SOFT SYSTEMS METHODOLOGY AS A POTENTIAL APPROACH TO UNDERSTANDING NON-MOTORISED TRANSPORT USERS IN SOUTH AFRICA

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ABSTRACT

Non-Motorised Transport (NMT) in South Africa is currently not completely integrated into transport and spatial planning as a formal mode of transport. This is evident when observing the current condition and utilisation of South Africa's NMT infrastructure. Pedestrians are frequently observed walking on the roads instead of on the newly built pedestrian walkways directly next to them. It is not uncommon in South Africa to find evidence of pedestrians who break through brick walls and cross highways illegally instead of using the pedestrian bridges provided. These examples demonstrate that the behaviour and needs of NMT users in South Africa are not understood and provided for by built environment planning and design practitioners (BEPDPs). The aim of this paper is to show the potential of using systems thinking and more particularly Soft Systems Methodology (SSM) as a practical and beneficial instrument that will guide BEPDPs with the ongoing learning process of understanding NMT users and their specific needs. An introduction to relevant systems thinking philosophies and methodologies are provided, followed by a discussion on the background, development and use of SSM in practice. This paper advocates the necessity of considering NMT as a mode of transport with the emphasis on the need for culture-oriented planning that can contribute to integrated innovative context sensitive mobility solutions and the promotion of green mobility. In achieving this, SSM is shown to provide useful tools for BEPDPs to seek understanding of the behaviour and needs of NMT users within the broader contexts of the mobility requirements of communities and to then provide fit-for-purpose NMT infrastructure and facilities.

1. INTRODUCTION

Non-motorised transport (NMT) is currently not fully considered as a formal mode of transport by many road authorities in South Africa (Labuschagne & Ribbens, 2014). This is evident when considering the lack of integration of NMT into transport and spatial planning. Existing NMT infrastructure is often insufficient and underutilised.

Pedestrians are frequently observed walking on the roads instead of on the newly built pedestrian walkways directly next to them. It is not uncommon in South Africa to find evidence of pedestrians who break through brick walls and cross highways illegally instead of using the pedestrian bridges provided. Informal traders also repeatedly occupy NMT facilities and prove to be very resistant to being removed or

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relocated. These examples demonstrate that the behaviour and needs of NMT users in South Africa are not understood by built environment planning and design practitioners (BEPDPs).

International NMT practices emphasise the need for South Africa to consider NMT as a formal mode of transport. NMT problem situations in South Africa arise from different stakeholders having conflicting viewpoints on the use of the infrastructure. BEPDPs in South Africa therefore need to by understand and deal with these conflict situations, using guiding tools that will improve the understanding of South Africa's NMT users' behaviours and needs. Mkhize et al (2009) identified the perception of NMT as one of the most important differences between NMT in The Netherlands and in South Africa respectively. The needed shift in the modal hierarchy cannot be done without taking this culture-orientated planning approach.

Systems thinking is a new approach that provides tools that might be useful for improving understanding of human behaviour and conflict situations. Soft Systems Methodology (SSM) has become a popular systems thinking tool that guides the user to approach complex problem situations systematically.

The aim of this paper is twofold. Firstly, it proposes the use of SSM as a possible tool when dealing with NMT problem situations in order to improve the understanding of South Africa's NMT users' behaviour and needs. Secondly, it provides an introduction to SSM for BEPDPs that includes the systems thinking philosophies and methodologies that forms the basis of SSM, the background and development of SSM and SSM in practice.

2. SYSTEMS THINKING PHILOSOPHIES AND METHODOLOGIES

2.1 Systems Thinking Philosophies

The prevailing worldview in our society today is the mechanistic or machine-based worldview (Midgley, 2003). Two fundamental aspects of mechanism are reductionism and subject/object dualism (separation of subject and object). The core philosophy of systems thinking revolves around the rejection of the mechanistic world view and the recognition of emergence, which implies that 'the whole is greater than the sum of its parts'. Another core philosophical principle of contemporary systems thinking according to Midgley (2000) is the moving away from the traditional notion of observation towards intervention. An example is the movement in philosophy that states that there is no such thing as a value neutral science (Midgley, 2000). Independent observation is therefore not possible but rather recognised as one practice of intervention (Midgley, 2000).

System thinking opens up the idea of theoretical pluralism where a number of theories based on different purposes and values within different context can be useful instead of using only one theory. Midgley (2000) states that "…a *valid* method is no longer synonymous with *scientific* method." Out of theoretical pluralism naturally flows methodological pluralism where different methodologies can be used together to tackle complexity (Midgley, 2000). Thinking critically about boundaries (boundary critique) is another fundamental cornerstone of systems thinking.

2.2 Systems Thinking Methodologies

In his book, "*Systemic Intervention: Philosophy, Methodology and Practice*" Midgley (2000) distinguishes three 'waves' in the history of systems thinking methodologies based on fundamental shifts in ideas.
Table 1 shows the three waves with the corresponding methodologies.

Table 1: Different traditions or waves of systems thinking adapted from (Reynolds & Holwell, 2010)

Waves of Systems Thinking	Selected systems approaches
First Wave of Systems Thinking (Hard)	General systems theory (Bertalanfy 1956) Classical (first order) cybernetics, 'mechanistic' cybernetics (Ashby 1956) Operations research (Churchman et al. 1957) Systems engineering (Hall 1962) Socio-technical systems (Trist et al. 1963) RAND-systems analysis (Optner 1965) System dynamics (Forrester 1971; Meadows et al. 1972)
Second Wave of Systems Thinking (Soft)	Inquiring systems design (Churchman 1971) Second order cybernetics (Bateson 1972) Soft systems methodology (Checkland 1972) Strategic assumption surface testing (Mason and Mitroff 1981) Interactive management (Ackoff 1981) Cognitive mapping for strategic options development and analysis (Eden 1988)
Third Wave of Systems Thinking (Critical)	Critical systems heuristics (Ulrich 1983) System of systems methodologies (Jackson 1990) Liberating systems theory (Flood 1990) Interpretive systemology (Fuenmayor 1991) Total systems intervention (Flood and Jackson 1991a) Systemic intervention (Midgley 2000)

The first wave focused mainly on quantitative mathematical modelling techniques. The second wave shifted the focus from quantitative modelling to the importance of understanding relationships and perceptions. The models were no longer seen as representations of reality, but were instead used to guide discussions and debates. The third wave of systems thinking takes power relations and conflicts into, and promotes methodological pluralism. The third wave is better known as *Critical Systems Thinking* (Midgley, 2000). This wave's aim was not to replace the methodologies of the previous waves, but rather to improve the methodologies by incorporating power issues as well as expand the manner in which the methodologies were applied.

SSM is categorised as one of the most used in the second wave methodologies. It is essential to understand though that the third wave of systems thinking aimed at giving guidance on how to improve the application of the methodologies. SSM is therefore used in the third wave of systems thinking as part of the *Creative Design of Methods* that Midgley (2000) describes as: "…*the development of a dynamic set of interrelated questions, expressing purposes for intervention that evolve over time, each which might need to be addressed using a different method, or part of method*".

He, as a contributor to the third wave of systems thinking, preferred the use of SSM in several of his case studies and applies SSM as part of his methodology *Systemic Intervention* (Midgley, 2000).

3. BACKGROUND AND DEVELOPMENT OF SSM

SSM originated as a result of the progression of systems ideas. The foremost idea concerns the basic features of systems that are summarised by two pairs of ideas, the one pair being emergence and hierarchy, and the other being communication and control (Checkland, 1981). Checkland (1981) also introduced the idea of human activity systems which comprises of sets of purposeful human activities, which can only manifest as perceptions by humans. The idea of using human activity systems or trying to 'engineer' them in order to improve real-world situations initially originated from the engineering world where engineers were increasingly needed to solve the problem of designing and implementing controllable complexes of equipment instead of just components, for example *Systems Engineering* and *Systems Analysis* (Checkland, 1981). The belief that real-world problems can be formulated as making a selection between alternative means to achieving a defined and known end is a distinguished characteristic of what Checkland (1981) defines *hard* systems thinking. SSM was developed as an attempt to apply one of the versions of the hard systems thinking to the 'soft' ill-structured problems of the real world by using the concepts of human activity systems.

The development of SSM resulted in a radical shift from the 'hard' systems idea to a new 'soft' systems idea that considered the effects of different world views. Models were no longer used to portray reality but were instead used to facilitate debate about 'improvement'. The approach shifted from trying to engineer 'systems' that exists in reality in order to achieve a defined objective to a process of learning in order to take action and improve the situation. The development of SSM shifted from the idea of a systemic world to a systemic process of inquiry as shown in Figure 1. Out of all of this came a model, known as the LUMAS model (Learning for a User by a Methodological-informed Approach to a Situation) which is a generic model for making sense of any real-world application of any methodology.

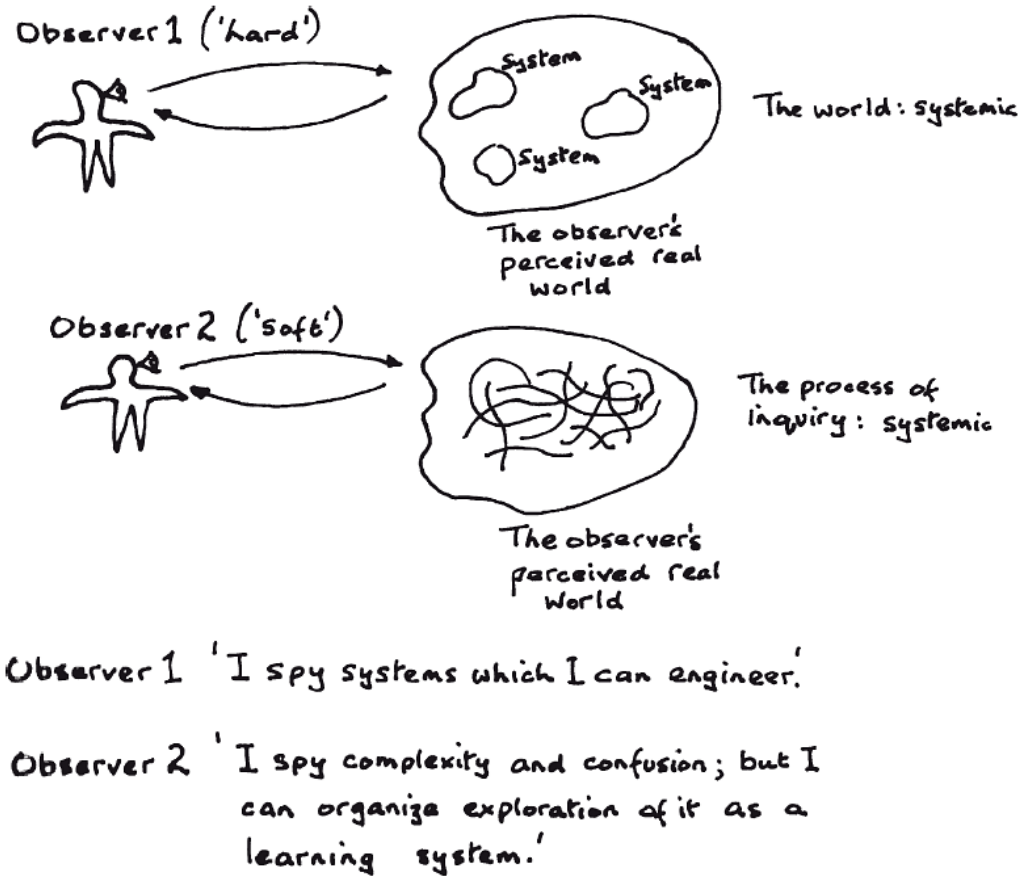

Figure 1: The 'hard' and 'soft' systems stances (Checkland & Poulter, 2006)

4. SSM'S FURTHER DEVELOPMENT

In *Learning for Action* (Checkland & Poulter, 2006) SSM is outlined as follows:

"*SSM is an action-oriented process of inquiry into problematic situations in the everyday world; users learn their way from finding out about the situation to defining/taking action to improve it. The learning emerges via an organised process in which the real situation is explored, using as intellectual devices – which serve to provide structure to discussion – models of purposeful activity built to encapsulate pure, stated worldviews*."

Checkland and Poulter (2006) describe the mature methodology as a process of four main phases:

- Finding Out
- Making Purposeful Activity Models
- Using Models to Structure Discussion about the Situation and its Improvement
- Defining 'Action to Improve'

These phases do not necessarily need to happen in sequence, in most cases they will go on simultaneously. Checkland and Poulter (2006) frequently emphasise that SSM should not be used as a recipe to be followed. These phases or steps merely guides beginners and should be used as a model to make sense of experiences as

one mentally negotiate one's way through the problematic situation. Figure 2 shows SSM's cycle of learning for action.

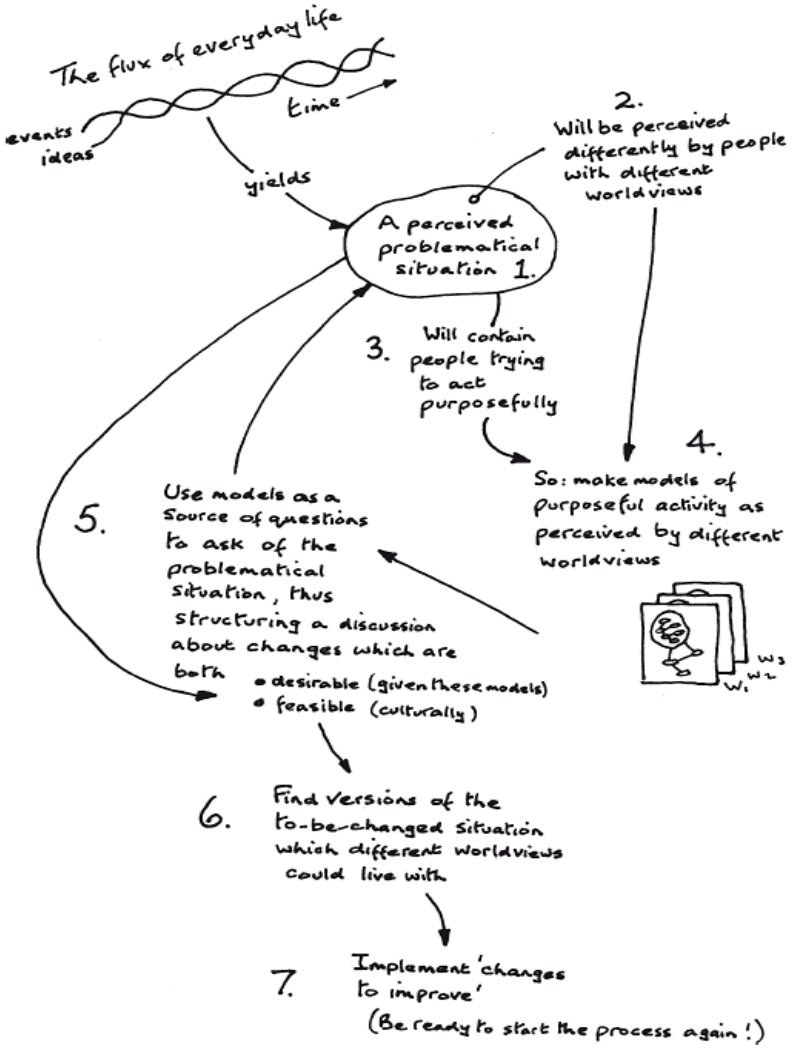

Figure 2: SSM's cycle for learning for action (Checkland & Poulter, 2006)

4.1 Finding Out

There are four ways of finding out about the problem situation that survived over the years as a normal part of the process of using SSM (Checkland & Poulter, 2006). This includes making rich pictures and three types of analyses that focus on the intervention itself, the social issues and lastly the political issues. These four ways are described in more detail in the sections below.

4.1.1 *Making Rich Pictures*

Complex human situations consist of multiple interacting relationships and relationships are more often than not better expressed by using pictures instead of linear prose (Checkland & Poulter, 2006). Drawing a picture of the situation helps the users to understand how the relationships within the situation works and provides a platform for discussion about the relationships that will generate the identification of new relationships not noticed earlier. This picture will become 'richer' as more

information is gained through interviews, meetings, reading documents etc. The aim in making a Rich Picture is to informally "…*capture the main entities, structures and viewpoints in the situation, the process going on, the current recognised issues and any potential ones*" (Checkland & Poulter, 2006).

4.1.2 Analysis One: The Intervention Itself

When SSM is used to improve a problematic situation there are three elements: the methodology; the use of the methodology by the practitioner and the situation. It is useful to identify three key roles in an intervention (Checkland & Poulter, 2006):

- The Client
  - Who caused the intervention to happen?
  - Someone without whom there would not be an investigation.
- The Practitioner
  - Who are conducting the investigation?
- The Issue Owner
  - Chosen by the practitioner as those concerned about or affected by the situation and the outcome of the effort to improve it.

'Analysis One' consists mainly of thinking about the situation, thereby identifying the people playing the different roles. SSM can be used in two ways, focussing on content or process. For example, SSM can used to address the content of a situation, SSM(c), or to address how to do the study/process itself, SSM(p). It is important to identify whether SSM is used as a content or process inquiry in a particular study.

4.1.3 Analysis Two: Social

In the later phases of SSM changes are identified that should be both *desirable* and *culturally feasible*. It is crucial to understand this social 'texture'. The social texture of a human situation consists of the interaction of roles, norms and values. Roles are the social positions that marks the differences between members of a group, norms are the expected behaviour associated with the roles and values are the criteria by which the behaviour within a role is judged (Checkland & Poulter, 2006). A lot can be learned about the problematic situation just by identifying the roles, norms and values that characterise the situation throughout the process and by writing down a progression of findings.

4.1.4 Analysis Three: Political

The politics of a situation is, just like the social context as explained above, crucial to understand in order to identify changes that are *desirable* and *culturally feasible*. Checkland and Poulter (2006) recommend identifying the commodities of power in the problem situation. How is it obtained, used or defended? How can these commodities of power be passed on or relinquished? The political 'culture' can thus be better understood by thinking about the situation in terms of commodities of power and by writing down the findings.

4.2 Making Purposeful Activity Models

To create an organised process of enquiry, models are made of purposeful human activity that will be used to ask questions about the real-world problem situation (Checkland & Poulter, 2006). Each model is built according to a particular world view or root definition. The process of building the purposeful human activity models starts with defining the root definitions. There are guidelines as to defining the root definitions. The first is the PQR-formula, do 'P' by 'Q' in order to achieve 'R', or the "What? How? and Why?" method. This formula helps to describe the world view of the model. A mnemonic, CATWOE (Customers; Actors; Transformation; World View; Owners; Actors), is also used to further define the root definition as explained in Figure 3.

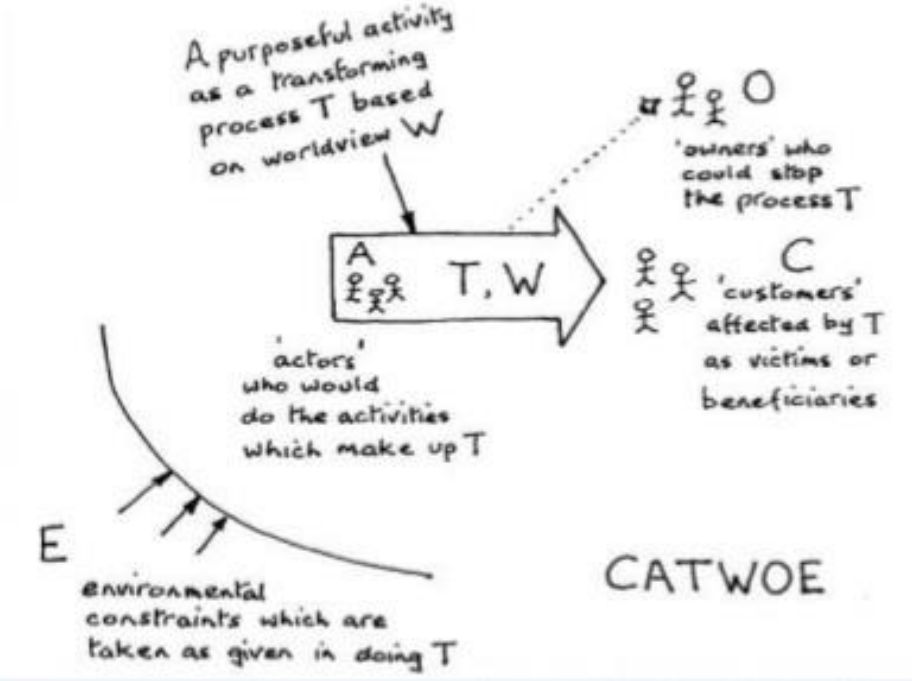

Figure 3: A generic model of any purposeful activity, which yields the mnemonic CATWOE (Checkland & Poulter, 2006)

The measures of performance of the system modelled should also be defined as three aspects (Checkland & Poulter, 2006):

- Efficacy
  - Is the Transformation working, or producing the intended outcomes?
- Efficiency
  - Is the Transformation being achieved with a minimum use of resources?
- Effectiveness
  - Is the Transformation helping to achieve the higher-level or longer-term aim?

Root definitions can be either 'Primary Task' or 'Issue-based'. 'Primary Task' models usually use the organisational boundaries that exist in the real-world, while 'Issue-based' models cut across organisational boundaries. The type of root definition should be clear before model building begins.

Checkland and Poulter (2006) list the guideline steps for building purposeful human activity models as:

1. Assemble the guidelines: PQR, CATWOE, the Root Definition, etc.
2. Write down three groups of activities
    a. Those which concern the thing which gets transformed
    b. Those activities which *do* the transforming
    c. Any activities concerned with dealing with the transformed entity
3. Connect these activities by arrows to indicate the dependencies of one activity on another
4. Add the monitoring and control activities
5. Check the model against the guidelines
    a. Does every phrase in the Root Definition lead to something in the model?
    b. Can every activity in the model be linked back to something in the Root Definition or CATWOE?

A generic model of a purposeful human activity system is shown in Figure 4.

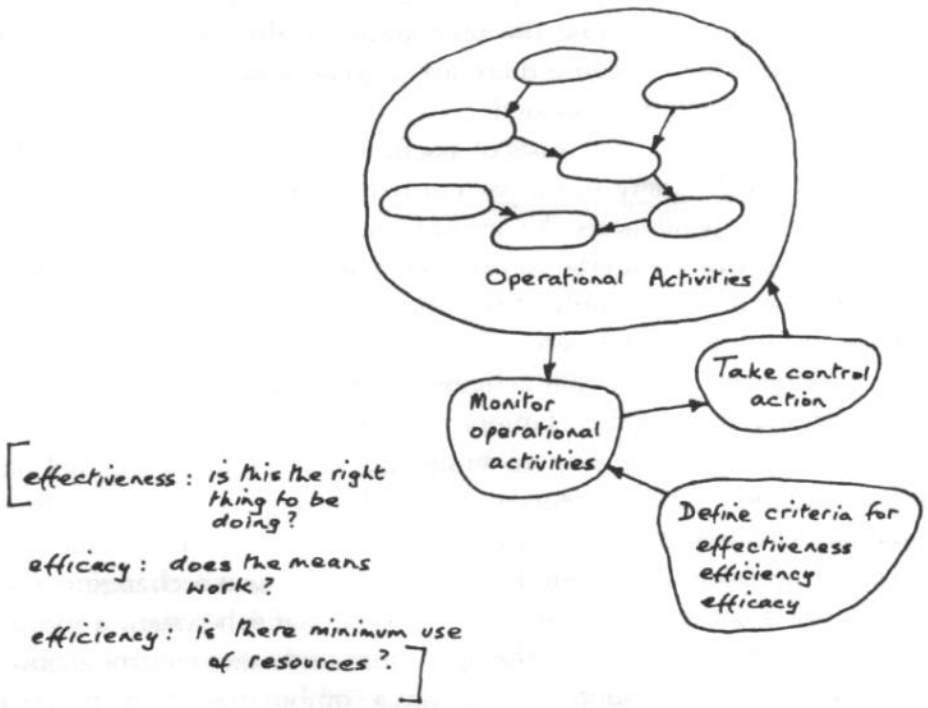

Figure 4: The general form of a purposeful activity model (Checkland & Poulter, 2006)

4.3 Using Models to Structure Discussion about the Situation and its Improvement

The purposeful human activity models are used as a guide to discussion between the stakeholders of a problem situation. It is important to remember that these models are not accounts of what we wish the real world to be like, but rather highlights the different world views of the problem situation and guides discussion on how to improve the problem situation. This discussion can be done in an informal manner with flip charts, in a formal manner as in the form of a chart matrix or as a form of comparison between what a system should be doing and what happens in reality (Checkland, 1981).

4.4 Defining 'Action to Improve'

It is fundamental to understand that the discussion phase in SSM does not seek to obtain *consensus* but rather *accommodation* regarding the solutions i.e. a solution that 'everybody can live with'. Consensus on important issues rarely happens in the real-world and that accommodation should be pursued instead. When considering the changes that need to be done, it is helpful to consider if the changes are being made to structures, processes or attitudes.

5. SSM IN PRACTICE

The use of SSM in practice has also developed over the years from being used as a methodology of the Second Wave of Systems Thinking to being used as a methodology of the Third Wave of Systems Thinking. This can be seen in the way that Midgley (Midgley, 2000) uses it as part of his *Systemic Intervention*. It can also be seen in the newest primary literature of SSM (Checkland, 2011; Checkland, 2000; Checkland & Poulter, 2006). There are now various situations in which SSM can be used in. *Learning for Action* (Checkland & Poulter, 2006) describes case studies where SSM was used in both management situations as well as the field of information systems. The way in which SSM is applied in the case studies is all different except for the fact that they are sharply orientated to doing something about the problematical situation (Checkland & Poulter, 2006).

This again emphasises the vital point that SSM is *not* a formula, method or technique but a set of *methodological principles*. Checkland and Poulter (2006) frequently mention how SSM is misunderstood and distorted in numerous secondary literature sources. He repeatedly reminds the reader of the LUMAS model and urges the users of SSM to treat it as a methodology rather than a method. A good example of how this is done can be found in the intervention of Midgley (Midgley, 2000) where he adapts SSM with the method of *Boundary Critique* when he uses it as part of his *Creative Design of Methods* or *Systemic Intervention*. He used SSM as part of a *Creative Design of Methods* in a number of diverse community development case studies (Midgley, 2000).

SSM should therefore be used creatively, with care and with an attitude of it as a continual learning process. Checkland and Poulter (2006) quote this statement from SSM in Action (Checkland & Scholes, 1990) about the style in which SSM should be

used: "…*the very best uses of SSM seem always to exhibit a certain dash, a light-footedness, a deft charm. In this sense the role of the approach is akin to the cavalry in nineteen century war: it can add a certain tone to what might otherwise be a vulgar brawl*."

6. SSM AND NMT

SSM is naturally used to find accommodation between stakeholders with conflicting worldviews. SSM is used, more generally, to improve *human activity situations* and *identify underlining issues,* varying in subject matter and manner (Checkland & Poulter, 2006). The wide range of SSM case studies for example include *Rethinking the Role of a Head-Office Function in Shell* (Checkland & Poulter, 2006) and *Developing Services with Young People (Under 16) Missing from Home or Care* (Midgley, 2000).

NMT consists of *human activity situations* or *human activity systems*. NMT should be considered a formal mode of transport within a new modal hierarchy. Stakeholder worldviews about transportation in South Africa must be influenced or accommodated. The paradigm shifts towards the new modal hierarchy includes improved understanding about the behaviour and needs of pedestrians and cyclists in South Africa, and *identifying the underlining issues*. SSM is relevant to dealing with these NMT problem situations.

SSM is not a method or technique but a set of methodological principles. The method used will be different for each unique NMT problem situation, from high level strategic problems to operational problem situations. BEPDPs should therefore regard SSM as a powerful additional skill that simply guides the learning process for those ill-defined, impossible to fix, wicked problem situations where there is opportunity for improvement.

7. CONCLUSION

This paper stresses the need for integrating NMT into transport and spatial planning as a formal mode of transport. NMT users' behaviour and needs are, however, not fully understood in South Africa as is evident in the minimal utilisation of infrastructure. BEPDPs therefore need tools to improve the understanding of the needs and behaviour of NMT users in South Africa. This paper provides an introduction of the underlining philosophies, methodologies and practice of SSM and recommends the use of SSM as a tool that guides BEPDPs when dealing with problem situations in order to improve understanding of user behaviour and different viewpoints within NMT contexts.

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