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Systems engineering of Natural gas distribution

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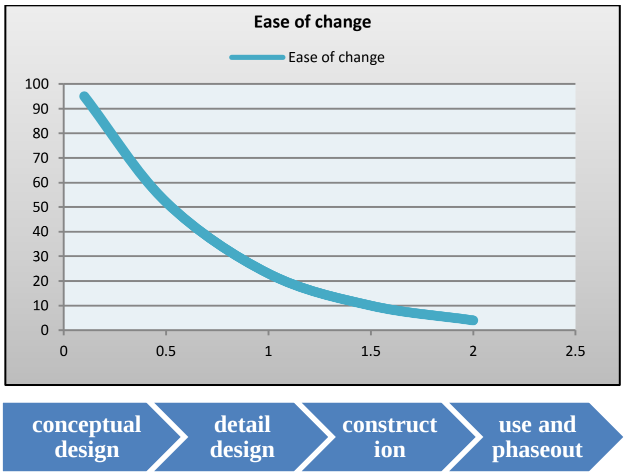
Abstract

Systems engineering relates to planning for a project that incorporates a number of interlinking elements and processes, usually from different disciplines. The internal and external environments of such a project are vulnerable to frequent or even constant change and flux, so that the planning process must incorporate automated system flexibility within set parameters. Whilst systems engineering is usually project-based, there are processes such as the delivery of energy that take the concept through a series of installations over many years and cost many billions of dollars. An example is the century-old distribution of liquid petroleum gas throughout Europe, using a series of collectors, processors and distributors, and maintaining energy supplies to more than 830 million people. Natural gas-processing and distribution in Europe, using systems engineering, is an extensive multidisciplinary industry subject to constant change from physical suppliers and political and economic constraints. This case study concerns the systems evaluation for StatoilHydro, as a major stakeholder in Europe's gas distribution system. The conclusion is that system engineering is warranted in a complex engineering environment which serves numerous stakeholders, from investors, governments to customers. Supporting findings relate to early planning, primary stakeholder (user) input, and allowing for flexibility in the system as change management.

Keywords: *Systems engineering, Internal and external environments etc.*

Introduction

In an environment of constant change, the ability to manage feedstock through modifying existing plant and to plan for efficient, reliable and cost-effective future plant has never been more important.



Source: Blanchard 2012.

Figure 1 Flexibility of variation in process life cycle

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Due to the nature of systems engineering, the conceptual phase produces the controlling paradigm which governs the entire planning process. Figure 1 illustrates the importance of this first phase in a process life cycle.

To maximise the economic delivery of feedstock such as LPG through modifying existing plant and undertaking greenfield projects, it is the opinion of this author that the conceptualisation phase is vital to the success of the project. By incorporating sufficient flexibility into the planning processes of systems engineering at the initial stage, variations and redesign can be minimised during installation and maintenance phases of the life cycle.

System engineering approach evaluation

Gas processing and distribution installations in Europe have proliferated over the past 15 years, Despite the economic downturn, multi-billion dollar projects in train in countries such as China, Saudi Arabia and India have strained global supply chains of professionals, skilled workers and plant and equipment suppliers, producing an imbalance between global supply and demand.

Moreover, expansion requires higher numbers of employees, thus organisations become larger and more complex. When gas trains become integrated as a system with distributors, interactions between various organisations in this industry climbed remarkably. In

Europe, StatoilHydro is an integrated technology-based international energy company primarily focused on upstream oil and gas operations for commercial distributors, and its share of the major pipeline systems in terms of operation is about 90 per cent (Fact Sheet, 1998) Consequently, today's systems show complex technical infrastructures which proves an urgent need for a broad, comprehensive and multidisciplinary understanding of the natural gas transport system (see figure 2).

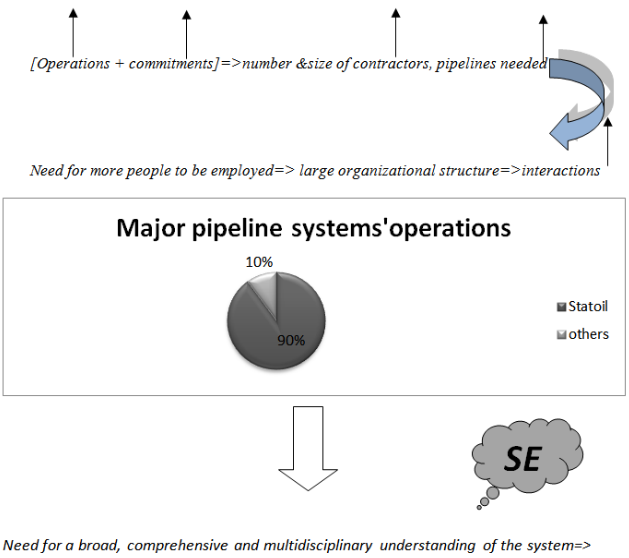


Figure 2 Evaluation of gas distribution in Europe

Operational phase

At the operational phase there are a number of project elements to be coordinated:

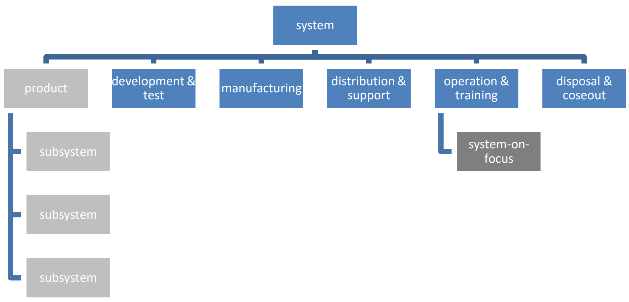
- Financial analyses
- Regulatory considerations, including environmental and social impact assessments
- Project management techniques
- Engineering and construction analyses
- Logistics and supply factors
- Quality assurance systems and auditing functions
- Safety, risk and hazardous operation analysis
- Supply contract management
- Operations research and linear programming (kerzner 2009).

These approaches facilitate good systems engineering, allowing full consideration of a range of disciplines at both the design and construction phases. Each follows a particular goal to contribute to the whole system; however; the goals of each must meet the criteria set up in the concept stage through multidiscipline coordination (Badiru, 2009)

The systems engineering approach used in this case identifies the conceptualisation and operations planning for the whole system, managing the complexity of the integrated collection, processing and distribution system through a systems analysis approach which allows maximum flexibility during the life of the project. Systems engineering allows communication between disciplines and project management of many parallel operations toward full commissioning (Walker 2007). Maintenance factors built into the system allows for future reengineering through change management.

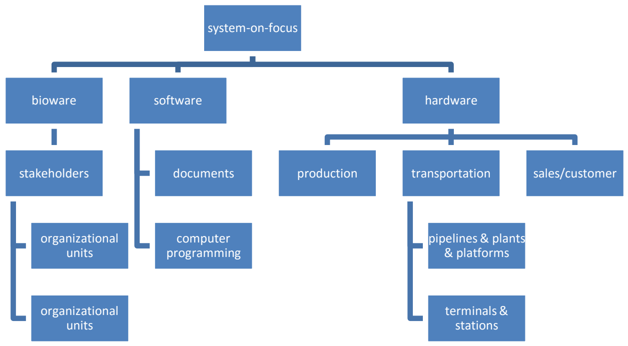
Systems engineering building blocks

Analysis of systems allows identification of the factors of production, distribution, and resources. Figures 3a and 3b illustrate the components of a production system, devolving to a system-on-focus to bring in the stakeholders in the enterprise (IEEE Std 1220-1998).



Source IEEE Std 1220-1998

Figure 3a, Building blocks for systems engineering framework



Source IEEE Std 1220-1998[2]

Figure 3b, Building blocks for the system-on-focus

The figures summarise the building blocks used for the model in the case study. They are not discussed further, due to restrictions on the case.

Characteristics of systems engineering design

The system engineering model follows a hard system methodology as it uses a deconstruction process to identify the elements of each subsystem. Categorised needs are then identified as a series of requirements for specification. Therefore, the hard system methodology is used and also IEEE 1220-1998 is applied, in particular in building blocks.

[2]Institute of Electrical and Electronics Engineers, Inc. Accessed 3 October 2009 from http://standards.ieee.org/ reading/ieee/std_public /description/se/ 1220-1998_desc.html (subscription required)

Identify and resolve complexity

In the bioware (human resources) subsystem, ten interdependent stakeholder groups are identified, involving production, transport and sales. The human-computer interface, termed bioware and software subsystems, is a useful position to resolve complexity in the flow of information between different stakeholders.
Other interrelationships occur in the system are hard-bioware and hard-software. By identifying them and studying the processes between them, processes between production and transport and sales are recognisable and traceable to decrease complexity of the system.

Evaluate the systems engineering application

The case methodology is appropriate to the situation since it not only deconstructs the system to facilitate problem-solving, it also provides for a holistic approach to the complex pipeline system. In addition, when issues arise and are identifiable as to source and effect, hard methodology leads to an acceptable solution. Strengths of the methodology are in the early stages analysis of the system and detailed and proper information of the current situation and therefore the author is familiar with the system and knows its processes; however, there is an assumption at the subsystem level that problems will manifest themselves and can be easily identified. Documentation and tailoring the SE approach are well expressed and they are traceable.

Conclusion

A system engineering approach is warranted in the current engineering environment with its complexity, complicated structures and numerous interactions between stakeholders. It is important to consider stakeholders in the early stages of analysis; ensure that appropriate sub-systems remain onstream, and to allow for future change management in the later phases of the project’s life cycle.

References

[1]. Badiru, A 2009, STEP project management: guide for science, technology, and engineering projects, Taylor & Francis, Boca Raton, FL.
[2]. Blanchard, B 2004, Systems engineering management, 3rd. ed, Wiley, Hoboken, NJ.
[3]. International Council on Systems Engineering (2000) Systems engineering handbook, version 2a, Wiley, Hoboken, NJ.
[4]. Checkland, P 1979, ‘Techniques in soft systems practice, part 2: Building conceptual models’, *Journal of Applied Systems Analysis*, vol.6, pp.41-49
[5]. Freeman, RL 2004, *Telecommunication systems engineering*, 4th ed, Wiley, Hoboken, NJ
[6]. Kerzner, H 2006, Project management: a systems approach to planning, scheduling, and controlling, Wiley, Hoboken, NJ.
[7]. Walker, A 2007, Project management in construction,5th ed, Blackwell, Oxford, England.