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Resilience: the concept, a literature review and future directions

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In an ever-more interconnected world (social, technological and environmental), no organisation can retain a competitive position and survive disruptions as an independent entity. This article provides a review of resilience literature in its widest context and later its application at an organisational level context. The origins of the concept are reported and consequently, the various fields of research are analysed. The concept is shown to remain essentially constant regardless of its field of enquiry and has much to inform the fields of organisation theory, strategy and operations management. This article identifies a number of areas for advancing resilience research, in particular: the relationship between human and organisational resilience; understanding interfaces between organisational and infrastructural resilience.

Keywords: resilience; literature review; risk; uncertainty; disaster preparedness; business continuity

1. Introduction

Countries, communities, organisations and individuals are all subject to a diverse and ever changing environment. The threats that this sometimes turbulent environment poses can vary in both severity and frequency and may originate internally or externally to a system. An event in one area can often have disastrous effects in another (Jüttner 2005). These events can take many forms as highlighted in many recent highly publicised events including the 2004 Indian Ocean Tsunami, the 2010 Haiti and Chile Earthquakes, the recent global financial crisis and the 2010 eruption of Icelandic volcano Eyjafjallajökull. Natural disasters, pandemic disease, terrorist attacks, economic recession, equipment failure and human error can all pose both a potentially unpredictable and severe threat to the continuity of an organisation's operation. Disasters are a multifarious concept composed of many different elements that seem to defy any precise definition (Alexander 2003). It is often only through hindsight that disasters look like the events that individuals, communities, organisations and countries should have prepared for. It is not only disasters but also small uncertainties or deviations that can cause challenges to organisations. Sometimes when large organisations (Rover Plc, Woolworths Plc) cannot withstand these challenges, it is essential that sufficient effort is channelled into making small and medium enterprises (SMEs) robust and resilient to withstand these uncertainties and challenges.

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This article explores the literature surrounding SMEs and understands resilience within the context of SMEs.

The term resilience is used in a wide variety of fields that include ecology (Walker *et al.* 2002), metallurgy (Callister 2003), individual and organisational psychology (Barnett and Pratt 2000, Powley 2009), supply chain management (Sheffi 2005), strategic management (Hamel and Valikangas 2003) and safety engineering (Hollnagel *et al.* 2006). Although the context of the term may change, across all of these fields the concept of resilience is closely related with the capability and ability of an element to return to a stable state after a disruption. When the notion of resilience is applied to organisations, this definition does not drastically change. Resilience is therefore related to both the individual and organisational responses to turbulence and discontinuities.

1.1 *Susceptibility to disruptions*

On 21 September 1999, a devastating earthquake measuring 7.3 on the Richter scale hit central Taiwan. The Ch-Chi earthquake was the largest earthquake in the area in almost 65 years, killing 2300 people, injuring 8000 and destroying 100,000 homes (Chen *et al.* 2007). The impact of the disaster had severe consequences for many organisations and infrastructure, where the total industrial production losses were estimated at \$1.2 billion (Papadakis 2006). The Hsinchu Industrial Park lay within 70 miles of the earthquake epicentre, which includes many large scale semiconductor fabrication facilities that are estimated to account for approximately 10% of the world's production of computer memory chips. Several other computer components were also manufactured within the industrial park. The impact of the disaster on PC production was dramatic; component supply was constrained during the following months due to the damage caused by the earthquake (Papadakis 2006). Companies such as Apple, Compaq, Dell, Gateway and IBM were all affected by the supply disruption (Papadakis 2006).

In March 2000, lightning struck an electrical cable causing power fluctuations throughout the state of New Mexico. Due to electrical fluctuations, a minor fire developed in a small production cell at a Philips semiconductor plant in Albuquerque (Norrman and Jansson 2004). Although not a major incident, the 10-min fire had drastic implications for the mobile phone producers Ericsson and Nokia (Tang 2006). The fire took place in one of the plants high grade clean rooms, and due to the fire, smoke and sprinkler water, the production of components was delayed for 3 weeks. After 6 months, the yield of radio-frequency chips was still only at 50% – it would take many years to get new equipment delivered and installed and operationally optimised (Norrman and Jansson 2004).

These examples show that disruptions can pose a major threat to the incumbency of an organisation. Disruptions can have a direct effect on an organisations ability to get finished goods into a market and provide critical services to customers. These events highlight the borderless nature of disruptions (Smith and Fischbacher 2009). However, how do some organisations overcome these events while others would fail? What enables these organisations to adapt and transcend these events? And what sets these organisations apart? Certainly organisations will have business continuity plans (Cerullo and Cerullo 2004) and disaster recovery plans in place; however, unless these procedures and plans can be intuitively applied during fast moving crises, the plans will not be effective (Seville *et al.* 2006).

Resilience against disruptions to organisations is the central focus of this study. The next section presents the methodological facets of the literature review. The resilience literature is then reviewed in its widest perspective. This is followed by a more focused consideration of resilience centred on organisations and includes system perspectives. Future research themes are proposed and followed by concluding remarks.

2. The SME context

There are a number of definitions of what constitutes an SME (Deros *et al.* 2006, Jafari *et al.* 2007). The category of micro, SMEs is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euro, and/or an annual balance sheet total not exceeding 43 million euro' (Article 2 of the Annex of Recommendation 2003/361/EC). SMEs together accounted for 99.9% of all enterprises in the UK (BIS 2010). Hence, the economic well being of the country will be very much dependent upon SMEs being or learning to be resilient. A research conducted by the insurance company AXA concluded that 46% of SMEs did not have a plan to deal with a business interruption (*Economist* 2005), while a survey of Business Continuity Management in UK firms published by the Chartered Management Institute found that only 40% of small firms in the study (which had a sample of 1150 firms of which 38% had fewer than 50 employees) had business continuity plans that demonstrated a proactive and intentional desire to organise restoration and recovery efforts in the event of a crisis (Woodman 2006). In another study (Royal and Sun Alliance 2006), it was concluded that around 59% of UK businesses did not have a formal Business Continuity Plan. However, in a study conducted by Kitching *et al.* (2009b) to investigate the influence of the credit crunch on SMEs, it was concluded that not all SMEs suffer heavily due to the credit crunch. The authors suggested that SMEs are able to be resilient in varying degrees by adapting to the challenge through their own activities to try and avoid the worst impact of restrictive credit market conditions. The extent of their resilience will however depend upon their capability and resource availability. In another research conducted by Kitching *et al.* (2009a), it was concluded that although limited resources render small firms vulnerable to changes in the external environment, through their own resource acquisition and mobilisation activities. SMEs are able to exert an important influence over their own performance and survival. They suggest that it is important to understand the strategy and the sources for achieving this resilience as it may influence its sustainability and influence on longer term business performance. Keong and Mei (2010) take a different approach towards studying SME resilience. They focus on the human involvement within organisations. Keong and Mei suggest that since SMEs are business organisations which consist of two or more people coming together to pursue specific objectives, normally economic objectives, it is reasonable to imply that resilient SMEs should also possess the resilient qualities of human beings because one cannot separate the business from the people forming and operating them. Hence, they suggest that the four important traits for resilience are: flexibility, motivation, perseverance and optimism. It is thus essential to investigate the different facets of 'Resilience' and whether any of the concepts can be applied to SMEs.

3. Review methodology

The objective of this article is to identify the diversity in academic thinking with regards to 'Resilience' as a concept, and thereafter, to identify gaps, issues and opportunities for further study and research using this concept for SMEs. A literature review was undertaken to get a holistic view of these diverse and interdisciplinary viewpoints, as it is a necessary step in structuring a research field and thus forms an integral part of any research exercise (Easterby-Smith *et al.* 2002). Conducting a literature review helps to identify the conceptual content of the field (McCutcheon and Meredith 1993) and guides towards theory development. The research discussed within this article is driven by theoretical assumptions as this allows conclusions to be drawn on the reviewed literature.

In conducting the literature review, the process steps as stipulated by Srivastava (2007) were followed and are given in Tables 1 and 2.

3.1 *Defining unit of analysis*

A single research paper/book: The limitation for this was that the paper/book was available easily through library databases or Google Scholar.

3.2 *Classification context*

The classification context was conducted. The higher level classification scheme comprised of three elements: perspectives, topics/concepts and methodologies. At the lower level each element had further elements for classification.

Perspectives: ecological, individual, community, organisational, supply chain

Topics/concepts: behaviour and dynamics, capabilities, strategy and performance

Methodologies: theory building, case study, survey and model/framework.

The classification stage also involved studying the different definitions of resilience under the perspectives.

3.3 *Material evaluation*

The material was analysed and sorted according to the classification context. This led to the identification of relevant issues and interpretation of the results.

3.4 *Collecting publications and delimiting the field*

The literature review focused upon books, edited volumes, journal articles, research reports and conference papers. Library databases and 'Google Scholar' were used with a keyword search using some important keywords such as for example 'Resilience' and 'Resilient SMEs. Overall 74 papers were finally analysed using the classification scheme. The papers which provided a direct link to the concept of 'resilience' were considered for the review.

The important aspect was to get a wide interdisciplinary perspective for the concept of 'resilience' and to investigate whether there was cross-learning across disciplines within the

Table 1. Definitions of resilience.

Author	Context	Definition
Bodin and Wiman (2004)	Physical systems	The speed at which a system returns to equilibrium after displacement, irrespective of oscillations indicates the elasticity (resilience)
Holling (1973)	Ecological systems	The measure of the persistence of systems and of the ability to absorb change and disturbance and still maintain the same relationships between state variables
Walker <i>et al.</i> (2004)	Ecological systems	The capacity of a system to absorb a disturbance and reorganise while undergoing change while retaining the same function, structure, identity and feedback
Gunderson (2000)	Ecological systems	The magnitude of disturbance that a system can absorb before its structure is redefined by changing the variables and processes that control behaviour
Tilman and Downing (1994)	Ecological systems	The speed at which a system returns to a single equilibrium point following a disruption
Walker <i>et al.</i> (2002)	Socio-ecological systems	The ability to maintain the functionality of a system when it is perturbed or the ability to maintain the elements required to renew or reorganise if a disturbance alters the structure of function of a system
Carpenter <i>et al.</i> (2001)	Socio-ecological systems	The magnitude of disturbance that a system can tolerate before it transitions into a different state that is controlled by a different set of processes
Luthans <i>et al.</i> (2006)	Psychology	The developable capacity to rebound from adversity
Bruneau <i>et al.</i> (2003)	Disaster management	The ability of social units to mitigate hazards, contain the effects of disasters when they occur and carry out recovery activities that minimise social disruption and mitigate the effects of future earthquakes
Paton <i>et al.</i> (2000)	Disaster management	Resilience describes an active process of self righting, learned resourcefulness and growth. The concept relates to the ability to function at a higher level psychologically given an individual's capabilities and previous experience
Coutu (2002)	Individual	Resilient individuals' possess three common characteristics. These include an acceptance of reality, a strong belief that life is meaningful and the ability to improvise
Hamel and Valikangas (2003)	Organisational	Resilience refers to the capacity to continuous reconstruction
Horne and Orr (1998)	Organisational	Resilience is the fundamental quality to respond productively to significant change that disrupts the expected pattern of event without introducing an extended period of regressive behaviour

(continued)

Table 1. Continued.

Author	Context	Definition
McDonald (2006)	Organisational	Resilience conveys the properties of being able to adapt to the requirements of the environment and being able to manage the environments variability
Hollnagel <i>et al.</i> (2006)	Engineering	The ability to sense, recognise, adapt and absorb variations, changes, disturbances, disruptions and surprises

facets of the classification scheme. The overall objective was to identify those concepts which would inform resilience within SMEs.

4. Wider resilience literature

The concept of resilience has received little systematic empirical work and independent attention (Sutcliffe and Vogus 2003). Predominately, resilience-based literature has been conceptual, focusing on developing a static knowledge base for the area through establishing the fundamental concepts and principles (De Jong and Ferguson-Hessle 1996). The literature based within the context of resilience as well as the literature within related areas can be grouped broadly into three general areas of classification. These correlate to the elements of resilience as identified by Ponomarov and Holcomb (2009). These include:

- readiness and preparedness
- response and adaption
- recovery or adjustment

Within a specific resilience-based context, although several authors attempt to broadly cover all of these general areas within a study, individually each area has received little systematic attention and empirical-based study. As a result a diverse literature base has developed.

The term was first popularised by Holling in 1973 within the seminal work titled ‘Resilience and Stability of Ecological Systems’. The work has formed the foundation for most studies of the concept of ecological resilience as well various other forms of resilience. Holling (1973) outlines how altering views of behaviour within ecological systems can create different approaches to the management of resources. To this end, Holling (1973) presents the viewpoints ‘resilience’ and ‘stability’. These have been further extended to form the terms ‘ecological resilience’ and ‘engineering resilience’ (Gunderson 2000, Walker *et al.* 2002). The resilience viewpoint emphasises the domains of attraction and the need for persistence through defining resilience as a measure of systems persistence and the ability to absorb disturbances and still maintain the same relationships between system entities. While the stability viewpoint emphasises maintaining the equilibrium within a predictable world and accumulating excess resources with minimum fluctuation of the system. The stability viewpoint is then defined as the ability of a system to return to an equilibrium state after a disturbance (Holling 1973).

Table 2. Perspectives, concepts and methodologies in the resilience literature.

Author(s)	Year	Perspectives				Topics/concepts				Methodologies			
		Ecological	Individual	Socio–ecological/ community	Organisational	Supply chain	Behaviour and dynamics	Capabilities	Strategy	Performance	Theory building	Case study	Survey
Thompson and Lehner	1976	✓											
Garnezy and Masten	1986		✓				✓					✓	
Werner	2009		✓				✓				✓	✓	
Holling	1996						✓						
Mallak	1998		✓		✓		✓				✓		
Horne and Orr	1998		✓		✓		✓				✓		
Masten and Coatsworth	1998		✓				✓				✓		
Peterson <i>et al.</i>	1998	✓					✓				✓		
Miller and Whitney	1999			✓			✓				✓		
Adger	2000			✓			✓				✓		
Gunderson	2000	✓					✓		✓		✓		
Paton <i>et al.</i>	2000			✓			✓				✓		
Luthar <i>et al.</i>	2000		✓		✓		✓				✓		
Mitchell <i>et al.</i>	2000	✓					✓		✓		✓		
Nystrom <i>et al.</i>	2000	✓					✓				✓		
Comfort <i>et al.</i>	2001			✓			✓		✓		✓		
Carpenter <i>et al.</i>	2001	✓		✓			✓				✓		
Holling	2001			✓					✓		✓		
Paton and Johnston	2001			✓					✓		✓		
Folke <i>et al.</i>	2002	✓		✓					✓		✓		
Coutu	2002												
Walker <i>et al.</i>	2002			✓			✓				✓		
Sutcliffe and Vogus	2003				✓		✓				✓		

(continued)

[illegible]

Table 3. Perspectives in resilience literature.

Perspectives				
Ecological	Individual	Socio–ecological/community	Organisational	Supply chain
15	19	17	21	9

Table 4. Topics studied under resilience.

Topics/concepts			
Behaviour and dynamics	Capabilities	Strategy	Performance
52	17	17	14

The concept of resilience is both multidisciplinary and multifaceted. The notion of resilience is firmly grounded within ecology and the working definitions used by many authors developed following Holling (1973) original research relating to ecosystem stability. There have been several definitions proposed for resilience, each slightly altered dependent on context. Table 1 gives the diversity of resilience definitions and also highlights distinctions between them.

Table 2 gives the resilience literature organised to reveal research contributions regarding perspectives taken, concepts discussed and the research methodologies utilised; 74 papers are contained within this table.

Although the literature review has considered a classification methodology the papers reviewed still represent a sample. However, it is interesting to study this sample to get a view for which areas are the strongest within the resilience literature.

A. The perspectives

Considering Table 3, it is evident that out of the papers selected for the review, there has been a balanced view across four perspectives ranging from the individual to the organisation, community and the ecology. Supply chain resilience which perhaps sits between the organisational and community perspectives has gained more focus post 2001.

B. Topics/concepts

Considering Table 4, it is evident that behaviour and dynamics features in 52 papers out of the sample of 74. Over the years, this seems to be the most researched topics within the realm of resilience. The other three: strategy, capabilities and performance either on their own or in conjunction with behaviour, feature in almost similar numbers across the reviewed papers; however, these topics are lower in numbers as compared to behaviour.

C. Methodologies

Considering Table 5, it is evident that theory building has been the main focus of researchers within the area of resilience. Case study and model development have been

Table 5. Methodologies used in research.

Methodologies			
Theory building	Case study	Survey	Model/framework
52	21	6	16

used in 20–25% of the cases. However, survey has not been a preferred methodology for the study of resilience.

5. Organisational level and systems resilience

Fundamentally, the concept of resilience is closely related with the capability and ability of an element to return to a pre-disturbance state after a disruption. When the notion of resilience is applied to communities and the wider context of organisations, this broad definition does not change. Resilience is related to both the individual and organisational responses to turbulence and discontinuities. This involves both the ability to withstand systematic discontinuities as well as the capability to adapt to new risk environments (Starr *et al.* 2003).

Communities and organisations have both been conceptualised as complex system by a variety of authors (Dooley 1997, Comfort *et al.* 2001, Crichton *et al.* 2009). A complex system is composed of interconnected agents that form a network of linkages that interact nonlinearly. This interaction gives rise to emergent behaviour. The systems interact within the network feedback, creating a loop and reinforcing the cause and effect relationship between system agents. In order to sustain the internal complexity of the system, constant energy and interaction between the system and the environment is required creating a dissipative system through the constant exchange of energy and matter. As such, complex systems are evolutionary and react to local information and are thereby capable of self organisation (Andriani 2003). As identified by Comfort *et al.* (2001) when an environments complexity increases, possibly through high impact or disruptive events, a systems performance decreases, as the system is unable to process the amount and range of information required to adequately establish the coordination required across the components of the response system. This is a result of the system requiring a significant increase in information exchange, communication and coordination in order to integrate the multiple levels of system operation and decisions caused by the increase in environmental and system complexity. As a result of this, in order to establish a strategy for reducing risk in uncertain environments, Comfort *et al.* (2001) suggests that a system should create a balance between anticipation or preparedness and resilience.

5.1 Vulnerability

The term ‘vulnerability’ carries with it several connotations, often connected to the susceptibility of a system to harm (Adger 2006). This view is reflected by McCarthy (2001) within the context of climate change. Here vulnerability is defined as the degree to which a system is susceptible to the effects of climate change. Within a broader context, the concept of vulnerability is most often defined as being subject to a range of effects. These include

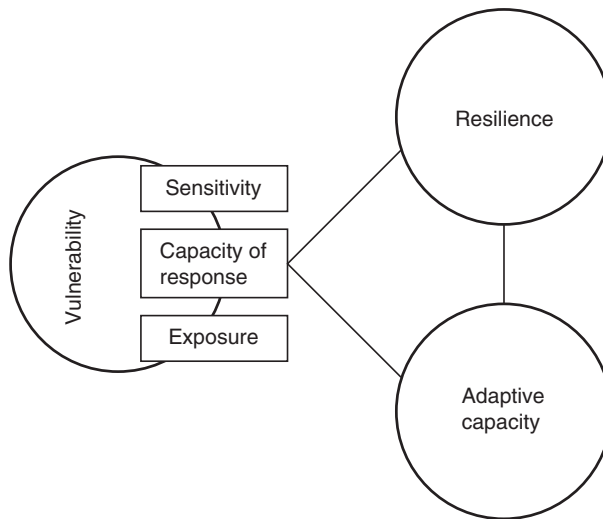


Figure 1. The concept of vulnerability.
Source: Adapted from Gallopín (2006).

exposure to perturbations, external stresses, sensitivity to perturbation (the degree to which the system is affected or altered due to perturbation) and the system's capacity of response (Gallopín 2006). Subsequently, the concept of vulnerability is inherently complex, impinging of several variables and can therefore be thought of as a dynamic entity (Dalziell and McManus 2004).

Gallopín (2006) identify the conceptual linkages between vulnerability, resilience and adaptive capacity. Within this representation, resilience is considered a subset or component of a systems capacity of response. A systems capacity of response relates to the ability of the system to adjust to a disturbance, moderate the effects, take advantage of any available opportunities and cope with the consequences of any system transformations (Gallopín 2006).

Within Gallopín's (2006) model of the components of vulnerability, it is clear that vulnerability is the overarching concept and that resilience and adaptive capacity are considered a conceptual subset. Through this, Gallopín (2006) refers to the vulnerability as the capacity to preserve the structure of a system, while resilience refers to the capacity to recover from disturbances. The same relationship between vulnerability and resilience is reflected by Turner *et al.* (2003) within the development of vulnerability analysis models within the concept of sustainability. Here, vulnerability is defined as the degree to which a system is likely to experience harm due to exposure to a threat or perturbation. As such, resilience is identified as a subset element of vulnerability (Figure 1).

5.2 Adaptive capacity

As shown by the examples of socio-ecological systems within Carpenter *et al.* (2001) study into resilience, the adaptive capacity of a system is related to the mechanisms for the creation of novelty and learning. Adaptive capacity is described by Gunderson (2000) in regards to ecological resilience as a systems robustness to alterations and changes in resilience. Within Gallopín's (2006) model of the components of vulnerability, a system

adaptive capacity is linked to a system capacity of response and defined as the ability of a system to evolve in order to accommodate environmental threats or changes and the ability to expand the range of variability.

Adaptive capacity reflects the ability of the system to respond to changes in its external environment, and to recover from damage to internal structures within the system that affect the ability to achieve its purpose. (Dalziell and McManus 2004)

Predominately, literature has referred to or emphasised resilience as a means to recover from disturbances; however, the concept of adaptive capacity may also lead to establishing new system equilibriums or stability domains, allowing a system to adapt to new environments (Fiksel 2006). Here, resilience is established from a system of adaptive capacities and can be regarded as the process of linking resources to outcomes (Norris *et al.* 2008). As such the adaptive capacity of a system can be regarded as the mechanism for resilience.

Carpenter *et al.* (2001) identify that the adaptive capacity of a system also reflects the learning aspect of system behaviour in response to a disruption. Within organisations, adaptive capacity refers to the ability to cope with unknown future circumstances (Staber and Sydow 2002). As such reflecting the definition set by Carpenter *et al.* (2001). As a result organisations that focus on adaptive capacity will not experience environments passively, instead the organisation will continuously develop and apply new knowledge in relation to the operating environment. Rather than identifying the existing demands and then exploiting the available resources, adaptive organisations will reconfigure quickly in changing environments (Staber and Sydow 2002). It is believed, the adaptive capacity of an organisation aids in better preparedness for turbulent environments.

5.3 Resilience

Resilience is both a function of both the vulnerability of a system and its adaptive capacity (Dalziell and McManus 2004). Fiksel (2003) identifies four major system characteristics that contribute to resilience. These include:

- diversity – the existence of multiple forms and behaviours
- efficiency – performance with modest resource consumption
- adaptability – flexibility to change in response to new pressures
- cohesion – existence of unifying relationships and linkages between system variables and elements.

To illustrate this, Fiksel (2003) presents simplified graphical representations of thermodynamic systems to characterise the different types of resilience. Each system has a stable state representing the lowest potential energy at which the system maintains order and function. When the system is subjected to a threat or perturbation, this state will shift along the trajectory of the adjacent states (Fiksel 2003). The examples of system behaviour are shown in Figure 2.

System 1 highlights an engineered system through which the system operates within a narrow band of possible states. Although the system is designed to be resistant to small disturbances from its equilibrium state, the system is unable to cope with larger scale or high impact events. As such the system may be regarded as resistant, but not as resilient. System 2 offers a greater resiliency to disturbances, as the system is able to retain fundamental function across a broad range of possible states and then gradually return to

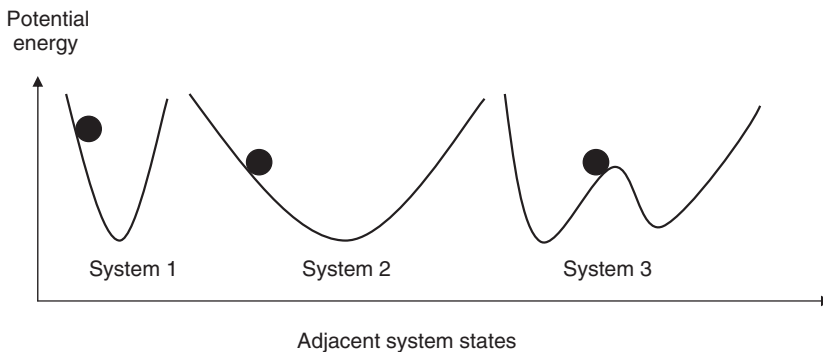


Figure 2. System trajectory.
Source: Fiskel (2003).

equilibrium. As a result system 2, typical of social and ecological systems, can be characterised as a resilient system. Although system 2 does classify as a resilient system, the characteristics of system 3 offer much greater resilience in the face of significant disturbance. Through the system having multiple equilibrium states, under certain condition the system is able to shift to a different state. This means that the system is able to tolerate larger perturbations. However, the shift to a different equilibrium point represents a fundamental change in the systems structure and function (Fiskel 2003).

6. Conclusion and future research directions

The authors find that from this study that there appears to be a strong focus around building theories and definitions of resilience. However, the literature is lacking in empirically proving the theories. In other words, there is little on how organisations, particularly SMEs, can achieve degrees of resilience. For the theory to be of value in the real world, more real world-based research needs to be done, particularly focused on empirical methods such as case study and survey which can significantly add to and validate theoretical constructs. Although a number of case studies are found within the literature, only three out of twenty one address the organisation as their point of perspective. Empirical research that uses case-based methods focusing on the organisation are currently few and further study here would add to current understanding.

Some areas of resilience have received significant academic attention and empirical study, such as ecological systems (Holling 1973, Gunderson 2000, Carpenter *et al.* 2001) and to a lesser extent socio-ecological systems (Walker *et al.* 2002, 2004). Areas such as organisational level resilience and particularly the extended enterprise and supply chains need a greater focus accordingly. There is also need to conduct good quality empirical-based research to fully develop the area and properly recognise the potential of developing the resilient characteristics within organisations and supply chains. Supply chain is a context that is currently well served particularly in the area of risk and its avoidance. Although risk is not wholly or strictly resilience, the authors' do see it as contained within the resilience scope.

Considering the various definitions of ‘resilience’ from the literature and as depicted in Table 1, it is essential to understand whether resilience is: a measure, a feature, a philosophy or a capability? Again, is being resilient a tangible capability or an intangible capability? Although these may be difficult questions to ground, the authors believe that this will largely depend upon the context: individual, organisational, supply chain, community, ecological. In some cases, there may be a need for the research to transcend all these contexts. Researchers must untangle the complexities involved.

This research finds that there is great potential for future research within the area of resilience. There is future scope to apply systems engineering resilience thinking to the aspect of SME resilience considering the SME as a sub-system within the extended supply chain. Ideas for other more specific research questions for future research within the area of SME resilience are: does individual human resilience characteristics have a greater influence on SME resilience than organisational resilience characteristics? How can SMEs develop resilient characteristics through network collaboration? In addition, the crucial interface between organisational and infrastructural resilience needs to be investigated, understood and eventually operationalised in practice.

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