

On the relation between System Dynamics and Soft Systems Methodology in consulting.

Introduction

Systems Thinking, and the tools of Systems Thinking, are increasingly finding a market within consulting in the United Kingdom. While System Dynamics has a demonstrably growing market, particularly within the Defence sector, it has been rather more difficult to market it as a relevant approach within other Government departments and in other sectors of industry. Soft Systems Methodology (SSM) has, in contrast, found a comparatively receptive market within a number of UK Government departments over some years. I have had little success in persuading foreign owned companies of the value of SSM in strategic reviews or information analysis. This may, to some degree, be evidence in support of the oft quoted view that it is difficult to overcome the “not invented here” attitude that is perceived to prevent UK methods and approaches finding ready access to American and other markets.

It may, on the other hand, be a response to the work done in British universities to explain the ideas of SSM, in part through the spread throughout the academic world of the acolytes of Prof Peter Checkland and Dr Brian Wilson at Lancaster University. Arguably, a major force for the adoption of SSM within UK Government has been the regular workshops conducted by Dr Wilson for the *Design of Information Systems (DIS)* MSc course and others at the Royal Military College of Science. Students of these courses have, in many cases, now reached influential positions within the Ministry of Defence, or have spread the message into new spheres of influence in second careers outside the military.

One further significant benefit of the DIS course was that, in addition to SSM, Prof Geoff Coyle contributed a valued course on System Dynamics. These contributions provided students with a suite of powerful tools to apply to complex systems problems.

As one who has moved into the world of business and Information Systems (IS) consulting after a military career, I have found both System Dynamics and Soft Systems Methodology to be immensely potent tools with which to address complex business problems. This paper is a subjective attempt to draw some lessons on the relationship between System Dynamics and SSM from those few consulting assignments in which it has been appropriate to consider using both approaches.

The purpose of this paper is therefore to report and reflect on experience in the conduct of consultancy assignments in which both System Dynamics and Soft Systems Methodology have been applied, or are to be applied.

In the paper, I discuss the nature of consulting assignments, and provide an example of the use of SSM in planning an intervention. I then provide a brief description of two assignments where both System Dynamics and SSM were used, and discuss the nature of the relationship between them. I report on the use of the methodologies in these examples, and reflect on the experience before drawing conclusions.

The Nature of Consultancy Assignments

Consultancy assignments arise for a number of business reasons, and are (usually) gained on the basis of competitive tender. In the UK, consultants are a justifiable business response to a short-term skills shortage. In such cases, typical assignments may range from manpower substitution, to address a need for particular skills or competences, to the provision of an independent and objective assessment of a particular business problem. Such assessments may inherently be of value because of the consultant's skills, knowledge and experience. They may also be of value through the production of a report that carries none of the "baggage" that would attach to an internal report, and is therefore capable of more acceptably recommending an unpopular or potentially contentious course of action.

In each of these cases, the problem identified is invariably a complex one and may involve cultural, political and dominance aspects in addition to what is perceived to be the business problem initially suggested as the focus of the assignment. The consultant treads a tightrope between those factions within the organisation with something to gain from the expected outcome of the intervention, and those with something to lose. The consultant has (generally) little authority, except a mirrored authority from those who have employed him or her, and must rely on the exercise of *influence* rather than any formal or positional authority.

The risks to the consultant are therefore significant – all consultants seek repeat business, and rely on our reputation, integrity and intellect to maintain the revenue stream. Winning a short or long contract requires a similar amount of effort, but the requirements of the short, reasonably scoped project or assignment are in many ways more demanding. This is particularly because there is a focus on deliverables and little time in which to develop trust and confidence. In contrast, a longer consultant/client relationship allows the consultant the opportunity to become an accustomed member of staff with the prospect of demonstrating worth by accepting peripheral tasks outside the strict terms of the contract. Social activities also make the consultant appear to "belong" and therefore there is a dynamic that leads to a greater likelihood of the relationship being continued¹. SSM, because of its

¹ It is noted in passing that the UK Government has introduced a requirement that consultants in long term positions must demonstrate that they are *not* in the position of employees; otherwise there is a harsher tax treatment that prevents consultants' limited companies from trading and paying dividends

economy, does not lend itself to long-term assignments, but rather to the short term, delivery focused project.

Most invitations to tender (ITTs), other than those for manpower substitutes, require some analysis of the problem as expressed by the organisation placing the tender. It is normal to require bidders to explain the approach they intend to use. Getting this right depends on understanding the problem, as well as proposing an approach that is *acceptable* to the organisation. Price may not be the only basis on which a tender is accepted, and it is usual, particularly in the case of Government tenders, for there to be a complex assessment model intended to reflect the relative priorities of the problem's stakeholders as well as Government policies on value for money, "public private partnerships" and risk. The consultant who can get inside the thoughts of the ITT's authors will have a valuable "inside track". However, the costs of bidding can be substantial and the bottom line is that, in the case of a complex or risky piece of work, the old adage "no-one ever got fired for hiring IBM" still has some prevalence!

Proposing an approach based on System Dynamics or SSM is not always well received by client organisations. Where the potential client has some understanding of the methodologies and the ideas underpinning them, it is reasonable to be explicit in naming them; where the potential client shows no evidence of understanding, it is generally safer (unless you have been invited to tender specifically because of your known expertise in the area) to use neutral terms such as "mission statements" or "activity models".

Further, where, for example, a mathematical approach to a problem is being proposed, a potential client is prepared to accept that they do not understand the approach, or have the skills necessary to conduct the analysis. When an approach uses the English language as the modelling language, there is a risk that a client will believe they understand, and will make assumptions based on the normal use of language rather than recognising that though the language is the same, its use in the analysis is quite different. The corollary is that the consultant must bear in mind that his or her "worldview", based on systems thinking², constrains them to use language in a specific way, and they must be careful to ensure that a common understanding is achieved.

It is therefore necessary to develop your credibility well in advance of bidding for work, and to ensure that your proposed approach to the organisation's perceived problem is both viable, and culturally acceptable.

normally. This is to prevent tax avoidance through small companies paying dividends, rather than salary payments that are subject to income tax and other taxes.

² Sterman (System Dynamics Review, Vol 18 No 4 Winter 2002, p503) states that "system dynamics is also a worldview". I prefer to regard *systems thinking* as the worldview, and System Dynamics as one means of operationalising that worldview.

The bidding process and planning the assignment

Preparing tender documents is a problematic activity in its own right. A number of threads run through the process. Planning and estimation (in terms of resourcing the approach to the problem for the purpose of pricing the response) are key.

SSM³ recognises the problem of planning an intervention. There are two distinct types of Root Definition⁴ and associated Conceptual Model, the *Issue-Based* model and the *Primary Task* model. In essence, the former has temporary relevance while some problem exists, while the latter has permanent relevance as long as the organisation and purpose exist.

The Issue Based model provides a logical approach to addressing the problem identified, based either on the analyst's understanding of the problem area or on a form of words agreed between the analyst and the client. An example of this agreed form of words ("Root Definition"), from the recent strategic review of a small manufacturing company, is:

“A Management Board owned system, operated by (analysts and company representatives), to derive a set of actions to enhance the long-term viability of the Company by undertaking an assessment of the current business processes and structural arrangements through the mapping, on to present practices and intentions, of an explicit and coherent concept relevant to the Company, in the form of a Consensus Primary Task Model (CPTM), in order to engage the company personnel in an open discussion as a means of obtaining agreement on the way forward.”⁵

Based on this Root Definition (RD), a conceptual model of *the problem solving process* was developed, and is reproduced below (Figure 1). (It is not clear in this case that a simulation could have facilitated the estimation and resource allocation needed to plan the intervention, but it does seem that in a more complex case there would be some value in doing so.)

It is accepted that there may be some criticism that *our* worldview constrained us to adopt SSM. Our view was that as the assignment was concerned with future processes and structure, this required an analysis of intent, rather than a focus on current practice. It was therefore appropriate to use SSM. Although the model incorporates an activity concerned with the construction of a CPTM, it was not obvious at the time that undertaking these activities would address

³ This paper does not attempt to describe Soft Systems Methodology – there are many sources, both published and Web based, that describe the traditional seven stage process. In practice, this model of SSM has been found to be too rigid to be useful, and much of the power of SSM derives from its flexibility.

⁴ The Root Definition is a well structured statement of purpose.

⁵ The RD and model have been slightly amended to maintain the anonymity of the company involved.

the problem in the manner expected by the clients' representatives. There was a clear indication that the client expected an outcome along the lines of "purchase more capital equipment" or "diversify into other/different markets". Such expected outcomes would seem to point to the need for a simulation model, and despite confidence in the value of SSM in conducting a "strategic review" there was some concern in the project team that the approach adopted would lead to a failure to meet the client's expectations for advice resulting from a strategic review. However, decisions of this type are not a "one off"; SSM is concerned with ensuring that the necessary activities are in place to allow this type of decision to be made whenever it is appropriate. It was therefore clear that the adoption of SSM did not act against the provision of advice of this type, as an end product of the analysis.

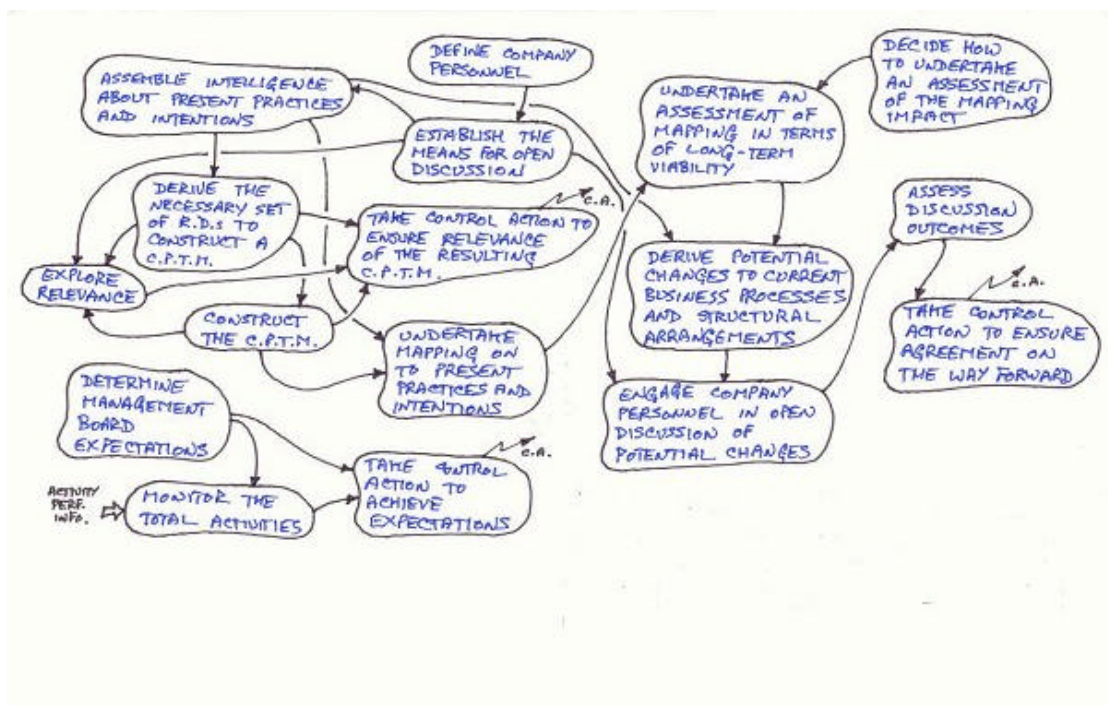


Figure 1. Issue Based model relevant to the company strategic review.

Among the main reasons why this approach was adopted were the credibility of the project team (consultants and client representatives), the willingness of the Managing Director to support what was promised to be an economical approach (involving a minimum disruption to normal working) and, crucially, the availability of public funding to support the project. Against this was the legacy of the failure of a previous study, by a different consulting company, to offer any perceived value, and a concern that other pressures (Six Sigma, Investors in People, etc) could lead to "study fatigue". The Company had an excellent reputation in its market, and had been trading successfully for some time, regardless of market factors.

This model enabled the project team to develop a plan, and estimate resource requirements. In the event, the development of Root Definitions based on interviews and information gathering and the construction of a CPTM took

only some 5 days of consulting effort. A workshop involving key stakeholders was then held, where the model was explained and changes, mainly resulting from a preference for domain language rather than a generic vocabulary, were agreed. Further effort was expended in comparing the activities in the CPTM with current activities, and a gap analysis was prepared and presented. This analysis led to the identification of potential “quick wins” and stimulated discussion within the Company on the potential “hows” through which to achieve the “whats” agreed in the CPTM.

At this stage, the consultancy input ceased, to allow the Company to assess potential “hows” and create their own action plan. It is hoped that further support will be sought at a later date to carry out an information analysis, so that appropriate information systems can be developed and introduced to support what will become a new business model for the Company. At the time of writing, the Company is considering ways of assessing potential “hows”, and it is in this task that it now appears appropriate to consider the use of System Dynamics, in addition to any need to construct abbreviated business cases. Future work encouraged by us will develop a System Dynamics simulation of the Company’s trading environment. This task will be carried out by a suitably qualified Board Member as part of the requirements for completion of a higher degree.

Conducting the activities depicted in the Issue-Based model shown above proved of value in that they:

- Obtained client buy-in to a revised business model;
- Indicated the systemic nature of the client’s operations;
- Restored client confidence in consultancy support, through economy of effort, an explicit audit trail and accessible deliverables;
- Identified scope for quick wins;
- Allowed the client to consider implementation decisions based on business criteria.

Studies involving the use of both System Dynamics and SSM

An earlier assignment involved the production of both SSM and System Dynamics models. In 1995, the British Army was considering its requirements for information support to a new battlefield communications system. The equipment being replaced already had a partially automated logistic support system, based on computer hosting of data extracted from paper reports from the equipment users. Some problems had been identified with the processes involved, and it was intended to provide a new system to host a Logistic Support Analysis Record (LSAR), based on US Department of Defense (DoD) Military Standards, and to capture the relevant data automatically.

These models were insufficient for the purpose of the feasibility study, which required the estimation of aspects of capacity and performance. Haslett⁶ notes that, based on the experience of setting real world problems for students, it is advisable to have a “clear definition of the problem to be modelled”. Such a clear definition did not exist at the outset, and only the SSM analysis provided the common understanding of the problem that allowed further work. This involved the development of a System Dynamics model of essentially the same system model as had been developed using SSM, and had been scoped to provide system boundaries. The model was coded using iThink® and a simulation report produced to provide evidence for the initial assumptions regarding workload estimates. The model is shown in Figure 3 below.

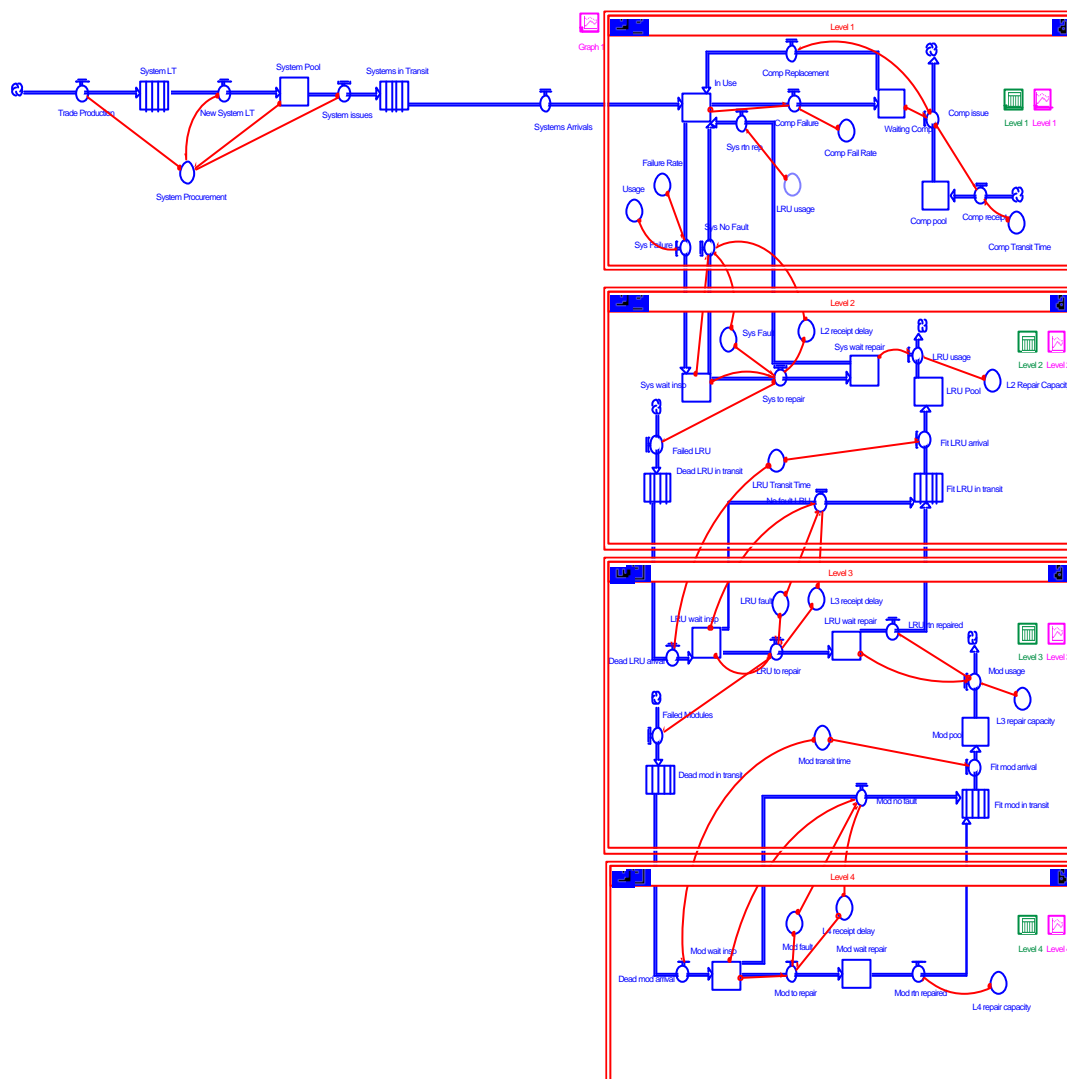


Figure 3. Potential logistics system iThink® model.

The major advantage of the System Dynamics model lay in the ability it gave us to assess the impact of policy on resource requirements, and hence to

⁶ Haslett, T. (2001) “Transition from Classroom to Practice”, System Dynamics Review Vol 17 No 2 Summer 2001. Page 167.

inform the construction of the business case necessary to progress the project. However, the team were also able, in the quantified model, to reflect the system and organisational boundaries imposed by the client and highlight the implications of these in terms of transport and administrative overhead. This provided signposts for the further SSM analysis of the system, in indicating where “lower level” models were required. These were duly produced.

A later assignment in which both methodologies were used was an assignment, carried out on behalf of the Royal Navy, focusing on future training needs and organisation. The use of SSM in this case is reported in Dr Wilson’s recent excellent book⁷. One activity within the 200 or so activities in the CPTM he delivered required that an assessment be conducted into the relationship between certain factors, in order to clarify policy. This question was addressed in a separate System Dynamics investigation, resulting in the model, a simplified version of a larger model, shown as Figure 4 below. The value of this model was to highlight the key relationship between average length of time a sailor spends at sea, a policy for which there was an explicit target, and total training loads. This evidence then drew out discussion on the political difficulties associated with this factor and the perceived reluctance of certain groups of service personnel to spend time away from home.

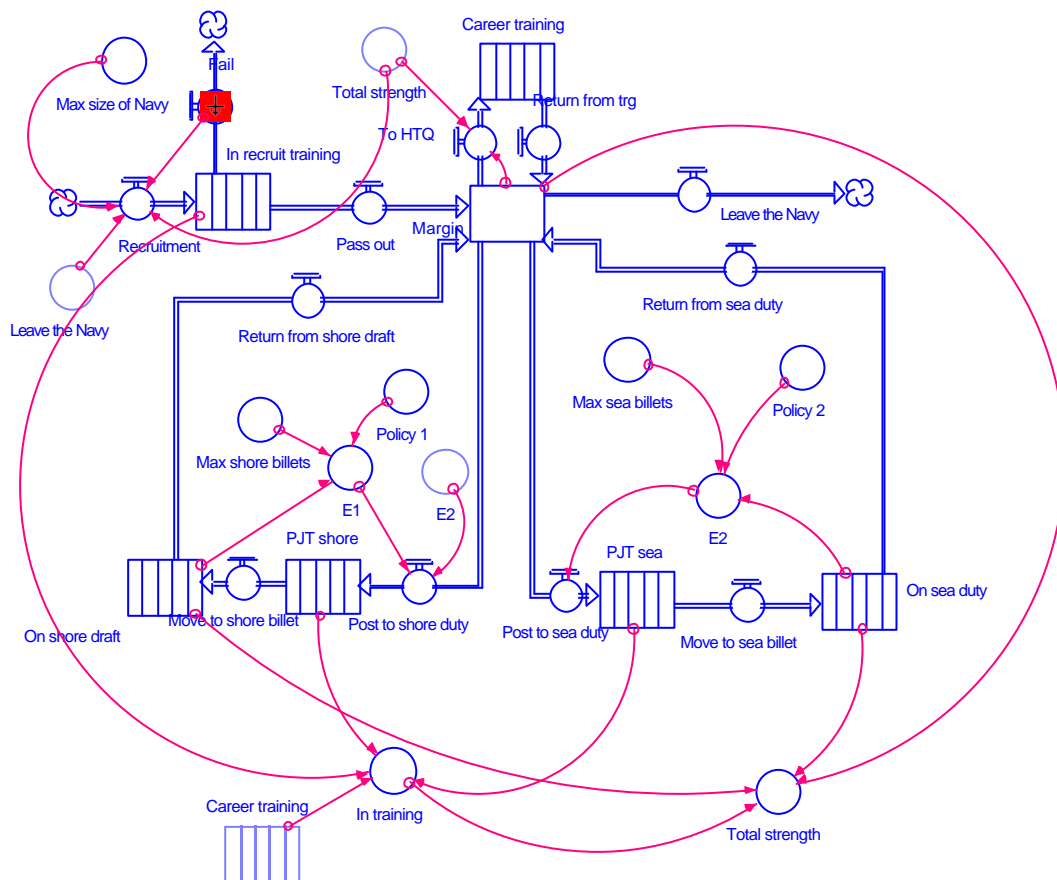


Figure 4. Model relevant to a previous policy for Royal Navy training.

⁷ Wilson, B. (2001) “Soft Systems Methodology - Conceptual Model Building and its Contribution”. John Wiley and Sons.

One feature of this assignment (conducted by separate consulting companies) was that the two modelling activities took approximately the same effort, in terms of man-days. It became obvious that the SSM approach was inherently more economical than System Dynamics, reflecting the lower interview load imposed by its “top down” approach.

Using the Methodologies

Aside from the obvious need to be adept with each methodology, it was discovered that there were a number of differences in the required skills or approach of the analyst. The key difference was found to be the language of communication with the client. In the case of SSM, the modelling language is English, with the emphasis on *verbs in the imperative*. The modelling language of System Dynamics is stocks and flows, in both the influence diagram and the simulation stages. The impact of this on the interaction with the client is that, when using System Dynamics, there must be an element of “client education” prior to modelling. This is unnecessary when using SSM, although it is often found necessary to translate SSM products *after* development, to aid clients’ understanding. Further, the organisations with which I have experience of using SSM tended to have some form of “mission statement” which could often be used as the basis for the development of Root Definitions. In all cases, there remains a need for some significant education of the client in respect of the *status* of models; it must be made clear that the conceptual models of SSM are not descriptions of any “ideal” system, and that results from System Dynamics simulations give insight into the behaviour of the *model*.

Clients who have physical products as a key business deliverable are apparently more receptive to the language of stocks and flows, and can readily grasp the relationship between their raw materials and products and the entities in a model. The concept of the passage of information within a model is, however, a more difficult idea to communicate.

The process or activity focus of the SSM conceptual model relates well to the current emphasis on process in many organisations, resulting from the needs to conform to process focused standards or management initiatives, including ISO9001 and Investors in People. Government and other administrative organisations therefore find Conceptual Models easier to grasp and appreciate the value of. Compared with System Dynamics, SSM is a less structured methodology and it is open (indeed it is encouraged) to the analyst or consultant to tailor the methodology to suit the problem situation. This skill, the scoping of the problem and adapting the approach to suit it, is a

facility acquired with experience. It is not one required when using System Dynamics⁸.

The purpose of interviews differs between the two methodologies. SSM requires a top down approach (though not necessarily starting at the “very top”), to determine relevant worldviews, organisational purpose and potential futures. System Dynamics needs a subset of these, as well as an understanding of current processes, decision policies and the ability to make mental models explicit. Where a decision relies on internal knowledge or information that is not explicit, then the consultant using System Dynamics must have the ability to elicit this detail. In my view, this makes the information gathering a more difficult task for the analyst or consultant. Both methodologies seem to require that the consultant have credibility and some *gravitas*. These are not intrinsically required by the methodologies, but are necessary to overcome the difficulties inherent in obtaining access to key personnel within the organisation, and for information gathering. Of course, not having the brand and status that comes from working for a “big name” consultancy, it is possible that this observation reflects a problem arising only in the case of the small consultancy!

Reflecting on the use of both methodologies

The experience of using, or considering, both System Dynamics and Soft Systems Methodology in the same consultancy assignment allows us to consider particular questions.

- *What is the key difference between the use of SSM and System Dynamics?* The assignments reported above seem to confirm our view that the prime difference between the purpose of using SSM and System Dynamics in consulting is that *SSM is concerned with the “whats” whereas System Dynamics is concerned with the “hows”*. This view is itself problematic. If it is the case that SSM is of value in constructing a consensus view of “what” the organisation is or should be, then a problem that is already defined and scoped should not be amenable to analysis using SSM. In practice, however, understanding of the “problem situation” is generally ambiguous and incomplete, as the examples above illustrate.
- *How was communication with the client affected by using both models?* In the case of the feasibility and scoping study for the UK Ministry of Defence (MOD) the client was a technical branch of the MOD’s logistics agency. Initial reaction to the SSM models was sceptical, whereas the System Dynamics model was apparently more readily

⁸ Vennix (Vennix, J.A.M., (1996) “Group Model Building”, Chichester, Wiley. p130.) summarises a number of approaches to designing a *group model-building project*, and provides guidelines for selecting the most appropriate approach in a given situation. This, in my view, is subtly different from the tailoring the experienced practitioner can apply to SSM.

accepted. The client *expected* to see deliverables produced using computers and software tools. The hand drawn SSM models, and in particular the “Rich Picture”, were initially met with some derision. This view changed over time, and the conceptual models came to be trusted more than computer output. It was reported that this was because the *source* of the models was trusted and could be probed to justify thoughts that underpinned any part of the model.

- *Did either model assist the development of the other?* Against my strongest principles, because of time constraints the System Dynamics model for the MOD logistics feasibility and scoping study was developed without first producing an influence diagram. It was found that the insight offered by the SSM conceptual model, which had been developed first, was inadequate as a foundation for the construction of a quantified model, but was considerably better than nothing. Construction of the iThink® model did not provide any additional understanding that affected our confidence in the SSM models. This is most likely to be because the simulation was at a different “level of resolution” from the SSM models.
- *What practical differences were there in the treatment of the models?* Perhaps surprisingly, the team encountered some concerns about the security classification of the models within MOD client organisations. It was understandable that there should be disquiet, as the models related to operational equipment or capability. In the event, it was argued (successfully) that the SSM models should be regarded as unclassified on the grounds that they depicted activities related to a “concept” rather than a real world system; these activities were ‘empty’ and could give no indication of the capability of any military system. This argument led to the quantified model being treated as having a higher classification because the quantities and metrics within it could be taken to relate to existing or potential military capability.
- *How did modelling improve the understanding of the system as a whole?* One of the aims of the studies reported was to determine information requirements. Both models were crucial in meeting this aim. The SSM models facilitate the derivation of operational and performance information requirements⁹ while the System Dynamics model leads to the identification of areas where explicit policies or relationship data are required. The SSM model also allows an organisation to be developed that closely aligns with activity boundaries. This both facilitates a consideration of corporate governance, and reduces scope for confusion by ensuring that responsibility, accountability and authority lie exclusively and logically with an appropriate part of the organisation. Neither model would provide all the necessary information on its own.

⁹ Operational information is that which is required in order to carry out the activity, performance information is that which allows the assessment of how well the activity is being done.

- *Was it possible to use either model to validate the other?* Yes, to some degree. This was particularly the case where the SSM model required some policy making activity; it was useful to be able to confirm that such a policy was reflected in the simulation. Since the SSM models are constructed on the basis of logic, their validation is not problematical. Using SSM to support other tests of the validity of System Dynamics models may therefore have broader value.
- *Were there any other subjective relations between the two models?* It was found that the ability to show sections of the simulation on one screen was an advantage over the A0 paper on which the SSM models were drawn. Clients are somewhat overawed by the extent of a large SSM model, and take a long time to come to terms with it. (This acceptance sometimes only arrives when the activities in the model have been formatted into a tabular document for further analysis.) The graphical facilities of the software and ability to play “what if” games allowed clients to develop a “feel” for the operation of the system, which helped their grasp of the relationships. Attempts to represent SSM conceptual models using software applications ranging from simple drawing packages to process management applications was of limited value, although some clients have imported SSM models into process or requirements management applications. I will myself type conceptual models into a drawing package, to facilitate report production, though our experience it that this often introduces errors. Subjectively, it is considered that this is because of the difficulty of retaining a systemic view when looking at only a small “window” on part of the overall system. In an effort to facilitate the client’s understanding of the CPTM, it has been found useful to provide a “subsystem decomposition”, which shows a logical grouping of activities into labelled subsystems and the key products or flows between them.

Conclusion

It is acknowledged that the review in this paper of the assignments referred to above is merely subjective reflection. These deliberations have done little to address Richardson’s¹⁰ concern that we need to “address the relationships between qualitative mapping and quantitative modeling”. The Consensus Primary Task Model of SSM is one particular form of qualitative model, of considerable value in a range of types of intervention. Experience in using both SSM and System Dynamics on the same project suggests that the prime difference between the two is that SSM is concerned with the “whats” while System Dynamics is concerned with the “hows”. In consequence, their use can be seen as complementary, rather than in competition.

¹⁰ Richardson, G.P. (1996) “Problems for the Future of System Dynamics”, System Dynamics Review Vol 12 No 2, Summer 1996. p150.

SSM is also more useful in organisations concerned with administration or management activities, such as departments of government, whereas System Dynamics fits more readily into assignments concerned with measurement and efficiency. Here too, however, SSM encourages the derivation of measurements of efficacy, efficiency and effectiveness; it is therefore a useful precursor to further analysis using a simulation model.