Really Learning

Developing people and services in health care

Systems thinking

Brief history:

Origins
Systems thinking originated in the 1920s within several disciplines, notably biology and engineering, out of the observation that there were many aspects which scientific analysis could not explore. Whereas the scientific method (summarised by Popper as the three Rs: reduction, repeatability and refutation) increases our knowledge and understanding by breaking things down into their constituent parts and exploring the properties of these parts, systems thinking explores the properties which exist once the parts have been combined into a whole. The expectation of the systems thinkers of the 40s and 50s was that the scientific method would one day have two components: analytical thinking and systems thinking. Its essence is seeing inter-relationships rather than linear cause and effect chains and in seeing processes of change rather than snapshots (Senge).

What is a system?
A system is a set of elements, connected together, which form a whole; this showing properties which are properties of the whole rather than of its component parts.(Checkland, Systems thinking, systems practice).

What is Systems Thinking?
Systems thinking is a way of interpreting the universe as a series of interconnected and inter-related wholes. It is a way of identifying the inherent organisation within a complex situation and has been called 'organised complexity'. It is a framework for seeing inter-relationships rather than things (Senge). Systems thinkers contrast dynamic complexity (the relationships between things) with detail complexity (details about things).

It is an approach, a set of general principles and specific tools and techniques, rather than a subject area in its own right; it can be applied within many different fields and is therefore described as a meta-discipline.

There are four fundamental types of systems*: natural systems, designed physical, designed abstract and human activity systems*. The last is seen as crucially different from the former three (Checkland) in that while they can be described objectively and 'can be no other than they are' human activity systems are understood differently by the various 'human actors' involved in them, who attribute different meanings to what they perceive. As long as each is logically consistent it is valid for the person making it and is therefore not right or wrong. Here objectivity has been described (Ackoff) as 'the social product of the open interaction of a wide variety of individual subjectivities'.

History

Aristotle noted that the 'whole is greater than the sum of its parts' but this concept became lost in the revolution in the scientific approach spearheaded by Newton in the 17th century. In the 1920 s biologists noted 'organised complexity' in the organisms they were studying. They observed a hierarchy of levels of organisation, each more complex than the one below it, with properties that emerge only at that level and do not exist (or have any meaning) at lower levels (Broad 1923, Smuts 192X). Von Bertalanffy, in 1940, distinguished between ***open and closed systems***; closed being completely autonomous and having no relationship with their environment; open exchanging with their environment materials, energy, and information. Closed systems are only to be found in the designed abstract class of systems, almost all of the systems that are of concern to health care professionals and managers will be open ones. Also in the '40s, Wiener and Bigelow, drawing on principles from control engineering and control theory and on their way to developing the field of cybernetics, realised the importance and ubiquity of ***feedback***; activity within a system is the result of the influence of one element on another, that influence being called feedback. They identified positive and negative feedback; positive has since been called amplifying or reinforcing feedback and negative has been termed balancing feedback. In the '50s a group of individuals from different fields came together to found the Society for the Advancement of ***General Systems Theory***, and systems thinking became an academic subject, amassing a body of knowledge, an academic status, and the usual subdivision due to specialisation,

Systems Engineering developed in the '50s, aimed at designing or changing (*that* sense of engineering) systems. Originally the province of engineers working with designed physical systems, it soon became applied to human activity systems also. The process of systems engineering involves:

- problem definition – articulation of the problem as seen by the engineer.
- choice of objectives – expression of the desired state.
- systems synthesis – written creation of possible alternative systems.
- systems analysis – analysis of the hypothetical systems in light of the objectives.
- system selection – of the 'winning' hypothetical system.
- system development – further work on the chosen system.
- current engineering – realisation in practice of the chosen system.

At about the same time ***Systems Analysis*** was developed by the RanD Corporation in the States, drawing on the Operational Research expertise that had blossomed in military settings in WW2. This was at root a form of cost-benefit analysis and requires:

- definition of objectives
- identification or generation of alternative techniques to achieve those objectives
- consideration of costs or resources required by the alternative options
- development of a mathematical model showing the interdependence of objectives, techniques, environment and resources
- articulation of the criterion, relating objectives and costs, for choosing the preferred alternative.

Both of these methods assume that there is an important class of real world problems that can be formulated as:

There is a desired state S1 and a current state S0, and alternative ways of getting from S0 to S1.

In other words it is assumed that the objective of the system is a given and that the role of the systems analyst or engineer is to work out how it can best be achieved. (Checkland)

When these methods were applied in social systems (for example to the public sector in the state of California in the early 1960s) the results were disappointing.

These methods, which all required the 'naming of the system and a defining of its objectives' (Checkland), and in which the engineer or analyst stands outside the system intervening in it to try and reach a desired end, became known **as *Hard Systems.***
During the 1970s, with the influential work of Ackoff, there became an increasing realisation that in human activity systems the system often cannot be 'named' convincingly, and that its objectives are frequently multiple and often conflicting. Ackoff introduced the term '***mess***' into the management science of the time:

a *puzzle* is a conundrum to which there is an answer if you can only find it
a *problem* is a conundrum to which there is no answer only better or worse approaches
a *mess* is a dynamic system of problems

He suggested that much of management is about dealing with messes.

In the '80s Checkland developed a methodology for working with '***Soft Sytems'***, those where 'the problem does not lend itself to being quantified; in complex problem situations, messy, ill-defined, ill structured, not independent of people and where there may be no agreement about appropriate objectives' (Daellenbach).

During the '70s and '80s much attention was paid to the '***modelling***' of systems, sometimes applying the notation developed in hard systems to soft systems, sometimes generating new ways of describing complex relationships. They all involve the following processes:

- familiarisation with the system, often this requires some immersion within it.
- a summary of the situation, which may identify a relevant system or a number of them.
- a description of the relevant system which will include identification of the person whose viewpoint is being represented, definition of the boundary , identification of the desired outputs, inputs , and wider system of interest.
- a representation of the system in the form of an influence diagram.

At the same period attention was paid to '***formulating the mess'***, in which the modelling of the system was only the first of three phases. Phase two is a mapping exercise in which the large number of factors obstructing achievement of the purpose of the system are categorised into a small number of classes. Phase three is 'telling the story' (Pourdehnad 1992) and involves 'telling a believable and compelling story that reveals the undesirable future implicit in the current state…and leads to a desire for change'.

System Design also originated in the '70s and has been developed further since. It is based on the observation (e.g. by Churchman, 1971) that 'the best way to learn a system is to design it'. The process requires that it be assumed that the system to be redesigned has been destroyed overnight, but everything in its environment remains the same. The challenge is to design it from scratch such that;

- there is a huge increase in throughput

•the process leads to a shared understanding among critical actors
• it generates ownership and commitment
•conflict is dissolved
•obstructions are converted into opportunities.

In the '80s and '90s systems thinking was popularised (i.e. made more accessible to practising managers and others) largely by Peter Senge of MIT. It was incorporated into a wider field of study about individual and organisational learning, heavily influenced by the work of Chris Argyris and David Bohm. One of the major contributions of this work has been the identification of '***systems archetypes'*** i.e. influence patterns that can be found in many different systems.

More recently still Plamping, Pratt and Gordon have applied systems thinking to intractable problems that involve health care. The systems they have explored involve many other stakeholders, e.g. other statutory agencies, users, communities, voluntary organisations, and so they have coined the term 'whole systems thinking'. The term '**whole systems'** has now passed into common usage in the NHS but with little evidence of understanding of the principles on which it is based.

Problems with Systems Thinking
The development of Chaos Theory has demonstrated that the early systems thinkers were over ambitious in their belief that the dynamics of a system could be completely analysed. We now know that complex, dynamic systems can be extremely sensitive to initial starting conditions, (the butterfly wing over the pacific), and we realise that a such a system is unlikely to yield to analysis in this way. Since we are not often trying to define a system with complete accuracy, however, the insights afforded by systems thinking are still useful when designing interventions in a system such as an organisation or a department.

Insights afforded by Systems Thinking.

a. Wholes have properties that are the **properties of the whole** and not of the parts. This means that 'dividing an elephant in half does not produce two small elephants'.(Senge).

b. Components of a system interact with each other in a reciprocal flow of influence, and in most management situations understanding this dynamic complexity is more important than understanding detail complexity. These **inter-relationships** mean that cause and effect are not closely related in time and space, and that the results of any intervention in a system may well be unexpected.

c. A system also interacts with its **environment**, and the behaviour of a system can only be understood in the context of its environment. The environment can be thought of in two parts: the environment over which the system does not exert power but does have some influence (sometimes known as the wider system of interest); and that over which it has no influence.

d. A system always has a purpose. Sometimes the purpose is evident to/ shared by all; sometimes the purpose differs in the perceptions of people who are involved in it. **Every**

human actor in a system brings to the system their understanding of its purpose and their view on the world (or *weltenschauung*). This view consists of three elements: rational, emotional and cultural.

e. Systems stabilise in equilibrium and they require a **source of energy** if this equilibrium is to shift, i.e. if there is to be change. The energy can come from outside the system (in which case the approach is a hard systems approach) or from within it ('a soft systems approach'). In a hard systems approach an 'outsider' will identify a purpose, a measure of performance, the decision making processes, the resources to be made available to the decision makers, the boundary between the system and its environment, and the system dynamics (inputs, outputs and relationships between components. In a soft systems approach the people within the system are encouraged to articulate their personal perceptions of the purpose, measures of performance, the boundary, inputs, outputs etc.

f. Dynamic complexity can be **modelled**, using notation that expresses positive and negative feedback, and the insights gained from this process can be used in the redesign of the system.

g. An understanding of interdependencies can be used to enhance the effectiveness of implementing change. **Network diagrams** are a means of doing so.

h. There are more soft systems than hard, and these multi-purpose, multi-structural, multiple process systems are too complex for anyone to understand fully. In systems like this the **players within them** must be able to reflect on the system, learn from its performance and make changes.

i. Systems nest within systems and the inter-relationships across an organisation must betaken into account when a change intervention is planned. This means that **organisation-wide approaches** are sometimes required.

Soft Systems Methodology

Description

Soft Systems Methodology (SSM) was developed, largely by Peter Checkland (1981), for use in situations where a number of different 'Weltanschauungen' are involved. In theory, this could mean any group of more than two people; in practice it is particularly useful in settings involving people from different professional backgrounds engaged together on a task. The methodology can be expressed as a number of steps, but these steps do not have to be undertaken sequentially; indeed the process is usually an iterative one. The steps are as follows.

1 Becoming familiar with the situation in which there is perceived to be a problem, in the richest possible way, identifying as many perceptions as possible, but without attempting to impose a structure, or definition of the 'problem'. One way of doing this is to 'record the elements of slow-to-change structure within the situation and the elements of continuously changing process, and forming a view of how [they] relate to each other' (Checkland, 1981). A rich picture is often the vehicle used for stage 1.

2 Expressing the problem situation, again without imposing on it a structure, but looking within the rich picture for a mismatch of structures and processes, such that a problem is identified.

3 Articulating what are known as root definitions of relevant systems. Every actor in the overall situation has a different perspective and each perspective is deemed to be a different system, thus the relevant systems will probably be those perceived by key players within the situation. Their concept of the purpose, the dynamics, the inputs and outputs, can be captured as a root definition. It is normally expressed as a sequence of verbs which convey the essence of the system. Other writers may characterise this as a mission.

4 Making and testing conceptual models using process flow charts, influence diagrams or any other means of representing the activities which must take place if the root definitions are to be achieved.

5 Comparing the models with the real situation, by observation, and by discussion with all of those involved.

6 Defining possible changes that are both desirable and feasible. These changes can be changes of structure, of process, and/or of attitude.

7 Taking action to implement the changes.

It is important to note that the situation itself is changed by the very use of this methodology. SSM differs from a hard systems approach in not having an external change agent whose role is to effect change. In SSM the role of any external agent is to facilitate the understanding of those players within the system so that they design and implement changes themselves.

Use

There follows an illustrative example of SSM in change management in health care delivery.

'Transforming healthcare delivery'

King's College Hospital in London uses an SSM approach for their change programme – 'Transforming Healthcare Delivery' – which was established in 1994. A small team of staff facilitate a range of projects around the organisation. All projects use a team of staff from the area within which the project is taking place, with the Transformation team providing facilitation. Facilitation is defined as 'managing the project and team meetings process so that the participants can focus together on achieving the project/meetings objectives'.

The initial stage of each project is to develop a common picture and understanding of the current situation. Often this will begin with developing a process map [see also Group 7] – of a system or the patient's journey through the system. This is always done as a team and reflects current reality; not what should happen but what actually does happen. Very often this will alter people's perceptions as, for example, doctors suddenly realise that nurses do a range of tasks they never knew about and vice versa. Staff who have worked on project teams will often express how much they have valued gaining an understanding of the patient's whole journey, and seeing their place within that.

Teams also need to gain a common understanding of the problems and difficulties within that system. A broad range of techniques are employed to achieve this. One of the most powerful is using patient views. Unstructured interviews with patients can give a large number of direct quotes (30 interviews have given over 400 quotes). These quotes can be mapped onto a process flow of the patient's journey at the appropriate point to demonstrate where the problem areas are. Additionally, they can be given to the project team, who can use clustering techniques to develop their own problem statements which they then try to solve.

Other techniques for gaining a common picture of the current situation include observation, more detailed questionnaires, and audit and analysis of routine data. It is important that the team design and administer the audit themselves if a common owned picture is to emerge. Root cause analysis is another useful tool to help a team deepen their understanding of a problem. Skilfully facilitated, this allows all members of the team to voice their understanding of why a problem occurs.

Supplied by Kate Grimes, Programme Leader, Transforming Healthcare Delivery, King's College Hospital.

Evidence

Perceptions of participants are encouraging but this approach has not yet been rigorously assessed.[1]

Commentary

SSM was originally developed to allow the use of a systems approach to explore social reality, rather than as a means of effecting change, so according to its own aims it has been successful. Variations on this approach have been used to effect change in a number of settings, including health care. It is used as part of other approaches, for example TQM and BPR). The Transformation programme at King’s, for example, originally began as one of two sites in the NHS piloting BPR..

SSM allows the multiple perspectives involved in health care to be explicitly recognised and given a voice. It is, however, time-consuming and in the initial stages can be perceived as unfocused or irrelevant to players who believe they already know the problem and its solution. The difficulty that arises most frequently is that of engaging medical staff. This is similar to the problems of engaging medical staff in initiatives such as TQM (see pages XX). Berwick, for example, observes (1992: 305) that:

> *where TQM has been tried in hospitals so far doctors are often not effective on quality improvement teams. They arrive late or not at all to the meetings, they dominate when they are present; and they sometimes leap to solutions before the team has done its proper diagnostic work on the process.*

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[1] Note to VI. Can you re-phrase this? SC