

The Gap between System Dynamics and Current Management Practice

- Some Messages to help reinforce the value of a Systems Approach to 21st. Century Management Practice.

Eric Wolstenholme, Professor of Business Learning, Leeds Business School, UK and Director, COGNITUS.

Abstract.

This paper will explore the differences between system dynamics and current business practice. The purpose of the paper is to contribute to an assessment of the impact which system dynamics is making to business. The analysis will reflect on the gap between systems thinking and current business thinking and on the gap between system dynamics simulation modelling and current business modelling practice.

An important conclusion is that some of the barriers to the understanding and use of system dynamics centre more on its relationship to what business organisations currently do, rather than to the methodology itself. System dynamics suffers from being almost too well conceived as an integrated set of propositions. The result is that current education and practice in system dynamics usually centres on describing the implicit value of these propositions, rather than bridging the gap between them and the current reality of business thinking and modelling practice. Some ideas will be presented for closing the gap.

Introduction. Both systems thinking and system dynamics modelling are currently being used in a wide range of management settings. This paper will draw on recent research and consulting experience to focus on factors affecting the success of their application. The approach will be to outline the purpose, target audience and characteristics of the methods and to compare them with the purpose, target audience and characteristics of alternative, competing practices. This analysis will be used to identify how the methods might be used with greater clarity and to better effect. Comments on theory and practice are drawn from a wide variety of sources which are not referenced for space reasons.

Systems thinking and competing methods. Systems thinking based on system dynamics consists of using mainly qualitative, generic concepts from system dynamics models to reach a wide and senior management audience. The usual practice is to use microworlds to develop a sense of systems understanding and to use archetype structures to classify and communicate management situations. There is considerable efforts being made to develop more integrated tools such as learning environments where multiple microworlds can be used together with multimedia for developing learning experiences. Systems thinking provides an integrated, holistic, multi-lens feedback approach which is by which to create hypotheses about the behaviour of management situations which can aid communication and understanding and learning. However, it is not simple to use. To explain archetypes or the structure of microworlds it is necessary to understand causal loop diagrams, have a predisposition to visual thinking and make a substantial investment in time and effort before benefits accrue.

The more widely used current management methods to assist senior management learning comprise strategic management, organisational management, human resource management, change management, business process re-engineering, knowledge/information management, total quality management and balanced scorecards. The characteristics of these approaches varies between taking a non-systemic, single lens viewpoint to having holistic tendencies, but having very variable detail and being limited to parts of organisations. These methods are essentially linear, open loop approaches and heavily data orientated, but generally well used (if only over a very limited life cycle). Recent experiences suggest that the main reasons for this are simplicity and a strong relationship to management functions. That is, what the organisation does and can relate to.

Systems dynamics and competing methods. System dynamics modelling provides a means of linking management processes to strategy, organisational responsibilities and information usage. It uses simulation to understand the consequences over time of alternative structures and policies. The important characteristics of the approach are the ability to, (i) facilitate intermediate level modelling in companies. That is, modelling across management functions, where each is represented at a similar level of resolution and at a sufficiently high level of aggregation to link operational processes to strategy, (ii) create operationally, rather than financially, driven models, (iii) incorporate the effects of time delays and non-linearities which cause phasing and hence surprises in behaviour over time, (iv) be applied at both a strategic and operational level, although the main audience is usually the middle or operational management, (v) provide a context of modelling for learning, which has an emphasis on process facilitation for team learning as well as on predictive outcomes. Learning to apply system dynamics elegantly and well requires an even greater overhead than learning systems thinking. Thinking visually and using generic stocks and flow structures to create operational structures requires a giant leap for most people. Even with extensive tutoring on real problem situations the process is not easy and much dedication is required before real enlightenment is possible.

Competing practice varies from companies who do almost no quantitative modelling, through those using extensive spreadsheet models, to those having very comprehensive and perhaps real time models for specific parts of the organisation, usually the operations function.

Consider first the use of spreadsheet models. Spreadsheets are simple to use but are very crude simulation tools which are non-visual and open loop. They often use many exogenous inputs and the assumptions on which they are based are far from transparent. Further, they are almost exclusively data and finance orientated. Accounting, investment and taxation functions are often modelled in enormous detail, whereas marketing and distribution are totally unrepresented. These characteristics make them strongly in the province of the finance area within companies which gives power to this function as well as contributing to model imbalance. This orientation results in plans being constructed from a financial viewpoint and only later checked for operational feasibility.

In contrast to spreadsheet models, many organisations have tended to develop very detailed models for single aspect of the business. Examples of this are the various material planning systems in use in manufacturing and the very complex reservoir models use in oil companies. These models are vital to the functions which they represent but are often used for inappropriate tasks in other functional areas because no alternative models exist. This is another source of modelling imbalance. Finally, in large organisations there is often a business analysis unit or operations research group whose function is to model. Although the modelling philosophy of such groups is changing with the use of soft OR, the predominant mode of operation is still modelling for prediction rather than learning and hence a remoteness from management needs.

Current research and consultancy experience suggests that modelling takes on many guises in business organisations and there will always be a problem in introducing any modelling despite the benefits it brings. The problems to be overcome in establishing modelling for learning based on system dynamics centre on five issues. (i) Management expectations. Total involvement with senior management means responding very quickly and often instant models are required. Whilst the introduction of system archetypes has had many benefits, one of the side problems is that it has raised management expectations about the speed with which models can be created. There is often a total underestimate by management of the work required to produce a specific company representation of a generic situation. (ii) Abstract parameters. System dynamics modelling often involves using high level average parameters which middle and operational management find some difficulty in relating to real activities in the business. (iii) Soft variables. An important characteristic of system dynamics modelling is the use of soft as well as hard relationships, say to mix human and marketing factors with production parameters. This means bridging the culture gap in organisations. (iv) Detail escalation. Each part of an organisation has a tendency to believe it is more important than others and this should be reflected in the detail with which it is modelled. (v) Model ownership. There is often a power struggle for ownership of a model which is not to the benefit of the modelling process.

Some ideas for bridging the Gap. Systems thinking is still a long way from the types of products currently used on a large scale in management development and systems modelling is still a long way from the compartmentalised modelling found in most companies.

The main process point is to accept that there is a gulf to be crossed in applying systems thinking and system dynamics. Just recognising this gap means that problem can be surfaced and discussed. Time must be spent to educate thinking or modelling teams to understand the process issues and to set expectations concerning the timing and volume of outputs accordingly. These issues should include: (i) discussion of what is really meant by balanced, intermediate level modelling, (ii) where the modelling power base currently lies in the company and the challenges this might raise in moving from finance to operationally driven modelling, (iii) what methods are currently being used in the company for management learning as these can be used as hooks by which to relate systems thinking and system dynamics to existing activities.

This latter point is of particular importance. Whenever management techniques have proved to be complex and difficult to apply there has been a tendency in the past to add to their complexity. Mathematical programming went through phases of complexity addition (for example, matrix generators and report writers) with the aim of making it more useful. The consequence was to make it less useful. A much more effective policy is to relate methods directly to real activities within the organisation and to current practice. In other words to bring the methods to the organisation rather than the organisation to the methods. For example, if a company is heavily involved in strategic management or balanced scorecards, use these as a window for introducing systems thinking and modelling.

Further, if a company has a focus on one particular activity it may be necessary to model these initially in as they are in practice rather than trying to build a model containing all the elements of system dynamics. For example, if a company has a focus on supply chains, it might be necessary to model this in open loop form initially to build understanding of process modelling, even if it is glaringly obvious that the real problem lies in the feedback between raw material supply and demand forecasting. From a systems thinking point of view there is also a need to avoid being too generic and abstract. Most companies like to feel that they are unique and need to discover their own internal generics from their own specifics, rather than the other way round. From a specific systems modelling point of view, it is important to get a relevant model working quickly which contains recognisable company structures and variable names and the best way to do this is by a top down approach, possibly using fictitious data. The importance of developing an internal vision in a company of what their own final model might look like cannot be overstated.

and an early mock-up helps. These statements have important implications for teaching and training in system dynamics.

Conclusions. This paper suggests that systems thinking and system dynamics have much to offer but are almost too generic, integrated and self contained to relate to specific management reality and practice. More thinking and research needs to focus on the way in which they relate to the current thinking in organisations and how these methods can move to organisational needs, rather than the current emphasis on management moving towards these methods.

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