Systems Engineering in Superannuation

R.I. Faulconbridge & K.L. Faulconbridge
UNSW & StateSuper
c/- School of Information Technology and Electrical Engineering
Australian Defence Force Academy
Campbell ACT 2600
Ph: (02) 6268-8202/Fax: (02) 6268-8443
Email: i.faulconbridge@adfa.edu.au

Abstract *– Systems engineering has been recognised as an engineering discipline for more than half a century. In that time, it has developed into a rigorous and methodical discipline used to develop effective solutions to complex problems. In more recent times, use of the phrase systems engineering to describe the discipline has started to decline. This decline is, in part, due to a desire to increase the relevance of the discipline beyond the traditional boundaries of Defence industry. This paper looks at the Australian superannuation industry as an example of an industry that would not normally be associated with systems engineering. Following a brief introduction to the industry and its processes, it is clear that the superannuation industry does embrace systems engineering philosophy. It is up to systems engineering professionals to recognise opportunities beyond the traditional boundaries and grow systems engineering into non-traditional industries such as the superannuation industry.*

Keywords *– Systems engineering, complex problems, non-traditional industry*

Introduction

The focus of this conference is to investigate the broad applicability of systems engineering to complex problems encountered across all industry sectors. The aim of this paper is to embrace the SETE2003 focus by taking an example of an industry sector not normally associated with systems engineering and investigating the processes it adopts to solve complex problems and produce complex solutions. As we see, there are striking similarities between this industry's practises and challenges and those of more traditional systems engineering industry sectors such as Defence. With such similarities existing across non-traditional industries, it stands to reason that systems engineering may be far more relevant across far more industries than most people believe.

The superannuation industry in Australia has been selected as an example of such an industry for two reasons; the superannuation industry is not normally associated with systems engineering, and the authors (between them) have a number of years of experience in both traditional systems engineering industries and the superannuation industry.

Background

In his excellent book on the history of radar, Robert Buderi describes an interesting shift in the focus and approach of project teams involved in large US Department of Defense (DoD) projects during the 1940s and 1950s [1]. During the early years of the Second World War, the focus was very much on bottom-up engineering that often resulted in a product seeking an application.

During the 1950s, however, when the pressure of war eased and resources became more scarce, a more logical, top-down, requirements-driven approach began to emerge. This shift in focus and approach in US DoD projects of the 1950s is popularly marked as the birth of systems engineering as we know it today. Since then, the top-down approach to developing solutions to complex problems has continued to develop and has been progressively refined. The continual development and refinement of systems engineering is chronologically documented in the suite of classic systems engineering standards starting with MIL-STD-499 in 1969 [2], leading to the current suite of standards including ANSI-EIA-632 [3] and IEEE-1220 [4].

With this sort of heritage, it is not surprising that systems engineering is normally associated with the design and development of large and complex weapons systems in the Defence industry. Unfortunately, however, systems engineering is also often considered synonymous with stifling procedure and unnecessary rigour and detail. The idea that systems engineering means unnecessary complexity of process usually results from the thoughtless application of the systems engineering discipline rather than the tailored approach advocated by systems engineering professionals. Regardless of where the reputation comes from, the term systems engineering is losing favour in a number of circles.

Systems engineering standards bodies have recognised the stigma sometimes attached to the term systems engineering and have started to avoid the use of the term. We need look no further than the focus of this SETE2003 (*Practical Approaches for Complex Systems*) for evidence of this. Possibly the best international example of this realisation comes from one of the latest systems engineering standards ANSI/EIA-632 entitled simply *Processes for Engineering a System*. Even finding a definition of the term systems engineering is difficult in the more recent standards. For example, although a thorough definition can be found in their interim standard released in 1994 (IEEE Std 1220-1994), IEEE have removed the definition from their current systems engineering standard, IEEE Std 1220-1998.

To be in the profession that engineers systems, we must understand exactly what a system is. EIA-632 provides useful guidance to help us understand what a system is. Essentially, EIA-632 explains that a system is a solution to a complex problem. The standard goes to some length to emphasise that a system does not need to involve a piece of hardware such as an aeroplane, tank or warship. Instead, the standard allows entities as diverse as documentation, media, policy or procedure to be considered systems in their own rights.

If systems engineers take their lead from conferences such as SETE2003 and standards such as EIA-632, they must appreciate that they are not in the systems engineering profession any more, but rather in the profession of solving complex problems. By taking this broader approach to the systems engineering profession, the application of systems engineering methodology and practice in non-traditional industry becomes virtually endless. This is the case simply because every industry seeks solutions to their own unique complex problems. This is a very powerful concept of critical importance to the continued growth and relevance of the systems engineering profession. By understanding the significant strengths associated with a systems engineering approach to problem solving and being aware of any potential shortfalls of the approach, it is possible to apply the discipline to a range of situations across a host of non-traditional industries.

This paper uses the Australian superannuation industry as an example of an industry facing complex problems and looking for effective solutions. It is instructive whilst reading the following description of the Australian superannuation industry to note the similarities between the development processes employed in the superannuation industry and system developments in more traditional systems engineering domains such as Defence. The similarities are striking.

Background of the Australian Superannuation Industry [5]

Through the Australian superannuation system, every Australian is provided with a concessionally taxed environment within which to save for retirement. To ensure stability and fairness in the industry, the superannuation industry is heavily regulated by the Commonwealth Government through federal legislation. Under the guise of Government Retirement Incomes Policy, Australian people are encouraged to become self-funding in their retirement in order to ease reliance on the Federally-funded Social Security System. Within the bounds of the Australian Constitution, employers are required to contribute a minimum percentage of salary to superannuation funds on behalf of employees (9% of salary [6]) and employees have options to contribute additional amounts.

Complex Requirements and an Ever-Changing Environment

In traditional systems engineering endeavours, the environment in which the system must operate is a rich source of both requirements and constraints. Normally, the operating environment is defined by factors including the physical variables, electromagnetic environment, and the potential for nuclear, biological, or chemical contaminants. The superannuation industry, at first glance, operates in a much more benign environment, but a closer look reveals a similarly hostile and challenging environment dominated by regulation, economics and law.

The complex Regulatory environment associated with the superannuation industry has developed over the last two decades. Its development is ongoing and the environment is ever-evolving. Superannuation legislation constrains the quantum and duration of contributions which can be made to superannuation funds, how superannuation funds can invest those monies and how and when benefits can be paid. In conjunction with this legislation, Tax laws place additional requirements on superannuation products to ensure monies are taxed appropriately at the time of contribution, during investment accrual and at the time of benefit emergence.

It is clear that developers and providers of superannuation products operate within a complex and constantly changing environment where the development of new products cannot be driven solely by the requirements of the market. Superannuation products must be developed, therefore, with not only the current environment in mind but also with flexibility and robustness to cater for future changes in the regulatory environment.

A Development Process for Superannuation Products

Systems engineering uses well-defined processes for developing systems. These processes generally start with the identification of a need for a new product and move through an iterative application of analysis, synthesis and evaluation before a system is eventually introduced into service. Documentation through a series of specifications, technical reviews and audits and test

and evaluation are all part of a rigorous systems engineering approach to system development. [7] The Australian superannuation industry has adopted a very similar approach to the development of their products. Their terminology is different and their approaches streamlined and tailored, however, the underlying fundamentals represent sound systems engineering principles.

The initial development of a new superannuation product is driven primarily by the emergence of a need. Key stakeholders such as employers, employees, self-employed people and the Government often drive the superannuation industry to satisfy an emerging need. In additional to externally-driven product development, the superannuation industry also conducts its own market research in an attempt to remain proactive in product development.

Regardless of where the need for change comes from, the development process remains the same. The requirements of the new product are analysed leading to the drafting of Product Specifications. Once drafted, key stakeholders are reintroduced into the process to review the Product specification, validate its contents and request that adjustments be made where necessary. Once the product specification is finalised, financial estimates such as likely product cost and profitability are calculated to allow authorisation of continued development.

Once development approval is given, detailed plans for the continued product development are drawn up and approved. Typically these include plans for documentation requirements, administrative procedures, training requirements and computer system specifications. Naturally, the entire process must conform to legislative requirements. For example, legislation dictates that the product documentation requirements include customer information brochures and prospectuses to support future (life-cycle) activities such as selling the product. Legislation also requires people involved in selling the products to undergo specified training and to hold certain qualifications.

With the weight of legislative constraints on product development and administration, superannuation product developers find it critically important to conduct continual compliance reviews and audits on their products, associated documentation and administrative procedures. This is to ensure that the product is administered in accordance with all product and legislative requirements; for example, whether correct fees have been charged and correct benefits have been paid at the times permitted by the legislation.

Moving the Product from Development to Market

There are many systems engineering lifecycles in existence today, but they all acknowledge the existence of two major stages; system acquisition and system operation/support. Systems engineering involvement is concentrated during system acquisition but does not end when a system enters service. Traditionally, operational test and evaluation continues and through life support issues such as training and maintenance are conducted. The transition from acquisition to operation in the superannuation industry is marked by the launching of the superannuation product.

Following the launch of a superannuation product, regular performance reviews occur to measure performance indicators such as market acceptance and investment performance. The administration of the product is also subject to continual review to ensure the actual cost of

administration conforms to the financial requirements contained in the product specifications. Administrative procedures are also reviewed as part of the formal compliance program to ensure regulatory compliance is maintained.

Ongoing review of product performance and compliance is normally conducted by a number of parties. The relevant managers of the fund conduct self-assessment of the product performance and compliance, however independent review by internal company compliance staff and external auditors also takes place. Of particular interest to compliance specialists during audits is performance against any changes in the legislative environment within which the product is operating.

Operators of superannuation products are, additionally, subject to onerous disclosure requirements in Government efforts to ensure the safety of members' superannuation investments. The regulators require annual financial and compliance reporting of the operations of the superannuation funds.

Retiring the Superannuation Product

The final step in a systems engineering lifecycle is the disposal or retirement of the system. Often, the retirement of one system marks the birth of a new system. Superannuation products are withdrawn from the market if they prove to be unprofitable to the provider or if the product is no longer suitable due to changes in the regulatory requirements.

The Superannuation Industry and Traditional Systems Engineering Industry

Even from a very brief introduction into the way the Australian superannuation industry develops products, it should be clear to systems engineering professionals that a number of analogies exist between the challenges facing the Australian superannuation industry and those of the more traditional systems engineering industries.

The superannuation industry is clearly faced with complex requirements that effectively define their problem. Some of the requirements conflict with one another, as do some of the key stakeholders with interests in the development process. Many of the requirements change over time, often as a result of the very complex and unpredictable environment in which the industry operates. The environment is largely beyond the control of those involved with the development of superannuation products. The environment is controlled by Government through legislation and by the broader economy. Changes in either requirements or environment are likely to drive product change so product development needs to be sufficiently robust to accommodate these changes.

Superannuation products have a finite life, they undergo a limited amount of testing and evaluation during development and are then offered to the general public for their acceptance or otherwise. During the period of use, the performance of the products is continually tested in the real (and changing) environment. The survival of the companies who develop and manage these products is dependent upon satisfactory performance under these challenging conditions.

This entire process should sound very familiar to systems engineers who have worked professionally in traditional industries such as Defence. It is clear that the superannuation industry follows well-defined and effective processes in developing their products and to that end, it could be argued that the Australian superannuation industry already makes use of systems engineering processes. They are not unique. The superannuation industry is just one example of an industry within a sector (finance) that is not currently associated with systems engineering yet is in exactly the same business as systems engineers; one of solving complex technical problems.

Recognising and Realising the Opportunity

Competent systems engineers possess the skills, expertise and tools that are of very real value to a range of industries such as the superannuation industry in their efforts to solve their complex problems. There is an opportunity for these engineers to expand their focus slightly from traditional industries such as Defence to include non-traditional industries such as the superannuation or finance industry as described in this case study.

The challenge is not so much in recognising the opportunity, but rather in realising the opportunity. Organisations practising within non-traditional industries have simply not heard of systems engineering before. Describing our profession and capabilities as systems engineering to these industries is likely to be met with an unenthusiastic response. These industries simply do not think of themselves as being in the systems engineering game or, indeed, in the engineering business at all. These industries do, however, realise that they need to understand and solve complex technical problems and this is the angle that systems engineering professionals should take when looking towards non-traditional markets.

To move into non-traditional industries, systems engineers must be willing to re-package themselves and to emphasise the strengths and benefits associated with a rigorous and methodical approach to solving complex technical problems. If we can achieve repackaging, there will be few bounds constraining the relevance and application of our discipline or the industries in which we work.

About the Authors

Ian Faulconbridge received BE and MEngSc degrees in electrical engineering from the University of New South Wales in 1990 and 1999 respectively and an MBA in project management from the University of Southern Queensland in 1996. Since 1990, he has held a number of systems engineering and project management positions in the fields of avionics, simulation and communications systems.

Ian is a Senior Lecturer in the School of Information Technology and Electrical Engineering at the University of New South Wales (Australian Defence Force Academy). He teaches electronics, systems engineering, avionics and radar and is the author of a book on radar and radar electronic warfare, and co-author of a book on systems engineering.

Additionally, Ian manages his own engineering consultancy providing short-term, independent, on-demand consulting in systems engineering management and a number of technical domains.

Karen Faulconbridge received a B.Comm degree from the University of Queensland in 1982 and has been working as a superannuation specialist for twenty years. She has worked in both the private and government sectors and specialises in the technical and compliance aspects of the Australian superannuation industry.

Karen is currently Manager, Policy Advice in the Trustee Executive of State Super in NSW and heads a specialist team.

State Super incorporates First State Super, which is an accumulation employer superannuation fund with assets of approximately $5.6 billion. The Pooled Fund for the five defined benefit schemes is the largest superannuation fund in Australia with assets in the order of $22.3 billion.

Among Karen's responsibilities are the formulation of new superannuation policies (and the review and amendment of existing policies), identifying the need for product initiatives and service enhancements and ensuring compliance with Commonwealth and NSW legislation.

References

1. Buderi, Robert. 1998. *The invention that changed the world – The story of radar from war to peace*. Abacus.
2. US Department of Defense. *MIL-STD-499(USAF) Engineering Management*. Washington.
3. Electronic Industries Association. 1999. *ANSI/EIA-632 Processes for Engineering a System*. Arlington.
4. Institute of Electrical and Electronic Engineers. 1998. *IEEE Std 1220-1998 IEEE Standard for Application and Management of the Systems Engineering Process*. New York.
5. Faulconbridge, R.I. & K.L Faulconbridge. 2002. *Let's Spread Our Wings*. INCOSE Insight Vol 5 Issue 1, pp 26-27.
6. Commonwealth of Australia. 1992. *Superannuation Guarantee (Administration) Act.* Canberra.
7. Faulconbridge, R. Ian, and Michael J. Ryan. 2003. *Managing complex technical projects – a systems engineering approach*. Boston: Artech House.