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Title	Building strategic resilience in food supply chain
Type	Article
URL	<a href="https://clock.uclan.ac.uk/18001/">https://clock.uclan.ac.uk/18001/</a>
DOI	<a href="https://doi.org/10.1108/BFJ-10-2015-0350">https://doi.org/10.1108/BFJ-10-2015-0350</a>
Date	2016
Citation	Manning, Louise and Soon, Jan Mei (2016) Building strategic resilience in food supply chain. British Food Journal, 118 (6). pp. 1477-1493. ISSN 0007-070X
Creators	Manning, Louise and Soon, Jan Mei

It is advisable to refer to the publisher's version if you intend to cite from the work.  
<https://doi.org/10.1108/BFJ-10-2015-0350>

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British Food Journal

## Building strategic resilience in the food supply chains

Journal:	<i>British Food Journal</i>
Manuscript ID	BFJ-10-2015-0350.R2
Manuscript Type:	Research Paper
Keywords:	Benchmarking, indicators, Stakeholders, Value, performance

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**Abstract**

Purpose: The aim of this paper is to consider the concept of strategic business resilience in order to postulate innovative mechanisms to drive business performance in the food supply chain.

Design: The research included a literature review and the development of a resilience model that can be adopted in the food supply chain at both a strategic and an operational level.

Findings: Conflict of interest **exist** for organisations that are seeking to strategically and effectively manage the pluralistic nature of internal and external supply chain risks. The model derived in this research can be used in the food supply chain to drive supply chain agility, organisational stability and longevity, and as a result continuous improvement.

Originality/value – This research is of academic value and of value to policy makers and practitioners in the food supply chain.

**Keywords** benchmarking, performance, indicators, stakeholders, value

**1. Introduction**

Implicit in the definition of resilience is the requirement for flexibility and adaptability as well as the capacity to absorb market and environmental shocks and still maintain a fully functioning food supply chain (Folke, 2006). Factors that influence food supply chains include: natural disasters, technological accidents, infectious diseases, terrorism, and food safety **incidents** (Leat and Revoredo-Giha, 2013), food fraud and wider food crime and market and pricing strategies. Factors that affect supply chain resilience can be *internal* i.e. within the supply chain network or *external* factors often outside the control of the organisations involved. These factors can be categorised as: *processes* such as transport, communication and infrastructure; *controls* including protocols, policies, procedures, systems

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3 30 and assumptions; and *demand and supply* related issues such as the fear of, or actual  
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5 31 disturbances to, the multi-directional flow of materials, product, finance and information  
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7 32 (Christopher and Peck, 2004). Driving a business strategy focused primarily on cost reduction  
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9 33 without sufficient regard for the risks that this strategy creates will make the food supply  
10  
11 34 chain more brittle (Viswanadham and Kameshwaran, 2013; Waters, 2007). Food supply chain  
12  
13 35 brittleness is centred on factors such as low financial margins, low profitability and low  
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15 36 resource stocks i.e. a lean management approach that can combine in multiple ways with  
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17 37 social factors (e.g. consumer trust and brand loyalty) and factors such as weather vulnerability  
18  
19 38 that affects quality or yield, price volatility or natural variation. The degree of financial  
20  
21 39 brittleness in a particular food supply chain will depend on the level of profitability, liquidity,  
22  
23 40 the ability to meet loan repayments and continue to implement capital investment plans that  
24  
25 41 underpin business growth. Ultimately, lower operating margins reduce financial flexibility  
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27 42 and create a more brittle supply chain that is vulnerable to major risks such as animal disease,  
28  
29 43 volatility in commodity markets and an increasing cost of legal and/or social compliance.  
30  
31 44 Conversely, food supply chain agility is determined by the level of financial return,  
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33 45 efficiency, innovation, resource management and the ability to have alternative sourcing  
34  
35 46 mechanisms in place for key ingredients, organisational responsiveness and underpinning  
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37 47 product quality that consistently meets customer requirements. For resilience to be assured in  
38  
39 48 the food supply chain brittle structural aspects need to be effectively managed and where  
40  
41 49 possible agility enhanced. Thus, it can be questioned whether the single concept of social-  
42  
43 50 ecological food supply chain resilience is normative (Keessen *et al.* 2013) or if there are  
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45 51 multiple meanings for what it is for an organisation, a discrete supply chain or indeed the  
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47 52 whole global food system to be deemed as being resilient. There is heterodoxy in the  
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49 53 vocabulary surrounding the meanings of resilience (Table 1) from it being the opposite of  
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51 54 vulnerability (Folke, 2006; Levina and Tirpak, 2006) to the ability to return to a stable state  
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55 i.e. business as usual (Morecroft et al. 2012; Holling et al. 1996; Pimm, 1991) through to the  
56 capacity for change, growth, and renewal. Folke (2006:259) suggests that resilience needs to  
57 embrace “*the opportunities that disturbance opens up in terms of recombination of evolved*  
58 *structures and processes, renewal of the system and emergence of new trajectories*”.

59 **Take in Table 1**

60

61 Five drivers identified by Foresight (2011) that will propel change in global food supply  
62 chains are: global population increase; change in the size and nature of per capita demand for  
63 food especially for meat and fish; climate change; competition for key resources (land, water  
64 and energy); and changes in values and ethical stances of consumers. Folke (2006) determines  
65 three concept of resilience: engineering resilience, ecological and socio-ecological resilience  
66 and this has been adapted to the food supply chain (Table 2). Engineering resilience is a  
67 transactional concept where the focal point for management is task-orientated and is one of  
68 recovery, constancy, and continuity. Ecological resilience considers the ability to withstand  
69 business shock requiring aspects of management such as persistence and robustness whilst  
70 socio-ecological resilience reflects transformational aspects of management that encompass  
71 learning, innovation and dynamic development. This self-organising process is in essence the  
72 equilibrium that is derived from reorganising, evolving and adapting as an organisation to the  
73 wider socio-economic environment that it operates in. Buffer capacity (also a key  
74 characteristic of ecological resilience) is the ability for an organisation or a supply chain to  
75 withstand shock and remain as a fully functioning business. Examples of how buffer capacity  
76 can be built is the use of buffer material and product stocks, or analysis of required skillsets  
77 for the organisation and a programme of capacity building in individuals through training and  
78 development. Thus, food supply chain resilience can be described and organisational goals  
79 can be developed either transactionally using financial, quantitative metrics or qualitatively in

terms of the ecological or holistic properties of resilience interfacing with what would generally be considered to be elements of an organisation's corporate social responsibility (CSR) strategy. However, organisations are increasingly expected to review their ethical performance in relation to stakeholders' expectations, identify how improvements could be made and then communicate these deliberations back to their stakeholders in order to deliver continued value (Manning *et al.* 2006; Manning, 2015). The whole process of value creation in food supply chains is realised through multi-organisational involvement and building mutual benefit (Caiazza and Volpe, 2012). Further they argue that a value chain is in fact an economic and social reality involving a set of actors and activities that interact and work together to satisfy the needs of specific markets. This definition supports the socio-economic view of strategic resilience (Caiazza *et al.* 2014; Caiazza and Volpe, 2012).

Whilst exploitation of natural resources could be considered as a key element of a global multinational corporation's (MNC) model of operation, this can create ecologically defined market failures in resource rich developing nations especially as a result of soil and groundwater depletion, reduction in forested areas etc. (Stiglitz, 2006). An organisation can seek to offset the environmental impact of these activities by a variety of means e.g. reducing waste, using emissions or outputs from one process as inputs into another, offsetting emissions by developing other sequestering activities. However, this stratagem focuses on mitigation of current practice rather than innovating and adapting the whole process to embed long term organisational resilience. Organisational ability to adapt to change can stall if there are high levels of complexity in terms of products, processes and intra- and inter-organisational structures (Power, 2005). Therefore, organisational resilience is to be the ability to reinvent dynamically business models and associated corporate strategies as circumstances change (Hamel and Välikangas, 2003). Ultimately, resilience must be embedded strategically and within the operating system, driving agility, an ability to be

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adaptive and deliver solutions especially with regard to emerging or re-emerging risks. The aim of this paper is to consider the concept of strategic business resilience in order to postulate innovative mechanisms to drive business performance in the food supply chain.

**2. Strategic and operational resilience**

Resilience is in part “the ability of an organisation to approach crisis situations as a potentially positive experience, and to utilise an enhanced ability to change as the economic, physical, political and social situation demands” (McManus, 2008:26). Strategic resilience is not about responding to a single crisis or rebounding from a setback, it encompasses anticipating and reacting to secular trends that can permanently impair the earning power of the core business (Hamel and Välikangas, 2003). Alternatively it has been suggested that strategic resilience “results when the organisation gains the capability to quickly convert threatening surprises into opportunities and to identify unique opportunities and act effectively before their competition” (Välikangas and Romme 2012:45). Further Välikangas and Romme (2012) differentiate between operational resilience and strategic resilience where the former is recovery focused e.g. after experiencing a crisis and tenacity in the face of threat i.e. reactive management and the latter is renewal focused in terms of changing without the driver of a crisis i.e. proactive management. The research has considered the concept of strategic and operational business resilience and postulated that innovative mechanisms need to be developed in order to embed resilience and drive performance and continuous improvement in the food supply chain.

Development of risk management strategies is a core executive process. Shareholders will place specific emphasis on ensuring the inherent risk to their financial investment is addressed in the strategic planning processes undertaken by senior management executives and executive boards. Indeed definition of organisational risk and the means for its control forms part of an executive annual report. A formulated approach has been described (Mintzberg,

1978) where *internal risks* associated with the organisation itself should be easier to quantify and thus mitigate than *external risk* (national or global social, political or economic forces) especially where there is a strong organisational operating system in place. Management can alleviate the effect of such risks by developing a risk register and then having contingency or disaster recovery strategies in place, but such a formulated, executive approach may still not react quickly enough to a sudden supply chain “shock” or an emergent, previously unknown risk. Strategic change is often by its nature ad hoc and irregular, never steady and results from the interaction of periods of continuity, change, flux and inertia (Mintzberg, 1978). Ensuring resilience in a wider business environment that is evolving rapidly requires two kinds of strategy firstly *intended strategy* i.e. what was planned and, secondly what is *realised strategy* i.e. what happened in practice. This emergent strategy is actually, what is exhibited by the organisation (Figure 1).

#### Take in Figure 1

Business continuity management (BCM) is the management process that identifies an organisation’s exposure to internal and external threats and as a result synthesizes hard and soft assets to provide effective prevention and recovery for the organisation i.e. operational resilience, whilst maintaining competitive advantage and value system integrity namely strategic resilience (Elliott *et al.* 2002). Operational BCM should be driven by an interactive rather than a purely reactive or proactive strategy and during contingency planning consideration should be given to ensure that plans developed in isolation can be actualised whether they are needed or not (Elliott *et al.* 2002; Mintzberg, 1978). The scope of contingency plans in the food supply chain can include factors such as natural disaster, climate variation, flood, fire, crop failure, yield reduction, animal disease outbreak, and failure of product to meet minimum quality specifications. Product recall, foodborne disease outbreak, supply chain failure (bankruptcy or financial failure of supply chain partners,



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3 155 logistical failure), food crime, threat or supply chain sabotage, and disruption to services e.g.  
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5 156 internet, electricity, waste disposal, water, and distribution networks as with the historic  
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7 157 incident of volcanic ash preventing movement of air freighted food should also be considered.  
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9 158 Transactional consideration of engineering resilience in the context of BCM reflects the time  
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11 159 to return to a stable state following shock, or perturbation, i.e. how quickly supply can be  
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13 160 resumed (Folke, 2006; Morecroft *et al.* 2012), but this is limited in terms of the socio-  
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15 161 ecological resilience requirements of creating supply chain value. This latter, self-organising,  
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17 162 approach drives the interplay between supply chain disturbance, reorganising, sustaining and  
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19 163 developing i.e. continuous improvement through enhancing adaptive capacity. In this context,  
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21 164 the focal point for management is facilitating transformability, learning, and innovation rather  
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23 165 than recovery or constancy. This requires fully integrated feedback systems and cross-chain  
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25 166 dynamic interactions between organisations (Table 2). In order to develop an appropriate  
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27 167 business continuity plan (BCP) that ensures strategic and operational resilience, consideration  
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29 168 must be given to the environment in which the BCP will operate, and to the degree of  
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31 169 turbulence in terms of the rate of change that is externally or internally driven. Therefore, the  
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33 170 strategy must be flexible, and include the ability to deliver a set of value-based aspirations.  
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35 171 Organisations need to consider resilience as being well beyond a BCP and develop strategies  
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37 172 that, as Mintzberg (1978) describes, are not just formulaic but allow for an iterative approach  
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39 173 to maintaining resilience. This requires management focus not to be purely on the  
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41 174 organisational process and the architectural framework of policies, protocols and systems  
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43 175 (system measures as defined by Tangen, 2005) but go further to consider how performance  
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45 176 measures can be developed that will inform and lead strategy.  
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47 177 In determining risk, there are a number of factors that can be considered including marketing  
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49 178 and pricing strategies, food safety incidents, food fraud and food crime, infections livestock  
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51 179 diseases, technological and infrastructure risks and national and localised natural disasters or  
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3 180 accidents (see Figure 2). These will have an impact on strategic resilience in terms of both  
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5 181 market and technology turbulence. Market turbulence is determined as the change in the  
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7 182 composition of customers and their preferences whereas technological turbulence refers to the  
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9 183 amount and unpredictability of change in production or service technologies (Slater and  
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11 184 Narver (1994) cited by Terawatanavong et al. 2011). Market and technology turbulence can  
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13 185 have both a push dynamic (from the challenges at primary production in terms of natural  
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15 186 resource availability, livestock disease outbreak, weather and seasonal impacts, influence of  
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17 187 ability to freely distribute product) through to a pull dynamic by the consumer. Primary level  
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19 188 food production is subject to a number of potential “shocks” that can cause poor yields or  
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21 189 crop failure either on an acute level in a single year or have chronic effects over a number of  
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23 190 years, even decades. These factors can often have more influence in terms of supply and  
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25 191 demand dynamics than ongoing technological research work in continuously developing the  
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27 192 genetic potential of the crop to yield (Ray *et al.* 2012). Due to multiplier factors, poor feed  
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29 193 crop yield and low product quality at primary production level impacts on further stages in the  
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31 194 food supply chain e.g. the escalating effect, in terms of net efficiency, of poor feed quality and  
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33 195 then lower feed conversion rate in the animals the feed is provided for. In food supply chains  
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35 196 accumulative weak performance will influence food availability, and affordability for the  
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37 197 world’s increasingly urban population with an aggregation of marginal losses, rather than  
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39 198 marginal gains. The aggregation of marginal gains theory is that multiple, seemingly  
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41 199 miniscule, improvements throughout any given process, can collectively achieve a far  
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43 200 superior output (Durrand *et al.* 2014; Eisen *et al.* 2014; Hill, 2014; Smith *et al.* 2014).  
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45 201 Conversely the aggregation of marginal losses theory is worthy of consideration in the wider  
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47 202 context of resilience and supply chain performance.  
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49 203 Assurance of strategic and operational resilience requires the integrated engagement of supply  
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51 204 chain actors at all stage of food production, distribution and information exchange in order to  
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3 205 limit vulnerability, external and internal risks. Threat Assessment Critical Control Point  
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5 206 (TACCP) is described in PAS 96 (2014:3) as the “*systematic management of risks through*  
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7 207 *the process of assessment of threats, identification of vulnerabilities, and implementation of*  
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9 208 *controls to raw materials, packaging, finished products, processes, premises, distribution*  
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11 209 *networks and business systems by a knowledgeable and trusted team with the authority to*  
12  
13 210 *implement changes to procedures*”. Thus, an appropriate and well-integrated TACCP plan is  
14  
15 211 just one element of a wider strategic resilience risk assessment that can be undertaken from  
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17 212 primary production through to the consumer. In order to drive a quantitative approach to  
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19 213 strategic resilience risk assessment, an architecture of analysis needs to be clearly defined,  
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21 214 although the architecture must be agile enough to accommodate sudden and unexpected  
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23 215 supply shocks in the event that they occur. Ultimately, corporate goals should be formulated  
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25 216 and these need to cascade into specific, relevant and time bound measures. These measures  
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27 217 can be strategic and influence the whole supply chain e.g. a supply chain level approach to  
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29 218 reducing waste or be operationally based measures that define performance at a single supply  
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31 219 chain stage. These corporate goals will as a result have influence either as a whole chain actor  
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33 220 or as a single stage actor. Interest in CSR benchmarking for demonstrating social and  
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35 221 environmental performance has promoted the development of supply chain guidelines and  
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37 222 codes of practice (Manning and Baines, 2004). Benchmarking as an activity can then monitor  
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39 223 the degree of integration between different measures and the actual organisational and/or  
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41 224 supply chain performance that is realised. The use of methods to construct and to assess  
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43 225 measureable socio-ecological indicators has been proposed (Mitchell *et al.* 1995; Hansen  
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45 226 1996; Bockstaller *et al.* 1997; Rigby *et al.* 2001; Hak *et al.* 2012). This approach suggests that  
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47 227 quantitative measures can be used to drive what for many are deemed qualitative social  
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49 228 aspirations and when the use of qualitative and semi-quantitative measures is open to  
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51 229 interpretation. Bell and Morse (2003) stated that supply chain performance indicators must be  
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230 *specific* (outcome bound); *quantitative* (measureable); *usable* (of practical value); *available*  
231 (data easily collated); *cost-effective* (not expensive to collect); and *sensitive* (demonstrate  
232 changes in circumstances). This does not preclude the use of qualitative indicators, but by  
233 their nature, qualitative indications do not drive business performance and continuous  
234 improvement in the same way as quantitative indicators. Bourlakis et al. (2014) differentiate  
235 between four categories of socio-ecological supply chain indicators (efficiency, flexibility,  
236 responsiveness and product quality). In Table 3, the work of Bourlakis *et al.* 2014 has been  
237 adapted for the four factors with consideration of economic, environmental and social  
238 characteristics that they can quantify. Consideration of this work highlights **that** a resilience  
239 indicator framework could be developed that can be used at a strategic level or an operational  
240 level to provide socio-economic organisational and supply chain measures that define  
241 business goals and objectives which are measureable i.e. quantitative.

### 242 **Take in Table 3**

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244 Benchmarking is the means by which targets, priorities and operations **are** established that  
245 will lead to competitive advantage (Oakland, 1993). Lau et al. (2005) characterise  
246 benchmarking as the systematic comparison of elements of performance in a company against  
247 those best practices of relevant companies, and then obtaining information that will help the  
248 observing company to identify and implement improvement. In order for benchmarking to be  
249 effective, it requires a measured consideration of whether the process will be implemented  
250 either at a strategic management level or at an operational, activity or enterprise level, or both.  
251 To reflect on this in another way, the benchmarking approach to developing resilience can be  
252 designed to underpin BCM strategies, long term strategic aims and objectives at the supply  
253 chain, or product category scale, as well as operationally drive the implementation of a CSR  
254 strategy or simply provide baseline data and then drive improvement. Synthesizing the

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3 255 literature reviewed in this study as Hamel and Välikangas (2003) propose strategic resilience  
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5 256 is not about simply responding to a single crisis or rebounding from a setback. Strategic  
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7 257 resilience considers, anticipates and mitigates pressures, and drivers that influence the socio-  
8  
9 258 economic environment in which the business operates. The factors considered are strategic  
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11 259 leadership, strategic decision-making, supply chain dynamics, value based dynamics and the  
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13 260 use of performance indicators in the context of external and internal influences and at the  
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15 261 executive, organisational and individual level (Table 4).  
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18 262 **Take in Table 4**

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23 264 Building on Table 4 and utilising the so-called 3Rs (ready-respond-recover) approach to  
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25 265 resilience proposed by Ponomarov and Holcomb (2009) a 3Rs strategic resilience risk  
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27 266 assessment framework for the food supply chain has been developed (Figure 2). This  
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29 267 framework via consideration of internal organisational and external supply chain risks, and  
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31 268 the ability of an individual organisation or a food supply chain to ready, respond and recover.  
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33 269 Six examples of risk are illustrated in the framework, although this is not an exhaustive list,  
34  
35 270 namely natural disasters, technological accident and infrastructure threats, infection or  
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37 271 disease, food fraud and wider food crime, food safety incidents, outbreaks and product recalls  
38  
39 272 and marketing and pricing strategies. The strategic resilience risk assessment framework  
40  
41 273 identifies industry risk assessment tools that are already utilised to determine risk, TACCP  
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43 274 with regard to food fraud and wider food crime and hazard analysis critical control point  
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45 275 (HACCP) which is an approach used to consider food safety risk and its mitigation.  
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48 276 **Take in Figure 2**

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53 278 Supply chain relationships depend on the abilities of the individual organisations in the food  
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55 279 supply chain to individually and collectively act efficiently, flexibly, in order to be agile,  
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responsive and meet the complicated customer specifications for their products and services each time. This requires a hierarchy of strategic resilience aims and objectives and an architecture of analysis to be built around the supply chain metrics that are developed

**Take in Figure 3.**

In the context of a generic food supply chain, a conceptual resilience indicator framework (Figure 3) has been proposed using the secondary processing stage as an example. Similar strategic resilience indicator frameworks can be developed for other stages of the food supply chain, bespoke to particular products, processes or scenarios. The framework also includes a range of indicators that can be used as part of a supply chain monitoring process to create value for the organisation itself improving its strategic and operational resilience and provide value for a range of stakeholders. These stakeholders include shareholders who may reflect on their being less financial risk and a greater underpinning of brand value, insurance companies who are requested to provide insurance against risks such as product recalls, stock rejection, etc. and supply chain partners, community groups and consumers who may each define supply chain value in their own distinct ways. The use of a strategic resilience indicator framework can provide opportunity for an organisation to address internal and external risk and mitigate such risk wherever possible. This approach is of value to practitioners in the food supply chain in order to reduce risk. Risk is determined at many levels in an organisation from executive risk registers in corporate documents to the development of BCM protocols and the use of TACCP and HACCP at an operational level as described in the paper. The resilience assessment tools explored in this research can assist practitioners to consider a more integrated approach to managing risk and developing strategic resilience management programmes.

**6. Conclusion**

The aim of this paper is to consider the concept of strategic business resilience in order to postulate innovative mechanisms to drive business performance in the food supply chain. A 3Rs (ready, respond and recovery) business resilience risk assessment framework and an associated resilience indicator framework has been developed to enable organisations in the food supply chain to determine and improve their strategic resilience in terms of both internal organisational and external supply chain risk factors. This incorporates the five strategic resilience factors (values-based dynamics, supply chain dynamics, strategic decision-making, strategic leadership, and use of performance indicators) into the 3Rs strategic resilience risk assessment framework (Figure 3) to identify ways to ensure readiness through formal procedures and protocols, effective response and recovery. The strategic resilience indicator framework (Figure 4) can be use to develop and utilise performance indicators that demonstrate the degree of vulnerability within the socio-economic environment in which the organisation operates. Conflict of interest exists for organisations that are seeking to strategically and effectively manage the pluralistic nature of internal and external supply chain risks. The model derived in this research can be used in the food supply chain to drive supply chain agility, organisational stability and longevity, and as a result continuous improvement.

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**Table 1. Meanings of resilience (Adapted from Keessen *et al.* 2013; Folke 2006 and others)**

Meaning	Source:
The opposite of vulnerability.	Folke, 2006; Levina and Tirpak, 2006
A criterion to evaluate the quality of a strategy for adaptation to a stimulus e.g. climate change.	Adger, 2006; Driessen and Van Rijswijk 2011
Ability of a system to adapt to change, but also the ability of a system to persist despite change.	Gunderson and Light, 2006
Ability of a system to return to its original state or move to a new, more desirable state after being disturbed.	Christopher and Peck, 2004
The time to return to a stable state following shock, or perturbation.	Morecroft <i>et al.</i> 2012; Holling 1996; Pimm 1991
Capacity for renewal, re-organisation and development.	Berkes <i>et al.</i> 2003; Gunderson and Holling, 2002
The amount of disturbance a system can take before its controls shift to another set of variables and relationships that dominate another stability region.	Folke, 2006
The capacity of a system to absorb disturbance and re-organise while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks.	Walker <i>et al.</i> 2004

**Table 2. Concepts of resilience (Adapted from Folke, 2006)**

Resilience concepts	Characteristics	Focal point for management	Context
<b>Engineering resilience</b>	<b>Transactional:</b> return time, efficiency	Recovery, constancy	Stable equilibrium i.e. returning to a steady state.
<b>Ecological resilience</b>	<b>Buffer capacity:</b> ability to withstand shock and maintain supply chain function	Persistence, robustness	Multiple equilibria, stability at a supply chain level
<b>Socio-ecological resilience</b>	<b>Self-organising:</b> interplay between disturbance, reorganising, sustaining and developing i.e. developing through adaptive capacity	Transformability, learning, innovation	Integrated systems feedback, cross-chain dynamic interactions

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491 **Table 3: Resilience indicator framework with indicator categories by type and**  
492 **characteristic (Adapted from Bourlakis *et al.* 2014)**

Indicator	Characteristic		
	Economic	Environmental	Social
Efficiency	Indicators relating to costs, margins and profitability or return on capital employed.	Indicators relating to resource efficiency, waste reduction, and carbon or water footprint.	Indicators relating to worker welfare and management of human capital e.g. staff turnover, productivity per person.
Flexibility	Indicators relating to the capability to provide individual service to customers e.g. differentiated stock keeping units (SKU), meeting changes in order levels or timings, minimising storage costs.	Indicators relating to environmental flexibility include the ability to irrigate crops if rainfall is insufficient, to change what type of forage is produced on the farm in the event of inclement weather.	Indicators relating to worker training and degree of flexibility e.g. multiple skills so can undertake more than one task. Degree of permanent versus contract staff if the fruit crop is late, orders are reduced from the retailer.
Responsiveness	Indicators relating to customer service, distribution and delivery costs.	Indicators relating to growing of new varieties adapted to climate variation, growing varieties that can tolerate more salt, less rainfall in a given region.	Indicators relating to animal welfare or labour standards e.g. reactivity to livestock mortality, livestock lameness, or health challenges. Responses to worker welfare issues.
Product quality	Indicators relating to compliance with product specifications e.g. carcase quality, intrinsic characteristics of fresh produce.	Indicators relating to environmental performance e.g. shelf-life, biodegradable or less environmentally intensive packaging.	Indicators relating to extrinsic production standards e.g. reduced stocking density, extensive production methods and consideration of worker conditions e.g. Fair Trade.

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**Table 4. Strategic resilience factors (Adapted from Caiazza and Volpe, 2015; Caiazza et al. 2014; Bourlakis et al. 2014; Delmas and Burbano, 2011; Muthuri et al. 2006; Elliott et al. 2002; Ackoff 1990; Mintzberg 1978)**

Factors	External influences	Internal influences	
	Executive level	Organisational level	Individual level
Values based dynamics	Pressure from: <ul style="list-style-type: none"> <li>Non-market actors (legislation, regulators and regulatory environment and non- governmental organisations);</li> <li>Market actors (consumers, investors and competitors);</li> <li>New challenges;</li> <li>Historic legacies;</li> <li>Community groups</li> </ul>	Pressure from: <ul style="list-style-type: none"> <li>Organisational structure;</li> <li>Organisational culture and sub-cultures;</li> <li>Effectiveness of intra-firm communication;</li> <li>Degree of organisational inertia;</li> <li>New organisational challenges; and</li> <li>Historic legacies.</li> </ul>	Psychological and cognitive pressure include: <ul style="list-style-type: none"> <li>Narrow decision framing;</li> <li>Hyperbolic intertemporal discounting; and</li> <li>Optimistic bias.</li> </ul> <p>This could be due to the use of inaccurate or incomplete information on which decisions are based.</p>
Supply chain dynamics	Pressure from: <ul style="list-style-type: none"> <li>Demand/supply dynamics;</li> <li>Externally driven processes such as transport, communication and infrastructure; and</li> <li>Externally driven controls including supply chain protocols, policies, procedures, systems and assumptions.</li> </ul>	Pressure from: <ul style="list-style-type: none"> <li>Internally driven processes including communication and infrastructure; and</li> <li>Internally driven controls including protocols, policies, procedures, and systems.</li> </ul>	Pressure from: <ul style="list-style-type: none"> <li>Internally driven processes operating at the individual level including communication and infrastructure; and</li> <li>Internally driven controls operating at the individual level including protocols, policies, procedures, and systems.</li> </ul>
Strategic leadership	Drives: <ul style="list-style-type: none"> <li>Leadership at Executive level through stakeholder expectations;</li> <li>Organisational operating system (external drivers); and</li> <li>Change management (at executive level).</li> </ul>	Drives: <ul style="list-style-type: none"> <li>Leadership at managerial level;</li> <li>Organisational operating system (internal drivers); and</li> <li>Change management at managerial level</li> </ul>	Drives: <ul style="list-style-type: none"> <li>Leadership at personal level;</li> <li>Organisational operating system (internal drivers); and</li> <li>Change management at a personal level.</li> </ul>
Decision making leadership	Drives: <ul style="list-style-type: none"> <li>Normative decisions (values and impact and decisions that create value);</li> <li>Policies and principles (rules and formulation of values for the organisation and in turn product and service value;</li> <li>Strategic decisions (focus on growth and issues that have an overarching organisational impact); and</li> <li>Tactical, operational decisions (focus on efficiency and cost) or those issues reported annually to shareholders.</li> </ul>	Drives: <ul style="list-style-type: none"> <li>Normative decisions (cultural and internal values);</li> <li>Policies and principles (internal);</li> <li>Strategic decisions (internally focused issues that have an organisational impact);</li> <li>Tactical, operational decisions (focus on efficiency and cost); and</li> <li>Tactical planning (operational, short-term goals)</li> </ul>	Drives: <ul style="list-style-type: none"> <li>Normative decisions (cultural and internal values);</li> <li>Policies and principles (internal);</li> <li>Strategic decisions (internally focused issues that have an organisational impact);</li> <li>Tactical operational decisions (focus on personal efficiency) ; and</li> <li>Tactical planning (personal, short-term goals).</li> </ul>
Use of performance indicators	<ul style="list-style-type: none"> <li>Externally driven from the need for regulatory compliance or market pressures to improve productivity through developing measures to drive efficiency, flexibility, responsiveness and product quality.</li> </ul>	<ul style="list-style-type: none"> <li>Internally driven from the need for regulatory compliance or market pressures to improve operational productivity through developing measures to drive efficiency, flexibility, responsiveness and product quality.</li> </ul>	<ul style="list-style-type: none"> <li>Internally driven from the need for regulatory compliance or market pressures to improve personal productivity through developing measures to drive efficiency, flexibility, responsiveness and product quality.</li> </ul>

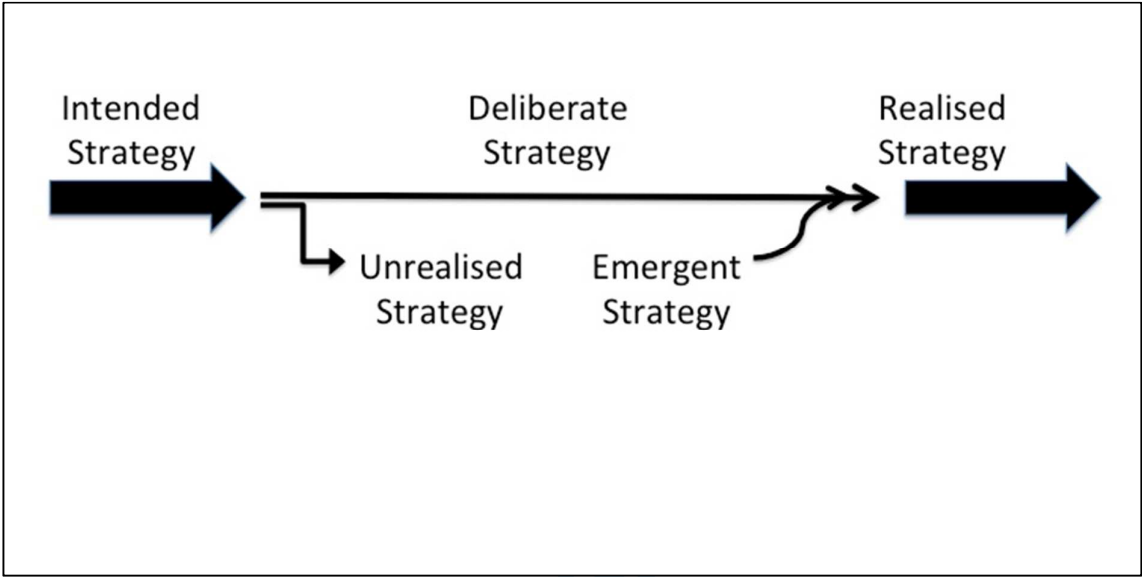


Figure 1. Types of Strategies (Mintzberg, 1978)



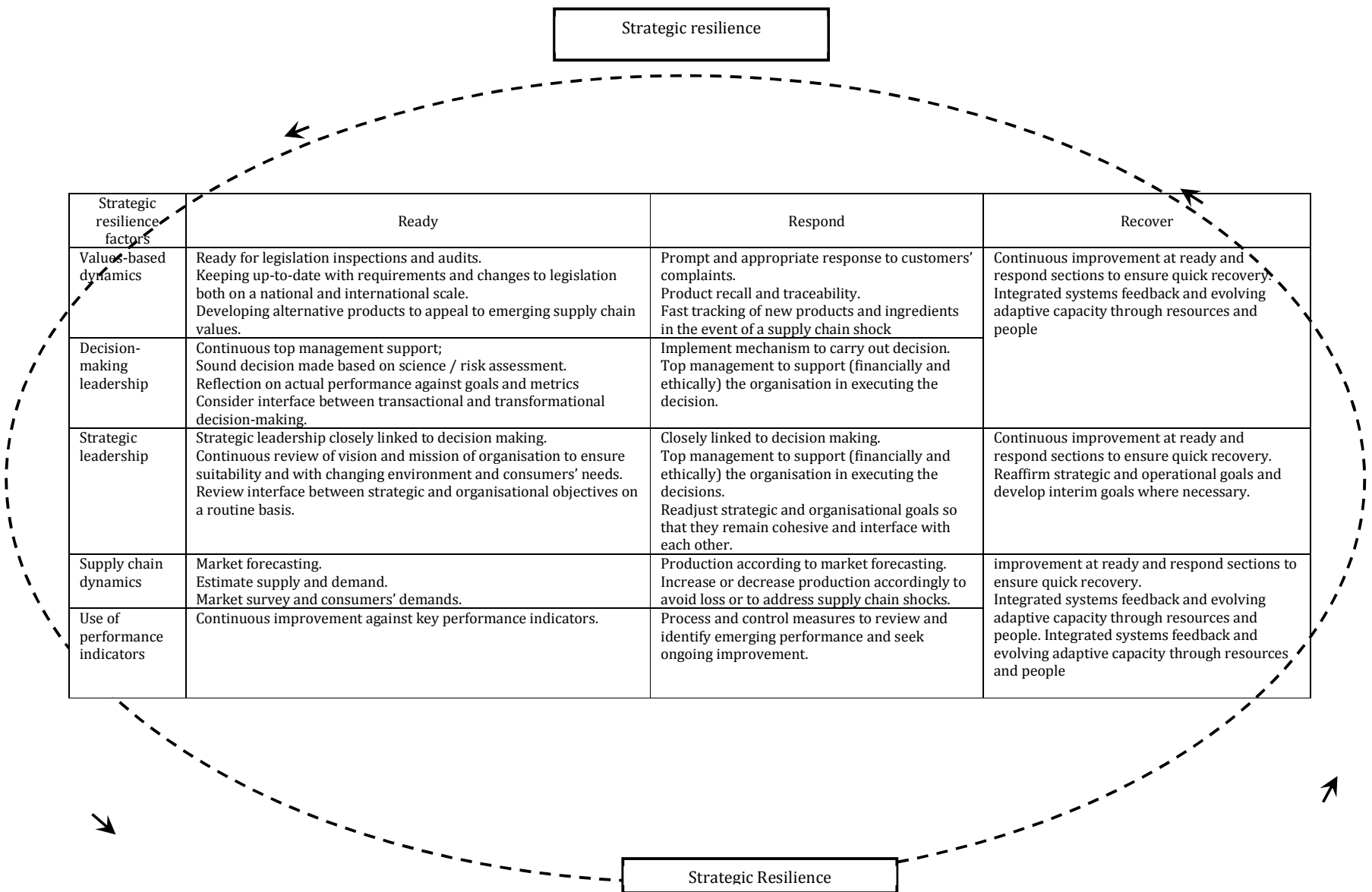
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External supply chain risks	Internal organisational risks	Ready	Respond	Recover
Natural global disasters affecting suppliers / neighbouring countries e.g. crop failure, drought, war etc.	Natural local disasters e.g. flood, snowstorm, fire etc.	Alternative approved ingredient and service suppliers, appropriate stock levels of key ingredients; weather forecasting, alternative approved packing, processing or storage facilities.	BCM plan in place. Crisis response management team take action according to agreed protocols; introduction of new production plans to avoid productivity loss and minimise disruption.	Continuous improvement at ready and respond sections to ensure quick recovery or change product mix so that continuity can be maintained. Review efficacy of strategies and procedures employed and update as necessary. Develop new protocols, adaption strategies, training programmes as required.
Technological accidents and infrastructure threats (e.g. accidents occurring at suppliers' farms / processing plant, transportation, communication breakdown, loss of data, technical knowledge).	Technological accidents in own processing plant, loss of data, technical knowledge, communication between organisational centres.	Alternative approved ingredient and service suppliers, appropriate stock levels of key ingredients; Predetermined agreement for other organisations even competitors to contract pack product until problem is addressed, clean-up and respond standard operating procedures (SOPs), alternative transport and distribution procedures in place, information back-up, recovery and retrieval procedures developed and ready to implement.	BCM plan in place. Crisis response management team take action according to agreed protocols; Clean-up / repair technological accidents and approval protocols for production to recommence; reduce production of particular products and alternative supply mechanisms put in place to avoid productivity loss. Implement information recovery and retrieval procedures.	
Infectious animal diseases (diseases affecting importing / exporting countries, competitors) e.g. avian influenza, swine fever, foot and mouth.	Infectious diseases (diseases affecting suppliers' farms) e.g. avian influenza, swine fever, foot and mouth.	Infectious disease continuity plans developed and annually tested, emergency procedures developed and tested. Predetermined agreement for alternative suppliers and markets so supply could be diverted to source from other regions or suppliers.	BCM plan in place. Crisis response management team take action according to agreed protocols; Source from different suppliers/ countries if disease outbreak is identified. Implement alternative food products if possible to ensure markets are not lost to competitors. Work with regulatory requirements in terms of movement restrictions etc. until lifted.	
Food fraud and wider food crime incl. terrorism, boycott.	Food fraud and food crime including food tampering, substitution adulteration.	Undertake TACCP assessment and develop response plan. Consider wider potential for food crime associated with products sold e.g. with high value foods, ethnic or specific culture foods. Identify "at-risk" products that require specific monitoring. Horizon scan for emerging and re-emerging food crime hazards. Review security procedures on a routine basis. Develop a plan for alternative suppliers. Implement employee screening and training programmes.	BCM plan in place. Crisis response management team take action according to agreed protocols; Implement controls identified within TACCP Plan or equivalent. Isolate product and implement product withdrawal or recall. Source from different suppliers, investigate reason behind food tampering and include law enforcement agencies where required.	
Food safety incidents / outbreaks / product recall.	Food safety incidents / outbreaks/ contamination from own processing plant.	Undertake food safety risk assessment including HACCP assessment and develop response plan. Determine risk to vulnerable groups. Develop traceability and product recall and withdrawal procedures and test these procedures on a routine basis. Horizon scan for emerging and re-emerging food safety hazards.	BCM plan in place. Crisis response management team take action according to agreed protocols; Implement controls identified within HACCP Plan or equivalent. Isolate product and implement product withdrawal or recall. Source from different suppliers, investigate reason behind food safety incident and include regulatory and law enforcement agencies where required. Undertake sampling and laboratory testing.	
Market and pricing strategies.	Market and pricing, economic crisis.	Financial budgeting and planning including financial contingency plans such as agreed extension to overdraft. Horizontal collaboration to ensure market and price security (Leat and Revoredo-Giha, 2013).	Modify products to address constraints where possible. Market / promote alternative products to address fluctuating food prices/ availability.	

Figure 2. 3Rs (ready, respond and recovery) strategic resilience risk assessment framework for food supply chain



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5 521 **Figure 3. Strategic Resilience Indicator Framework incorporating values, decision-making, strategic, supply and performance**  
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