An Overview of the Soft Systems Methodology

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The Soft Systems Methodology (SSM) was born out of research conducted at Lancaster University to apply Systems Engineering approaches to solve “management/business problems”. In other words they attempted to apply a Hard Systems approach to fix business problems. What they discovered was the approach often stumbled at the first step of problem definition. This happens quite simply because the different stakeholders have divergent views on what constitutes the system, the purpose of the system and therefore the problem. Two key players in the development of the SSM are Peter Checkland [1999] and Brian Wilson [2001] who through “action research” were able to put together a practical and pragmatic approach to the identification and solution of “soft” ill-defined problems. This methodology was more than just a process; Checkland and Wilson also developed a set of tools to help users carry out the steps. These include:

- Rich Picture
- Conceptual Model
- CATWOE
- Formal Systems Model

More on these later because, at this point, I would like to focus on the approach. Figure 1 presents a view of the SSM. Since its origin back in 1970’s and 80’s it has changed as various workers have added their bit. Figure 1 shows a 7-step process approach to SSM. I have chosen this view, that while it is an early representation, it does allow several key and important aspects of SSM to be made clear.

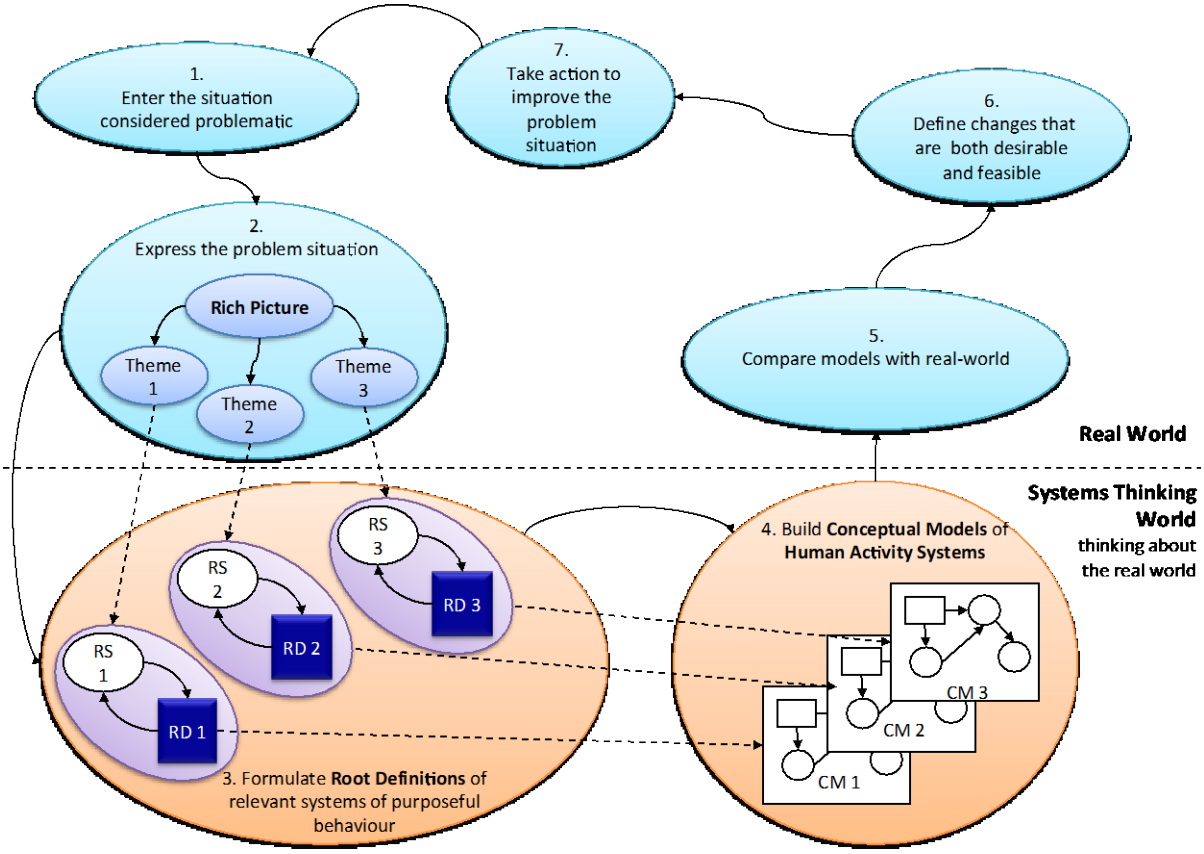

Figure 1: The 7 Step Soft Systems Methodology

Before launching into detail about the 7-steps it is worthwhile explaining the overall philosophy behind SSM. It was born of the recognition that the real world is complex and messy primarily because we, human beings, inhabit it. Each of us will have a different perception of the same situation. That perception will be based upon concepts and beliefs we hold in our head – a mental model(s) that we use to make judgments about reality. A simple example of this comes from Brian Wilson [2001] one of the originators of SSM. He asks us to imagine two people watching a TV programme. Both have watched exactly the same pictures and heard exactly the same sounds yet they reach completely different conclusions about whether it was a good or poor programme. They express their conclusions and then have an argument as to who is right! Actually, both are right because each has used their own mental model that comprises concepts of what is good or not.

If these concepts that form the mental models could be explicit rather than implicit, they could be used to compare against what was observed allowing each observer to defend their judgment. They may well disagree with the respective merits of their models, but the argument can now be carried out on a more rational and defendable basis. It is the two words “rational” and “defendable” that are important and form the basis of the SSM.

In simple terms SSM takes the messy arguments of the real world caused by people having different perceptions and creates defendable and rational models for comparison with what is happening in the real world to help made judgments or recommendations as to the response to the issue or problem. These rational and defendable models are called **Conceptual Models** are a based upon the use of defensible logic. I would like to emphasise here is that the Conceptual Models are not models of the real world that we experience but logical models of what it could be like. SSM isn’t really problem solving in the sense of analyzing the real world to find the root causes of issues. Central though to the building of the models is the use **defensible logic** that is deduced from a statement of purpose captured in a **Root Definition** of a relevant system. It is very important to note that these Conceptual Models are models of what logically needs to be done to achieve the purpose expressed in the Root Definition. Conceptual Models are a model of what “good” looks like that can be compared to reality in order to identify where change could be made. Unfortunately, the language of SSM is not one of every day use.

Returning now to figure 1, we can see that the lower have of the diagram is concerned with this abstract systems thinking where step 3 is concerned with formulating the Root Definitions and step 4 is developing the Conceptual Models of what needs to be done. In formulating the SSM Checkland *et al* where interested in systems that involve humans performing tasks and activities as opposed to the classic equipment or machine focused Systems Engineering world that they came. To reinforce this they speak about the Conceptual Models as **Human Activity System.** The upper half of figure 1 is concerned with the real world, starting on the left hand side with attempting to establish what to thinks about. The right-hand side is concerned with what we are usefully going to be based upon the knowledge gain by comparing the logical Conceptual Models against the reality experienced.

Let’s go through these 7 steps in a bit more detail.

Step 1 Enter situation considered problematic: This step is concerned with the real world and the gathering of information and views about situations that are considered to be problematic and therefore there is some scope for improvement. Typically, once it has been agreed that some change or review is needed, this step also involves some basic research into the situation to gather information on the key stakeholders and current performance and issues.

Step 2 Express the problem situation: Recognising that the real world is messy, the second step in concerned with capturing the multiple views of the situation. To accomplish this Checkland *et al* developed the notion of a **Rich Picture** to capture the various perceptions. They understood that complex situations could not be adequately captured by words alone, diagrams and pictures are far more effective and can pack a higher density of information per cm^2. The idea behind the construction of a Rich Picture of a particular situation is that it:

- Allows differences of interpretation to be identified
- Permits agreement to be made on the interpretation to be taken
- Is a source of inspiration as to what relevant systems could be modeled through the assimilation of relationships, issues etc. It helps identify themes to take into the systems world.

Because every situation is different and it is necessary to capture this potential variety, there are no formal Rich Picture modeling symbols. However, over the years of use, a number have become accepted as standard. Figure 2 shows a Rich Picture drawn by myself together with work colleagues. It was drawn as part of a marketing meeting to discuss how to win new business and it sums up our current situation.

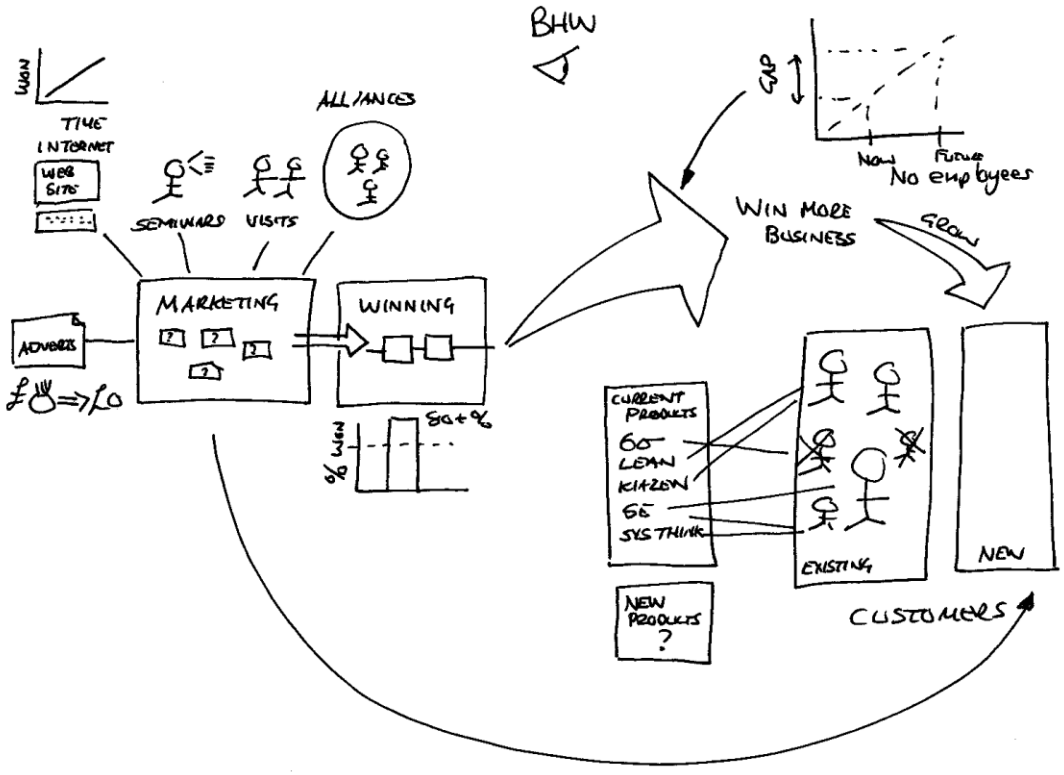

Figure 2: Win More Business Rich Picture.

My training and consultancy company BHW needs to win more business if it is to meet its strategic goal of increasing size. What the picture captures are many subtleties that could not be achieved by words alone. For example, the box labeled “marketing” contains lots of randomly placed boxes containing “?”. This was drawn to say we don’t have an effective marketing system. Around this box are some of the approaches to marketing we have tried, two of which have associated performance results. We have tried advertising (at great expense) but it yielded no business. Equally our website is now a major contributor to new business. The box labeled “winning” shows an orderly process, we are quite good at this achieving a success rate of over 80%; we know what to do and how to do it.

The bottom right hand corner of the picture shows our existing customers (some big some small in terms of revenue stream) aligned to our “product” portfolio (typically training courses). Here you can see that an existing customer has been crossed out – a re-structuring has caused a shift in training provision to an internally based system.

What does this picture tell me? Primarily it helps me identify the **Relevant Systems** that I can take into the systems world. These are:

- Marketing system
- New product system

Step 3 Formulate Root Definitions of relevant systems of purposeful behaviour: This is a critical step in the SSM. The Root Definition is a statement of purpose that captures the essence of the particular situation of the relevant system. At the heart of the Root Definition is the transformation that is performed by the relevant system. This is captured by the main verb in the Root Definition.

Let’s have a look at one for the “marketing system” identified above:

Root Definition for the BHW Marketing System
A company owned system to market the products and services of the company to existing and future clients by the most appropriate cost-effective means.

The Root Definition is important since it is this that is used to logically deduce what the company will have to **do** in order meet the definition. This is captured as a Conceptual Model. To help ensure that a draft Root Definition is acceptable Checkland and Smyth (1976) developed the mnemonic CATWOE where:

[C] The Customer: The individual(s) who receive the output from the transformation (in recent times it has been recognised that the out of the transformation may be ‘’negative” for some customers and “positive” others. This has led to a refinement of CATWOE to BATWOVE where the C is broken into Beneficiaries and Victims!

[A] The Actors: Those individuals who would DO the activities of the transformation if the system were made real

[T] The Transformation: The purposeful activity expressed as a transformation of input to output

[W] Weltanschauung: It's a German word that literally means “world view”. It is the belief that makes sense of the root definition

[O] Owner: the wider system decision maker who is concerned with the performance of the system

[E] Environmental Constraints: the key constrains outside the system boundary that are significant to the system

Let’s return to the Root Definition drafted for the marketing system and see how CATWOE fits

[C] Existing and future clients
[A] The company
[T] Market the products and services of the company
[W] Providing the most appropriate marketing to a particular client will promote company products and services
[O] The company
[E] Appropriate means

If you experience difficultly in applying CATWOE to a draft Root Definition, then it needs re-drafting. Personally, I tend to have a go at the Root Definition and then use CATWOE as a test of quality. Some people recommend using it to help construct the draft. What is important is getting the transformation correct, particularly the inputs and outputs. Here Checkland, Wilson and the other SSM originators are quite strong in their understanding of what the transformation should be like. They argue that the concept is frequently misunderstood with many inadequate representations of system inputs and outputs. Figure 3 pictorially shows the transformation concept:

Figure 3: The Transformation Process

The usual error is to confuse the system input (that entity which gets changed into the output) with the resources needed to bring about the transformation. For example, for the marketing system a relevant transformation would be:

Un-marketed Products and services -> Marketed Products and Services

Whereas the following are wrong!

Publicity material -> more business
Seminars -> more enquiries

Checkland defined some simple (but often forgotten) rule when defining transformations:

- T transforms I into O
- I must be present in O but in a changed state
- An abstract I must yield and abstract O
- A concrete I must yield a concrete O

Hence from these I hope you see why my marketing transformation is correct, but the other two are not. Getting a correct representation of T is important because it makes the model building relatively straightforward.

Step 4: Build Conceptual Model of Human Activity Systems

The best way to introduce this stage is to show an output – a Conceptual Model. Figure 5 shows an example draft Conceptual Model for the BHW Marketing System.

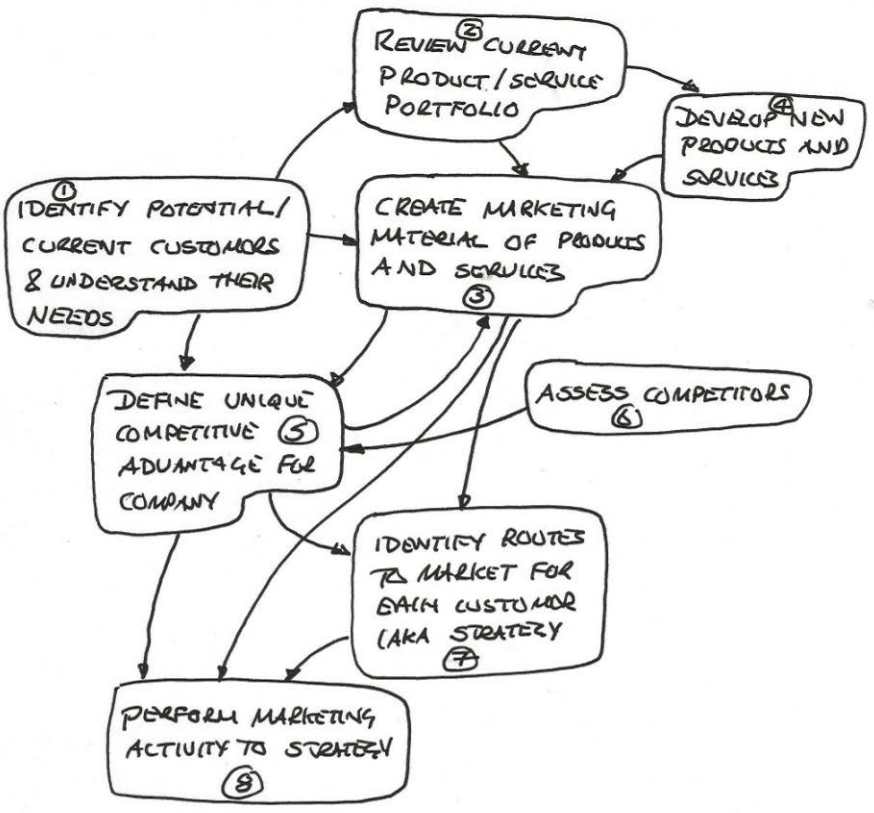

Figure 5: Draft Conceptual Model of the BHW Marketing System.

The Conceptual Model shown in figure 5 is not quite complete yet but is typical of the starting point when constructing the model. The symbols used are based upon those used by Brian Wilson [2001] with the activities that are necessary to undertake the transformation defined in the Root Definition in the "squarish" boxes. Checkland suggested aiming for 7±2 activities that are at the "same scale". The 7±2 comes, of course, from the work of George Miler [1970]. The other key point to note about figure 5 is that each activity square contains a description of the activity that starts with a verb – and not any old verb but an imperative or command verb.

The arrows show the logical dependences. I have also numbered the activities. This is not standard practice but one I adopt for easy reference and also for traceability if the activities are further decomposed. Returning to the arrows, you will see an arrow going from activity 1 to activity 2. This means that activity 2 is dependent upon activity 1, not that activity 1 must be complete before activity 2 can start, but certain sub-activities must be completed. Typically, this is because activity 2 needs some of the outputs of activity 1.

Again, not standard practice but something I find very useful when constructing Conceptual Models is to make simple notes (on sticky notes) about the rationale behind a particular activity in the model. Wilson (2001) coined the term "defensible logic" when constructing Conceptual Models and it is important to remember we are NOT modelling the real-world system but those activities that are necessary to deliver the Transformation in the Root Definition. I'm not pessimistic, but I like to have my arguments ready for the occasional cynic you find in the real world. Figure 6 shows the sticky notes I wrote when developing figure 5.

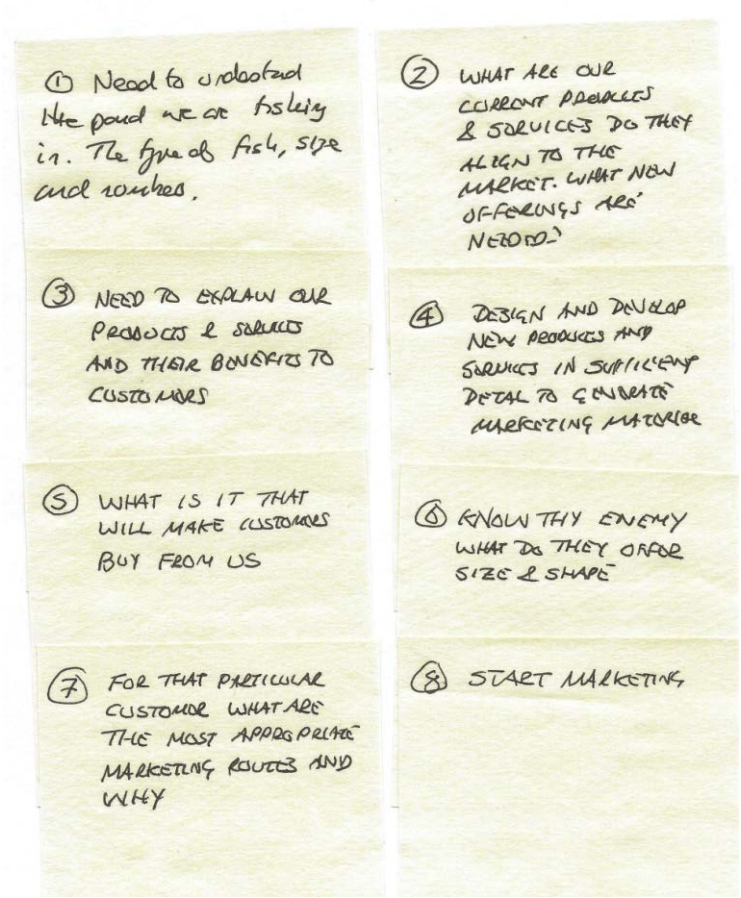

Figure 6: The Rationale for the Activities in the Draft Conceptual Model

When I introduced the Conceptual Model shown in figure 5, I said it was not complete. Soft Systems Methodology, Root Definitions, CATWOE and Conceptual Models were specifically developed for **Human Activity Systems** (HAS). These are systems that achieve their purpose through human activity as opposed to software intensive systems or hardware (product) intensive systems. It is the fact that HAS contains humans that makes figure 5 incomplete.

As an engineer I used to design systems that the output was known and certain. For example, a gearbox where one revolution on the input shaft will produce precisely X revolutions of the output shaft. We could even model wear in a predictable way and take that into account, knowing exactly when to replace a component because it would fail in the next few cycles. These systems are deterministic. Throw a few humans in to the equation and determinism goes out the window.

Humans are neither "repeatable" nor "reproducible" in their actions. If I ask somebody to repeat an activity the results or output will vary. I spend many nights each year in hotels, often the same hotel where I will be checked-in by the same member of staff, but every check-in experience is different. Reproducible is getting different people to perform an activity the same – not possible. Furthermore, we learn, we adapt, and we evolve and so our behaviour and performance will change over time. It is this inherent variability in human performance that led Checkland *et al* to deem it necessary with HAS to introduce monitoring and control of the **operational** activities in figure 5. The operational activities are those activities that are logically necessary to perform the transformation stated in the Root Definition Each activity in figure 5 needs to be monitored to determine whether it is being done well and control action taken if it is not.

There appears to be a "split in the ranks" at this point between Checkland and Wilson as to how to model this control action. Let's start by looking at Checkland's view. Checkland argued that the Conceptual Model should be that of a system, an entity which can adapt and survive in a changing environment. It is because of this that it is necessary to add to the operational subsystem a monitor and control subsystem that examines the operations and take control to maintain or improve them. He said "any [human activity] system model is thus a combination of an operational subsystem and a monitoring and control subsystem" as shown in figure 7. I have added the "[human activity]" to the quotation because some systems do not have a monitoring and control subsystem and to infer that all systems must is not correct. The gearbox I used and an example of a hardware-based system (depending on type) does not have to have a monitor and control sub-system. Having said that many modern gearboxes include a significant amount of monitoring and control. I feel there is an interesting aside here regarding system level. The gearbox in the transmission subsystem of a motorcar, may not have a monitor and control element, nor may the transmission subsystem. But is I go a level higher as the motorcar or system level, there will be a monitor and control element provide by the human driver who will monitor the vehicles speed, engine revolutions, engine sound to decide (take control action) when to change gear.

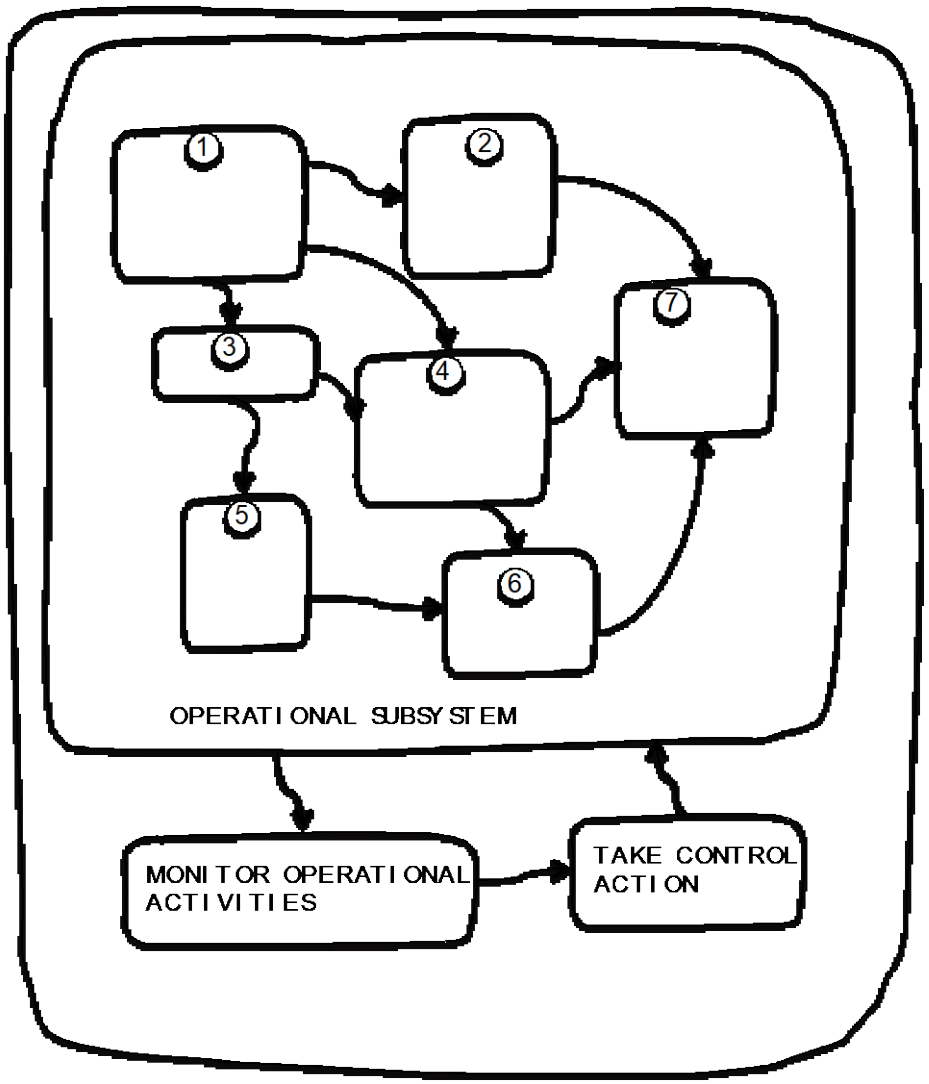

Figure 7: The general structure of a model of a purposeful Human Activity System

The way in which Checkland approached "monitoring and control" was by thinking about failure and argued (Forbes and Checkland [1978]) that there are three potential answers which were expressed as the three E's

Effective: is the system doing the right thing - contributing to the higher-level goals
Efficacy: is the system providing the desired result
Efficient: is the system using the minimum of resources

The introduction of the three E's led to the realisation that two levels of control are necessary. The first monitoring and controlling the operational activities would address Efficiency and Efficacy. The second level is monitoring and controlling the monitored and controlled operational activities. Checkland argues that the effectiveness of a system of interest can only be assessed by taking in to account the wider system, or systems, to which it is part. This two-level monitor and control view is shown in figure 8.

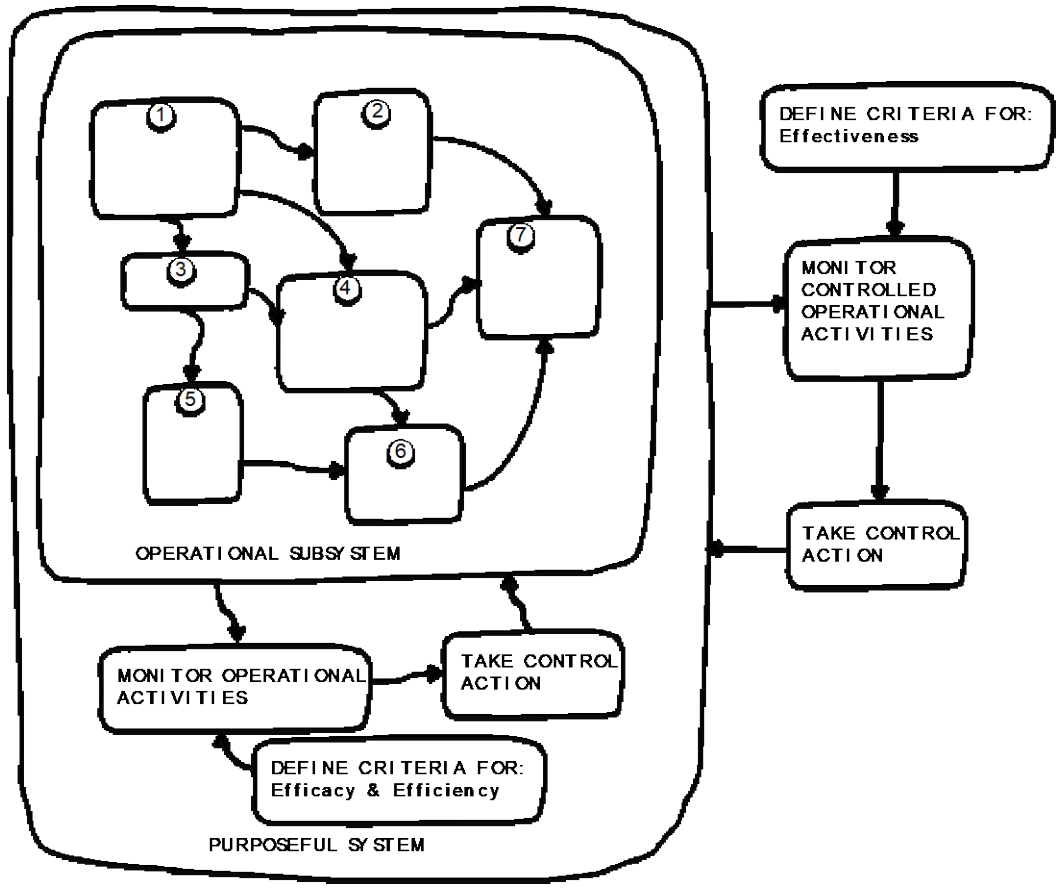

Figure 8: The general structure of a model of a purposeful Human Activity System showing the higher-level monitoring and control necessary for assessing and managing effectiveness.

It is this second level of monitoring and control that Wilson objected too. He argued that since the operational activities are determined by defensible logic from the Root Definition they must be correct, they must be effective. Therefore, only one level of control is actually necessary. To reinforce his point, he also started to draw his Conceptual Models differently introducing some new symbols. Firstly, he argued that every activity in the operational subsystem will need to be monitored and therefore there should be an arrow from the various activities to the "Monitor Operational Activities" activity. All these arrows would add unnecessary detail and lead to confusion; hence Wilson introduced the block arrow to represent performance information collected from every operational activity as shown in figure 9a. Equally, the "Take Control Action" activity can produce a control output to every operational activity. To represent this Wilson introduced the crooked arrow shown in figure 9b.

Figure 9: Wilson's Additional Symbols for Conceptual Models

Using these symbols, Wilson would represent Figure 8 differently as shown in figure 10.

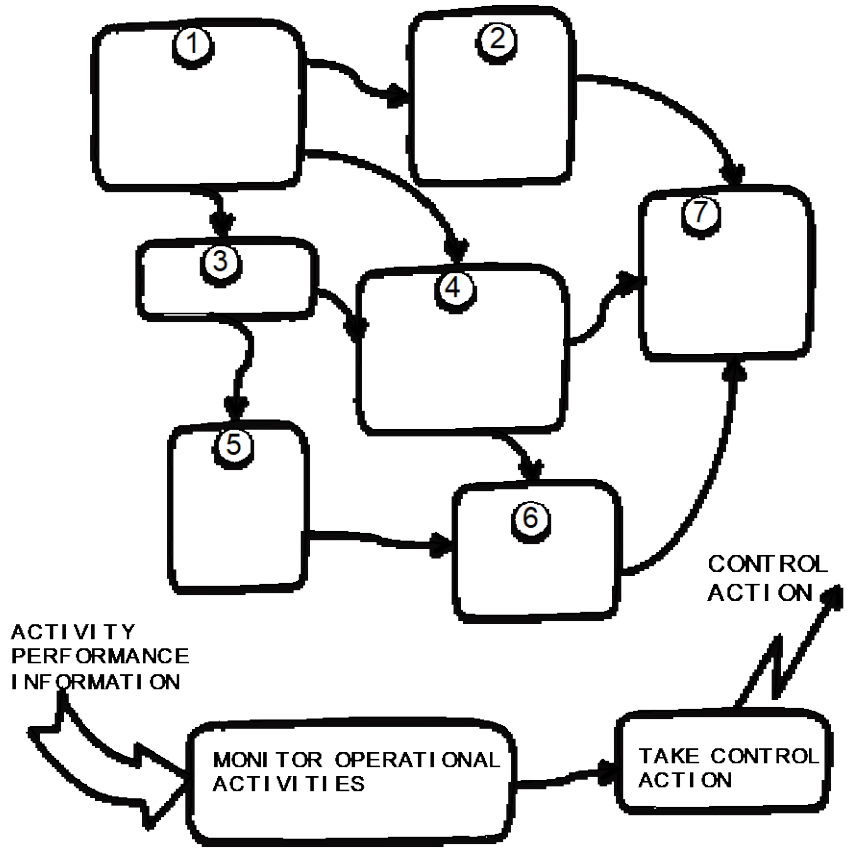

Figure 10: The general structure of a model of a purposeful Human Activity System using Wilson's Notation

I can see both points of view and depending which side of bed I get out of will side with one or the other. Systems over time will adapt and evolve to their changing environment and therefore there may well be a need to ensure that the "system" is still correct – effective. However, for any given purpose statement what has to be done to achieve that purpose is invariant. It will not change over time.

The key thing to remember is that that we are trying to piece together, with our Conceptual Model, a logical view of the activities necessary to achieve a system purpose.

Step 5: Compare Models with the real world

Step 5 is where we return to the real world and compare the reality we experience with that captured in the models. The purpose of the comparison is to initiate discussion from which changes to improve the situation can be identified. The approach uses the models to provide a means of perceiving a different view of reality by testing assumptions that may exist but are ill founded. It is the differences between what happened in reality and the logical model that raises the questions that will ultimately lead to change.

The way I undertake Step 5 is construct a table with three columns. The first contains the activities in the Conceptual Model. The second contains what happens in reality and the third what can we do to bring reality closer to the logically defensible Conceptual Model. A table for my company's marketing dilemma is shown in figure 11.

Conceptual Model Activities	Real World	What could we do
Identify potential/ current customers & understand their needs	Performed on an *ad hoc* basis by the partners. No real systematic approach to identifying potential customers and elicitation of needs	1. Design develop and implement a more systematic approach
Review current product/service portfolio	Portfolio developed on an as requested basis. No overarching strategy for product or service offerings	2. Establish a formal review process with in each business area and across the company as a whole
Create marketing material of products and services	Created on an as required basis. No consistent format, approach or message.	3. Agree a standard format for marketing material and develop materials for all current products and services
Develop new products and services	Performed on an as required basis for prospective customers	4. Establish business area planning for new products and services
Define unique competitive advantage for Company	Endless debates about what is unique about the company. It clearly is unique as our client base comprises mainly large multi-national companies or government organizations	5. Seek advice and guidance on how to define and agree our unique competitive advantage
Assess Competition	No systematic analysis performed	6. Don't bother – if our products and services are okay clients will come OR 7. Undertake a detail competition assessment exercise
Identify routes to market for each customer (strategy)	To date a rather random approach	8. Perhaps need guidance on what is possible
Performing marketing activity to strategy	Not done – marketing passive	Do it!
Monitor Operational activities	Established quarterly marketing meetings	9. Make this element a formal item on the Meeting Agenda
Take Control Action	Nothing	10. Use the Marketing meeting actions to drive the control action

Figure 11: Conceptual Model – real world Comparison Table

Step 6: Define Changes that are both Desirable and Feasible

The table shown in figure 11 contains a number of things we could do that would take the real-world actuality closer to the Conceptual Model. In the ideal world all the recommendations would be

implemented. The company is however, a live organization with finite resources (in terms of people and money). Pragmatically we will have chosen the order and timescales for implementing (or not) the recommendations. While this sounds like an easy step, it is in fact fraught with difficultly. People will not always be motivated to implement change even if it is founded on the logic of the Conceptual Model. Because SSM was developed for Human Activity Systems it is necessary to recognise that people involved in the potential change could hold conflicting views even if the logic of the Conceptual Model is undeniable. If change and culture clash – culture wins. This need for cultural feasibility is something which scientists and engineers sometimes find difficult. They tend to overemphasize the importance of logic and fail to notice cultural aspects that determine whether or not change will occur. This is one reason why it is important to think carefully about the Weltanschauung of each Root Definition.

Returning to company's marketing dilemma, our approach to this was to use a *Change Management* tool called an Ease Benefit Matrix. This is shown in Figure 12 where the size of the circles indicates the amount or resources required to complete the task. The larger the circle the more resources deemed necessary. The numbers relate back to the "what could we do" column in figure 11. So, for example the 3-circle is saying we have an idea for change (Agree a standard format for marketing material and develop materials for all current products and services) that has a high benefit, is relatively easy to do but will require significant resources to complete.

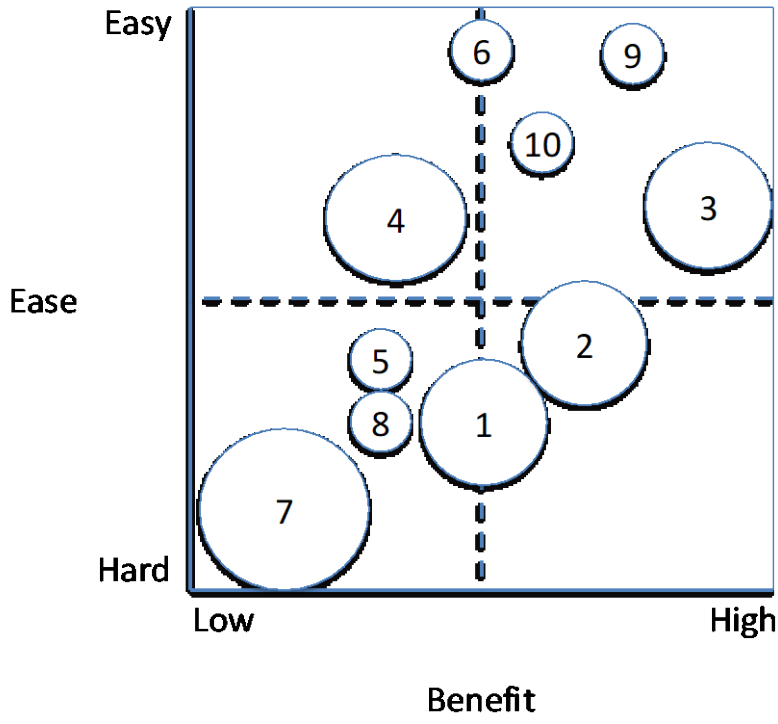

Figure 12: Ease Benefit Matrix

Like all tools, the Ease Benefit Matrix should be used to promote, structure and organize thinking and debate that will allow decisions for change to be made.

Step 7 Take action to Improve the Problem Situation: Once we have identified the changes that are considered 'desirable' and 'feasible' effort is expended to implement these. This implementation will result in new systems that will affect the bigger system leading to more opportunities and problems; and so, the process starts again.

Summary

I find the SSM fascinating because of its approach. Rather than hunt for root causes to fix a problem, just use logic to define what "good" look like and move towards it. It is subtly different from other "problem" solving approaches and therefore can offer a refreshing alternative. I have to admit, however, it has taken me some time to get to grips with SSM primarily because the texts on the subject as not easy reads.

References

Checkland P. Systems Thinking, Systems Practice, 1999, Wiley, ISBN 0-471-98606-2

Wilson B. Soft Systems Methodology Conceptual Model Building and its Contribution, 2001, Wiley ISBN0-471-89489-3

Miller G.A. "The Psychology of Communication" 1970, Pelican books, 140211411

Forbes, P. and Checkland, P.B. (1987). 'Monitoring and control in systems models', Internal Discussion Paper 3/87, Department of Systems, University of Lancaster