White Paper

The Limits of an Engineering Approach to Architecture, and when to bring in the Soft Systems Methodology - Paper 2

WP0143 | April 2014

Ceri Williams

Ceri has thirty years in the IT industry, originally delivering complex control systems and subsequently broadening focus to Enterprise Architecture, Governance and transformation of the IT function. Working as a chief architect, consultant and coach, he enables FTSE 250 organizations to make medium and long term decisions on the shape of the Enterprise Architecture and positioning of the IT function.

He advocates putting people at the heart of technology and business change with focus on the human enablers and constraints. His work deals with the way in which rigorous engineering and architecture disciplines are integrated with the cognitive and behavioural capabilities of the people who practice them.

The previous White Paper in this series [Ref 1] provided a brief history of Systems Thinking & the Soft Systems method. It considered the relationship between Soft and Hard Systems – their similarities and differences. The paper described the emergence of Soft Systems as a defined field, from before it was given a name to today's discipline, making the connection with Enterprise Architecture and what it means for Enterprise Architects.

In particular, Paper 1 highlighted the boundary limit of 'hard systems' – that an engineering approach excludes consideration of psychological, social and cultural factors, and makes a key assumption that there is one 'version of the truth' - that viewpoints are just projections of that truth for specific stakeholders. This paper explores that boundary more closely through the eyes of an Enterprise Architect in a set of challenging situations. Through storytelling, it describes how an Enterprise Architect can and must transcend the limits of an engineering approach and embrace multiple, inconsistent versions of the truth – making Enterprise Architecture accessible.

This paper builds on the similarities and differences as a means of understanding where an Enterprise Architect can be more effective by switching between an engineering approach and the soft systems methodology (SSM). It proposes that while the Enterprise is always complex, it is not an engineering object. This means that an exclusive focus on a 'hard systems' approach prevents the Enterprise Architect and associated stakeholders from understanding the Enterprise in a way

that leads to effective and efficient improvement. This paper explores the limits of adopting an Engineering-intensive approach to EA and how integrating it with Soft Systems provides a comprehensive set of tools for the vast majority of situations.

The rest of this Paper is organized as follows:

- **A (very) Short History of Soft Systems:** this extract taken from Paper 1, provides a very short outline of the Soft Systems Method: what it is, where it came from, and why it is significant. Reader wishing to deepen their background in the topic before embarking on this Paper can read Paper 1 [Ref 1]
- **Complex Systems Inc.:** this Paper and some of those that follow, use vignettes from a fictitious organization to illustrate they key points - Complex Systems Inc. – with the resident Enterprise Architect at large.
- **Formal Definition:** this section examines in more detail a key defining feature of the boundary between Hard and Soft systems. Paper 1 proposed that an engineering approach requires that problems and Systems can be represented by formal definitions (i.e. having conventionally recognized form, structure or set of rules). It assumes that they are structured, well-formed and logical. SSM integrates Systems and problems that can with those that cannot be represented by formal definitions.
- **Single Version of 'The Truth':** another key defining feature of the Hard/Soft boundary is that an engineering, Hard Systems approach assumes that while there may be multiple viewpoints of a system, they are all filtered views of a single, objective, canonical definition of a system or problem. SSM is tolerant and accepting of subjectivity and multiple 'versions of the truth'. It treats all models as viewpoints that express how stakeholders perceive the system.

A (very) Short History of Soft Systems (from Paper 1 [Ref 1])

The first lines of the Wikipedia entry covering Soft Systems [Ref 2] reads: “Soft systems methodology (SSM) is a systemic approach for tackling real-world problematic situations. Soft Systems provide a framework for users to deal with the kind of messy problem situations that lack a formal problem definition”. Enterprise Architecture deals with “real-world problematic situations” and routinely encounters “messy problem situations that lack a formal problem definition” – this is why a re-imagining of Enterprise Architecture as a blend of Soft Systems and Systems Engineering disciplines is now needed, and provides us with a complete set of concepts and tools with which to operate in a complex, people-centric environment.

The Soft Systems Methodology originally emerged in the 1960s in response to problems encountered in tackling management and organizational problems using a systems engineering approach. Again, from the Wikipedia entry: “The team found that Systems Engineering, which was a methodology so far only used for dealing with technical problems, proved very difficult to apply in real world management problem situations. This was especially so because the approach assumed the existence of a formal problem definition. However, it was found that such a unitary definition of what constitutes ‘the problem’ was often missing in organizational problem situations, where different stakeholders often have very divergent views on what constitutes ‘the problem’”. I would add that the Systems Engineering approach also makes a number of (usually unstated) assumptions. Specifically that:

The problem and solution space can be modeled as a single definitive version of ‘the truth’ that is common to all stakeholders. The environment (the world!) can be base-lined to facilitate analysis; it does not move faster than the baseline, or the problem solving work depending on it, can react.

The time taken to assemble the baseline and develop a solution is short enough that the solution is relevant and valuable at the time it is implemented.

Every movement has its gurus, and Soft Systems is no exception. The first mainstream work to encode and specialize the knowledge around Soft Systems centered around Lancaster University, UK in the mid-1960s pioneered by Prof. Gwilym Jenkins and subsequently by Dr. Brian Wilson, before reaching the mass market through the work of Prof. Peter Checkland. A number of useful references are included at the end of this White Paper.

Despite the name, the Soft Systems Method does not differentiate between 'Soft' and 'Hard' systems. It does not even treat 'Hard' and 'Soft' as features of the problem under consideration – they are features of the relationship between the problem and the person interested in it. They relate to the way in which the problem analyst perceives and interacts with the situation. For this reason it provides the best reference point for Enterprise Architecture and an inclusive, systematic framework for integrating Engineering and Soft Systems approaches. For the sake of clarity in this series of papers, provided we accept that we construct our viewpoint to represent a 'system' and that 'Hard' and 'Soft' are not intrinsic to the system, we shall refer to 'Hard' and 'Soft' Systems.

For further reading and a very concise and complete account, see Ref [3].

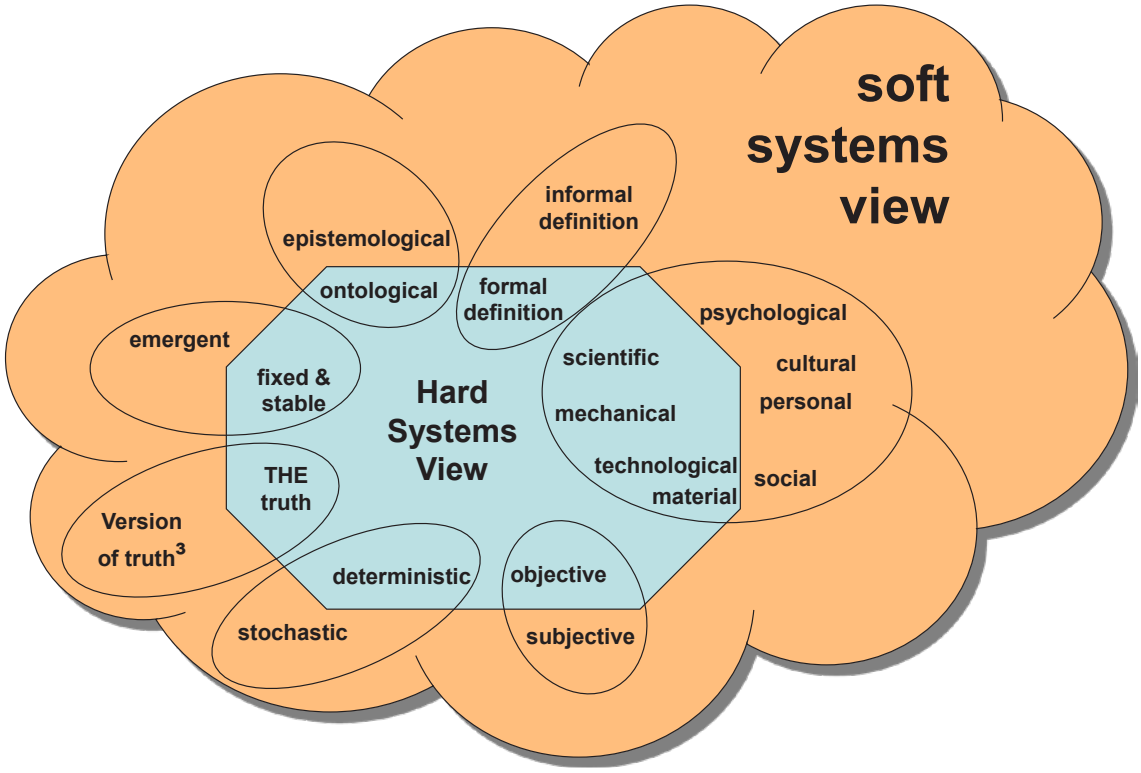

Figure 1 – The Relationship between Soft and Hard System viewpoints

Key Concepts

For the purpose of this series of White Papers and in line with the general consensus in the field, Soft Systems and Hard Systems are treated as views of a system, rather than features of the system itself. Hard Systems are generally well suited to treatment with a Systems Engineering approach, Soft Systems with Soft Systems methods. These viewpoints can be differentiated as described in Figure 1. The following Table 1 considers the main distinctions between Hard and Soft systems and highlights those considered in the remainder of this paper in **Bold**.

Soft System View	Hard System View
Inclusive of scientific, technological, mechanical, material, psychological, social and cultural domains.	Inclusive of scientific, technological, mechanical, material domains. Exclusive of psychological, social and cultural domains.
Accepts that Systems develop emergent properties that cannot be foreseen at the outset. Provides concepts and tools to cater for this.	Assumes fixed and defined System and environment in which it operates. Unanticipated changes to either require re-entry into the Systems Engineering process at some point.
Provides the ability to integrate Systems that exhibit features and behavior that may be random, stochastic (i.e. statistical) and deterministic (i.e. individual cases predictable by analysis).	Deals effectively with deterministic systems and environments in which they exist. Has limited ability to deal with stochastic systems.
Tolerant and accepting of subjectivity and multiple 'versions of the truth'. Treats all models as viewpoints that express how stakeholders perceive the system. Accepting of dissonant and inconsistent viewpoints.	**Considers multiple viewpoints as filtered views of a single, objective, canonical definition of a system or problem. Assumes and requires common agreement across all stakeholders, convergence and consistency of viewpoints.**
Conceives of 'System' as an epistemological entity – i.e. as made up of conceptual and mental schemas & models that determine the perception of what the system is. Considers the perceptual schemas are an integral part of the 'system'.	Conceives of 'System' as made up of ontological entities – i.e. representation of, or actual entities physically existing or proposed to exist in the real world. The 'system' is independent of the way in which it is described.
Integrates Systems and problems that can and cannot be represented by formal definitions. Formal definition may not be possible either because of the nature of the System or because there is no suitable formal language with which to describe it.	**Requires that problems and Systems can be represented by formal definitions (i.e. having conventionally recognized form, structure or set of rules). Assumes that they are structured, well-formed and logical.**
Recognizes the significance of stakeholder values and world views (Weltanschauung) and their impact on the scope and shape of the System.	Recognizes stakeholder values and world views only to the extent that they filter the information that represents the system and separates stakeholder concerns.

Table 1 – Differences between Soft and Hard Systems Viewpoints

Complex Systems Inc.

Throughout these papers, I use a fictitious organization and situations within it to provide examples highlighting the transition zone where engineering should give way to soft systems and vice-versa – Complex Systems Inc. (CSI). This organization and the situations are a composite of real-life cases that I have experienced and that recur on a regular basis, presented as a set of archetypes.

Complex Systems is a FTSE 250 mobile telecommunications provider with a central Business Information Systems function of 350 people co-located on a HQ site along with business support (Business Support Systems - BSS) functions such as HR, Finance & Supply Chain Management. CSI has a significant in-house development and service provision capability and a number of outsource arrangements to provide platforms, networks and commodity productivity tools used in the context of business support. It delivers technologically-intensive products and services to the consumer and business markets. The development and delivery of these products and services is predominantly performed by a separate Product Development function, although there is an increasingly close relationship between business support and product systems. A third function provides the communications network that enables the products and services (Operational Support System - OSS) – this too is becoming more closely integrated to both the product and business support capabilities.

The pace of product development is marketing-led and creates new products and variants at a frenetic pace. The internal IS function is being downsized and re-purposed to sit between internal customers and a new single outsourced provider. What was the IS function will become a thin ‘Intelligent Customer’ function, focused on demand management and internal customer engagement.

The OSS function is the oldest and most mature part of the organization. It has adopted and developed rigorous engineering practices that enable it to introduce major technological changes to the network capability as well as maximizing the return on investment of existing network capability through upgrading and enhancement. The Head of BSS systems thinks there is an opportunity to use these rigorous practices to assist in re-engineering the IS organization.

Formal Definition

Paper 1 proposed that an engineering approach requires that problems and Systems can be represented by formal definitions (i.e. having conventionally recognized form, structure or set of rules). It assumes that they are structured, well-formed and logical. SSM integrates Systems and problems that can with those that cannot be represented by formal definitions. Formal definition may not be possible either because of the nature of the System or because there is no suitable formal language with which to describe it.

The Enterprise Architect is not spoilt for choice when it comes to languages with which to define a System. Languages from Yourdon & SSADM, through UML to BPMN and ArchiMate have all been used to define the characteristics of Systems, and Systems of Systems. However, while the symbols and syntax of these languages is often well defined, the semantics are left to the Architect to define for a particular environment. Drill in to the precise meaning of 'Logical' or 'Service' and many remain open to interpretation. Establishing the completion criteria that answers the question 'Have we finished our Conceptual Model yet?' is even more elusive. Even were they to too precisely define their semantics, their use is confined to an exclusive set of educated specialists. In these hands, the language constructs become a powerful tool – but only for the specification of Hard systems. Models developed and expressed through these constructs quickly become ossified and resist change arising from emergent understanding and exploration of the situation. Soft systems require richer forms of expression. Forms that are used to describe and iteratively understand the problem/solution space, rather than define them rigorously. Rich Pictures and Purposeful Activity Models provide these rich forms.

Rich Pictures were originally an artefact that emerged from SSM to enable participants who are not expert in definition to express their world views and interact with them to develop their understanding of their situations. There are no rules for a Rich Picture other than they should be inclusive of how participants wish to express their situation in a way that includes the 'Hard' elements such as the 'flow of money' and 'operational components' to the 'non-Hard' elements such as 'market forces' and 'anti-government pressure' (see Figure 2).

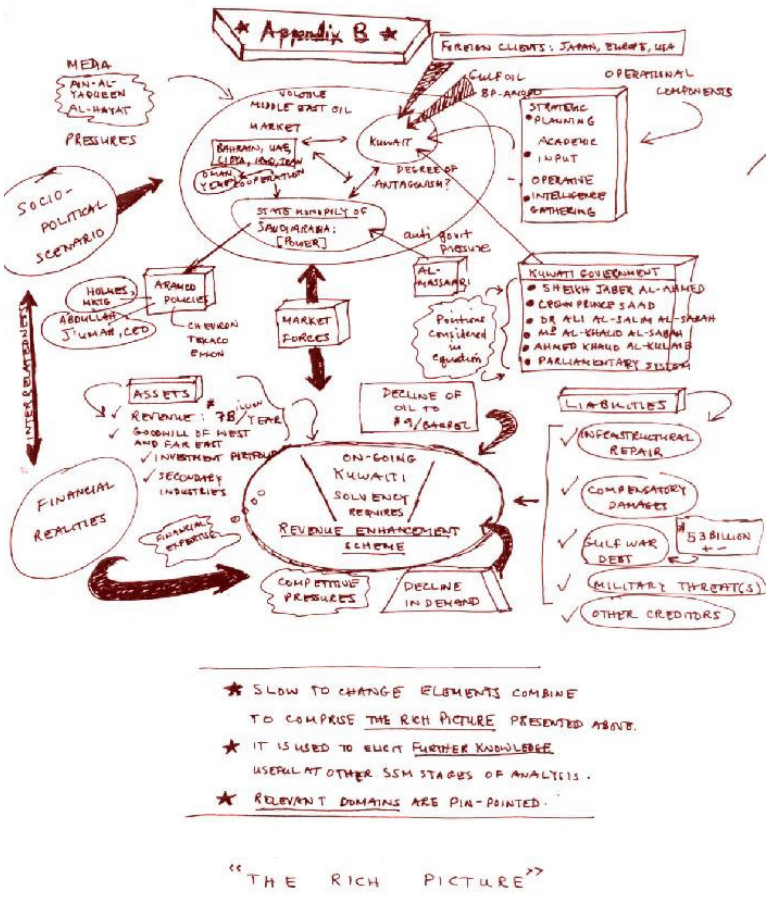

Figure 2 – The Rich Picture

Typical guidance on their use might include (see [Ref 5]):

- A rich picture is an attempt to assemble everything that might be relevant to a problem situation. You should try to represent every observation that occurs to you.
- Use words only where ideas fail you for a sketch that encapsulates your meaning.
- Do not seek to impose any particular style or structure on the picture. Place the elements on your sheet of paper wherever seems appropriate. At a later stage you may find that the placement itself was significant.
- Avoid thinking in systems terms: that is, using ideas like "Well, the situation is made up of an ecosystem, an agricultural production system and a planning system."
- Your picture should include not only the 'hard' factual data about the situation but also the 'soft' subjective information.
- Look at the social roles of those involved within the situation, and at the kinds of behaviour expected from people in those roles. If you see any conflicts, indicate them.
- Include yourself in the picture, or, if you are doing it as a member of a group, include the members of the group.

An illustration from Complex Systems Inc.: the Head of BSS systems commissions a team led by an Enterprise Architect (EA) to capture of the as-is IS organization Architecture, complete with roles, business processes, work products. The team soon finds out that there is massive variation in the way in which the same task is done by different people as the rules are based on the judgment of individuals & combinations of circumstances, information quality, gut feel, risk interpretation and personal relationships with their customers. This causes a number of difficulties for the modeling team as they respond by trying to model all the variations and a catalogue of elaborate business rules. The EA decides to continue with the use of models, but with a different purpose – to be used informally to help stakeholders explore the problem space, rather than define as-is or to-be states.

Each team discovers the value of the SSM concepts Rich Pictures and Purposeful Activity Models [Figure 3] as an effective means of engaging with the situation and each-other. These are, in fact, models, but are kept deliberately ambiguous and alive to provide some unifying constructs from which purposeful and accidental variation can be explored. Based on a high level model, conversation and intuition, through exploring their area, one of the teams decides that some elements of the 'way we do things round here' are subject to variation that is a) not necessary and b) confuses the customers. The models became a reference onto which each Stakeholders own 'worldview' could be projected and integrated with others.

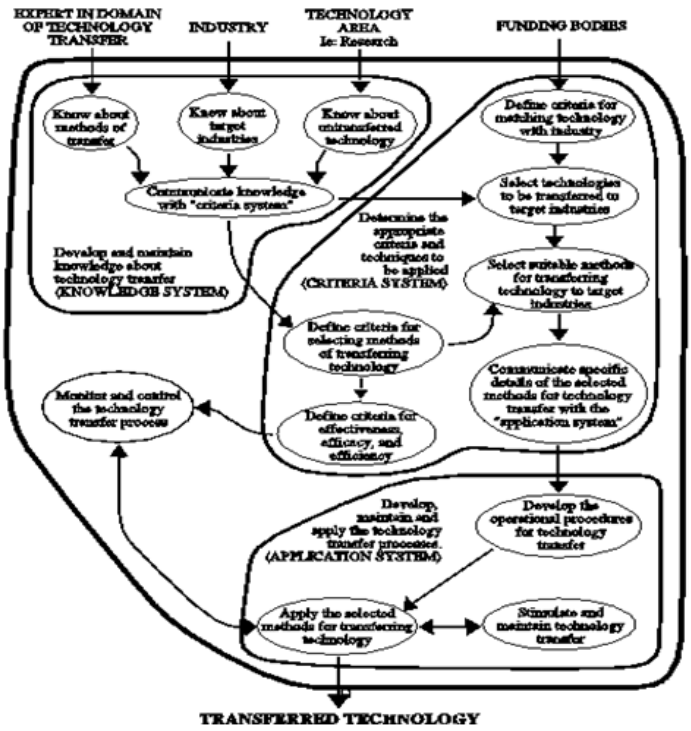

Figure 3 – Purposeful Activity Model

The key difference here is that the models are used to describe rather than define; they are only devices that provide stimulation to explore the situations and provide a reference point against which to evaluate ideas for change. In this case, the BSS EA explored the boundary between formal and informal use of concepts, models and language. She transcended the limits of a modeling approach that focused on rigorous use of visual language to define by repurposing the modeling activity to describe in a way that engages non-architect stakeholders. Thus drawing them in and enabling them to be resourceful, rather than alienated and disempowered. The use of Rich Pictures and Purposeful Activity Models' as an integral part of a highly iterative, sense-making process, rather than as end points of a production process was a key shift made by the EA. This shift was only made by enabling the participants to directly engage with the model rather than mediating engagement through a modeling expert. Democratization of the modeling process promotes the kind of ownership that is pivotal for successful implementation of change – the change process does not just start once the experts have defined the 'to-be' model, it starts on day 1 of the modeling process.

Single Version of the 'Truth'

An engineering, Hard Systems approach assumes that while there may be multiple viewpoints of a system, they are all filtered views of a single, objective, canonical definition of a system or problem. It assumes and demands common agreement across all stakeholders, convergence and consistency of viewpoints. Both TOGAF and IEEE 1471 are clear that this is the case, with IEEE 1471 differentiating between 'constructed' (i.e. composite views made up from several sources) and 'projected' (i.e. extracted from a common source) views. While the Hard systems approach sees the inconsistency arising from constructed views as necessarily a bad thing, SSM is tolerant and accepting of subjectivity and multiple 'versions of the truth'. It treats all models as viewpoints that express how stakeholders perceive the system. SSM is accepting of dissonant and inconsistent viewpoints as valid, but with an underlying assumption that somewhere, there is the common ground that provides the critical mass for change.

A key feature of SSM facilitates integration of these approaches – World Views. SSM sees that the inconsistencies arise from different World Views of the participants. It makes the giant leap of including the World Views as an integral part of the system itself. This means that the engineering hard systems world view is itself an integral part of a broader system, as are the views of all stakeholders involved. Apparent inconsistences can then be explained and addressed as differences in viewpoint, including the psychological, social and cultural aspects of the worlds inhabited by the participants. Including world view in as an integral part of the system, turns the system into an epistemological construct from a hard systems

assumption that it is an ontological one – this is another key difference between an engineering approach and SSM.

SSM does not at present provide specific guidance on how to model a World View. It relies principally on the participant's awareness of their existence, and the way they legitimize difference, to have the desired effect. However, the EA could use some existing concepts that recur in most Architecture frameworks to help 'model' the worldviews. A World View could be described (but not defined!) by articulating the values, objectives, language, beliefs and traits of the worlds represented by the participants. Concepts such as 'Outcomes', 'Objectives', 'Rules' and 'Standards' can be deployed to do this and are already a part of TOGAF.

SSM also provides some structural support for the process by which world views are put into perspective alongside other key features of the system under consideration. The CATWOE mnemonic identifies concepts that will be more familiar to participants from a more analytical background. The elements are:

- **Clients** – Who are the beneficiaries or victims of this particular system? (Who would benefit or suffer from its operations?)
- **Actors** – Who are responsible for implementing this system? (Who would carry out the activities which make this system work?)
- **Transformation** – What transformation does this system bring about? (What are the inputs and what transformation do they go through to become the outputs?)
- **Worldview** – What particular worldview justifies the existence of this system? (What point of view makes this system meaningful?)
- **Owner** – Who has the authority to abolish this system or change its measures of performance?
- **Environmental constraints** – Which external constraints does this system take as a given?

When combined with the SSM concept of Root Definition, the EA can be fully equipped to comfortably enter the subjective space of world views, but with a significant measure of structure and repeatability in the process. A Root Definition in SSM is defined as a "succinct statement of appropriate systems". It pretty much defines the scope of the systems under consideration. Again, there are parallels in Systems Engineering and modeling – in Systems Engineering, the 'System of Interest' is a key concept (Figure 4), as is the 'Context Diagram' in Yourdon notation (Figure 5).

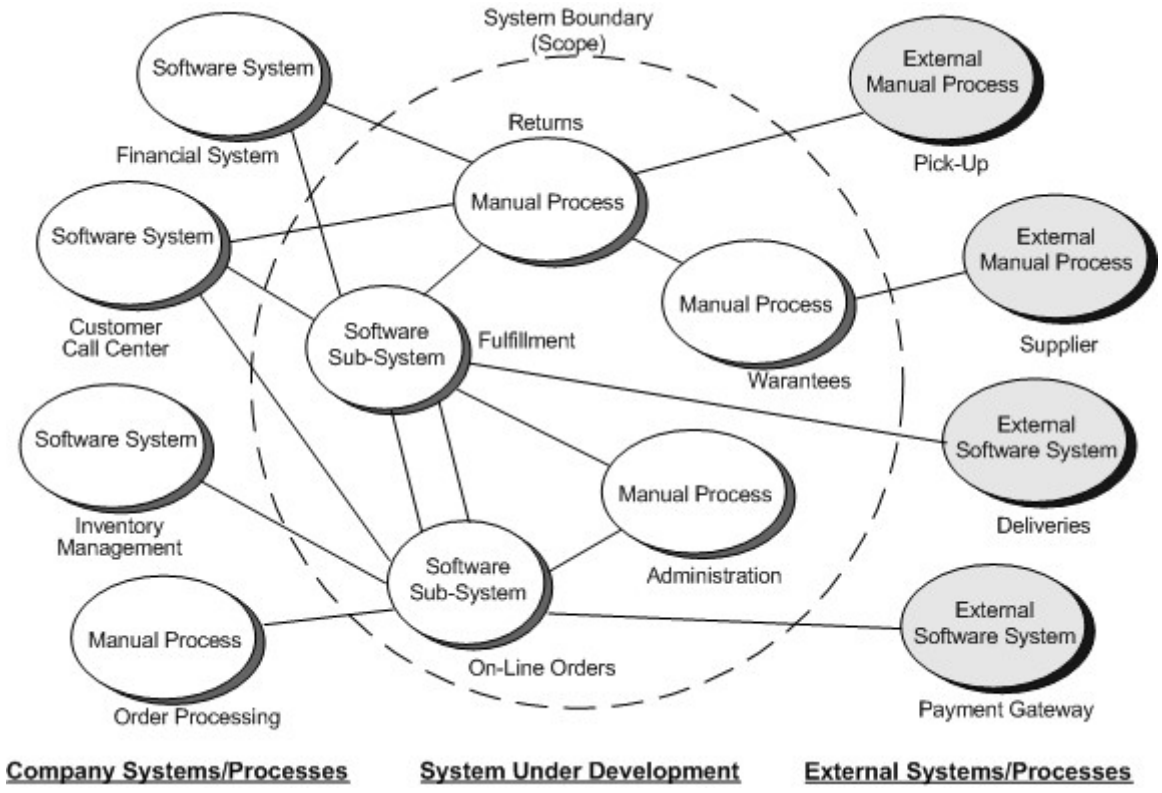

Figure 4 – the Systems Engineering System of Interest (SoI)

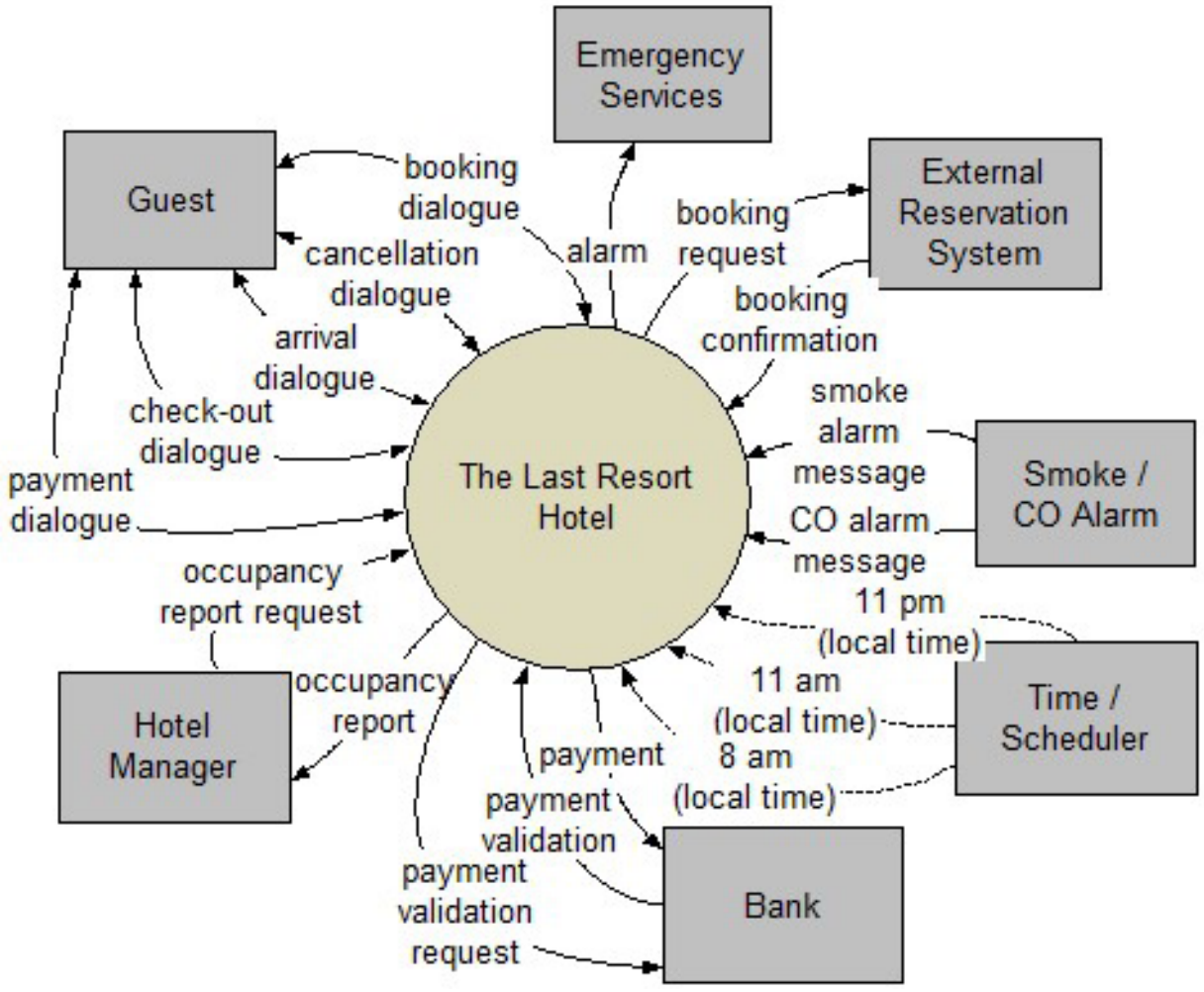

Figure 5 – Yourdon Context Diagram

However, SSM enriches these concepts with psychological, social and cultural features. CATWOE helps participants include all necessary elements in the root definition before engaging in modeling activities. There is regular iteration between Root Definition, CATWOE and modeling as participants explore and learn about their context, each other and what they are trying to achieve. Root definitions can be activity-based (e.g. a system to deliver an operational information system to support purchasing decisions against environmental criteria) or issue-based (e.g. a system to build stakeholding of a sceptical staff for an information system designed to aid environmental decision making). Their purpose is to learn about a complex situation so as to make positive improvements. For example, the Olympic Games could be seen as a system to:

- Bankrupt self-selecting cities on a four year cycle
- Institutionalize a global celebration of sporting prowess and cooperation amongst nation states.
- Provide inputs into a global capitalist system in which there are limited number of beneficiaries.
- Allow sports ministers to extract money from treasuries for the development of a national sporting competence

While most stakeholders will already familiar with several of the concepts (like ‘Owner’ and ‘Customer’), the introduction of ‘World View’ is likely to be new, and quite different. Just getting this concept on their radar quickly helps reinforce that there is no single, pure, authoritative perspective. Making worldview an explicit part of the system helps to defuse the disruptive force of perceived difference and gets stakeholders into a productive mode quicker as participants become comfortable that their world view would not be ignored, and that all were legitimate and material to the process.

An illustration from Complex Systems Inc.: The BSS EA is tasked with facilitating stakeholders to explore and define the boundary of the ‘Intelligent Customer’ function. However, despite the use of Rich Pictures and Purposeful Activity Models, stakeholders fail to agree on the boundary. After some reflection with the teams, the EA realizes that a key problem is that there is a major clash of worldviews between the Commercial, Supplier Management and Business Relationship Management (BRM) stakeholders.

At its root, the issue is not trivial – it’s nothing short of the identity of the Intelligent Customer function – its purpose and mission. The BRM belief is that it enables the internal customers to explore the ‘art of the possible’ in how systems can help improve their business, Commercial believes it is there to ensure no inappropriate expectations and commitments are made to suppliers and to fix the price of all changes.

Meanwhile, Supplier Management believes that Complex Systems Inc. and its suppliers need to shift their relationship to a partnering model, focused on delivery of shared objectives rather than execution of detailed transactional processes. While these are the root causes of disagreement, at this moment, it is not clear to anyone that they are so. The EA notices this and introduces the participants to the concept of World Views and in particular that they are now to be considered explicitly as part of the 'Intelligent Customer' system under scrutiny. This act legitimizes apparent difference between participants and takes the heat out of the proceedings. Each participant reflects on the values, objectives, language, beliefs and traits of their world and shares their insight with others.

This inclusive approach made it easier than to recognize the common ground and reach compromizes that the parties could live with, even if they didn't like them. Thus, Commercial became content that the CSI/ Supplier relationships could become an open partnership based on defined, SMART common objectives that could be verified, focused on efficacy, efficiency and effectiveness. This shift could then enable the Business Relationship Management function to liberate the supplier community to participate in a rich dialogue to explore 'without commitment or prejudice' the art of the possible, enabling the internal customer to get the 'biggest bang per buck'.

The next White Paper in this series considers further differences between Hard and Soft Systems, and how Enterprise Architects can weave the ideas of Soft Systems methods into their business-as-usual practice without confusing their stakeholders.

I hope you have enjoyed this White Paper. Please get in touch if you have views to offer on the topic and feedback on the series, either direct to Orbus or via my eMail at: ceri.williams@theintegrationpractice.co.uk.

References:

[1] Enterprise Architecture meets Soft Systems, Paper 1: A brief History of Soft Systems and why it matters to Enterprise Architects. Orbus: *http://www.orbussoftware.com/resources/authors/ceri-williams/*

[2] Soft Systems Method: *https://en.wikipedia.org/wiki/Soft_systems*

[3] Checkland, P & Poulter, J: learning for Action – A Short Definitive Account of Soft Systems Methodology and its use for Practitioners, Teachers and Students. ISBN: 9780470025543

[4] Rich Pictures: *http://systems.open.ac.uk/materials/T552/pages/rich/rp-what.html* The Open University [3] An Introduction to General Systems Thinking. (The Scientist and His Categories). Gerald M Weinberg. ISBN 0-932633-49-8

[5] *http://projects.kmi.open.ac.uk/ecosensus/about/ssm-more.html* - Ecosensus provides a very concise summary of SSM tools and techniques

Orbus Software
3rd Floor
111 Buckingham Palace Road
London
SW1W 0SR
United Kingdom

+44 (0) 870 991 1851
enquiries@orbussoftware.com
www.orbussoftware.com

orbus software