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Ensuring Continued Enterprise Resilience: Developing a Method for Monitoring Health

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Abstract

In January 2015 the British Secretary of State for Defence stated that his department *"must not merely be match-fit, it must be permanently fit"* in order to be ready to meet the full range of operational tasks. This paper describes research that is being conducted in response to this challenge and that, once complete, will address key shortfalls in the evidence base required to support executive decisions-making. The aim of the research is to investigate how large and complex enterprises can be engineered to ensure continued resilience - i.e. that they will always be able to perform in the future environment. This paper also describes the development of a systems engineering approach (using hierarchical process modelling) for monitoring the health of the enterprise as an enabler for this continued resilience.

Keywords: Resilience; Enterprise Resilience; Enterprise Health Monitoring; Anticipatory Systems.

1. Introduction

In January 2015 the British Secretary of State for Defence stated that his department *"must not merely be match-fit, it must be permanently fit"* in order to be ready to meet the full range of current and future operational tasks. Clearly this is a very significant challenge and one that, whilst most-obviously evidenced in the operational domain has implications across the whole enterprise – from capability planning through acquisition to force generation.

It is postulated here that the solution to this challenge lies in engineering the Ministry of Defence (MOD) for resilience. Resilience has been the subject of much scholarly debate in the systems literature since Holling[1] first

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applied the concept in the context of ecosystems in 1973. Whilst he defined it as *"the measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters and still persist"* an increasingly commonly held view now is that resilience concerns *"the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions"*[2]. This later definition is coherent with how MOD defines survivability for military platforms as a combination of not being hit (susceptibility), not being damaged when hit (vulnerability) and the recovering quickly from damage (recoverability). These definitions reflect the fact that there are at least two types of resilience – robust resistance (also known as static resilience or ecological resilience) and agile adaptability (also known as dynamic resilience or engineering resilience)[3].

The application of resilience concepts at an enterprise level (also referred to as organizational resilience) – as inferred here – is not new. A systematic literature review using a Scopus search of business and management journal articles mentioning "organi*ation* resilience" revealed 62 papers, with the earliest being Mallak (1998)[4] and the ten most highly cited papers – Bhamra, Dani, & Burnard (2011)[5]; Crichton, Ramsay, & Kelly (2009)[6]; Ignatiadis & Nandhakumar (2007)[7]; Lengnick-Hall, Beck, & Lengnick-Hall (2011)[8]; Linnenluecke, Griffiths, & Winn (2012)[9]; Mallak (1998)[4]; O'Brien & Read (2005)[10]; Riolli & Savicki (2003)[11]; Somers (2009)[12]; and Winn, Kirchgeorg, Griffiths, Linnenluecke, & Gunther (2011)1[3] spanning subjects such as production, disaster prevention and crisis management, human resources, and business strategy and the environment.

However, within this corpus a very recent review by Annarelli & Nonino (2015)[3] focuses on strategic and operational management, which aligns closely with the research objectives here, and offers new ideas about research directions. This paper picks up on one of these research directions to investigate *"the impact of introducing information systems on organizational resilience"*.

The collation and processing of contextual information is at the heart of resilient systems and their anticipatory behaviour[4] - – *"behavioural changes the system is undergoing in the present … caused by events that have not happened yet but are entailed to happen in the future"*. Anticipatory behaviour is common in biological systems. For example, deciduous trees drop their leaves, shut down photosynthesis and withdraw their sap into their roots in the autumn in advance the freezing temperatures of winter. Whilst such behaviour can never guarantee success (i.e. winter-hardy plants can be damaged or killed by an early or late cold snap), it has been found to play a key role in taking action appropriate to the conditions.

Enterprise health is an area of increasing importance in the management science literature where it is recognised as a key enabler for sustainable performance – *"Performance is about delivering financial results in the here and now. Health is about the ability to do it year in, year out"*– and that companies that manage both performance and health are more successful than those who only manage health (by a factor of 2) and those who only manage performance (by a factor of 3)[17]. Whilst MOD monitors performance and risk quarterly and uses this information to support strategic and operational decision-making, it currently does not monitor health.

This research then is concerned with introducing an information system to enable enterprise health monitoring (via the collation and processing of internal contextual information) in order to contribute to enterprise resilience. The paper now proceeds to:

- Explore the problem space through problematization in order to draw out the full range of issues surrounding enterprise health monitoring;
- Explore what enterprise health means from a systems perspective to propose a constitutive definition for enterprise health;
- Review four distinct methods that have been employed to good effect in three different sectors and use these to further develop the constitutive definition;
- Extend this definition into a Hierarchical Process Model that could form at least part of an information system to support strategic and/or operational decision-making;
- Reflect critically on both the products of the development process in light of the issues raised through the problematization and so outline areas of ongoing and future research; and
- Identify a number of areas for further work.

2. Problematizing Enterprise Health Monitoring

Influenced by the work of Alvesson & Sandberg (2011)[16], 'problematization' was used to draw out useful research questions. Here, rather than adopting their full methodology, the authors simply focused on the typological aspect of the primary metaphor – that of match fitness – to identify and articulate key assumptions and develop some alternatives. The authors also make use of the work of Pizzo (2015)[17], who problematized resilience whilst focussed on city planning and that of Raco & Street (2012)[18] who observe that whilst the term resilience is often used to mean *"a politically neutral, common-sense policy objective, underpinned by a pragmatic philosophy*" (ibid, p. 1066), in practice it usually masks differences in views over principal objectives.

The results from 'Problematizing Enterprise Health Monitoring' are summarised in Figure 1. This paper focuses on the first two questions (as it is focused on the development of an approach for Enterprise Health Monitoring), but the other questions will be returned to in the discussion section where the approach developed for use in the MOD context will be critiqued and where the authors also consider where differing views are most likely to be exposed (recalling from above that resilience is often a contested notion).

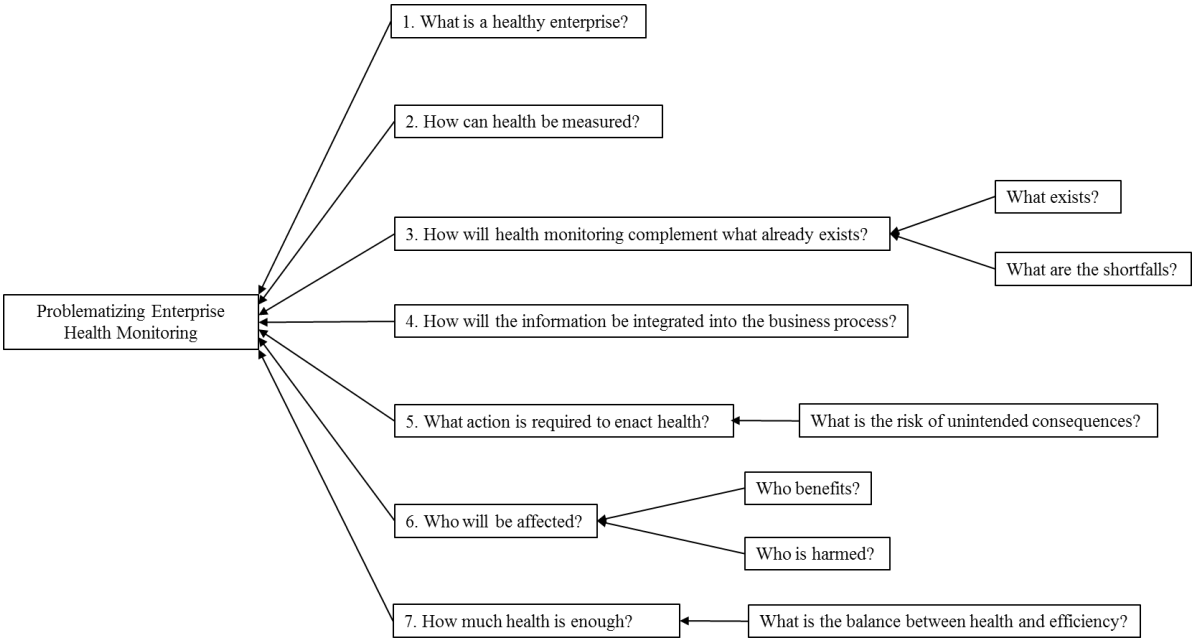

Figure 1. Problematizing enterprise health monitoring to draw out candidate research questions

3. Defining health from system principles

Performance has been defined as *"what an enterprise delivers to its stakeholders in financial and operating terms"*[4] and thus is measured in terms that are independent of the system itself – what can be termed 'downstream' measures. Health has been defined as *"the ability of an enterprise to align, execute and renew itself faster than the competition so that it can sustain exceptional performance over time"*[15]. Health therefore is measured in terms that relate directly to the system (or enterprise) itself and the inputs to the system too (extended enterprise). Figure 2 illustrates these points in the context of a simple linear system.

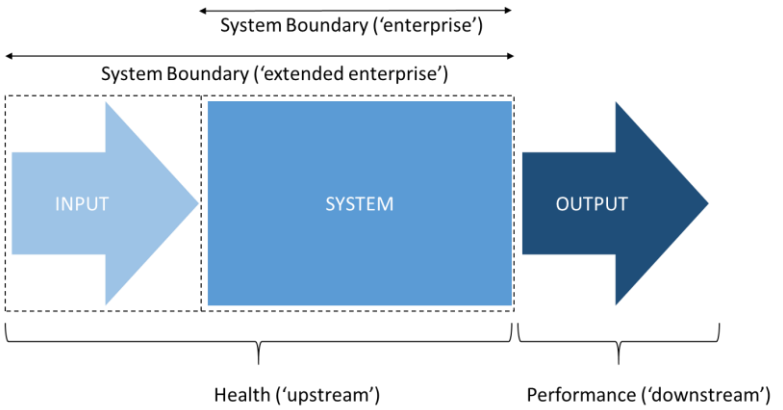

Figure 2 – Health and performance for a simple system

However, in a complex system, behaviour is driven at least as much by interactions between components as by the components themselves. In reactive systems these interactions are characterized by feedback. In anticipatory systems these interactions are characterized by both feedback and feedforward[19]. These concepts are illustrated in Figure 3 where the system has been defined at the sub-system level in accordance with Viable System Model (VSM) nomenclature - VSM identifies that viability is dependent on the capacity of, and strong links between, five key system elements – Identity (S5), Strategy (S4), Control (S3), Coordination (S2) and Operations (S1)[20-22].

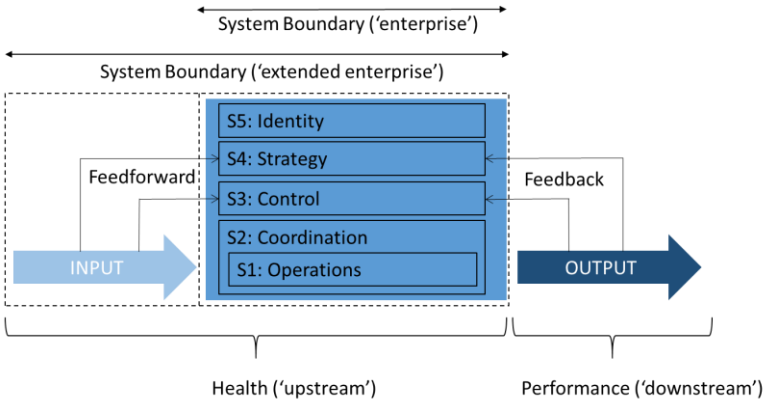

Figure 3 – Health and performance for a complex system

Adaptation is shown to be triggered via feedback and/or feedforward interaction between the system and its environment on two levels. First there is the minor adaptation that the Control function can handle without a change in Strategy (e.g. if this were a manufacturing systems and the strategy was to make bicycles then adaptation relating to build quality (feedback) and/or component supply (feedforward) could be handled by relatively minor adaptation). Second, there is the major adaptation that only the Strategy function can handle (e.g. market saturation (feedback) and/or emerging technologies (feedforward) presents significant threats and/or opportunities such that a new strategy is required (e.g. build drones for personal transport).

But how should adaptability be represented in a definition of health? Should it be embedded within each of the constituent parts of the enterprise or should it be broken out by itself to give it due prominence? Following from again from Rosen – this time his (M,R) model where M = metabolism (what the systems needs to do exist) and R = repair (what the system needs to do to counteract disturbances in its operating environment)[23] – it is broken out alongside three other key aspects of a viable enterprise (Identity, Resources and Management) to yield a four dimensional framework for health:

Identity: Setting coherent internal context for guiding and motivating operations

Resources: Developing the capability and capacity of internal components

Management: Coordinating and controlling how resources interact and are deployed

Adaptability: Reconfiguring the above in response to changing circumstances

Note that strategy has been excluded from this definition. This recognises that it is possible to be healthy without being appropriately directed and that there is a difference between doing things right (performance) and doing the right things (strategy). To illustrate, consider a marathon runner who is fit to race (healthy) and to run fast (performance) but who runs too fast to soon (strategy) and so records a poor time. Whilst strategy is viewed as a key component for viability (along with, performance and health), it is not viewed as a key component of health. Rather it is viewed as a separate complement and not a constituent.

4. Developing a framework for monitoring health

In order to add detailed characteristics to each of the dimensions described above (and simultaneously check and validate these dimensions), four health monitoring methods that have been employed to support enterprise assessments in the public, private and third sectors were studied. These comprise: Enterprise Capability Self-Assessment Tool (New Zealand Ministry of Social Development); Enterprise Health Index (McKinsey); Health Check (Bond) and Organizational Assessment Framework (International Development Research Centre).

The New Zealand Ministry of Social Development (MSD) has developed an Enterprise Capability Self-Assessment Tool[24] in response to a challenge that it was not 'fit-for-purpose'. The tool is a questionnaire that is structured around 10 capabilities: (1) Strategic Governance; (2) Financial Viability and Sustainability; (3) Adaptive Leadership; (4) Enterprise Management; (5) Workforce Development; (6) Outcomes Focus; (7) Enterprise Technology; (8) Innovation; (9) Collaboration; and (10) Enterprise Responsiveness.

The McKinsey Organizational Health Index (OHI)[15] has been used extensively to guide interventions in the private sector. It identifies 3 key attributes of organizational health—internal alignment, quality of execution, and capacity for renewal—that are linked to 9 supporting elements: (1) Direction; (2) Leadership; (3) Culture & Climate; (4) Accountability; (5) Coordination and Control; (6) Capabilities; (7) Motivation; (8) External Orientation; and (9) Innovation and Learning. In turn, these 9 elements are underpinned by 37 more specific management practices.

Bond (a UK membership body) helps international development organizations understand their strengths and weaknesses through the provision of a Health Check self-assessment tool[25]. Information is collected in a survey format that assesses 79 'building blocks' on a 5-point maturity scale, brigaded under 11 'pillars' that comprise: (1) Identity and Integrity; (2) Leadership and Strategy; (3) Partners; (4) Beneficiaries; (5) Programmes; (6) People; (7) Money; (8) External Relations; (9) Monitoring, Evaluation and Learning; (10) Internal Collaboration; and (11) Influencing.

The Canadian International Development Research Centre has developed an Organizational Assessment Framework[26] to provide development practitioners with a systemic approach to *"better understand organizational performance and to pinpoint the elements that affect performance"*. The framework posits that Organizational Performance is a function of its enabling Organizational Motivation, Organizational Capacity and Environment that are comprised of with 17 associated factors: (1) History; (2) Mission; (3) Culture; (4) Incentives; (5) Strategic Leadership; (6) Structure; (7) Human Resources; (8) Financial Management; (9) Infrastructure; (10) Program Management; (11) Process Management; (12) Interorganizational Links; (13) Administrative; (14) Political; (15) Social/Cultural; (16) Economic; and (17) Stakeholder.

These methods have been mapped against the 4 dimensions developed from systems principles above and used to identify a set of 21 characteristics (see Figure 4). Note that the IDRC environmental factors (13-17) are excluded because they characterise the external context for assessment and so whilst they relate to health they are not a constituent part of health. It is interesting to note that whilst there is in good support for the four dimensions, the amount of support for the individual characteristics is variable. For example, all four methods map to the individual

characteristics of a. Purpose, d. Leadership and f. Personnel whereas eight characteristics map to only one of the methods (g. Technology, h. Infrastructure, i. Information, j, Commissioning, n. Decisions, o. Communications, s. Change Management and u. Financial Flexibility).

Health Characteristic		Health Monitoring Approach			
		Ministry of Social Development	**McKinsey**	**Bond**	**IDRC**
IDENTITY	a. Purpose	6. Outcomes Focus	1. Direction	4. Beneficiaries	2. Mission
			8. External Orientation	8. External Relations	
	b. Values			1. Identity & Integrity	1. History
	c. Culture		3. Culture &Climate		3. Culture
	d. Leadership	1. Strategic Governance	2. Leadership	2. Leadership & Strategy	5. Strategic leadership
	e. Incentives		4. Motivation		4. Incentives
RESOURCES	f. Personnel	5. Workforce Development	6. Capabilities	6. People	7. Human Resources
		10. Organisational Responsiveness			
	g. Technology	7. Organisational Technology			
	h. Infrastructure				9. Infrastructure
	i. Information			9. Monitoring	
	j. Commissioning			3. Partners	
MANAGEMENT	k. Governance		4. Accountability		6. Structures
	l. Coordination & Control	4. Operational Management	5. Coordination and Control	11. Influencing	12. Inter-organisational links
	m. Processes			5. Programmes	8. Financial management
					10. Program management
					11. Process management
	n. Decisions			7. Money	
	o. Communications			10. Internal Communications	
ADAPTABILITY	p. Innovation	8. Innovation	9. Innovation and Learning		
	q. Learning & Development				
	r. Knowledge Management				
	s. Change Management	3. Adaptive Leadership			
	t. Informal Networks	9. Collaboration			12. Inter-organisational links
	u. Financial Flexibility	2. Financial viability			

Figure 4 – Developing the framework to identify a set of 'health characteristics' mapped against existing methods

This framework has been further developed from the basic structure presented in Figure 4 by making use of a conceptual systems modelling approach based on Hierarchical Process Modelling. The motivation and specifics of this approach are addressed in the next section.

5. Developing a Hierarchical Process Model

Hierarchical Process Modelling (and its product the Hierarchical Process Model or HPM) was developed at the University of Bristol based on the original idea of combining uncertain inference using Interval Probability Theory (IPT) with a strong process-based view of system description[27]. It has been used in the Civil Engineering domain to support evidential discourse in engineering decision-making[28] and also as an epistemic device to decide how to intervene in a messy problematical situation[29].

A HPM provides a conceptual schema for enacting a transformation. Eliciting hierarchical system structure flows from this top-level transformational process through repeated questioning of how? until there is no longer a sub-process answer to these how? questions. A performance measure is assigned to each of the leaf nodes in this tree structure and then aggregated up using sufficiency and necessity conditions drawing upon IPT. This performance measure is implemented through the use of interval numbers and is represented by the use of the 'Italian Flag' visualisation. This visualisation details what is known to be good about this process (green), what is known to be bad about this process (red) and what is uncertain or unknown (white). The key is to focus on the sources of poor performance (the red) and the sources of uncertainty (the white).

A key aspect of developing a HPM is defining the processes that support the top-level process in the model in gerund form. The use of gerunds (a word construct that means "(which is) to be carried out") is based on a

modification of the original verb-modelling in Soft Systems Methodology. This small but significant linguistic trick stimulates a degree of creativity in modelling where even physical entities can be considered as processes e.g. a chair becomes "supporting sitter" in gerund form and thus enables the modelling process to remain conceptual. Answering how? for this process opens up other options for achieving success, other than just a chair. This has been done for the characteristics identified earlier (see Figure 5).

	Health Characteristic	Process definition (in gerund form) in support of a transformation of "Maintaining the health of the enterprise"
IDENTITY	a. Purpose	Working from a clear purpose that provides motivation for activity across the enterprise (why?)
	b. Values	Working to a set of positive values that are used to guide operations across the enterprise (how?)
	c. Culture	Maintaining a positve and open culture that is aligned with purpose and values
	d. Leadership	Providing inspiring leadership that motivates the workforce and creates the right environment for success
	e. Incentives	Ensuring that incentives align with Purpose, Values and Culture
RESOURCES	f. Personnel	Maintaining a suitable qualified, experienced and professionalised workforce
	g. Technology	Exploiting technology to increase efficacy, effectiveness and efficiency
	h. Infrastructure	Maintaining physical infrastructure necessary to effectively and efficiently support the delivery of outcomes
	i. Information	Maintaining information infrastructure necessary to effectively and efficiently support the delivery of outcomes
	j. Commissioning	Ensuring timely access to the right partners and suppliers of products and services
MANAGEMENT	k. Governance	Governing through clear structure, roles and responsibilities, risk management and assurance
	l. Coordination & Control	Coordinating efforts across the eneterpise to maixmise synergies and minimise duplications
	m. Processes	Adhering to processes that balance the need for control of risk against the need to innovate in critical areas
	n. Decisions	Delegating decision-making authority appropriately throughout the enterprise
	o. Communications	Maintaining clear and open lines of formal bi-directional communication both vertically (up and down) and horizontally (across silos)
ADAPTABILITY	p. Innovation	Encouraging and rewarding staff for using their knowledge to solve problems and/or improve delivery in innovative ways
	q. Learning & Development	Continuously learning and developing across the enterprise including from experience (i.e. lessons learnt)
	r. Knowledge Management	Managing knowledge effectively and efficiently over time effectively and efficiently support the delivery of outcomes
	s. Change Management	Bringing expertise to bear in the conception, design and implemention of change programmes
	t. Informal Networks	Minimising silos through maintenance of informal networks (including for knowledge sharing)
	u. Financial Flexibility	Maintaining financial flexibility to exploit opportunities and/or respond to threats

Figure 5 – Defining health characteristics as processes for implementation as a HPM

These processes are then brigaded under the four dimensions defined above (and already set out in gerund form – i.e. *Identity: Setting coherent internal context for guiding and motivating operations*) in support of a top-level process of "Maintaining the health of the enterprise". This is illustrated in Figure 6 (where only Identity is broken out for ease of illustration).

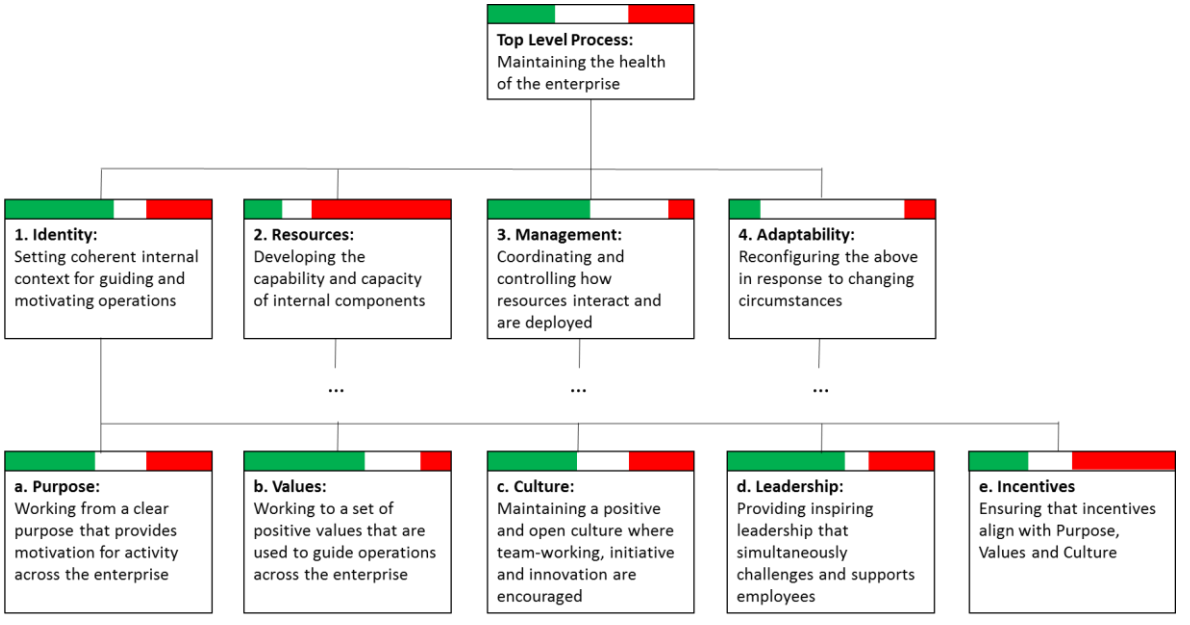

Figure 6 - Developing a HPM for 'Maintaining the health of the enterprise'

6. Discussion

6.1 Critiquing the approach from a conceptual perspective

One of the main conclusions from our problematization of monitoring enterprise health in the MOD context is to realise that much of is used to base the development of our own framework is largely empirical. As might have been anticipated from the summarising headings for the health characteristics, it is only the process definitions under 'Identity' that offer the possibility of any critical insight beyond the empirical. This issue is analysed from a Critical Realist perspective based on the approach developed by Mingers (2000)[30] and refer specifically to Figure 1 of (Mingers, 2004, p. 94)[31], which presents a useful diagrammatic view of the stratification of the 'Real' domain.

Within the Identity characteristics of the developed framework, only Purpose, Values and Leadership emerge from the interplay of those *"mechanisms and structures with enduring properties"* (ibid) – such as the historical, cultural, institutional, technological, and physical structures – that can be considered to exist and that bound and influence human agency. Thus, existing between the real and empirical, these are the characteristics that with further development might be added to, or decomposed into finer definition, to provide a rather rich space in which to explore the underpinnings of the mainly empirical set of measures of organizational resilience identified so far.

This analysis also leads into one of the main difficulties. The empirical concerns are measurable with only a little difficulty, whereas concepts of Purpose, Values and Leadership in this intermediating layer are fraught with problems of contested definition and inaccessibility to direct measurement. However, it is precisely within these difficulties that where progress is most likely. Returning to our earlier idea of problematizing organizational resilience - the answers to the 'who' questions in Figure 1 will largely depend on these difficult to ascertain notions of Purpose, Values and Leadership within the enterprise and the framework developed will likely only be useful and enduring if these characteristics are more fully understood.

Following HPM protocols, with the current state of knowledge very high degree of epistemic risk would need to be applied to any assessment of setting a coherent internal context for guiding and motivating operations, within the overall goal of maintaining the health of the enterprise. This is therefore one area for further work. In the spirit of de Ven and Poole (2005)[32], who have characterised the different ways of understanding organization change, "*process studies of organizing by narrating emergent actions and activities by which collective endeavors unfold*" could be employed to address these presently nebulous concepts. If a comprehensive understanding of useful measures of organizational resilience is found to depend on a critical examination of concepts such as purpose, values and leadership then it is clear that such an endeavour is ultimately grounded in largely ethical concerns.

6.2 Critiquing the approach from a pragmatic perspective

Whilst the conceptual critique in the previous section considered the nature of the health characteristics and the question of how they might be measured it is also necessary to think pragmatically about how health monitoring will complement what already exists and how the information can be integrated into the business process i.e. how could this (some might say partly-complete) framework be operationalised to meet the exigencies of the organization?

When these questions are coupled with the necessary actions required to bring about a healthier enterprise and work with those affected by the changes, the nature of problem can be envisioned to switch from one in which the resilience framework is used as a measurement device in an imagined control loop of action, to one in which the it is used a conceptual device to bring about shared understanding and shared commitment to taking action to improve the resilience of the enterprise. Therefore, the concept of resilience can be seen to be embodied in an action oriented approach to shared understanding and taking action, quite similar to the soft systems approach described by Checkland and Holwell (2004)[33].

Whilst additional questions will regardless need to be addressed (e.g. the need to minimise the data collation burden on enterprise and the need to ensure appropriate interpretation of information and that limitations are understood (ethics) as a concern of a measurement framework approach), shifting to a more soft systems orientation transforms these into questions about participation and engagement with resilient thinking across the organization. The final

question of how much health is enough thus reduces to one of how to go about achieving a shared to a level of ambition rather than how to achieve an imposed goal. This switch in emphasis towards a soft systems interpretation, if not a full soft systems approach, also means that we can return to the question of 'measuring' purpose, values and leadership and propose that the ethical response is defined by the *process* by which they discussed, debated and changed collectively within the organization.

7.3 Identifying areas for further work

This work has been presented as a linear, three-stage cascade from outline framework to constitutive definition to model. Of course there has been much iteration and re-work along the way and this has been a key aspect of the development process. This is not to say that further development will not take place. On the contrary, work is on-going in five areas.

1. Clarifying ethical considerations: The above critique has led us to consider that the questions of organizational resilience along dimensions of values, leadership and purpose are ultimately ethical in nature and that a soft systems approach suggests the way forward is one of designing process rather than measurement.

2. Engaging Senior Stakeholders: Engagement with senior stakeholders is on-going to understand how the model will support decision-making specific to their roles and whether the expanded evidence base – especially with regard to ethnographies – will provide the requisite affordance to enable anticipative action.

3. Refining the model: There is clear need to go to lower levels of detail in almost all areas to ensure that meaningful assessments can be made and be supported by evidence. However, the need for grounding in actuality of the context must be balanced against the need to readily visualise and access the results. Whilst HPM is very helpful in this regard – the structure and supporting aggregation mechanisms affording variable focus at a range of levels – the input from stakeholders will be critical for prioritizing specific areas for development.

4. Integrating the assessment approach into business processes: Whilst this set of health characteristics has been proposed, further work is also required to understand how each will be assessed. The assessment approach will in large part be driven by the desired assessment frequency. For example, an annual assessment could be supported by resource-intensive workshop methods, whereas monthly assessments will need to leverage data-intensive approaches and there will be a range of hybrid approaches in between. The on-going stakeholder engagement will again be critical to design data collection and processing methods (from the top down), but this will need to be complemented by an exploration of what data is available to support assessments (from the bottom up) and accommodation between the two reached.

5. Investigating transferability: It is currently unclear whether this approach is transferrable to other large and complex enterprises. Whilst the development has been based upon context-independent systems principles and mapped against existing methods proven in public, private and third sectors, the development has been driven by a need for application within a specific public sector. Presentation and publication will enable critique by other sectors and likely lead to important developments – both in terms of missing characteristics and in terms of generalizing language for broader adoption. However, it should be recognized that one size will never fit all and that adaptation for tailoring to context is not only desirable but inevitable.

7. Conclusions

This paper has detailed the initial development of new approach for monitoring enterprise health. The approach involves the population and leveraging of a Hierarchical Process Model that represents 21 health characteristics under 4 dimensions – Identity, Resources, Management and Adaptability. The development effort has drawn upon established systems principles and best practice extant in the private, public and third sectors.

The approach has the potential to address a key shortfall in the evidence base available to MOD executive decision-makers. This additional information (that pertains to the internal operating context) has the potential to enable anticipatory action and so address issues upstream before they impact upon downstream performance. This aligns with the challenges set down to increase the resilience of MOD and so deliver against the full range of operational tasks, both now and in the future.

This paper has also detailed a number of areas for further research. Whilst work is ongoing to operationalise the approach – addressing the additional research questions identified through the initial problematization and also the issues surfaced through critical reflection (both for conceptual and pragmatic viewpoints) – it remains for future work to understand how this approach could be transferred to impact upon decision making in other contexts.

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