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Benefits of examining the sustainability of non-profit organisations from a system dynamics perspective

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Abstract

Non-profit organisations (NPO's) contribute in a variety of ways to the betterment of society and to the upliftment of the human race. However, their dependence on external donors for funding and the voluntary provision of services has made the survival of such organisations a perilous and uncertain journey. Added to this, is the many variables, and the feedback relationships between them, that influence the overall sustainability of non-profit organisations.

Thus, a fragmented view looking at only a limited number of factors that influence non-profit sustainability presents many limitations. For this reason, a systems thinking methodology known as System Dynamics (SD) is proposed for a more holistic consideration of the issue of non-profit sustainability by examining the beneficial implications of such an application.

Key phrases
complexity; feedback loops; non-profit organisation; sustainability; systems thinking; system dynamics

1. INTRODUCTION

Non-profit organisations (NPO's) play an important role in providing resources or public goods that are either undersupplied or not supplied by the state and private sector (ranging from food to education and other types of skills), to parts of the population who do not have access to these resources, but desperately require them (Kingma 1997:135). Thus, they act as intermediaries between governments and their citizens by attempting to make up for governmental inadequacies in the provision of public goods (Mzini 2011:276). For this reason, when registering a non-profit organisation in South Africa, it is compulsory to state in its Memorandum of Incorporation, the public benefit the organisation wishes to achieve through the establishment of such an organisation (Steenkamp 2011:15).

A useful way of understanding the definition of an NPO is to consider the fundamental characteristics exemplified by these types of organisations. According to Salamon and Anheier (1997 cited in Anheier 2000:2) NPOs demonstrate the following characteristics:

- they are separate institutions from public or government institutions;
- they are organised, in the sense of having some institutional reality which separates them from informal entities;
- they do not distribute profits generated to owners or equivalents, and thus exist not to make a profit, but to reinvest such profits into their social upliftment activities;
- they are able to govern or control their own activities as they possess their own internal governance structures;
- they have a strong voluntary element by being non-compulsory in essence and are constituted of those who wish to participate on a voluntary basis.

2. NON-PROFIT ORGANISATIONS AND SUSTAINABILITY

Sustainability refers, most fundamentally, to the ability of the NPO to survive and thus, to ensure that its social mission is carried out effectively by meeting its commitments to its customers, patrons and the community in which it operates (Weerawardena, McDonald & Mort 2010:347). Considering that this sector takes on the responsibility of confronting complex social issues without a steady flow of resources and infrastructure, the issue of the sustainability of the non-profit sector becomes an important issue to examine (Hannum *et al.* 2011:18).

While the sustainability of an NPO depends largely on the returns on its investments, a number of other factors, and the interplay of such factors, also influence its sustainability. Schuh and Leviton (2006:172-173) claim that the state of a non-profit organisation's development can be gauged by assessing five pivotal organisational elements, namely its governance, organisational development, internal operations, financial resources and main/core services.

Governance pertains to the management of the NPO and thus includes the board of directors, the legal status of the organisation, the quality of the relationships between management and staff within the organisation, and the functioning of the organisation (Schuh & Leviton 2006:175).These factors change as the organisation develops from a being a newly created venture to an established organisation.

Financial resources are the monetary resources required by the organisation to fulfil its social mission/s adequately, and thus to ensure its sustainability over time (Schuh & Leviton 2006). If the organisation does not have adequate money to facilitate its various projects and operational requirements, then it will not be able to accomplish its social mission and will, therefore, not be sustainable. The more financial resources a NPO has at its disposal, the more likely it will be sustainable. In addition, if a non-profit organisation is financially secure, it will have more flexibility to choose funding sources that are more congruent with its social mission (Schuh & Leviton 2006:176).

Internal Operations includes all the elements relevant to the internal functioning of the organisation, such as administrative functions, logistical support, skill and expertise levels of employees, technology and the separation of tasks among those within the organisation (Schuh & Leviton 2006:176). Core Services refers to the specific services offered, or social work done by the non-profit organisation through the various projects it implements at street level (Schuh & Leviton 2006:177). These services will differ from one non-profit organisation to another, depending on their social missions.

Organisation Development pertains to the manner in which an organisation is structured in order to meet its mission, including the height and width of such structures (Schuh & Leviton 2006:176). Organisations with a tall structure have more levels of hierarchy, departments, sub-departments, formal procedures and policies, etc. than those with shorter organisational structures; the nature of these structures can change as the organisation develops and grows (Schuh & Leviton 2006). However, NPOs tend to downplay the importance of infrastructural development because they perceive the provision of services in the fulfilment of their social mission to be a far greater priority.

According to Weerawardena *et al*. (2010:354) "… the need for sustainability has made a tremendous impact on the NPOs, forcing them to adopt a strategic orientation in all activities undertaken by them". Thus, the striving for sustainability can be regarded as being at the heart of non-profit operations and management and is directly related to their ability (or inability) to fulfil their social mission.

If the non-profit sector cannot sustain itself, it cannot produce the social benefits it promised and this will impact the very reason for its existence. Thus, the issue of sustainability is imperative to the survival of all NPOs, especially since such organisations occupy a more uncertain and

perilous position than conventional organisations (Morris, Coombes, Schindehutte & Allen 2007:12). The issue of sustainability should therefore be uppermost in the thoughts and operations of non-profit managers and leaders specifically as it will determine the manner in which they do business and whether or not they will ultimately survive (Mesch 2010:173).

3. SYSTEM DYNAMICS

System Dynamics (SD) can be regarded as a tool or set of ideas rooted in systems thinking philosophy, which attempts to understand problematic situations in their entirety by not only examining the explicit real world manifestations of problematic situations, but by delving deeper. It is proposed that a deeper investigation of the structure of a system will reveal hidden feedbacks that contribute to the problematic situation, hence ensuring its continued existence (Scholl 2001:3). Simply zeroing into a particular aspect of a problematic situation and attempting to deal with the explicit symptoms may bring temporary relief, but in the long run, such symptoms may reappear in a more extreme form (Forrester, 1994, p. 6).

Therefore, change of this nature represents a concerted effort to delve deeply into the root causes of a problematic situation, in order to bring about positive systems-wide change through the utilisation and application of particular policies. SD examines the structure of a system to identify the information flows comprising and underlying that particular system, with consideration given to the fact that it is both the structure of the system and its information flows that determine the overall behavior of that system (Forrester 1992:10; 1998:3).

With regard to the specific stages in the modelling or SD process, experts have proposed a process that varies from three to seven stages, as depicted in the Table 1 by Luna-Reyes and Anderson (2003:275)

The stages identified by each of the authors do not deviate significantly from one another and thus, there are great similarities in the stages they identify as comprising the modelling (or system dynamics) process. According to the most recent formulisation by Sterman (2001:18-22), all modelling processes comprise five stages, including that of problem articulation, the development of a dynamic hypothesis, formulation of stock and flow models, testing of the model and implementation of the relevant policies that are known to be effective in bringing about the desired change.

TABLE 1: The system dynamics modelling across the classic literature.

Randers (1980)	Richardson & Pugh (1981)	Roberts *et al.* (1983)	Wolstenholme (1990)	Sterman (2000)
Conceptualisations	Problem definition	Problem definition	Diagram construction and analysis	Problem articulation
	System conceptualisation	System conceptualisation		Dynamic hypothesis
Formulation	Model formulation	Model representation	Simulation phase (stage 1)	Formulation
Testing	Analysis of model behaviour	Model behaviour		Testing
	Model evaluation	Model evaluation		
Implementation	Policy analysis	Policy analysis and model use	Simulation phase (stage 2)	Policy formulation and evaluation
	Model use			

Source: Luna-Reyes & Anderson 2003:275

3.1 Problem articulation

Dynamic Complexity refers to the idea that particular problems are comprised of a variety of different variables that influence each other constantly. In addition, these variables, and the way in which they interact, change over time, thus giving rise to circumstances that are highly dynamic and ever-changing (Sterman 2000:10, 2006:506).

The SD modelling process must begin with identification of a problematic situation to which the tools of the system dynamics process can be adequately applied. This pertains to problems that demonstrate a high degree of dynamic complexity, and which are thus difficult to solve. In such circumstances, finding an all-encompassing solution is highly optimistic.

3.2 Development of a dynamic hypothesis

The development of a dynamic hypothesis entails the construction of influence or feedback loop diagrams with the assistance of all stakeholders affected or involved in the problematic situation that was identified in the previous stage. The dynamic hypothesis is created to make it easier for stakeholders and modellers themselves to see how the dynamic behaviour of the system is determined and influenced by its causal structure (Lane 2000:4).

The SD facilitator's main aim is to make the mental models of the affected stakeholders explicit, as it is these mental models that can reveal the perceptions and beliefs they hold, and which are highly relevant to understanding and effectively dealing with the problematic situation.

Information that can be garnered from empirical methods of research, such as interviews, archival data, existing documentation and previous research pertaining to the problematic situation, should also be utilised in this process as it is recognised that, although the SD model is a mathematical one, most of the information utilised by the modeller will be qualitative in nature (Luna-Reyes & Andersen 2003:271). Influence or feedback loop diagrams, also known as causal loop diagrams, are the primary means of conveying the dynamic hypothesis. These diagrams are constructed by identifying the essential variables comprising the problematic situation, and thereafter indicating how these variables influence one another (Sterman 2000).

Such influence can manifest in two behaviours: reinforcing or amplifying behaviours in which one variable influences another in the same direction, thus giving rise to positive feedback loops, and balancing behaviours, in which one variable influences another in the opposite direction, thus giving rise to negative feedback loops (Sterman 2000:137-141). This is demonstrated in Figure 1 as an example of the influence of birth and death rates on population.

The two loops pictured in Figure 1 provide examples of a reinforcing loop (left) in which the variables build on one another (as births increase, population increases, which in turn contributes to an increase, after a period of time, in the number of births as there are more people to have babies) and a balancing loop (right) in which the variables balance each other out, in the sense that as the population increases, people also die, which simultaneously decreases the population rate.

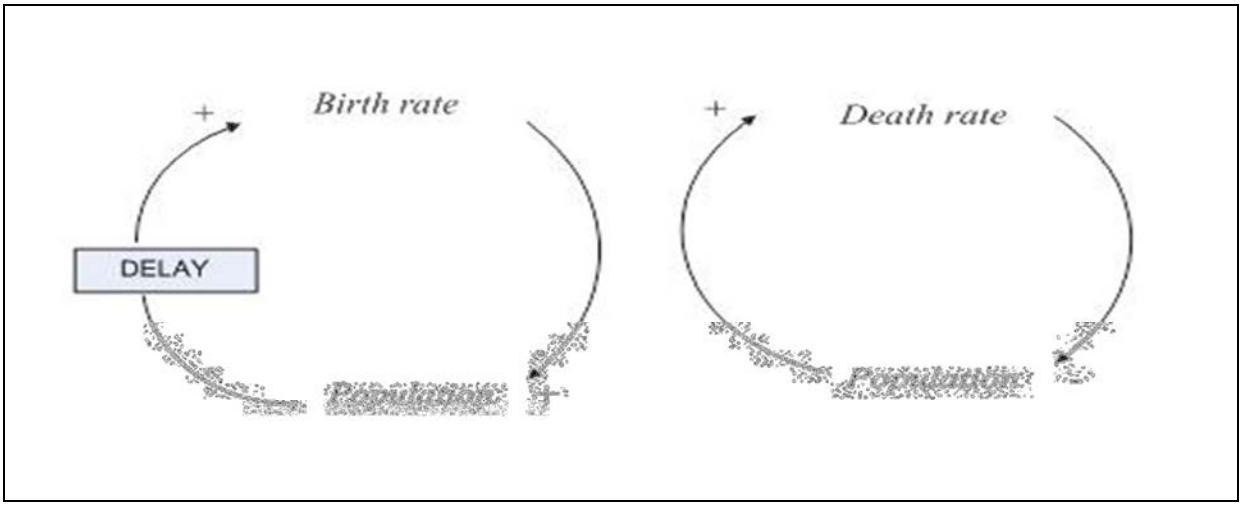

FIGURE 1: Reinforcing loop (with delay) and balancing loop

Source: Sterman 2000:138

As these loops are identified and combined to map out the effects of their influence, the causal loop diagram becomes more complex and revealing, such as the one below which depicts the factors identified as influencing the quality of service provided in an insurance sector (Barkur, Varambally & Rodrigues 2007:514).

Figure 2 depicts the factors identified as influencing performance management in an organisation (Akkermans & Van Oorschot, 2005, p. 935).

3.3 Formulation of a simulation model

The formulation of a simulation model signals the transition of the SD process from a predominantly qualitative process to a quantitative one. The variables comprising the influence diagram are converted into a stock and flow diagram, with stocks or levels representing things that can increase or decrease (such as financial resources, organisational capacity, population), while flows or rates represent things that are responsible for an increase or decrease of a stock or level (Hirsch, Levine & Miller 2007:3).

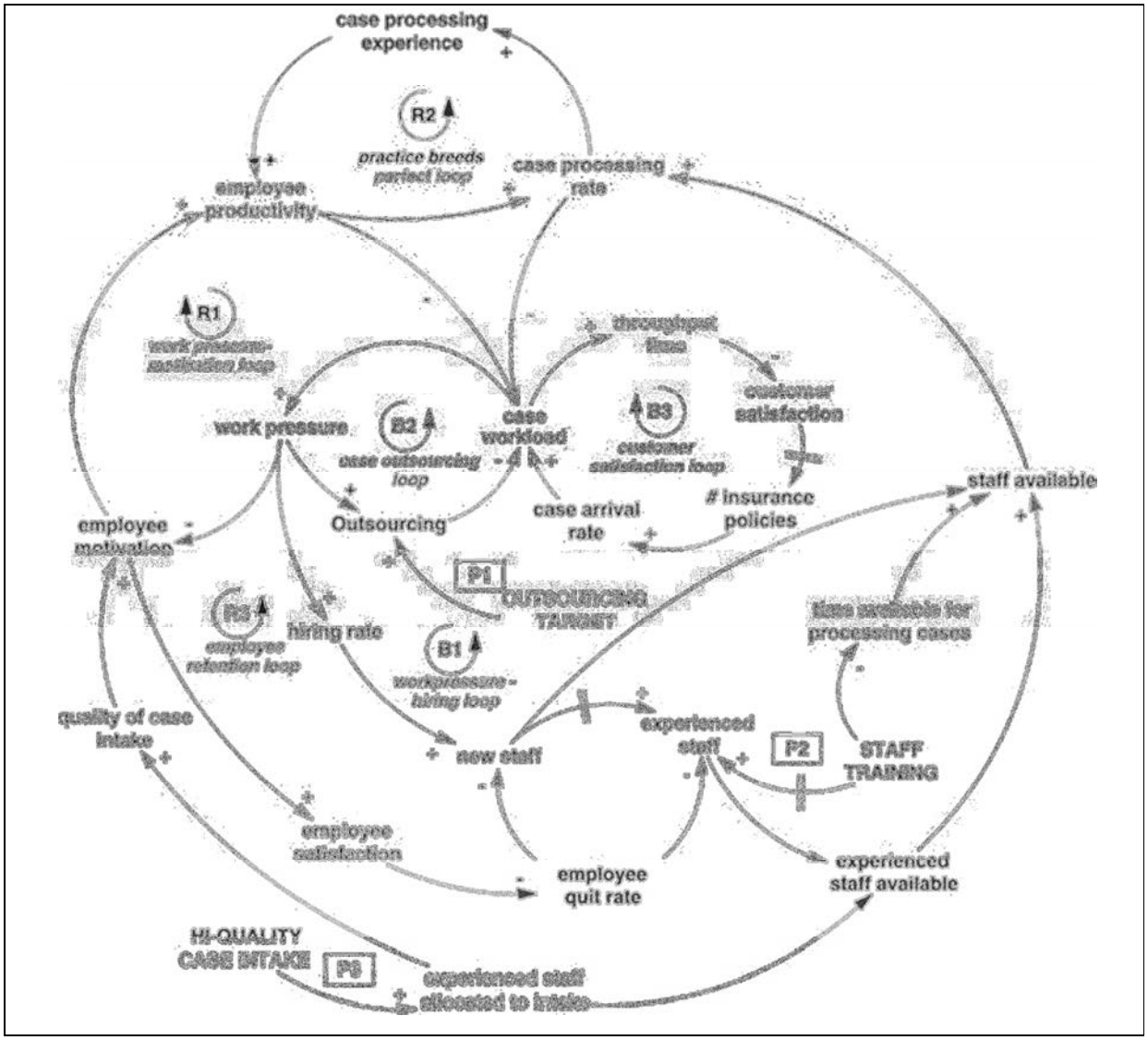

FIGURE 2: Complex influence diagram with reinforcing loops
Source: Barkur *et al.* 2007:514

Service backlog, for example (Oliva & Sterman 2001:896), as seen in Figure 3, is a stock that increases as customers place more orders and decreases as such orders are fulfilled. Things that have an effect on the inflows and outflows influencing a stock ('customers orders' and 'order fulfilment' in this example) are incorporated in the stock-flow diagram via converters and connectors (depicted as circles and lines with arrowheads).

3.4 Testing of the model

This stage of the SD process entails evaluating the correctness or robustness of the constructed model. Forrester & Senge (1980 cited in Barlas 1994:4-6) prescribe a multitude of conditions which the model must fulfil to ensure that it is sufficiently robust and sufficient for the task for which it was designed. For example, the model must represent the actual structure of the problem situation as accurately as possible so as to be a true representation of the problem situation being investigated.

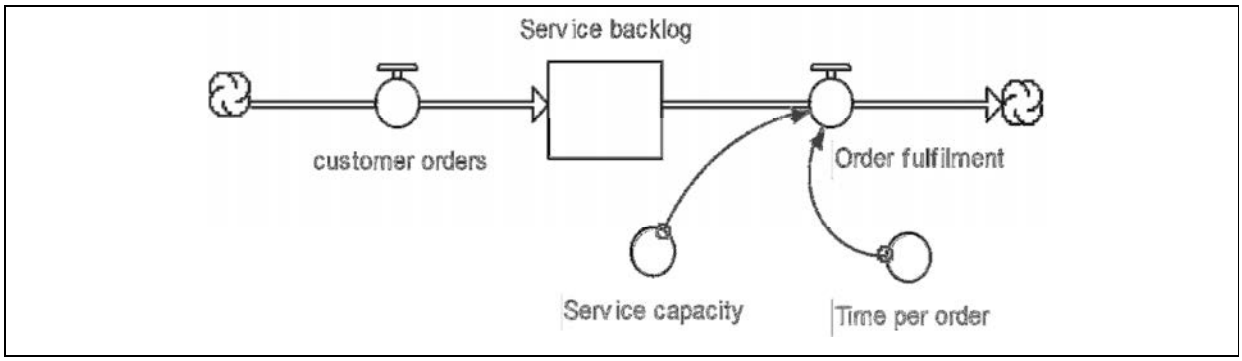

FIGURE 3: Stock-flow diagram depicting factors influencing service backlog

Source: Adapted from Oliva & Sterman 2001:906

3.5 The implementation stage

Once the various simulations are completed, the modeller will acquire knowledge about how the system will behave over time once various policies are implemented. Thus, the computer simulations allow different scenarios to be tested, to determine the effect of such scenarios in the real world (Kunc 2012:30). In this way, stakeholders can make more informed decisions about the policies they wish to implement by seeing the consequences of such policies directly, via the repeated computer simulations. Therefore, such simulations are powerful aids to the stakeholders' decision-making strategies regarding how best to deal with, or understand, the problematic situation (Sterman 2000:34).

The process described above does not end with the last stage because SD modelling is an iterative process (Mashayekhi & Ghili 2012:183; Morecroft 2007:106; Sterman 2001:21). This means that once the stages are completed, it is possible, based on the feedback from or

consequences of the implementation of the discovered policies, to begin the process all over again to lead to further learning.

4. BENEFITS OF INVESTIGATING NPO SUSTAINABILITY FROM A SD PERSPECTIVE

The NPO's dependence on donations, gifts and grants and other types of funding from sources outside the organisation itself makes it vulnerable, especially since it must also compete with its for-profit counterparts in the race for financial and other resources (Ryan 1999:136). Added to this is the highly uncertain, turbulent and complex environment in which all organisations, including NPOs, are embedded (Bradshaw 2007:4).

This complexity is heightened by the constant interactions between, and relationships with, various stakeholders, including the board of trustees, volunteers, employees, government funders, commercial partners, as depicted in Figure 4, adapted from (Hannum *et al.* 2011:8) ENREF 10 without which the non-profit cannot survive or flourish.

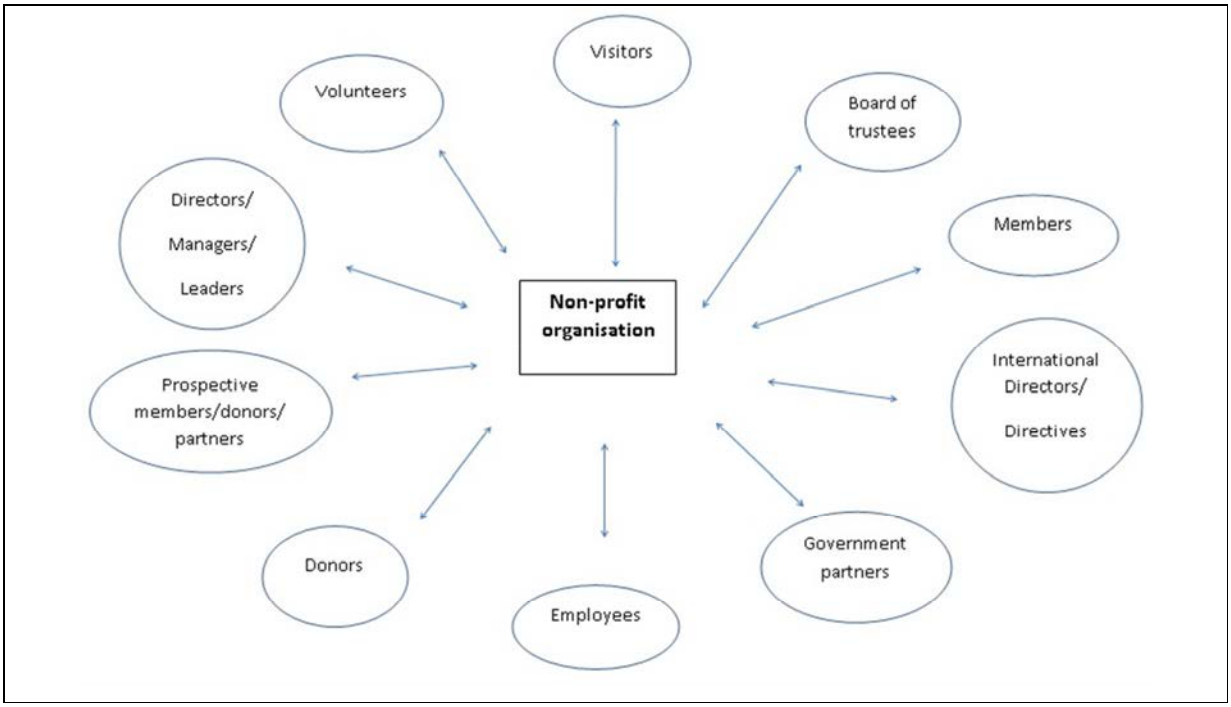

FIGURE 4: Some of the various stakeholders contributing to complexity in, and for, the non-profit organisation

Source: Adapted from Hanuum *et al.* 2011:8

Even though the elements of each stakeholder as presented in the diagram above are often conceptualised as being disparate, it must be realised that the effectiveness or lack thereof of the non-profit organisation's functioning will depend on the energy that is created via the collaboration of all the above stakeholders. Thus, non-profit organisational effectiveness can be interpreted as the emergent property of all interactions with, and between, the various stakeholders and that this 'energy' is greater than the energy that can be generated by any of the stakeholders alone.

There are multitudes of internal and external factors that play a role in determining and influencing the sustainability of NPOs. Previous research has focused on specific factors relating to NPOs, such as organisational culture (Lewis 2003a), management (Lewis 2003b), worker well-being (Benz 2005), entrepreneurship capabilities (Dees 1998), partnerships with corporate entities (Huxham & Vangen 1996), strategic performance management (Kaplan 2001), social accounting (Richmond, Mook & Jack 2003), but there has not been a holistic examination of the forces that contribute to the sustainability of the NPO.

From a review of the existing literature, the following sub sections were identified as some of the main benefits of the application of the SD methodology to the issue of non-profit sustainability.

4.1 Facilitates recognition of the "big picture"

From the above, it can be seen that the non-profit sector, and all organisations embedded in it, have to deal with high degrees of dynamic complexity and are vulnerable to the influence of many variables. In addition, the continuous feedbacks and information flows between these variables can render attempts to examine the sustainability of NPOs from a fragmented or piece-meal approach as ineffective, with policies implemented from this perspective producing little change, none at all or change that is unintended.

This deficiency can be addressed by the ability of the SD modelling process to take a holistic perspective of the issue of non-profit sustainability, as well as its ability to encourage stakeholders to probe into the deeper lying issues that influence non-profit sustainability so as to "help us to learn about dynamic complexity, understand the sources of policy resistance, and design more effective policies" (Sterman 2001:10).

The large number of non-profit organisations that have to close down fairly shortly after opening their doors (Cornelius, Moyers, Bell, Brown & Scott 2011 cited in Hannum *et al*. 2011:17) indicates that the non-profit sector desperately requires more innovative and holistic approaches in the investigation of their sustainability; SD presents such an approach as it is specifically geared towards a holistic orientation in which projects are modelled at a higher level of abstraction (Rodrigues & Bowers 1996:217).

4.2 Creates learning laboratories for policy intervention

The simulation phase of the SD modelling process involves the creation of a model that depicts the stocks and flows identified by stakeholders as pivotal in influencing or sustaining the problem situation. Once the model is complete (which can occur after many cycles of revision, adaption and extension of the model itself) it is simulated to produce a time graph which reveals how the system will behave over time.

If unsatisfactory progress of the system over time is depicted, stakeholders and policymakers (and the modelling team as well) must, based on the time analysis, suggest possible policies that can be implemented so as to contribute to more positive progression of the system over time. These policies are then incorporated into the model, which then undergoes another round of simulations to identify how the system will behave once such policies have being implemented. If it proves to be beneficial, these policies can be applied to the real world system on which the simulation and model was based. If the policies produce no benefits, or lead to undesirable system behaviour, the team must then seek alternative policies that, once simulated, will produce more beneficial system behaviour.

In this way, such simulations afford the modelling team, stakeholders and policymakers the flexibility not only to make crucial discoveries about the underlying structure of the problem situation, but the simulation process itself allows them great flexibility and freedom to test out the interventions they come up with, without fear of the repercussions or wastage of resources that might have ensued had they applied such interventions in the real world setting.

As Sterman (2006:511) asserts: “Simulations provide low-cost laboratories for learning. The virtual world allows time and space to be compressed or dilated. Actions can be repeated under the same or different conditions. One can stop the action to reflect. One can make decisions

that are infeasible or unethical in the real system. Participants can receive perfect and immediate outcome feedback. In one afternoon, one can gain years of simulated experience."

NPOs who are already dealing with uncertainty and varying degrees of internal turbulence cannot run the risk of implementing policies that may deplete them of their already scarce and thus precious resources. Therefore, they need to be assured that policies they do implement, will produce some kind of benefit and will not lead to more losses than they can cope with. The repeated simulations will enable non-profit policymakers to be warned of possible deficiencies inherent in particular policies before they are applied in the real world (Murthy, Gujrati & Iyer 2010:21), thus preventing unnecessary wastage of resources.

Once the simulated policies are eventually applied in the real world, the polices themselves will lead to changes in the structure of the system that have to be incorporated into the previous model to allow it to be as accurate a representation of the changed circumstances as possible. This will create a learning laboratory for policymakers, as they will be able to adapt the model, run the simulations and continuously assess the behaviour of the system as time progresses both in the real world and the simulation world (Sterman 2006:511).

This will contribute to continuous and active learning in and about the organisational system (Sterman 2001:21) without the need for external consultants who may not know the intricacies of the system or problem situation, and who often disappear once the policies they advocate are implemented, regardless of whether those policies were beneficial or not.

4.3 Represents a move away from either-or approaches to non-profit sustainability

The combination of qualitative and quantitative tools and methods utilised by the SD modelling process provides a departure from the tendency to investigate non-profit sustainability issues from either a quantitative perspective or a qualitative perspective alone. As Hirsch *et al*. (2007:252) assert: "By incorporating both types of variables into a model, SD allows us to treat [both types of insights] as equally valid as empirical research and submit these ideas to logical scrutiny."

As explained earlier, the initial stages of defining the problem, developing a dynamic hypothesis and even the formulation of the simulation model, require active engagement with all relevant

stakeholders and policymakers immersed in the problem situation. Here, the emphasis is on trying to understand the structure of the problem situation from as many perspectives as possible so as to develop a model that is highly realistic. The methods used to understand the problem situation at this level of intensity are typically qualitative in nature, such as the interviewing of policymakers and stakeholders, focus group sessions with all affected parties and the extraction of themes of major importance from all analysed data that is eventually accommodated in the model.

The estimation of parameters for each stock and flow comprising the SD model brings into play the quantitative elements of the SD modelling process which, with the accompanying simulations, bring a degree of rigor and validity to the process that would have been absent if such investigations were based on qualitative means alone. As Radzicki and Trees (1992:543) state: "…because the relevant loops are required to be translated into computer source code, the institutionalist is forced to state them in the precise and universal language of mathematics. This ensures that they can be unambiguously examined for logical consistency, shown to others, debated, but not changed without explicit action."

SD software is also able to accommodate the influence of feedback loops in understanding the behaviour of the system, and is therefore suitable for understanding the nonlinear features of such systems (Forrester 2007:366) - something that cannot be ignored when investigating dynamically complex social systems and related issues, such as the sustainability of NPOs. This goes beyond the deficiencies of earlier quantitative methods which failed to "make adequate linkages to the mental databases of practicing managers. Traditional quantitative methods have not incorporated the feedback structure surrounding decision-making." (Forrester 1998:9)

4.4 Powerful tool for overcoming bounded rationality

The non-profit sector is vulnerable to a high degree of dynamic complexity and there are many variables that influence the sustainability of NPOs. With all this complexity, it becomes difficult for the human mind to understand the overall effect of such feedback influences on the system as a whole, a situation sometimes referred to as 'bounded rationality'.

The idea of bounded rationality asserts that humans are unable to make decisions based on all the information available to them when such information is especially plentiful. In such cases, they process available information in manageable cognitive packages which ultimately cannot take cognisance of the full array of feedback information flows present in that situation, or the

time influences and delays inherent in such information flows (Radzicki & Trees 1992:547). Therefore, their perception of a particularly complex issue, situation or problem tends to be faulty, fragmented and an inaccurate representation of reality.

Thus, our cognitive abilities are deficient in dealing with real world complexity (Sterman 2006:510). In the face of such complexity, the ability to solve feedback (and thus stock and flow) dilemmas is becoming increasingly central to decision-making (Gonzalez & Wong 2012:3). Undoubtedly, it is the human mind's inability to compute large amounts of dynamic complexity that has been one of the impediments to understanding the sustainability of NPOs. The models created in the SD modelling process and the ensuing simulations will be able to counteract the effects of policymakers' bounded rationality.

They do so by being able to incorporate a great number of variables, as well as the information flows and time delays between them and other nonlinearities (Hjorth & Bagheri 2006:81) into a single, cohesive model that can then be simulated to see how all these variables and the interactions between them contribute to the system's behaviour across a particular time period. This is supported by the fact that simulation-assisted research is now being recognised as the "third branch of science (after theory and experiment)" (Sterman 2006:511) due to its many benefits for the understanding of a wide spectrum of issues.

5. CONCLUSION

The literature indicates that there are many benefits to applying a systems thinking methodology of understanding the issue of non-profit sustainability in a more holistic manner than has been done before. SD seems a worthy tool in this endeavour, due to its capacity to incorporate a wide array of variables and the feedbacks between them, into a single model which can then be simulated to examine the system's behaviour over time.

As such, it is useful, not only in understanding non-profit sustainability, but for understanding contemporary managerial issues that demonstrate similar levels of complexity. Hence, a better understanding of the tools and process of SD will be a beneficial weapon in any managers' arsenal, especially for dealing with the continuous change that characterises most organisations. A critique of such a methodology, as well as the results of its application in understanding non-profit sustainability in a particular organisation, will form the point of departure of future papers.

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