SYSTEMS ENGINEERING

In modern times society and industry deliver goods and services more and more through large systems. Whether it is a railroad, airline, mine, bank, hospital, airport, factory, processing plant, telecoms system, weapon system, industrial/consumer product system or large-scale information system, all these systems include 7 generic elements:

- Equipment (Hardware)
- Personnel (Bioware)
- Computer Software (Software)
- Infrastructure (Infraware)
- Documents & Data (Dataware)
- Consumables (Consumaware)
- Insourced Services

The constituent systems of a business enterprise or organization (called business systems) and their system elements are largely interactive and interdependent, resulting in significant complexity. Moreover, the creation, operation and improvement of these systems always require a spectrum of knowledge disciplines and interdisciplines - the integration of which represents a complex task in itself. Internationalization and globalization increased the rate of change in society and industry, adding to the complexity of new systems. All of the above increases risk and may affect the degree of success.

Towards the middle of the twentieth century humankind began to realize that a more powerful and comprehensive approach was needed to handle the complexity of large systems: multi-disciplinary complexity, phenomenological complexity, and large-scope complexity. This led to the evolvement of Systems Engineering.

Systems Engineering is not another engineering discipline (the word "engineering" in the name is somewhat misleading). Modern Systems Engineering is regarded as a meta-discipline (with systems science providing fundamentals). Systems Engineering broadly comprises the trans-disciplinary activities ensuring optimal satisfaction of client needs and wants through an integrative approach to a total system (including operating, support, and management segments) that will perform the whole process (covering matter, energy, and data/info dimensions) throughout the entire useful system life. Systems Engineering spans the system realization and system utilization macro phases of the system life cycle. The Systems Engineering body of knowledge includes principles, constructs, methodologies, formalisms, techniques, and tools underpinning its eleven knowledge areas:

- Requirements Engineering
- Logical (& Functional) Modelling
- Architecture & Interface Modelling
- System Performance Modelling
- Life Cycle Cost Modelling
- System Analysis & Trade-off Modelling
- Technology Transitioning
- Verification & Validation
- System Performance Assessment
- Techno-economic Risk Management
- Systems Engineering Process Management

The central thrust of Systems Engineering throughout the system life cycle is directed at feasibility, viability, and optimality – of the initial system solution as well as through-life improvement solutions.

G Philip RUST

De Villiers Co.