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A Framework for Resilience Thinking

C. Wright[a], V. Kiparoglou[b], M. Williams[c], J. Hilton[d] a*

[a]Cardiff School of Computer Science and Informatics, Cardiff University, 5 The Parade, Cardiff CF24 3AA, United Kingdom
[b]Centre for Disaster Studies, University of Glamorgan, Pontypridd CF37 1DL, United Kingdom
[c]Business School, The University of Exeter, Prince of Wales Road, Exeter EX4 4SB
[d]Dept of Informatics & Systems Engineering, Cranfield University, Shrivenham SN6 8LA, United Kingdom

Abstract

The first step to achieving an understanding of how complex adaptive systems such as enterprises can be made more resilient is to understand what is meant by 'resilience'. Resilience as a concept has been contextually developed in a wide range of disciplines, providing a variety of resilience concepts of various foci and potential relevance to enterprise systems. This paper demonstrates how the use of systems thinking principles and systems thinking methods have contributed to the development of a research framework for enterprise resilience, by drawing together resilience concepts from multiple disciplines. Soft Systems Methodology is used to draw together viewpoints from fields including ecology, physics, sociology, psychology and disaster management. The incorporation of an enterprise system model enables resilience concepts to be contextualised for enterprises and is used to develop a set of key features of a resilience system, providing a framework to guide further research. Significant contributions are an inclusive theoretical framework for a resilient enterprise and an example of the use of systems thinking methods as a means of organising multi-disciplinary research, including the novel use of Wilson's Enterprise Model in developing the theoretical framework.

Keywords: Resilience; Complex Adaptive Systems; Soft Systems Methodology; Systems Thinking; Research Framework

* C. Wright. Tel.: +44-29-2087-9288
E-mail address: wrightrc@cardiff.ac.uk.

1. Background

The EPSRC- and ESRC-funded CuReSS Project set out to explore the development of a blueprint for resilience, suitable for use in an enterprise setting, by developing knowledge about the functions and features which contribute to resilience, drawn from an exploration of the human body. What is meant by "enterprise" is "a human endeavour such as a community or an organisation". To be able to examine these aspects, it is important to be explicit about what we mean by "resilience". This is problematic because resilience appears to mean different things to different people, especially people from different disciplines.

Reviews of the resilience literature are already available and aim to draw together the broad array of ideas on resilience, but as yet, there is no single, clear definition of "resilience" which can be applied universally, or specifically for enterprises. Manyena [1] cites a number of relevant works from various domains, and concludes, "*The examination of resilience with respect to its definition, its relationship with vulnerability, and whether it applies to people or structures or both, reveals the need to tackle the philosophical questions that continue to blur the concept*."

A number of notable contributions towards defining resilience have been made which illustrate that there are various viewpoints. For example, Folke [2] describes a range of definitions for resilience that includes "*the capacity […] to absorb disturbance and reorganize while undergoing change*", "*the ability of human communities to withstand external shocks to their social infrastructure*" and "*robustness*".

Cutter et al [3] cite a number of relevant works and describe resilience as:

"...the ability of a social system to respond and recover from disasters and includes those inherent conditions that allow the system to absorb impacts and cope with an event, as well as post-event, adaptive processes that facilitate the ability of the social system to re-organise, change and learn in response to a threat."

DuPlessis VanBreda [4] describes a number of viewpoints from social theory, citing Egeland et al (1993), "[Resilience is] *the capacity for successful adaptation, positive functioning or competence … despite high-risk status, chronic stress, or following prolonged or severe trauma."* Kaplan et al [5], *" .. the capacity to maintain competent functioning in the face of major life stressors."* Vaillant [6], *"self-righting tendencies" of the person, "both the capacity to be bent without breaking and the capacity, once bent, to spring back".* Garmezy [7], *"... the skills, abilities, knowledge, and insight that accumulate over time as people struggle to surmount adversity and meet challenges".*

From a community perspective, Wilson [8] states that "*community resilience can be both preventative (avoiding poor outcomes by developing coping strategies), or it may facilitate recovery after a traumatic event or catastrophe. Resilience is, therefore, about the ability of a system to absorb impacts ∕ disturbance and to re-organise into a fully functioning system, as well as post-event adaptive processes*".

An examination of the EPSRC/ESRC Sandpit: Contributions to Next Generation Resilience online debate, "What do we mean by 'Resilience'?" revealed a spread of viewpoints about resilience existing across today's academic community. For example:
- *"Open distributed systems that have capabilities to dynamically adapt to unexpected and harmful events including faults and errors."*
- *"A means of coping, surviving and getting through."*
- *"A sign of strength, adaptability and flourishing."*
- *"System that copes with intermittent external shocks. (As opposed to robust, durable and stable.) Consider predicted and unpredicted events."*
- *"You need the ability to conceive of possible events. Think of the future – be able to imagine things that haven't happened yet... Prepare for potential and react to unexpected."*

- *"A set of context-specific (specific to the nature of that being disrupted) emergent properties that provide the means to anticipate, mitigate or respond to disruption."*
- *"Elasticity – the sort you have to stretch really hard to break."*
- *"More about visioning than prediction – more about being resourceful than exact – includes collective effort that a community can offer."*

With such a broad scope of definitions both from the literature and from individual academics, our challenge is to provide an explicit definition of "resilience", being "what we take resilience to be". This is important in order to focus our exploration of aspects of the human body and be clear when developing ideas to help organisations and communities improve their resilience.

To achieve this integrated understanding, it was felt necessary to take an approach which deals with differences in perspectives and provides a method for bringing them together in a meaningful way. Rather than attempting to identify the "best" definition of resilience, which would be difficult to establish and defend, a definition which encompasses the widest range of ideas and brings them together into a meaningful "whole" was felt to be more appropriate. This interpretive perspective is widely supported in the Systems Thinking arena in particular by the Soft Systems approaches.

Organisations and communities can be thought of as being collections of people pursuing purposeful activity, or "Human Activity Systems" [9]. The goal is to open minds to aspects of resilience which may not have been previously considered. The method must therefore enable the inclusion of concepts from a wide range of domains, and be based upon ideas which are specifically applicable to human activity systems.

2. Method

Soft Systems Methodology (SSM) offers a suitable approach [10]. SSM was developed by Peter Checkland and was later adapted into a practitioner application by his colleague Brian Wilson. It is recognised as a methodology to help structure thinking about situations where people have different viewpoints, and to help bring together the different perspectives of a problematic situation in a meaningful way. SSM does not aim to describe reality, but provides a way of thinking about reality. It uses models as a useful means of describing complex situations conceptually, offering the potential to help in describing our notion of a resilient enterprise, which will be drawn from the ideas given. SSM provides techniques which can help to give confidence that all elements in a conceptual model are logically derived and therefore defensible. SSM is specifically applicable to the analysis and design of human activity systems, and so is relevant to our area of interest. It cannot not provide the "right" or "only" answer with respect to any definition of resilience, but our belief is that it can help with developing a definition or framework which is explicit, defensible, understandable to others, which can be challenged by experts and refined should knowledge be improved or as knowledge develops.

What follows is a description of how SSM has been used to develop an inclusive generic definition of a resilient enterprise, analysing the ideas put forward to the Next Generation Resilience debate, "What do we mean by resilience?", together with additional data from an email survey and from selected published works. The data is relevant because it provides a variety of different viewpoints, the participants are experts in their various fields, and come from a range of knowledge domains. The data is not expected to be complete as the purpose is to provide a proof of concept only. We accept there may be gaps in the data, but it is sufficient to demonstrate the suitability of the selected approach.

3. Results

The starting point was to think about resilience as being a system's goal or purpose. By defining the purpose of a system (or sub-system), it is possible, using the methodology, to build a conceptual model

containing the necessary activities that the system should undertake in order to achieve its defined purpose. Provided the definitions are agreed with, this becomes a logically defensible conceptual model of the system in focus. There are different viewpoints of what resilience may be, but it is felt that they are all viewpoints of the same idea, i.e. of resilience. Therefore all relevant viewpoints were to be described and incorporated into a single conceptual model of a system to achieve all of those purposes.

The first stage was to develop root definitions of our resilience system. In order to be valid, a root definition must, as a minimum, describe (T) the core transformation undertaken by the system and (W) the world-view or means believed relevant in order to achieve the transformation. It is important to include (C) the system beneficiary, (A) the actors of the system, (O) the entity with overall ownership or ability to cease the system's existence, and (E) the relevant environmental constraints of the system, as far as they are known/relevant. This set is often referred to in the literature by the CATWOE mnemonic and, according to SSM, are the necessary elements of a human activity system.

Defining our root definitions from the set of raw concepts, however, proved to be somewhat problematic. A single concept on its own is not sufficient to complete a root definition for a resilience human activity system, so it was not possible to take this approach and develop a set of root definitions which could be mapped directly to individual resilience concepts. In an attempt to fulfil CATWOE, concepts obtained from the original literature review and Sandpit contributions were grouped according to similarity, and the groups were named according to the dominant theme. Groups identified were: Achieving purpose; Visioning and preparedness; Options; Adaptation; Measurement; Interdependence; Lifecycle; Survival; and Coping.

This gave a more interesting and meaningful pattern but again, each group on its own did not provide sufficient perspective to enable development of root definitions based upon each group. This is because they are concepts of resilience characteristics from different domains, and not necessarily systemic descriptions of a resilience system. However, the groupings did appear to offer the potential to describe a resilience system, provided some means of organising them into a more systemic whole relevant to enterprises could be found.

It was decided, in order to support this way of thinking, to introduce the additional organising principles of Wilson's Enterprise Model [10]. The Enterprise Model is a systems thinking concept of an enterprise system. In addition to the Core Transformation (T), we considered systems that provide Support (Sx) to the core transformation, systems that Link (Lx) the enterprise to its wider environment, and systems relevant to Planning, Montoring and Control (PMCx) of the enterprise. With the aim being to understand enterprise resilience, it is therefore relevant to incorporate a recognised generic model of enterprise human activity systems, and to think about resilience as being some kind of attribute of the enterprise system, which in turn has its own purpose (whether this be formally defined or not). Our set of resilience concepts, therefore, can be thought of as various functions and features of the enterprise system which provide it with the attribute of resilience. The Enterprise Model, by being a complete system concept, can guide the organisation of these functions and features into a meaningful whole. Each grouping can be incorporated into a set of root definitions which describe a conceptual sub-system (a complete system in its own right with further sub-systems) of the overall enterprise system, whose purpose is to achieve the attribute of resilience for the enterprise.

The resultant set of root definitions were as follows:

> *T1: A system to ensure an enterprise has the current and ongoing capacity and capability to*
> *continue to achieve its specified (or unspecified) purpose(s) in the face of predicted and*
> *unpredicted exposure to hazards, disruptive events and continual stress which may originate*
> *externally from the environment, via interdependent system connectivity and/or internally*
> *through anticipating, preventing, mitigating, responding expediently to minimise the extent,*
> *duration and cost of any disruption, learning, adapting and recovering whilst recognising any*

potential hierarchy of purposes and emergent behaviour within the enterprise, balancing efficiency losses against protection gains.

S1: A system to reduce to an acceptable level the extent, duration and cost of any disruption by having the necessary capacity and capabilities, making them ready in response to identified imminent events and stress, and applying them expediently in response to detected happening events and stress.

S2: A system to reduce to an acceptable level exposure to identified hazards, disruption and stress by identifying possible, imminent and happening events and stress that may have an impact on key activities, reducing vulnerabilities and implementing countermeasures as appropriate.

S3: A system to recover from shocks by assessing damage, securing necessary resources, repairing and renewing as appropriate.

L1: A system to detect imminent and happening relevant events and stress by developing knowledge of precursors to events and stress and indicators of events and stress happening, monitoring and interpreting associated signals and communicating this information in a timely manner.

L2: A system to identify possible hazards, disruption and stress by imagining and developing scenarios of what may happen or be achieved and assembling this intelligence together with intelligence about historical events and lessons learned and storing, processing and making available this information as required.

L3: A system to provide required service levels to systems which depend upon the enterprise by assigning appropriate authority and responsibility, establishing and maintaining appropriate arrangements between the enterprise and the dependent system, whilst taking into account the requirements of systems upon which the enterprise is dependent.

L4: A system to ensure the continued provision of required service levels from systems upon which the enterprise is dependent by assigning appropriate authority and responsibility, establishing and maintaining appropriate arrangements between the enterprise and the systems upon which it is dependent, whilst taking into account the requirements of systems which are dependent upon the enterprise.

PMC1: A system to enable adaptation by identifying lessons learned and acting upon them as appropriate.

PMC2: A system to ensure enterprise developments and principles lead to continued survival and that it operates within legal and ethical constraints.

PMC3: A system to balance efficiency losses against protection gains by identifying efficiency levels and protection levels and making decisions about trade-offs

PMC4: A system to ensure capacity and capability align with current enterprise purpose by reviewing enterprise purpose, determining requirements and acquiring, developing and disposing of capacity and adjusting capability as appropriate.

A conceptual model of the resilience system (being a conceptual sub-system of any wider enterprise system) was developed. By understanding the logical dependencies, activities can then be related together in groups, with each group representing a sub-system of the wider resilience system. By aggregating activities in this way, the development of a concise, high-level conceptual model of a resilience system becomes possible [Figure 1]. This conceptual model describes, at a high level, the activities undertaken by a resilient enterprise and, thus illustrates what we are taking resilience to be. It can be used to make explicit and communicate our ideas, and was used as a framework to guide further research about how

enterprise resilience may be achieved; particularly with our exploration of the human body as a metaphor for resilience. In addition, it provides the basis of a textual definition of enterprise resilience, developed from the insights it provides. This was validated with a large water supply company in the UK.
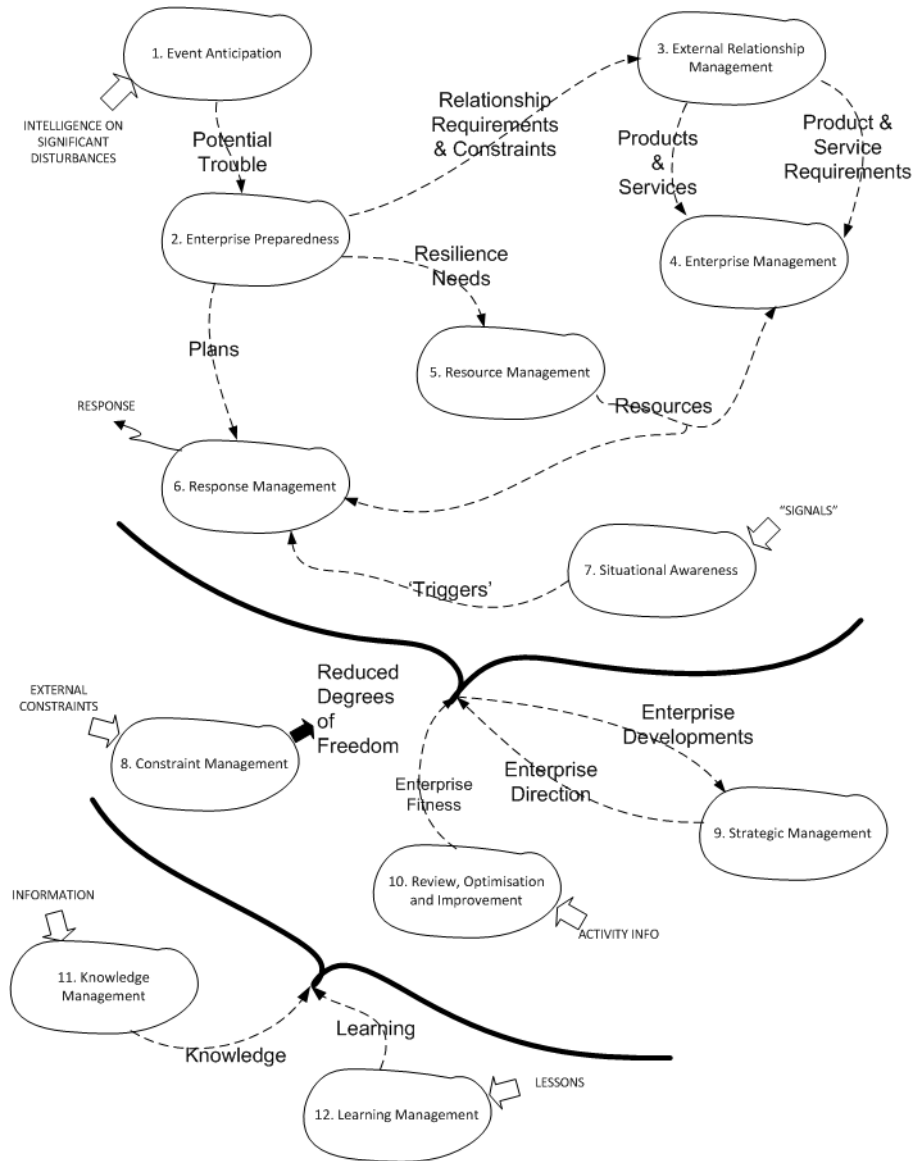

Fig. 1. Conceptual model of an enterprise resilience system

The resulting core definition of resilience is given below as (A); functions and features which are relevant to achieving resilience in an enterprise were also revealed (B); and our conceptual model indicated aspects associated with resilience which should be taken into account (C).

(A)   Resilience (of an enterprise) is:

"ensuring an enterprise has the current and ongoing capacity and capability to continue to achieve its specified (or unspecified) purpose(s) in the face of predicted and unpredicted exposure to hazards, disruptive events and continual stress"

(B)   Resilience is achieved by:

"anticipating, preventing, mitigating, responding expediently to minimise the extent, duration and cost of any disruption, learning, adapting and recovering"

(C)   Activities related to resilience need to take into account:

"hazards, disruptive events and continual stress which may originate externally from the environment, via interdependent system connectivity and/or internally; potential hierarchy of purposes and emergent behaviour within the enterprise; the need for a balance between efficiency losses and protection gains; the requirement for continued survival; and that the enterprise operates within recognised legal and ethical constraints."

4. Conclusion

Our conceptual model of a resilience system and our textual definition of enterprise resilience are our means of making explicit what we are taking resilience to be when we aim in our current investigation to determine what it is about the human body that makes it resilient, and how this knowledge can be made useful in the context of communities and organisations.

Soft Systems Methodology has enabled us to organise our knowledge about resilience, to make it explicit and to communicate this knowledge. By making the model and definition explicit, we reveal our assumptions about what we think resilience might be, which is useful for understanding the limitations of any subsequent knowledge being developed. In this way our ideas are also open to scrutiny, challenge and, if necessary, modification. A key benefit of using SSM for this purpose was in bringing together a diverse set of concepts into a meaningful whole.

Wilson's Enterprise Model enabled the concepts to be contextualised for the purposes of describing what resilience might be for an enterprise. The insight gained was that resilience may be thought of as a desirable (or sometimes undesirable) characteristic of an enterprise system, and that it is possible to conceptualise a sub-system within a wider enterprise system whose goal it is to provide resilience for that enterprise. This we have called the resilience system. The methodology has also provided insight that a resilience system itself can be thought of in terms of interconnected sub-systems.

SSM is a useful approach for developing a research framework, in that the activity of using the methodology to synthesise resilience concepts has provided the research team with a deeper understanding and clearer vision of what 'resilience' can be taken to mean. The model set a clear boundary and scope for our further investigation in the form of a framework for resilience thinking. This study contributes a useful example of how SSM and Wilson's Enterprise Model can be used to support complex systems thinking, and to support problem structuring in research.

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