A Unified Deductive System Based Approach", Alfred Kuhn, 1974.

What is a system?

A system is a combination of interacting elements organised to achieve one or more stated purposes.
As defined in ISO/IEC/IEEE 15288 [8].

An element is any identifiable entity.
As defined by Kuhn [9].

What is systems engineering?

Systems engineering is an interdisciplinary approach governing the total technical and managerial effort required to transform a set of stakeholder needs, expectations, and constraints into a solution and to support that solution.
As defined in ISO/IEC/IEEE 15288 [8].

Collaborative Engineering Management describes SyntheSys' approach to systems engineering with expert personnel and appropriate tool support. We have helped many organisations increase their competitiveness through advice on processes, training and the introduction of software tools.

Please contact us to find out more.

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SyntheSys provides defence systems, training, systems and software engineering and technical management services over a spectrum of different industry sectors. Along with distinct support and consultancy services, our innovative product range makes us first choice provider for both large and small organisations. Established in 1988, the company focus is on fusing technical expertise with intuitive software applications to solve common industry challenges.