THE TAMING WICKED PROBLEMS FRAMEWORK: REFLECTIONS IN THE MAKING

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Abstract

Over the last four years a community-university partnership in the Limpopo province, South Africa, has co-generated a framework for building resilience to complex challenges called the Taming Wicked Problems Framework. The Framework was developed through experiential learning during a pilot project designed to improve the transitioning of a community-based organisation from the now outdated Abstain, Be faithful, Condomise HIV prevention strategy to the contemporary combination HIV and AIDS risk reduction. This article reflects on how the Framework can contribute to developing community-university resilience to wicked problems and/or Black Swan events using case material from the pilot. Wicked problems and/or Black Swan events are (a) complex phenomena; (b) there are often no solutions to the challenge/s they present, but resilience to 'tame' their impact can be co-generated; (c) this field of engaged scholarship is underdeveloped and (d) there is value that community-university partnerships can leverage from the engagement. The conclusion indicates that the Framework is an innovative contribution to engaged scholarship that responds to complex societal challenges by building resilience to the challenge, rather than trying to solve them.

Keywords: Black Swan events; community engagement; complexity; HIV and AIDS; multi-ontology; resilience; unknown unknowns

1. INTRODUCTION

This article reflects on the potentials of the Taming Wicked Problems Framework (henceforth 'the Framework') to contribute to processes of developing resilience to 'wicked problems' (Rittel and Webber, 1973) and/or 'Black Swan' events (Taleb, 2007) in the context of engaged scholarship and Mode 2 knowledge generation — with 'Mode 2' understood to be knowledge co-generation “for the sake of social change and transformation” (de Beer, 2014:133). The Framework was constructed using a multi-ontology lens, with “ontology (the nature of the system) determin[ing] epistemology (the nature of possible knowing)” (parentheses in the original text, Snowden, 2011:143). The multi-ontology Framework was designed to enable a community-university partnership to have the dexterity to move beyond the constraints of the conventional scientific paradigm associated with Newtonian reductionism when the ontological context necessitated it.

The reason for developing a multi-ontology Framework is that whilst the conventional Newtonian reductionist paradigm has generated extraordinary gains in predictable, stable ontological contexts, it has been argued that in unstable, complex contexts this ontological perspective is inappropriate (Weaver, 1948). This paradigm is inappropriate in complex contexts because it is restricted to parameters of scientific enquiry that rely on identifying and responding to linear, cause-effect relationships between phenomena as the basis for engineering predictable, downstream outcomes. In unstable, complex contexts which are influenced by nonlinear relationships between phenomena that generate unpredictable outcomes the predictive capacity is severely, if not completely, diminished which has both ontological and epistemological implications (Cole, 1999).

Not only is the dominant, reductionist ontological / epistemological scientific method unsuited to challenges containing some nonlinearity, the scientific community tends to uncritically favour this paradigm, irrespective of context (Kuhn, 1962). This represents a potential Achilles' heel within the body of knowledge associated with engaged scholarship. The Framework was developed to absorb this potential scientific Achilles' heel within engaged, Mode 2, scholarship.

In this instance the Framework was applied by a community-university partnership in the Waterberg District, Limpopo Province, South Africa to contribute to efforts that were being made by a community based organisation (CBO) to transition from the outdated Abstain, Be faithful, Condomise (ABC) HIV prevention strategy to combination HIV and AIDS risk-reduction that the National Department of Health (NDoH) is now implementing (Burman and Aphane, 2016a).

This article is structured in the following way: first, the relevance of context is introduced, using wicked problems and Black Swan events as metaphors of significance in the 21st Century. Second, the notion of complexity is presented as the theoretical foundation for working in these types of contexts. Third, the method of engagement — the Framework — and the case material is provided as a basis for the discussion. Finally, a discussion is presented which reflects on (a) the utility of the Framework for building resilience in the context of wicked problems and/or Black Swan events; (b) the community-university partnership opportunities that the Framework enables and (c) implications for engaged scholarship and policy.

2. LOCAL WICKED PROBLEMS AND GLOBAL BLACK SWAN EVENTS

There are known knowns; these are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know. Former US Secretary of Defense, Donald H. Rumsfeld (2002)[1]

[1]This excerpt has become famous. It was made on 12th February 2002 at a US Department of Defence News Briefing. The full transcript is available at http://archive.defense.gov/Transcripts/Transcript.aspx?TranscriptID=2636

In this article wicked problems and Black Swan events are used to emphasise that co-generating knowledge that has utility to community-university partnerships requires that the real-world context of the engagement be critically scrutinised from an ontological perspective ('the nature of the system') prior to taking action. The reason for critically scrutinising the ontological context prior to engagement is to ensure that the decisions that are being taken — and the epistemological parameters of the subsequent actions — are contextually relevant. In South Africa, much like the rest of the world, this is becoming increasingly important as local communities are facing challenges that contain some nonlinear, complex dynamics — including 'unknown unknowns'.

2.1 Wicked problems

The expression 'wicked problem' was first articulated by Churchman (1967), but is most commonly associated with Rittel and Webber (1973) in the context of urban planning. Since that time, the notion of a wicked problem as a relevant concept in the 21st Century has grown exponentially and is now referred to in policy documents (Head and O'Flynn, 2015). Wicked problems are understood to represent “any complex issue which defies complete definition and for which there can be no final solution; such problems are diabolical in that they resist the usual attempts to resolve them” (Brown, Harris and Russell, 2010:302). Wicked problems also have the following characteristics: the source of the problem is contested; the problem itself is difficult to identify; the problem normally becomes evident with hindsight and attempts to solve it can produce unexpected — and sometimes negative — impacts (Mertens, 2015); also see (Sharts-Hopko, 2013).

2.2 Black Swans

About 300 years ago in Australia, the first black swan was observed by a European. This caused alarm within the European scientific community. Until that time, only white swans had been observed. Therefore, Eurocentric scientific convention demanded that all swans should be white. The empirical observation of a black swan — which had no pre-defined category into which the scientific community could situate it — is the source of a philosophical debate surrounding the nature of knowledge in the context of 'unknown unknowns' (Taleb, 2007). Taleb suggests that Black Swans are typically: (1) outliers (situated outside the realm of regular expectations) because nothing in the past can convincingly point to its possibility; (2) the likelihood of them occurring are medium risk, but they can produce extreme, localised impacts; and (3) explanations for their occurrence are derived after the fact, making it explainable only in retrospect (i.e. – not predictable prior to the event).

The Black Swan debate now spans multiple disciplines including, inter alia: climate change (Cheung, Pauly and Sarmiento, 2013), parasitology (Khan and Fallon, 2013), ecology (Wintle, Runge and Bekessy, 2010), economics

(Taleb, 2007), management (Ramasesh and Browning, 2014) and policy making (Pawson, Wong and Owen, 2011). Not only does the concept of the Black Swan influence multiple disciplines, it has been argued that in the era of globalised interdependencies these medium risk, high impact events are likely to increase exponentially (Masys, Ray-Bennett, Shiroshita and Jackson, 2014). Whilst the convergence of global forces generates the Black Swan, the impact is experienced locally — and innovative, locally appropriate resilience strategies are required to counter the impacts (Chambers, 2014).

2.3 The uniqueness of the context that wicked problems and Black Swan events generate

Wicked problems closely resemble the Department of Science and Technology's Fifth Grand Challenge (Department of Science and Technology, 2008) and Black Swan events are similar to the shocks that the National Development Plan (NDP) warns of (National Planning Commission, 2013). The unique denominator that binds them together is that they represent contexts which contain some nonlinear complexity and/or 'unknown unknowns' — which has both ontological and epistemological implications.

The implications are straightforward: in contexts that contain some nonlinear complexity and/or 'unknown unknowns', being able to rely on past experiences to enable evidence informed predictions is an unreliable basis for action. These types of challenges require a mind-set that is inclusive of 'multi-ontology' perspectives (Snowden, 2005). It also requires a mind-set that focuses on developing resilience to a challenge, or to “tame its growl” (Churchman, 1967:B-141) because often there is no solution — but building resilience capacity at the local level is a realistic proposition (Termeer, Dewulf, Breeman and Stiller, 2013). Working with complexity represents one methodological bridge between working in unpredictable, multi-ontology contexts and building resilience to these types of challenges.

2.4 Nonlinear complexity

Linear systems, which are at — or close to — equilibrium, are predictable because they are impervious to small, novel stimuli. Nonlinear systems which are far from equilibrium are susceptible to change when they encounter small, novel stimuli (Dunn, Brown, Bos, and Bakker, 2016). In both of these types of system, the outcome is a consequence of discrete, mediating relationships, Figure 1.

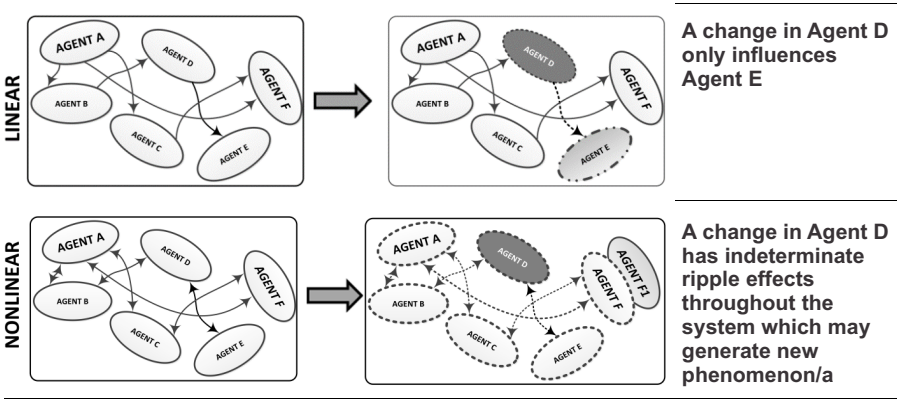

Figure 1: Systemic susceptibility to small, novel stimuli

Figure 1 indicates that a small change produces variable impacts within different types of systems. If a linear system is fully understood, it is possible to predict how a change in one part of the system will influence another part of the system, thereby enabling strategies to be designed and implemented in order to engineer pre-defined outcomes. However, in the nonlinear scenario, change that emerges from one part of the system has ripple effects within the system — due to the interconnected feedback loops between the agents within the system — generating indeterminate impacts that can influence downstream outputs or outcomes. Not only may indeterminate impacts occur, it has been shown that the ripple effects within the system can generate the impetus required for new phenomenon/a to emerge (Gould and Vrba, 1982).

Complex systems exhibit characteristics generated by both ordered linear, cause-effect relationships and unordered, nonlinear relationships between phenomena that co-constitute the properties of the system. This means that complex problems are not responsive to methodological approaches that overlook the interconnected, nonlinear relational properties and associated feedback loops. This indeterminate mix of linearity and nonlinearity means that complex systems demonstrate “predictable patterns [….] created by emergent system behaviours, or the aggregation of individual agent behaviours” that influence downstream outputs and outcomes — called 'emergence' in the jargon of complexity — (emphasis added, Sarriot and Kouletio, 2014:270). Agents are understood to be anything that influences the system and aggregations emerge from the feedback mechanisms between — and interactions of — the agents (Pincus and Metten, 2010). These dynamics give “the system a degree of unpredictability” (Stirzaker, Biggs, Roux, and Cilliers, 2010:600). The 'degree of unpredictability' emerges because in complex systems, both the “agents and the system constrain one another, especially over time” rendering the system less stable than its ordered counterparts (Snowden and Boone, 2007:73).

A critical component of the potentials of the partially constrained aggregations within complex systems is that they demonstrate both self-organising and self-regulating, nonlinear properties which can create changes in emergent outputs and outcomes which may not be proportional to the changes in input (Shiell, Hawe and Gold, 2008). These mutually constraining influences provide an innovative opportunity for interventions if both the properties and the characteristics of the emergence are managed appropriately (Snowden and Boone, 2007).

2.5 Managing complexity

Change in complex systems is generated by the interplay of both the positive, amplifying feedback and the negative, dampening feedback between the agents which co-constitute the properties of the system. Managing complex systems requires influencing the systemic properties, rather than focusing on the descriptive emergence represented by the characteristics of the system, because overlooking the "mechanisms that continually reinstate [the original feedback loops] are likely to be futile, resulting only in short-term changes" (Coleman, Vallacher, Nowak and Bui-Wrzosinska, 2007:1549). This is the underlying logic of the Framework.

3. CONTEXT OF THE PILOT AND METHODOLOGY

3.1 The context of the pilot

The Framework was developed and applied during an on-going engaged research project that began in 2013 between the Rural Development and Innovation Hub, University of Limpopo (UL) and the Waterberg Welfare Society (WWS). The details that are reported on below represent a brief overview of the findings that are relevant to this article, and other aspects of the collaboration have been reported on elsewhere (Burman and Aphane, 2016a).

WWS is a CBO that focuses on improving wellness in the context of HIV and AIDS. They represent a significant CBO in the Waterberg District, employing approximately 65 people who work across the prevention, treatment and care continuum. The wicked problem that was identified by the community partner was the pervasive influence of the now outdated 'Abstain, Be Faithful, Condomise' (ABC) health promotion message. ABC was first endorsed by the World Health Organisation in 1992 (WHO, 1992) and then promoted globally by the 'United States President's Emergency Plan for AIDS Relief' (PEPFAR). With increased coverage of antiretroviral medications the epidemiological context altered significantly and ABC was phased out. Simultaneously, the South African National AIDS Council (SANAC) began promoting "combination prevention" (South African National AIDS Council, 2012:14). However, the legacy of ABC remained a wicked problem for WWS because it was frustrating their efforts to promote wellness in the new epidemiological context (Burman and Aphane, 2016a).

In response to this the university component of the partnership developed a multi-ontology theoretical framework to build resilience capacity to reduce the impact of the ABC-legacy (Burman, Aphane, Mtapuri and Delobelle, 2015). The theoretical framework has gradually been transformed through experiential learning during the pilot into a more definitive statement which has been labelled the Taming Wicked Problems Framework.

3.2 The methodological approach applied during the pilot[2]

A non-probability expert sampling technique was used to identify twelve WWS employees, representing all of the Departments, who would participate in pilot. During the first twelve months, fifteen dual moderator, semi-structured group discussions took place using a combination of local languages — Sepedi and Setswana — and English. The qualitative findings were then translated and back translated twice before being coded and stored using Nvivo 10. Six of the interviews focused on the Cynefin framework which were coded using a thematic content analysis technique (Elo and Kyngas, 2008) and nine focused on identifying the emergence that occurred during that period using the Causal Layered Analysis (CLA) technique (Bishop and Dzidic, 2014).

4. THE TAMING WICKED PROBLEMS FRAMEWORK

The design of the Framework was influenced by a theoretical statement in the Harvard Business Review (Snowden and Boone, 2007) and other literature relating to transdisciplinary complexity. Implementation is straight forward and the most up to date description of the process is provided below, Figure 2, with a summary in Table 1.

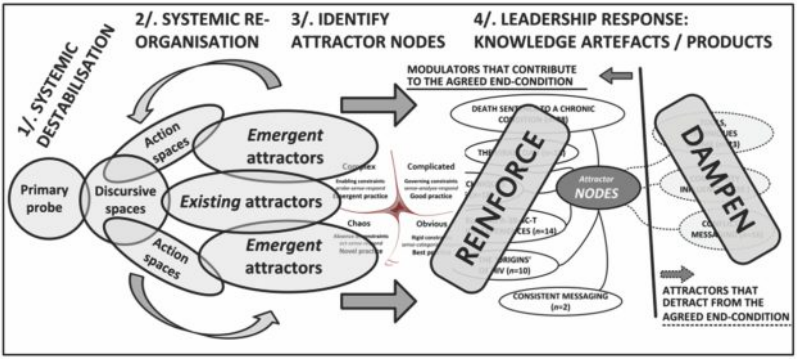

Figure 2: the Taming Wicked Problems Framework

In the sections below an overview of each aspect of the Framework is provided.

[2]Ethical clearance was secured by the Turfloop Research and Ethics Committee prior to implementation.

4.1. Establishing if the challenge contains some nonlinearity

Prior to implementation, discussions with WWS indicated that the ABC-legacy demonstrated many of the characteristics of a wicked problem. This suggested that there was no clear cut solution to the challenge so it was necessary to develop a resilience response that was designed to 'tame' the problem — rather than try and solve it'.[3]

4.2 Agreeing an end-condition

Prior to implementation an end-condition was agreed by the partnership. The end-condition is a broad statement about what the ambition of the partnership represents. The end-condition is a deliberately ambiguous statement because the nonlinearity contained within the complex systems means that it is not possible to precisely predict what will emerge during the intervention. Using the expression end-condition — as opposed to working towards a specific, pre-defined objective — means that as resilience opportunities emerge, appropriate response strategies can be developed and applied (Signal, Walton, Ni Mhurchu, Maddison, Bowers, Carter, Gorton, Heta, Lanumata, McKerchar, O'Dea and Pearce, 2013). In this instance the agreed "end-condition" was anything that reduced the "aggregate community viral load" (Burman and Aphane, 2016a:95).

4.3 Systemic destabilisation

Once the end-condition has been agreed the next step entails identifying a catalyst that destabilises the system. Destabilising the system is a strategy used to shift the system from a state of homeostasis to a far from equilibrium state. Creativity and change is more likely to occur when complex systems are in the latter state (Dunn *et al.,* 2016). Identifying a suitable catalyst may take time and trial and error, but the investment is worthwhile. The catalyst is called a 'Probe' and in this instance it was an educational package containing up to date information about the relationships between human beings, the lived environment and the HI virus.[4]

4.4 Systemic re-organisation

As was noted above, complex systems are unstable, self-organising and self-regulating. In this instance, after the destabilisation the participants began a process of absorbing some of the information contained within the educational package (self-organisation), discussing the opportunities contained within that information and gradually applied it to their work with their clients (self-regulation).

[3]With the benefit of hindsight — now that the Cynefin framework has been tested in the field, see below — it is suggested that the Cynefin framework provides a useful heuristic to determine if the challenge contains some nonlinearity. This provides decision makers with a more dynamic tool for deciding what sort of engaged response is required, rather than relying exclusively on comparing the challenge with a description of a wicked problem or a Black Swan event.

[4]In Figure 3 the Probe is labelled as the Primary Probe because during the intervention it is likely that other probes may emerge — either organically or deliberately — which could destabilise the system further.

During this phase the participants were re-examining their prior knowledge stock, or "sensori-memorabilia" (Burman, Mamabolo, Aphane, Lebese and Delobelle, 2013:22)[5], influenced by the information contained within the educational package and their experience of working within their local context. This phase has similarities with adult learning literature (Wals, 2007); praxis (Freire, 1973) and Frame Theory (Goffman, 1974) — thus is influenced by processes associated with selective attention (Drew, Vo and Wolfe, 2013) and sense-making (Weick, 1995).

During this phase the university component of the partnership did not influence the participants' opinions about, or application of, the different parts of the educational package. The university team did make numerous visits to monitor the influence of the educational package, but they did not interfere with its uptake, or application, by WWS. This is essential because if the sense-making process is to have resonance with both local culture and commensurate social practices, it must be developed through *localised* sense-making and not by external agents, such as the university component of the partnership.

4.5 Identifying the emergent attractors

As was noted above, in nonlinear complex systems the agents are constrained by the system and the system is constrained by the agents which is "reflected in patterns of behaviour, that is, shapes in space or movements over time, which are never exactly repeated but are always similar to each other" (Stacey, 2003:44). This means that there are multiple far from equilibrium clusters within the system. These clusters are called attractors (Gilstrap, 2005) and have been re-labelled by the partnership so that the meaning is more accessible to people unfamiliar with the specialist language of complexity. Attractors that contribute to achieving the end-condition have been labelled 'wellness modulators' to distinguish them from 'attractor nodes' that detract from achieving the end-condition. The attractors were identified by analysing the narrative recordings from all of the follow-up interviews using the CLA technique. After the potential attractors were identified by the university component of the partnership they were presented to the WWS participants for validation.

4.6 Decision making: the Cynefin framework (between Phases 3 and 4)

The Cynefin framework, Figure 3, is a decision making heuristic designed to enable leaders to clarify whether situations are stable and predictable (ordered) or unstable and complex (unordered) so that appropriate epistemological leadership responses to the different types of ontological context can be designed and implemented (Snowden and Boone, 2007).

[5]"The expression 'sensori-memorabilia' is used as a metaphor for the historically acquired body of knowledge, information and experience that is used as a sensemaking repository that is selectively applied as systemic responses to internal or external feedback that seeks to deliberately problematize the popular — yet overly linear — notion of 'sensori-data' in a naive Pavlovian sense" (Burman et al., 2013: 22).

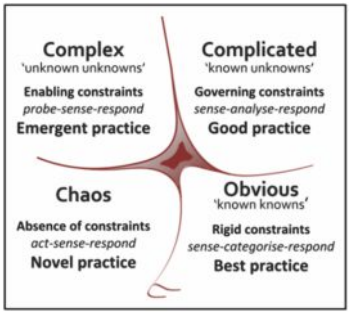

Figure 3: The Cynefin framework. Source: adapted from Snowden and Boone (2007:72)[6]

The Cynefin framework is comprised of four quadrants. 'Complicated' and 'Obvious' represent ordered domains in which linear, cause-effect relationships generate predictable outcomes. The 'Obvious' domain represents a decision making context that contains 'known knowns' — the system is *at* equilibrium — and should be responded to with *best* practices. The 'Complicated' domain represents a decision making context in which there are 'known unknowns' — the system is *close to* equilibrium — which should be responded to with specialist expertise and appropriate *good* practices. The other two domains — 'Complex' and 'Chaos' — contain some nonlinearity that generate unpredictable emergence — in both instances the system is *far from* equilibrium. 'Complex' corresponds with 'unknown unknowns' which should be responded to with *experiential action research* responses. The domain of 'Chaos' should be responded to with novel practices and then monitored for opportunities to stabilise the system.

At this stage the Cynefin framework was used to evaluate the leadership decisions that were required in preparation for Phase 4 of the pilot. To achieve this each of the challenges that related to the ABC-legacy were positioned on the Cynefin framework by the WWS participants. This provided the partnership with insights into the ontological basis for the next phase. The exercise was also used as a mid-term monitoring and evaluation tool. To achieve this, movement of any of the challenges on the Cynefin framework from one domain to another was identified and the movement was explained in detail by the participants. From the perspective of managing complexity this is relevant because any movement from far from equilibrium, nonlinear unorder to linear order — which is either close to, or at, equilibrium — represents a de facto indicator that resilience capacity that contributes to the agreed end-condition is developing (Burman and Aphane, 2016c). This approach parallels the observation by Pawson *et al.* (2011:543) that successful policy making represents “the steady conversion of 'unknowns' to 'knowns'".

[6]The 'unknown unknowns', 'known unknowns' and 'known knowns' have been added by the authors of this article. https://en.wikipedia.org/wiki/Cynefin#/media/File:Cynefin_as_of_1st_June_2014.png

4.7 The leadership response

Following the confirmation of the attractors by the WWS participants, the next phase included developing strategies to reinforce the wellness modulators and to dampen the impact of the attractor nodes that detract from achieving the end-condition. This involves an interdisciplinary approach to create artefacts that can be used to either reinforce or dampen the impact of the emergent attractors. An interdisciplinary approach is preferable because it increases the creative potentials of the process (Andriani and Cattani, 2016). Once the knowledge artefacts are developed as prototypes they are tested in the field using 'safe-fail' techniques so that movement towards the end-condition is accelerated (Dickens, 2012). This phase of the pilot is currently on-going and it is hoped that knowledge products can also be developed as a form of third stream income for the partnership.

Table 1: A reflection on the Taming Wicked Problems Framework from the perspective of engaged research

Phases in the Framework	Reflections based on the experiential learning from the pilot	
	Partnership responsibilities	Contribution to the achieving the agreed end-condition
Establishing if the challenge is wicked using the Cynefin framework	Joint	If it is wicked, it is probably complex. If it is complex deal with it through an appropriate ontological / epistemological framework. Do not fall back on the default, Newtonian comfort zone.
Agreeing an end-condition	Joint, but primarily community	Enables diverse and variable creativity. Does not unnecessarily restrict options. Provides a flexible framework for enabling heterogeneous mini-resilience strategies to emerge during the intervention.
Systemic destabilisation	University, but agreed by community leadership	Catalyses the re-framing process. In this instance, an education package was used. Creativity is required to identify a suitable catalyst, or safe-fail strategies can be deployed.
Systemic re-organisation	Community	Iterative experiential learning as the participants transformed new concepts (the educational package) into social practices (promoting wellness within their community). Also facilitates an organic, locally relevant channelling of the concepts so that the transformation process is hardwired to incorporate and reflect local cultural nuances.
Identifying attractors	University, validated by WWS	Identification of action spaces for the next phases.
Decision making: the Cynefin framework	Facilitated by the university	Identification of action spaces for the next phases. Also a monitoring and evaluation device.
Leadership response	Joint, and new partners are ideally recruited to increase creative potentials of the process	Knowledge artefacts and knowledge products are developed to increase the impact they have on the end -condition. When possible, dampen the impact of the attractors that detract from achieving the end-condition.

Table 1 summarises the Framework rationale. In the section that follows a brief description of the impact of this application of the Framework is provided.

5. IMPACT OF THE FRAMEWORK

An overview of the impact of the Framework including the emergent attractors and the movement within the Cynefin framework are presented below.

5.1 Emergent attractors

During the pilot four dominant wellness modulators that contributed to the agreed end-condition and one dominant attractor node that detracted from that ambition emerged. There were also technical attractors that emerged, Table 2.

Table 2: Abridged version of the findings. Source: Burman and Aphane (2016a:100)

Emergent phenomena	**The factors associated with achieving the end-condition**
Wellness modulators	**Emergent phenomena that contributed to achieving the agreed end-condition**
HIV no longer being perceived as a death sentence. It was now perceived to be a chronic condition	Management of HIV; disclosure and testing.
The viral load	The viral load modulator was used to explain anomalies such as false negative test results, the Window period and serodiscordant couples.
Relating the new knowledge to prior experiences	This related to the way in which people at WWS and the broader community were able to re-evaluate their prior experiences in light of the new knowledge.
The origins of HIV	This refers to the scientific origins of HIV approximately 100 years ago. Based on the narrative, this was a very difficult wellness modulator to understand. However, during the validation process with the community partner it became apparent that the strength of this wellness modulator was that it was a powerful counter-argument to local beliefs systems known as 'ritual defilement', or more specifically 'makgoma'. For details of 'makgoma' see Shirindi and Makofane (2015).
Attractor nodes	**Phenomena that detracted from achieving the end-condition.**
Community influence	This affected many aspects of HIV-related issues, but by far the biggest influence was on the well-being of children and adolescents who are HIV positive.
Technical attractors	**Tools and techniques that could reinforce the wellness modulators**
Time, tools and techniques to apply the learning with the broader community	A few Departments had managed to develop tools and/or techniques to apply the new information contained in the educational package, but there was a major challenge with resources to achieve this. Developing the information into knowledge artefacts or products is the current focus of the pilot.

Table 2 provides an overview of the emergence during the twelve month period after the educational package was delivered. The four wellness modulators are all new phenomena that WWS began applying as educational heuristics in their work. The 'community influence' attractor node that detracts from achieving the end-condition existed prior to the pilot and it is uncertain at this time what impact the emergent wellness modulators will have on the 'community influence' attractor node. The technical attractor — 'time, tools and techniques' — is the focus of the current work.

5.2 Monitoring and evaluation of the pilot using the Cynefin framework

After the attractors had been validated by WWS, the participants re-examined the local HIV-landscape using the Cynefin framework as a critical monitoring and evaluation heuristic. They reported that during the twelve month period after the educational package was delivered there was movement of eight issues that detracted from achieving the end-condition towards the ordered domains of the Cynefin framework ('Obvious' and 'Complicated'), but twelve themes remained in the unordered 'Complex' domain and two issues remained in the domain of 'Chaos', Figure 4.

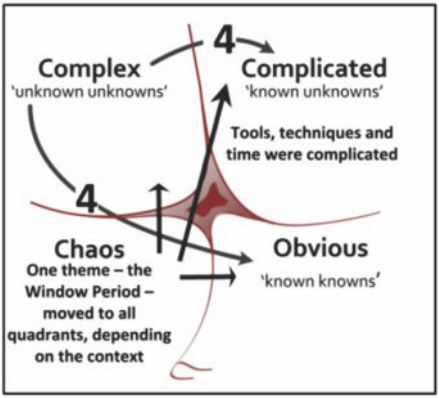

Figure 4: Movement of themes within the Cynefin framework. Source: Burman and Aphane (2016c)

Figure 4 indicates that there was some movement from the nonlinear, unordered domains towards the linear, ordered domains of 'Obvious' and 'Complicated'. This suggests that at that time the pilot had not co-generated solutions to the ABC-legacy challenge, but some resilience was developing because movement from 'unknowns' to 'knowns' is a de facto indicator of resilience capacity (Pawson *et al.,* 2011). The issues that are now in the 'Obvious' domain are being applied by WWS personnel and the 'Complicated' theme of developing tools and techniques to apply the new wellness modulators is the current aspect of the pilot.

These findings relating to attractors and movement within the Cynefin framework are used as the basis for the Discussion in the context of wicked problems, Black Swan events, complexity and engaged scholarship.

6. DISCUSSION

Wicked problems were introduced because typically they have no clear cut solution and often they contain some nonlinear complexity. Black Swans were introduced because they represent medium risk, high impact events — generated by global convergences — that are experienced locally and contain some 'unknown unknowns'. Both wicked problems and Black Swan events represent the context of some engaged research activities. Complexity was introduced as a perspective that offers an opportunity for working with nonlinearity and 'unknown unknowns'. The Framework was introduced because it is a multi-ontology construct that is designed to build localised resilience to challenges that contain some nonlinear complexity and/or 'unknown unknowns'. This enables two points to be discussed from the perspective of applying complexity to build resilience to wicked problems and/or Black Swan events and four points with regard to other potential benefits.

6.1 The utility of the Framework for developing resilience strategies in the context of wicked problems or the impact of Black Swan events

In the case material that has been described above, four novel wellness modulators emerged during the pilot. The wellness modulators emerged through both linear and nonlinear feedback from within the system (the WWS work environment). The process of emergence was generated entirely by WWS employees, influenced by interactions with their clients and reflective sense-making. The wellness modulators make sense in that particular locality and it was impossible to predict at the beginning of the pilot what characteristics they would have — or if they would emerge at all. The wellness modulators have not provided a solution to the challenge identified by WWS, but are contributing to building localised resilience to it.

From the perspective of engaged research this suggests that (a) when attempting to confront wicked problems and/or the impact of Black Swan events, taming them is a realistic ambition because — in this type of context — there may be no solution to the challenge; (b) the identification of emergent wellness modulators did contribute to an agreed end-condition, so identifying them is relevant and (c) reinforcing the embryonic wellness modulators so that the impact is maximised is required because they represent emergent innovations which require nurturing.

This process requires (a) being prepared for some failure; (b) learning from the experience and implementing corrective measures; (c) being bold enough to acknowledge that whilst the partnership agrees what the characteristics of the end-condition are, the precise form is indeterminate and will only become apparent as an intervention gathers momentum and (d) acknowledging that uncertainty and serendipity play a dispositional role in the process — and

having the partnership capacity to respond to those unexpected opportunities with dexterity.

In the context of wicked problems or Black Swans, following in the genre of the quote from Pawson *et al.* (2011), above, when working with social complexity any movement from 'unknowns' to 'knowns' represents an indicator that resilience capacity is developing, Figure 5.

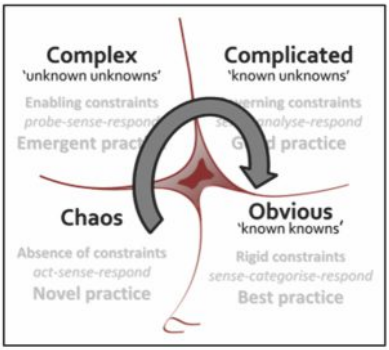

Figure 5: Movement from 'unknowns' to 'knowns' represent a *de facto* indicator that emergent resilience capacity is developing

The Cynefin framework provided a heuristic for monitoring — and to a lesser extent — evaluating the resilience that emerged during the pilot. In the case material that that has been presented there is evidence that some resilience capacity was being developed because there was movement from 'unknowns' to 'knowns'. However, with the emergence of the new attractor nodes, creative opportunities also developed. This suggests that there are two generic opportunities available when working with complex systems, Figure 6.

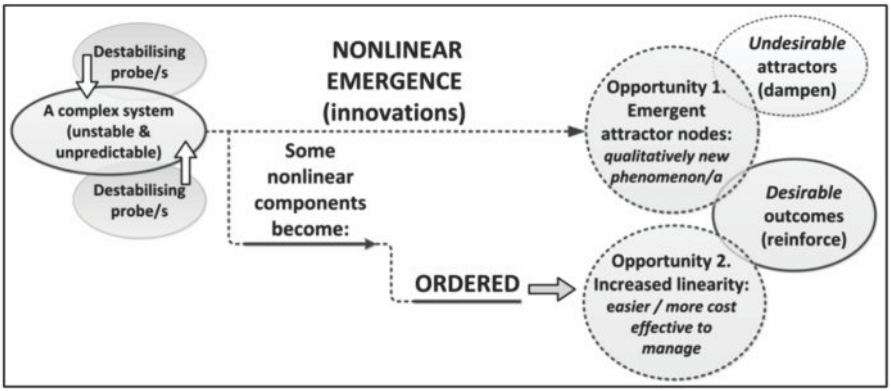

Figure 6: Two opportunities that partial constraints and instability enable

Figure 6 represents the two dominant opportunities that have been described. It also demonstrates that it is to be expected that unpredictable emergence is an inevitable component of the Framework design due to the ontological disposition of the complex system. This means that the intervention implementers must expect that wellness attractors, which contribute to the end-condition and attractor nodes, which detract from achieving the end-condition, are likely to emerge. In this sense, the Framework is pragmatic if the implementers are prepared to manage these different types of emergence appropriately. It also suggests that the Framework is hardwired to incorporate and respond to the unintended consequences of an intervention before they escalate into phenomena that have the potential to de-rail it.

6.2 The partnership opportunities that were identified

The Framework does not require specialist expertise and relies on joint, community-university application of skills and capacity. Tables 3 and 4 provide an overview of the skills and capacities that have been generated through the engaged pilot to date.

Table 3: skills that have been applied and developed during the pilot

<table>
<tr><th>Entity</th><th>Phase one (identifying and delivering the probe/s)</th><th>Phase two (community response)</th><th>Phase three (identifying attractors)</th><th>Phase four (implementing safe-fail initiatives to reinforce / destabilise the attractors)</th></tr>
<tr><td rowspan="3">Academic (theory)</td><td colspan="4">Complexity science, theory & complex adaptive systems.</td></tr>
<tr><td rowspan="2">Critical / analytical thinking skills & Problem Tree Analysis.</td><td rowspan="2">Social, or transformative, adult learning that is inclusive of ‘frame theory’.</td><td>Interviewing, transcription, coding, qualitative Grounded Theory analysis & Thematic Content analysis (CLA).</td><td>Primarily quantitative but also monitor using CLA (qualitative) to monitor for further changes in the landscape.</td></tr>
<tr><td>If possible augment with quantitative metrics.</td><td>Analysis of safe-fail methodology.</td></tr>
<tr><td rowspan="2">Academic (practical)</td><td rowspan="2">Applying theory to practice.</td><td rowspan="2">Iterative, participatory, experiential learning skills, Cynefin framework.</td><td>Qualitative and quantitative skills development.</td><td rowspan="2">Iterative, participatory, experiential learning skills.</td></tr>
<tr><td>Safe-fail methodology.</td></tr>
<tr><td rowspan="2">Community partner</td><td colspan="4">Complexity science, theory & complex adaptive systems.</td></tr>
<tr><td>Critical / analytical thinking skills, Problem Tree Analysis, Cynefin framework & opportunities to critically review their working practices.</td><td colspan="3">Hands on experience of safe-fail techniques and altered working practices.</td></tr>
<tr><td>Community-university partnerships</td><td colspan="4">Opportunities to disseminate work through alternative media; multidisciplinary working, other.</td></tr>
</table>

Table 4: capacity that has been applied and developed during the pilot

Entity	Capacities developed
Community partner	Evidence of ability to improve the local HIV and AIDS landscape; skills development; techniques development; increased innovation capacity.
Broader community	Improved HIV and AIDS landscape.
University (students)	Academic and practical experience; improved knowledge of HIV and AIDS risk - reduction strategies; confidence to develop home-grown solutions to local challenges; social responsibility development; mentorship; lea dership skills; project planning & implementation skills.
University (academics)	Fertile ground for research; publications; transdisciplinary working & community engagement opportunities; improved knowledge of HIV risk-reduction strategies.
The partnership	Strengthened relationships, trust and exposure to different knowledge systems contributing to an expansive form of action oriented science.
University (institutional)	Improved innovation capacity; improved HIV and AIDS landscape; opportunities to integrate teaching and learning with research (new knowledge can be included within different curricula); development of new community engagement strategies (replication of the process to other complex challenges); development of community partnerships if the students wish to transfer the approach to their communities.

Tables 3 and 4 provide an indication of the skills and capacities that the learning experience has involved. The multi-ontology Framework has provided opportunities to reinforce existing capacity and simultaneously required developing new skills and capacities.

6.3 Implications for engaged scholarship, the knowledge project and policy

Masys *et al.* (2014) have argued that wicked problems and Black Swan events are likely to increase in the future. The Framework that has been presented can be adapted to other community-university challenges and represents a novel addition to existing resilience strategies designed to 'tame' challenges that contain some nonlinear complexity and/or 'unknown unknowns'.

From the perspective of engaged research, wellness modulators represent novel, experiential knowledge artefacts that make sense in a particular context. Not only are they locally relevant artefacts, it is plausible that if they have wider appeal they could be transformed into third stream income generating knowledge products. This claim is made because a review of secondary sources indicates that similar attractors may have influenced the rapid, 10%, decline in HIV prevalence in Zimbabwe during the period 1997-2007 (Halperin, Mugurungi, Hallett, Muchini, Campbell, Magure, Benedikt and Gregson, 2011; Burman and Aphane, 2016b). Exploiting this opportunity requires further work, but holds potentials to generate benefits that can be accrued from the Framework.

As was noted above, Mode 2 knowledge generation is associated with knowledge “for the sake of social change and transformation” (de Beer, 2014:133) and the Framework is aligned to that aim. However, in the context of wicked problems and/or Black Swan events, there is a necessity to go beyond a single ontology interpretation of Mode 2 knowledge generation to

multi-ontology forms of Mode 2 praxis. The epistemic necessity to expand the response parameters to multi-ontology forms of Mode 2 praxis in the context of nonlinear complexity and/or 'unknown unknowns'.[7] The Framework is designed to facilitate the type of naturalistic dexterity, but further research is required to fully understand the implications from the perspective of the engaged, Mode 2 knowledge project.

The Department of Science and Technology's Fifth Grand Challenge argues that there is a requirement to improve insights into the "human and social dynamics [that] are at the core of nearly every major challenge facing South Africa" (Department of Science and Technology, 2008:23). At this stage the authors do not claim to understand all of the dynamics that enable the outcomes that have been reported on. However, by starting from nonlinear complexity and 'unknown unknowns', a novel intervention design that has generated some dynamic, innovative resilience strategies has been developed. A policy shift that reinforces the relevance of nonlinear complexity and 'unknown unknowns' — and the subsequent multi-ontology implications as an integral aspect of community-university partnerships may encourage more academic engagement in this field. It is also plausible that this investment could contribute to building resilience to the shocks that the NDP warns of.

6.4 Limitations

At this stage the bulk of the reflections are based on one case study, with some supporting secondary data. This does represent a limitation which needs to be rectified through other engaged research of this genre.

7. CONCLUSION

An argument has been presented that the Taming Wicked Problems Framework reflects a novel form of engaged research that can (a) contribute to building localised resilience capacity to 'tame' the impacts of wicked problems and/or the impact of Black Swan events; (b) more broadly, the Framework can contribute to developing community-university resilience in contexts that contain some nonlinear complexity — when the system is close to, or at, equilibrium — and/or 'unknown unknowns' — when the system is far from equilibrium — and (c) contribute to the scholarship of the engaged knowledge project. The Framework was presented along with findings from one case study. The Framework is underpinned by a multi-ontology perspective that responds to both the linear and nonlinear properties found in complex systems. The Framework also responds to systems that contain 'unknown unknowns'. The contribution that this reflection makes to the broader engaged knowledge project involves a brief argument that — in the

[7]The expression 'epistemic necessity' was prompted by a presentation made by Maistry and Lorten, (2016). They are acknowledged accordingly.

context of nonlinear global change — there is an epistemic necessity to expand the response options beyond the restrictive ontological parameters of the conventional, reductionist Newtonian scientific default setting to multi-ontology, Mode 2 perspectives that can contribute to co-generating resilience to intractable challenges, rather than trying to solve them.

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