Conceptualizing resilience in engineering systems: An analysis of the literature

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Appendix

The table below contains the full analysis of 251 definitions of resilience excerpted in Table 2.

Reff. no.	Author	Definition	System type	Performance	Conditions	Resilient properties
	From (Bhamra, Dani, & Burnard, 2011)					
(1)	Bodin and Wiman (2004)	The speed at which a system returns to equilibrium after displacement, irrespective of oscillations indicates the elasticity (resilience).	Unspecified/generic	Equilibrium	Displacement, oscillation	return speed
(2)	Holling (1973)	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.	Ecological systems	Relationships between state variables	Disturbance, change	Persistence, absorption
(3)	Walker et al. (2004)	The capacity of a system to absorb a disturbance and reorganise while undergoing change while retaining the same function, structure, identity and feedback.	Ecological systems	Function, structure, identity, and feedback	Disturbance	Absorption, reorganisation
(4)	Gunderson (2000)	The magnitude of disturbance that a system can absorb before its structure is redefined by changing the variables and processes that control behaviour.	Ecological systems	Redefinition	Disturbance	Absorb
(5)	Tilman and Downing (1994)	The speed at which a system returns to a single equilibrium point following a disruption.	Ecological systems	Single equilibrium point	Disruption	Return speed
(6)	Walker et al. (2002)	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	Socio-ecological systems	Functionality, Elements required for renewal or reorganisation	Perturbation, disturbance	Renewal, reorganisation
(7)	Carpenter et al. (2001)	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	Socio-ecological systems	The current state	Disturbance	Tolerate
(8)	Bruneau et al. (2003)	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	Socio-ecological systems	Social disruption	Hazards and disasters	Prevent, mitigate, contain, and recover

		the effects of future earthquakes.				
(9)	Hamel and Valikangas (2003)	The capacity for continuous reconstruction	Organisations/firms			Reconstructio n
(10)	Horne and Orr (1998)	Resilience is the fundamental quality to respond productively to significant change that disrupts the expected pattern of events without introducing an extended period of regressive behaviour	Organisations/firms	Behaviour	Change disrupting the expected pattern of events	Productive response
(11)	McDonald (2006)	Being able to adapt to the requirements of the environment and being able to manage the environments variability.	Organisations/firms	Meeting the requirements of the environment	Environmental variability	Adaptation, management of variability
(12)	Hollnagel et al. (2006)	The ability to sense, recognise, adapt and absorb variations, changes, disturbances, disruptions and surprises	Technical systems		Variations Changes, Disturbances, Disruptions Surprises	Sensing Recognising Adapting Absorbing
	From (Hosseini, Barker, & Ramirez-Marquez, 2016)					
(13)	Allenby and Fink [53]	the "capability of a system to maintain its functions and structure in the face of internal and external change and to degrade gracefully when it must."	Unspecified/generic	Functions and structure	internal and external change	Maintain, degrade gracefully
(14)	Pregenzer [54]	the "measure of a system's ability to absorb continuous and unpredictable change and still maintain its vital functions."	Unspecified/generic	Vital functions	continuous and unpredictable change	Absorption
(15)	Haimes [55]	the "ability of system to withstand a major disruption within acceptable degradation parameters and to recover with a suitable time and reasonable costs and risks."	Unspecified/generic	System degradation	Major disruption	Withstand, acceptable degradation, recover within acceptable time
(16)	Infrastructur e Security Partnership [56]	the capability to prevent or protect against significant multi-hazard threats and incidents, including terrorist attacks, and to recover and reconstitute critical services with minimum devastation to public safety and health.	Technical systems	Critical services, devastation	Significant multi-hazard threats and incidents	Prevention, protection, recovery, reconstitution
(17)	Vugrin et al. [57]	"Given the occurrence of a particular disruptive event (or set of events), the resilience of a system to that event (or events) is that system's ability to reduce efficiently both the magnitude and duration of deviation from targeted system performance levels."	Unspecified/generic	Deviation from targeted system performance levels	disruptive event (or set of events)	Reduce the magnitude and duration
(18)	Sheffi [19]	The inherent ability to *keep* or *recover* a steady state, thereby allowing it	Organisations/firms	Normal operations	Disruptive event,	Keeping or recovering steady state

		to continue normal operations after a disruptive event or in the presence of continuous stress			continuous stress	
(19)	Vogus and Sutcliffe [20]	The ability of an organization to absorb strain and improve functioning despite the presence of adversity.	Organisations/firms	Function	Strain Adversity	Absorbing Improving
(20)	Sheffi [21]	The company's ability to, and speed at which they can, return to their normal performance level (e.g., inventory, capacity, service rate) following by disruptive event.	Organisations/firms	Performance level	Disruptive events	Ability and speed of return to normal performance
(21)	Adger [28]	The ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change.	Socio-ecological systems		External stresses, disturbances and environmental change	Coping
(22)	The Community and Regional Resilience Institute [29]	The capability to predict risk, restrict adverse consequences, and return rapidly through survival, adaptability, and growth in the face of turbulent changes.	Socio-ecological systems		Turbulent change	Predict, restrict adverse consequences, return rapidly, survival, adaptability, growth
(23)	Keck and Sakdapolrak [30]	Comprised of three dimensions: coping capacities, adaptive capacities, and transformative capacities.	Socio-ecological systems			Coping capacities, adaptive capacities, and transformative capacities.
(24)	Cohen et al. [31]	The ability of a community to function properly during disruptions or crises.	Socio-ecological systems	Proper function	Disruption Crisis	
(25)	Pfefferbaum et al. [32]	The ability of community members to take meaningful, deliberate, collective action to remedy the effect of a problem, including the ability to interpret the environment, intervene, and move on	Socio-ecological systems	Effect of a problem	Problem	Meaningful, deliberate, collective action, interpret the environment, intervene, and move on
(26)	Rose and Liao [43]	The inherent ability and adaptive response that enables firms and regions to avoid maximum potential losses.	Economic systems	Maximum potential losses		Ability and adaptive response
(27)	Rose [44]	Static economic resilience is the capability of an entity or system to continue its functionality like producing when faced with a severe shock. Dynamic economic resilience is defined as the speed at which a system recovers from a severe shock to achieve a steady state.	Economic systems	Functionality	Severe shock	Continue functionality with faced with severe shock, Recover from severe shock

(28)	Martin [45]	The capacity to reconfigure, that is adapt, its structure (firms, industries, technologies, institutions) so as to maintain an acceptable growth path in output, employment and wealth over time.	Economic systems	Acceptable growth path in output employment and wealth over time		Adapt structure
(29)	Youn et al. [14]	The sum of the passive survival rate (reliability) and proactive survival rate (restoration) of a system.	Technical systems			Reliability, restoration
(30)	Hollnagel et al. [15]	The intrinsic ability of a system to adjust its functionality in the presence of a disturbance and unpredicted changes.	Technical systems	Functionality	Disturbance and unpredicted changes	Adjust
(31)	The American Society of Mechanical Engineers (ASME) [17]	The ability of a system to sustain external and internal disruptions without discontinuity of performing the system's function or, if the function is disconnected, to fully recover the function rapidly.	Technical systems	Function	External and internal disruptions	Sustain continuity or recover rapidly
(32)	National Infrastructure Advisory Council (NIAC) [52]	The ability to predict, absorb, adapt, and/or quickly recover from a disruptive event such as natural disasters.	Technical systems		Disruptive event	Predict, absorb, adapt, and/or quickly recover
	(Francis & Bekera, 2014)					
(33)	[51]	The ablity to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event	Technical systems		Disruptive events	Anticipate, absorb, adapt to, and/or rapidly recover
(34)	[12]	In the context of critical infrastructure, resilience refers to: Coordinated planning across sectors and networks, Responsive, flexible and timely recovery measures, and The development of an organizational culture that has the ability to provide a minimum level of service during interruptions, emergencies and disasters, and return to full operations quickly	Technical systems	Service operations	Interruptions, emergencies and disasters	Coordinated planning, timely recovery measures, minimum level of serve during disruptions, return to full operations quickly
(35)	[70]	The ability of a system to recover from adversity, either back to its original state or an adjusted state based on new	Technical systems	System state	Adversity	Recovery, reengineering

		requirements; building resilience requires long-term effort involving reengineering fundamental processes, both technical and social				
(36)	[71]	The ability of an organization to anticipate, circumvent threats to its existence & primary goals and rapidly recover.	Organisations/firms	Organisational existence and primary goals	Threats	Anticipate, circumvent,
(37)	[72]	Resilience is the ability to recognize & adapt to handle unanticipated perturbations that call into question the model of competence, and demand a shift of process, strategies and coordination.	Organisations/firms		Unanticipated perturbations	Recognise and adapt
(38)	[73]	Resilient organizations are therefore characterized by a balance of stability and flexibility that allows for adaptations in the face of uncertainties without losing control.	Organisations/firms	Control	Uncertainties	Stability, flexibility, adaptation
(39)	[74]	Organization's ability to efficiently adjust to harmful influences rather than to shun or resist them.	Organisations/firms		Harmful influences	Efficient adjustment
(40)	[11]	Capacity of an organization to recognize threats and hazards and make adjustments that will improve future protection efforts and risk reduction measures.	Organisations/firms		Threats, hazards	Recognise and make adjustments
(41)	[50]	The system's ability to sustain a shock without completely deteriorating; that is, most conceptions of resilience involve some idea of adapting to and bouncing back from a disruption.	Organisations/firms	Deterioration	Shock	Adaptation and bounce-back
(42)	[75]	The ability of the system to maintain its identity in the face of change and external shocks & disturbances. Component of the system, the relationship among these components and the ability of these components & relationships to maintain themselves constitutes system identity	Socio-ecological systems	System identify	Change, external shocks, disturbances	Maintain
(43)	[76]	Resilience is a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between	Socio-ecological systems	Relationships between populations or state variables	Change and disturbance	Persistence and absorption

		populations or state variables.				
(44)	[78]	The inherent & adaptive responses to hazards that enable individuals and communities to avoid some potential losses. It can take place at the level of the firm, household, market, or macro economy. In contrast to the pre-event character of mitigation, economic resilience emphasizes ingenuity and resourcefulness applied during and after the event	Economic systems	Avoiding losses	Hazards	Ingenuity and resourcefulness
(45)	[79]	The ability of the system to withstand either market or environmental shocks without losing the capacity to allocate resources efficiently.	Economic systems	Capacity to allocate resources efficiently	Shock	Ability to withstand
(46)	[41]	The capacity for an enterprise to survive, adapt, and grow in the face of turbulent change.	Economic systems		Turbulent change	Survival, adaptation and growth
(47)	[11]	The ability to resist, absorb, recover from or successfully adapt to adversity or a change in conditions.	Unspecified/generic		Adversity, change in conditions	Resist, recover, adapt
(48)	[41]	The capacity of the system to tolerate disturbances while retaining its structure and function.	Unspecified/generic	System structure and function retention	Disturbances	Tolerate
(49)	[82]	How well the system adapts and to what range or source of variation.	Unspecified/generic		Variation	Adapt
(50)	[83]	The time of return to a global equilibrium following a disturbance. Ecological resilience is the amount of disturbance that a system can absorb before it changes state.	Unspecified/generic	Equilibrium	Disturbance	Absorb without state change
(51)	[11]	The ability of systems, infrastructures, government, business, and citizenry to resist, absorb, recover from, or adapt to an adverse occurrence that may cause harm, destruction, or loss of national significance.	Unspecified/generic	Harm, destruction, or loss of national significance	Adverse occurrence	Resist, absorb, recover, adapt
(52)	[84]	Resilience is the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization and the capacity to adapt to stress and change. Resilience in business	Unspecified/generic	Retention of structure and ways of functioning	Disturbance, interruption	self-organization, adapt, recover, resume operations

		terms can be defined as the ability of an organization, resource or structure to sustain the impact of a business interruption and to recover, resume its operations and provide at least minimal services.				
(53)	[85]	Resilience can be understood as the ability of the system to reduce the chances of a shock, to absorb a shock if it occurs (abrupt reduction of performance) and to recover quickly after a shock (re-establish normal performance).	Unspecified/generic	Outages	Shock	reduce the chances of a shock and recover quickly
	From (Wilt & Long, 2016)					
(54)	Annerelli & Nonino (2016)	Ability to face disruption and unexpected events by strategic awareness	Organisations/firms		Disruption, unexpected events	Strategic awareness
(55)	Bahi et al. (2016)	Ability to avoid more frequent failures and outage durations that are longer than acceptable.	Technical systems	Failures, outage duration		Avoid failure, limit outage duration
(56)	Baroud et al. (2013)	The ability to "bounce back" from disruptive event.	Technical systems		Disruptive event	Bounce back
(57)	Berke et al (2008)	Capacity to restructure, adapt and adjust to stress. Ability to mitigate disasters, contain losses and recovers rapidly.	Socio-ecological systems	Losses	Stress, disasters	Restructuring, adapt, adjust, mitigation, containment, recovery
(58)	Bhayathrathan and Patil (2015)	Provides and maintains an acceptable level of service after disruptions to normal operations.	Technical systems	Service	Disruptions	
(59)	Boyes (2015)	Ability of systems to withstand cyber attacks by time to failure and average time to recovery.	Technical systems		Cyber attacks	Withstand
(60)	Coaffee and Rodgers (2008)	Control during disruptions and "bounce back" ability.	Tourism		Disruptions	Control, bounce back
(61)	Dolev et al. (2006)	Network's ability during extreme conditions.	Unspecified/generic	Network ability	Extreme conditions	
(62)	Filippini and Silva (2014)	Resistance to disturbance and recovery from failures.	Unspecified/generic		Disturbance	Resistance, recovery
(63)	Gomes et al. (2016)	Pre-event strategic planning to manage post-event consequences.	Technical systems		Events	strategic planning, managing consequences
(64)	Ip and Wang (2011)	Return of a system to a stable state following strong permutation caused by disaster.	Technical systems	Stable system state	Disaster	Return
(65)	Johnson and Nagarur (2012)	Ability of a system to return to original state or move to more efficient state after disruption.	Supply chains	Original or more efficient state	Disruption	
(66)	Kavanagh (2007)	Capacity of infrastructure and operations to respond & recover from disaster.	Unspecified/generic		Disaster	Response, recovery
(67)	Matthews, Piralta and	Capacity of a community to adapt to disaster, by resisting or changing to	Technical systems	Function	Disaster	Adaptation, resistance, change

	Matthews (2014)	reach and maintain acceptable functioning.				
(68)	Murray-Tuite (2006)	System adapt to hazards while maintain acceptable levels of service.	Technical systems	Service	Hazards	Adaptation
(69)	Nakanishi, Black and Matsou (2014)	The ability, skills, and/or knowledge to use resources effectively to survive and function.	Technical systems	Survival, function		Effective use of resources
(70)	Ponomarov and Holcomb t al. (2015)	Return of systems to a given percentage of pre-disaster operations.	Socio-ecological systems	A given percentage of pre-disaster operations	Disaster	Return
(71)	Sabatino (2016)	How fast a displaced system returns to its equilibrium, the ability to absorb disturbance, and ability to withstand market/environment shocks and still allocate resources.	Organisations/firms	Equilibrium, continued allocation of resources	Disturbance, shocks	Return, Absorb, withstand
(72)	Scholl and Patin (2014)	Process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance.	Technical systems	functioning	Disturbance	Adaptive capacities
(73)	Serulle et al. (2016)	The maintenance of a given level of service or to restore itself to that level within a set time.	Technical systems	Service		Restoration time
(74)	Soni, Jain and Kumar (2016)	The ability of a system to return to a stable state after disruption.	Supply chains	Stable state	Disruption	Return
(75)	Sterbentz et al. (2014)	Ability of a network to provide and maintain acceptable levels of service after a disaster.	Technical systems	Service	Disaster	
(76)	Sullivan (2013)	Endures and overcomes climate change, energy and economic challenges.	Technical systems		Challenges	Endure, overcome
(77)	Thomas et al. (2016)	The ability of a company to be able to return to its original state or be able to move towards a more desirable state after a disturbance.	Supply chains	Original or more desirable state	Disturbance	Return
(78)	Tyrell and Johnson (2008)	The ability of social, economic, and ecological systems to recover from tourism-induced stress.	Tourism		Stress	Recovery
(79)	Usdin (2014)	How systems learn from and adapt to trauma related experiences.	Socio-ecological systems		Trauma	Learning, adaptation
	From (Kamalahmadi & Parast, 2016)					
(80)	Horne (1997)	"The ability of a system to withstand the stresses of environmental loading based on the combination/ composition of the subsystems, their structural inter-linkages, and the way environmental change is transmitted and spread throughout the entire system"	Organisations/firms		Stress	Withstand

(81)	Wildavsky (1988)	"The dynamic capacity of organizational adaptability that grows and develops over time"	Organisations/firms			Adaptability
(82)	Horne and Orr (1998)	"A fundamental quality of individuals, groups, organizations, and systems as a whole to respond proactively to significant change that disrupts the expected pattern of events without engaging in an extended period of regressive behavior"	Organisations/firms	Regressive behaviour	Significant change	Proactive response
(83)	Mallak (1998)	"Resilience is the ability of an individual or organization to expeditiously design and implement positive adaptive behaviors matched to the immediate situation, while enduring minimal stress"	Organisations/firms	Stress endurance		Adaptive behaviors
(84)	Coutu (2002)	"The ability of an organization to face reality with staunchness, make meaning of hardship and improvise solutions from thin air"	Organisations/firms			Staunchness, make meaning of hardship, improvise
(85)	Starr et al. (2003)	"The ability and capacity to withstand systemic discontinuities and adapt to new risk environments"	Organisations/firms		Discontinuity, new risk environments	Withstand, adapt
(86)	Sutcliffe and Vogus (2003), Vogus and Sutcliffe (2007)	"The maintenance of positive adjustment under challenging conditions such that the organization emerges from those conditions strengthened and more resourceful"	Organisations/firms	Strength, resourcefulness	Challenging conditions	Positive adjustment
(87)	Sheffi and Rice (2004)	"It is a firm's ability to absorb disruptions or enables the supply chain network to return to state conditions faster and thus has a positive impact on firm performance"	Organisations/firms	Performance	Disruption	Absorb
(88)	Reinmoeller and Van Baardwijk (2005)	"The capability to self-renew over time through innovation"	Organisations/firms	Self-renewal		Innovation
(89)	Woods (2006)	"The capacity to anticipate unsafe and unexpected events for organizational survival in the face of threats, including the prevention or mitigation of failures in the systems"	Organisations/firms		Unsafe and unexpected events	Anticipation, prevention, mitigation, threats, failure
(90)	Madni and Jackson (2009)	"A resilient system encompassed the actions including avoiding, adsorbing, adapting to, and recovering from disruptions"	Organisations/firms		Disruptions	Avoiding, adsorbing, adapting

(91)	Burnard and Bhamra (2011)	"The emergent property of organizational systems that relates to the inherent and adaptive qualities and capabilities that enable an organization's adaptive capacity during turbulent periods. The mechanisms of organizational resilience thereby strive to improve an organization's situational awareness, reduce organizational vulnerabilities to systemic risk environments and restore efficacy following the events of a disruption"	Organisations/firms	Organisational vulnerabilities	Turbulent periods, disruption	Adaptive qualities and capabilities
(92)	Lengnick-Hall et al. (2011)	"The firm ability to effectively absorb, develop situation specific responses to, and ultimately engage in transformative activities to capitalize on disruptive surprises that potentially threaten organizational survival"	Organisations/firms	Organisational survival	Disruptive surprises	Absorb, respond
(93)	Alberts (2011)	"Resilience provides an entity with the ability to repair, replace, patch, or otherwise reconstitute lost capability or performance (and hence effectiveness), at least in part and over time, from misfortune, damage or a destabilizing perturbation in the environment"	Organisations/firms	Capability, performance	Misfortune, damage or destabilizing perturbation	Repair, replace, patch, or otherwise reconstitute
(94)	Pettit et al. (2013)	"The capacity for an enterprise to survive, adapt, and grow in the face of change and uncertainty"	Organisations/firms		Change and uncertainty	Survival, adaptation
(95)	Winston (2014)	"An ability not just to recover from hits but to avoid problems altogether"	Organisations/firms		Problems	Recovery, avoidance
(96)	Gilly et al. (2014)	"First, a reactive capacity of the company to resist an external event; second, a more active capacity to anticipate events and thus open new development pathways."	Organisations/firms	Development	External events	Resist, anticipate
(97)	Roberta Pereira et al. (2014)	The capability of supply chains to respond quickly to unexpected events so as to restore operations to the previous performance level or even to a new and better one	Supply chains	Previous performance level or even to a new and better one	Unexpected events	Response speed, restore
(98)	Kim et al. (2005)	"We define supply network resilience as a network-level attribute	Supply chains		Disruptions	Withstand

		to withstand disruptions that may be triggered at the node or arc level."				
	From (Righi, Saurin, & Wachs, 2015)					
(99)	Grotberg [127]	"resilience is a universal capacity which allows a person, group or community to prevent, minimize or overcome the damaging effects of adversity"	Unspecified/generic	Damaging effects	Adversity	Prevent, minimize, overcome
(100)	Hollnagel [11]	"resilience is an organization's ability to adjust to harmful influences rather than to shun or resist them"	Unspecified/generic		Harmful influences	Adjust
(101)	Wildavsky [10]	"resilience is the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back"	Unspecified/generic		Unanticipated dangers	Cope, bounce back
(102)	Woods [132]	"resilience, as a form of adaptive capacity, is a system's potential for adaptive action in the future when information varies, conditions change, or new kinds of events occur, any of which challenge the viability of previous adaptations, models, or assumptions"	Unspecified/generic		Information variation, changing conditions, new kinds of events	Adaptive capacity
(103)	Hollnagel [11]	"resilience is the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations even after a major mishap or in the presence of continuous stress"	Unspecified/generic	Required operations	Disturbances	Adjust
	From (Ali, Mahfouz, & Arisha, 2017)					
(104)	Rice and Caniato (2003,p.25)	Resilience is widely used to characterize an organization's ability to react to an unexpected disruption, such as one caused by a terrorist attack or a natural disaster, and restore normal operations	Supply chains		Disruption	React
(105)	Christopher and Peck (2004,p.2)	The ability of a system to return to its original state or move to a new, more desirable state after being disturbed	Supply chains	The system state	Disturbance	Ability to return
(106)	Sheffi and Rice (2005,p.41)	The ability to bounce back from a disruption	Supply chains		Disruption	Bounce back
(107)	Datta et al. (2007, p. 189)	Supply chain resilience is defined as not only the ability to maintain control over performance variability in the face of disturbance but also a property of	Supply chains	Performance	Disturbance, shifts, uncertain demands	Maintaining control, adaptation, response

		being adaptive and capable of sustained response to sudden and significant shifts in the environment in the form of uncertain demands				
(108)	Ponomarov and Holcomb (2009, p. 131)	The adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function	Supply chains	Operations, connectedness , control, function, structure	unexpected events, disruptions	Adaptive capability, respond, recover
(109)	Klibi et al. al. (2010, p. 287)	". . . resilience is the capability of a SCN to avoid disruptions or quickly recover from failures"	Supply chains		Disruptions, failures	Avoidance, recovery speed
(110)	Jüttner and Maklan (2011, p. 247)	Supply chain resilience addresses the supply chain's ability to cope with the consequences of unavoidable risk events in order to return to its original operations or move to a new, more desirable state after being disturbed	Supply chains	Original operations	Unavoidable risk events	Coping,
(111)	Blackhurst et al. (2011, p. 374)	We specifically define supply chain resilience as a firm's ability to recover from disruptive events	Supply chains		Disruptive events	Recovery
(112)	Ponis and Koronis (2012, pp. 925-926)	The ability to proactively plan and design the Supply Chain network for anticipating unexpected disruptive (negative) events, respond adaptively to disruptions while maintaining control over structure and function and transcending to a post-event robust state of operations, if possible, more favourable than the one prior to the event, thus gaining competitive advantage	Supply chains	Structure, function, more robust post-event state, competitive advantage	Unexpected disruptive (negative) events	Plan, anticipation,
(113)	Wieland and Wallenburg (2013, p. 301)	In this research, resilience is understood as the ability of a supply chain to cope with change	Supply chains		Change	Coping
(114)	Melnyk et al. (2014,p.36)	The ability of a supply chain to both resist disruptions and recover operational capability after disruptions occur	Supply chains	Operational capability	Disruptions	Resisting, recovery
(115)	Day (2014,p.3)	Resilience is "the capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution,	Supply chains	Survival, growth	Turbulent change	Anticipation, limit impact, bounce back, survival, growth

		and growth in the face of turbulent change"				
(116)	Hohenstein et al. (2015, p. 108)	Supply chain's ability to be prepared for unexpected risk events, responding and recovering quickly to potential disruptions to return to its original situation or grow by moving to a new, more desirable state in order to increase customer service, market share and financial performance	Supply chains	Original or more desirable state	disruptions	Preparedness, response, recovery speed
(117)	Ambulkar et al. (2015, p. 112)	Firm's resilience to supply chain disruptions is defined as the capability of the firm to be alert to, adapt	Supply chains		Disruptions	Alertness, adaptation
	From (Matarrita-Cascante, Trejos, Qin, Joo, & Debner, 2017)					
(118)	Tobin (1999)	Resilient communities are defined as societies, which are structurally organized to minimize the effects of disasters and at the same time have the ability to recover quickly by restoring the socioeconomic vitality of the community	Socio-ecological systems	Socioeconomic vitality	Disasters	Minimise effects, recovery quickly, restoration
(119)	Cutter et al. (2008)	The ability of a social system to respond and recover from disasters and the 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-organize, change, and learn in response to a threat	Socio-ecological systems		Disasters, threats	Response, recovery, absorb, coping, adaptation, re-organise, change, learn
(120)	Magis (2010)	The existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise	Socio-ecological systems	Thriving	change, uncertainty, unpredictability, and surprise	Existence, development, and engagement of community resources
(121)	Cohen, Leykin, Lahad, Goldberg, and Aharonson-Daniel (2013)	A community's ability to function amidst crises or disruptions	Socio-ecological systems	Function	Crisis, disruptions	
(122)	Kuir-Ayius (2016)	The ability of communities to respond and adapt after disturbance through learning and	Socio-ecological systems	community capitals, sustainability	Disturbance	Response, adaptation

		collaboration with all relevant stakeholders, and strategic planning at local and national levels to maintain, measure, and strengthen community capitals, and hence achieve sustainability				
(123)	Hu et al. (2013)	Ability of a system or enterprise to minimize the effects of a disruption	Unspecified/generic		Disruption	Minimise effects
(124)	Todini (2000)	Capability of the designed system to react and to overcome stress conditions	Unspecified/generic		Stress conditions	React, overcome
(125)	Ta et al. (2009)	Ability of a transportation system to absorb the consequences of disruptions, reduce the impact thereof, and maintain freight mobility	Unspecified/generic	Freight mobility	Disruptions	Absorb consequences
(126)	Hearnshaw and Wilson (2013)	Extend to which a system is able to perform its functions despite disruptions or damage created by disturbances	Unspecified/generic	Function	Disruptions, damage, disturbances	
(127)	Reed et al. (2009)	Ability to bounce back after a major disturbance	Unspecified/generic		Disturbance	Bounce back
(128)	Burnard and Bhamra (2011)	Emergent property of organizational systems related to the inherent and adaptive qualities and capabilities that enable adaptive capacity during turbulent periods	Unspecified/generic		Turbulent periods	Adaptive capacity
(129)	Falasca et al. (2008)	Ability of a supply chain to reduce (1) the probabilities of disruptions, (2) the consequences thereof, and (3) the time to recover normal performance	Unspecified/generic		Disruptions	reduce (1) the probabilities of disruptions, (2) the consequences thereof, and (3) the time to recover normal performance
(130)	Vogus and Sutcliffe (2007)	Ability of an organization to maintain positive adjustment under challenging internal and/or external conditions in order to emerge strengthened and more resourceful	Unspecified/generic	Strength, resourcefulness	challenging internal and/or external conditions	Positive adjustment
(131)	Sheffi (2005)	Being better positioned than competitors to deal with, and even gain advantage from, disruptions	Unspecified/generic	Competitiveness	Disruptions	Deal with, and even gain advantage from, disruptions
(132)	Gong et al. (2014)	Ability to recover quickly from disruptions and ensure customers are minimally affected	Unspecified/generic	Effect on customers	Disruptions	Recover
(133)	Rice Jr and Caniato (2003)	Ability of an organization to react to an unexpected disruption	Unspecified/generic	Normal operations	Unexpected disruption	React

		and restore normal operations				
(134)	Tang (2006a)	Property of a firm's strategy; to sustain operations during a major disruption and recover quickly after a major disruption	Unspecified/generic	Operations	Major disruption	Sustain, recover
(135)	Antunes (2011)	Capability to maintain operations under a wide spectrum of potential breakdowns	Unspecified/generic	Operations	Breakdowns	Maintain
(136)	Colbourn (1993)	Expected number of node pairs which can communicate in the network, when links fail independently with known probabilities	Unspecified/generic	Number of node pairs which can communicate	Failing links	
(137)	Erdene-Ochir et al. (2010)	Ability of a network to continue to operate in presence of compromised nodes; the capacity of a network to endure and overcome internal attacks	Unspecified/generic	Operation	Compromised nodes, internal attacks	Endure, overcome
(138)	Najjar and Gaudiot (1990)	Maximum number of node failures that can be sustained while the network remains connected with a probability 1-p	Unspecified/generic	Connectedness	Node failures	
(139)	Sterbenz et al. (2010, 2011a, 2011b)	Ability of a network to provide and maintain an acceptable level of service in the face of various faults and challenges to normal operation	Unspecified/generic	Service level	Faults, challenges	Maintain
(140)	Smith et al. (2011)	Ability of a network to defend against, and maintain an acceptable level of service in the presence of, malicious attacks, software and hardware faults, human mistakes and large-scale natural disasters	Unspecified/generic	Service level	Malicious attacks, software and hardware faults, human mistakes and large-scale natural disasters	Defend
(141)	Brede and de Vries (2009)	Ability to recover a previous operational state after a dynamic perturbation	Unspecified/generic	Operational state	Dynamic perturbations	Recovery
(142)	Henry and Ramirez-Marquez (2012)	Ability of an entity to recover from an external disruptive event	Unspecified/generic		Disruptive events	Recovery
(143)	Pant et al. (2014)	Ability of systems to bounce back from disruptive events, be they malevolent attacks, man-made accidents, or natural disasters	Unspecified/generic		Disruptive events	Bounce back,
(144)	Madni and Jackson (2009)	Ability to circumvent accidents through anticipation, survive disruptions through recovery, and grow through adaptation	Unspecified/generic	Survival, growth	Accidents, disruptions	Circumvent, recovery, adaptation, survival, growth
	From (Meerow, Newell, & Stults, 2016)					
(145)	Alberti et al. (2003)	". . . the degree to which cities tolerate alteration	Urban systems	Avoiding reorganisation	Alteration	Toleration

		before reorganizing around a new set of structures and processes" (p. 1170).				
(146)	Godschalk (2003)	". . . a sustainable network of physical systems and human communities" (p. 137)	Urban systems			Sustainability
(147)	Pickett et al. (2004)	. . . the ability of a system to adjust in the face of changing conditions" (p. 373).	Urban systems		Chancing conditions	Adjust
(148)	Ernstson et al. (2010)	"To sustain a certain dynamic regime, urban governance also needs to build transformative capacity to face uncertainty and change" (p. 533).	Urban systems		Uncertainty and change	Dynamic regime, transformative capacity
(149)	Campanella (2006)	". . . the capacity of a city to rebound from destruction" (p. 141)	Urban systems		Destruction	Rebound
(150)	Wardekker et al. (2010)	". . . a system that can tolerate disturbances (events and trends) through characteristics or measures that limit their impacts, by reducing or counteracting the damage and disruption, and allow the system to respond, recover, and adapt quickly to such disturbances" (p. 988).	Urban systems		Disturbances, events, trends	Toleration, limit impact, counteracting, recovery
(151)	Ahern (2011)	". . . the capacity of systems to reorganize and recover from change and disturbance without changing to other states . . . systems that are "safe to fail" (p. 341)	Urban systems	System state	Change, disturbance	Reorganisatio n, recovery
(152)	Leichenko (2011) [9]	"The ability of a city or urban system to withstand a wide array of shocks and stresses" (p. 164)	Urban systems		Shocks, stresses	Withstand
(153)	Liao (2012)	". . . the capacity of the city to tolerate flooding and to reorganize should physical damage and socioeconomic disruption occur, so as to prevent deaths and injuries and maintain current socioeconomic identity" (p. 5).	Urban systems	Death, injuries, identify	Flooding	Toleration, reorganisation ,
(154)	Lamond and Proverbs (2009)	". . . encompasses the idea that towns and cities should be able to recover quickly from major and minor disasters" (p. 63).	Urban systems		Disasters	Recovery speed
(155)	Lhomme et al. (2013)	". . . the ability of a city to absorb disturbance and recover its functions after a disturbance" (p. 222).	Urban systems	Function	Disturbance	Absorb, recover
(156)	Chelleri (2012)	". . . should be framed within the resilience	Urban systems			Persistence

		(system persistence), transition (system incremental change) and transformation (system reconfiguration) views" (p. 287).				
(157)	Hamilton (2009)	"ability to recover and continue to provide their main functions of living, commerce, industry, government and social gathering in the face of calamities and other hazards" (p. 109)	Urban systems	Function	Calamities and other hazards	Recovery speed
(158)	Brugmann (2012)	"the ability of an urban asset, location and/or system to provide predictable performance – benefits and utility and associated rents and other cash flows – under a wide range of circumstances" (p. 217). 18	Urban systems	Performance	A wide range of circumstances	
(159)	Desouza and Flanery (2013)	"ability to absorb, adapt and respond to changes in urban systems" (p. 89)	Urban systems		Changes	Absorb, adapt, respond
(160)	Romero-Lankao and Gnatz (2013)	". . . a capacity of urban populations and systems to endure a wide array of hazards and stresses" (p. 358).	Urban systems		Hazards, stresses	Endure
(161)	Asprone and Latora (2013)	". . . capacity to adapt or respond to unusual often radically destructive events" (p. 4069).	Urban systems		Radically destructive events	Adapt, respond
(162)	Brown et al. (2012) [20]]	"The capacity of an individual, community or institution to dynamically and effectively respond to shifting climate circumstances while continuing to function at an acceptable level. This definition includes the ability to resist or withstand impacts, as well as the ability to recover and re-organize in order to establish the necessary functionality to prevent catastrophic failure at a minimum and the ability to thrive at best. Resilience is thus a spectrum, ranging from avoidance of breakdown to a state where transformational change is possible." (p. 534)	Urban systems	Function	Shifting climate circumstances	resist or withstand recover and re-organize, prevent
(163)	Henstra (2012) [21]	"A climate-resilient city . . . has the capacity to withstand climate change stresses, to respond effectively to climate-related hazards, and to recover quickly from residual negative impacts" (p. 178).	Urban systems		Stresses, negative impacts	Withstand, respond, recovery speed

(164)	Lu and Stead (2013) [22]	"the ability of a city to absorb disturbance while maintaining its functions and structures" (p. 200).	Urban systems	Function, structure	Disturbance	Absorb
(165)	Thornbush et al. (2013) [23]	"a general quality of the city's social, economic, and natural systems to be sufficiently future-proof" (p. 2).	Urban systems			Future proof
(166)	Tyler and Moench (2012) [6]	"In the case of urban climate adaptation, an approach based on resilience encourages practitioners to consider innovation and change to aid recovery from stresses and shocks that may or may not be predictable...three generalizable elements of urban resilience: systems, agents and institutions." (p. 312)	Urban systems		Stresses, shocks	Recovery, innovation, change
(167)	Wamsler et al. (2013) [8]	"A disaster resilient city can be understood as a city that has managed . . . to: (a) reduce or avoid current and future hazards; (b) reduce current and future susceptibility to hazards; (c) establish functioning mechanisms and structures for disaster response; and (d) establish functioning mechanisms and structures for disaster recovery" (p. 71).	Urban systems		Hazards, disasters	Reduction, avoidance, reduced susceptibility, response, recovery
(168)	Wardekker et al., (2010) [24]	"A resilience approach makes the system less prone to disturbances, enables quick and flexible responses, and is better capable of dealing with surprises than traditional predictive approaches . . . a 'bottom-up' way of thinking about adaptation that aims to promote a system's capability of coping with disturbances and surprises" (p. 988)	Urban systems		Disturbances and surprises	Less disturbance prone, response, coping
	From (Modica & Reggiani, 2015)					
(169)	Briguglio et al. 2006	'The 'nurtured' ability of an economy to recover from or adjust to the effects of adverse shocks to which it maybe inherently exposed' (p. 1)	Economic systems		Adverse shocks	Recovery, adjust
(170)	Duvaletal. 2007	'Economic resilience may be loosely defined as the ability to maintain output close to potential in the aftermath of shocks' (p. 2)	Economic systems	Closeness of output to potential	Shocks	

(171)	Hill et al. 2008	'the ability to recover successfully from shocks to its economy that either throw it off its growth path or have the potential to throw it off its growth path' (p.4)	Economic systems	Growth path	Shocks	Recovery
(172)	Rose 2007	'the ability of an entity or system to maintain function of (e.g., continue producing) when shocked' (p. 384)	Unspecified/generic	Function	Shocks	
(173)	Rose and Krausmann 2013	'hastening the speed of recovery from a shock' (p. 2)	Unspecified/generic		Shocks	Recovery speed
(174)	Ashby et al. 2008	'The extent to which local places and local government are capable of riding the global economic punches, working within environmental limits, dealing with external changes, bouncing back quickly, and having high levels of social inclusion'	Socio-ecological systems	Social inclusion	Punches, limits, changes	Bouncing back quickly
(175)	Bristow 2010	'Resilience emphasises the importance of healthy, dynamic local businesses—businesses which are 'competitive' and successful—and yet it does so in a manner which sees virtuous interrelationships between competition, environment and distribution' (p.156)	Socio-ecological systems			
(176)	Coles and Buckle 2004	'The total of the individual elements that thorough capacities, skills, and knowledge are able to participate fully in recovery from disasters and to cope with wider social, economic and political communities' (p. 6)	Socio-ecological systems		Disasters	Recovery, coping
(177)	Davies 2011	'The capacity of a regional economy to withstand change or to retain its core functions despite external upheaval', (p.370)	Socio-ecological systems	Function	Upheaval	Withstand, retain
(178)	Foster 2007	'The ability of a region to anticipate, prepare for, respond to and recover from a disturbance' (p.14)	Socio-ecological systems		Disturbance	anticipate, prepare for, respond, recover
(179)	Hill et al. 2011	'[Regional resilience] is the ability of a regional economy to maintain or return to a pre-existing state (typically assumed to be an equilibrium state) in the presence of some type of exogenous (i.e., externally generated) shock' (p. 1)	Socio-ecological systems	Pre-existing state	Shocks	Maintain, return,

(180)	Paton and Johnston 2001	'The capability to "bounce back" and to use physical and economic resources effectively to aid recovery following exposure to hazard activity' (p. 158)	Socio-ecological systems		Hazard activity	Bounce back, recovery
(181)	Pendall et al. 2010	'Resilient city would be one that resumed its previous [economic/population/built form] growth trajectory after a lag' (p. 73)	Urban systems	Growth trajectory	Lag	Resumption
(182)	Pend all et al. 2012	'A resilient region, is one whose governance decisions identify and anticipate stresses, avoid those that can be avoided, and mitigate those that cannot, thereby protecting individuals and households from many harms and helping them recover from others' (p. 272)	Socio-ecological systems	Protection from harm	Stress	Identify, anticipate, avoid, mitigate, recover
(183)	Swanstrom 2008	'A resilient region would be one in which markets and local political structures continually adapt to changing environmental conditions and only when these processes fail, often due to misguided intervention by higher level authorities which stifle their ability to innovate, is the system forced to alter the big structures' (p. 10)	Socio-ecological systems		Changing conditions	Adapt
(184)	Wolfe 2010	'How a particular economy gets locked into a specific pattern of growth through a cumulative series of decisions over time. This perspective is also concerned with how new paths are launched and regions alter their trajectory of development' (p.140)	Socio-ecological systems			
	From (Meerow & Newell, 2015)					
(185)	Pimm (1984, 322)	"How fast the variables return towards their equilibrium following a perturbation"	Ecological systems	Equilibrium	Perturbation	Return
(186)	Carpenter and colleagues (2001, 765)	"The magnitude of disturbance that can be tolerated before a socioecological system (SES) moves to a different region of state space controlled by a different set of processes"	Socio-ecological systems	Current state space	Disturbance	Toleration

(187)	Rose (2007, 384)	"The speed at which an entity or system recovers from a severe shock to achieve a desired state"	Economic systems	Desired state	Severe shock	Recovery speed
(188)	Zhu and Ruth (2013, 74)	"The ability [for industrial ecosystems] to maintain their defining feature of eco-efficient material and energy flows under disruptions"	Economic systems	Defining feature	Disruptions	
(189)	Zeng and colleagues (2013, 12)	"The critical threshold . . . at which a phase transition occurs from normal state to collapse"	Unspecified/generic	Normal state	Exceeding critical threshold	
(190)	Ouyang (2014, 53)	"The joint ability of a system to resist (prevent and withstand) any possible hazards, absorb the initial damage, and recover to normal operation"	Technical systems	Normal operation	Hazards	Resist (prevent and withstand), absorb, recover
	From (Tukamuhabwa, Stevenson, Busby, & Zorzini, 2015)					
(191)	Barroso et al. (2010)	SCRES is the supply chain's ability to react to the negative effects caused by disturbances that occur at a given moment in order to maintain the supply chain's objectives	Supply chains	Objectives	Negative effects	React
(192)	Brandon-Jones et al. (2014)	SCRES is defined as the ability of a system to return to its original state, within an acceptable period of time, after being disturbed	Supply chains	Original state	Disturbances	Return speed
(193)	Carvalho, Duarte, and Cruz Machado (2011)	SCRES is concerned with the system's ability to return to its original state or to a new more desirable one after experiencing a disturbance and avoiding occurrence of failure modes	Supply chains	Original state, more desirable state	Disturbance	Return
(194)	Carvalho et al. (2012)	SCRES is the ability of the supply chain to cope with unexpected disturbances	Supply chains		Disturbances	Coping
(195)	Christopher and Rutherford (2004)	Christopher and Rutherford Resilience is the ability of a system to return to its original (or desired) state after being disturbed	Supply chains	Original (or desired) state	Disturbance	Return
(196)	Closs and McGarrell (2004)	SCRES is the supply chain's ability to withstand and recover from an incident. A resilient supply chain is proactive – anticipating and establishing planned steps to prevent and respond to incidents. Such supply chains quickly rebuild or re-establish alternative means of operations	Supply chains	Operations	Incidents	Withstand, recovery, anticipation, rebuilding, re-establishing

		when the subject of an incident.				
(197)	Datta, Christopher, and Allen (2007)	Resilience of the supply network is the ability of the production–distribution system to meet each customer demand for each product on time and to quantity	Supply chains	Meet customer demand		
(198)	Erol, Sauser, and Mansouri (2010)	Resilience is a response to unexpected or unforeseen changes and disturbances, and an ability to adapt and respond to such changes	Supply chains		Unexpected or unforeseen changes and disturbances	Adapt, respond
(199)	Guoping and Xinqiu (2010b)	SCRES is the ability of the supply chain to return to its original or ideal status under emergency risk environment	Supply chains	Original or ideal status	Emergency risk environments	Return
(200)	Longo and Oren (2008)	Resilience is a critical property that, in a context of supply chain change management, allows the supply chain to react to internal/external risks and vulnerabilities, quickly recovering an equilibrium state capable of guaranteeing high performance and efficiency levels	Supply chains	Equilibrium, performance, efficiency	Internal/external risks and vulnerabilities	React, recovery speed
(201)	Rice and Caniato (2003)	Resilience in the supply network environment is the ability to react to unexpected disruption and restore normal supply network operations	Supply chains	Normal operations	Unexpected disruptions	React, restore
(202)	Sheffi (2005)	Resilience in terms of the corporate world is the ability of the company to bounce back from a large disruption including the speed with which it returns to a normal level of performance	Supply chains	Normal performance	Large disruptions	Bounce back, return speed
(203)	Shuai, Wang, and Zhao (2011)	Resilience is defined as the rapid recovery ability to equilibrium after the supply chain is attacked by a disturbance and we use the recovery time to measure the ability	Supply chains	Equilibrium	Disturbance	Rapid recovery
(204)	Xiao, Yu, and Gong (2012)	SCRES is the supply chain's ability to return to the original or ideal status after external disruption and includes both the abilities of adaptability to the environment and recovery from the disruption	Supply chains	Original ideal status	Disruption	Return, adaptability, recovery
(205)	Yao and Meurier (2012)	Supply resilience is defined as the ability to bounce back from disruptions and to	Supply chains		Changing environment	Bounce back, permanently deal with and respond

		permanently deal with and respond to the changing environment				
	From (Xu, Marinova, & Guo, 2015)					
(206)	Adger (2000); Bruneau et al. (2003); Langridge et al. (2006)	The ability of communities to withstand external shocks, mitigate and recover from hazards	Supply chains		External shock	Withstand, mitigate, recovery
(207)	Carpenter et al. (2001); Resilience Alliance (2012, p. n.p.)	The capacity of a system to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes	Socio-ecological	System state	Disturbance	Tolerances
	From (Sanchez, Velez, Ramón-jerónimo, & Araujo, 2017)					
(208)	Rice and Caniato (2003, p. 25)	In today's business environment, resilience is widely used to characterize an organization's ability to react to an unexpected disruption, such as one caused by a terrorist attack or a natural disaster, and restore normal operations	Supply chains	Normal operations	Unexpected disruption	React
(209)	Sheffi (2005, p. 13)	The ability of a material to recover its original shape following a deformation. For companies, it measures their ability to, and speed at which they can, return to their normal performance level – production, services and fill rate – after an HILP disruption	Supply chains	Performance level	Deformation	Recovery
(210)	Sarathy (2006, p. 40)	A resilient supply chain is one that can bounce back quickly from a disruption	Supply chains		Disruption	Bounce back speed
(211)	Pereira (2009, p. 374)	building a resilient supply chain with the ability to maintain, resume, and restore its original (or desired) state after being disrupted should also be considered (and) emphasize that due to its nature, resilience should mean the ability to change smoothly and rapidly, by either creating redundancy or increasing flexibility	Supply chains	Original (or desired) state	Disruption	maintain, resume, and restore, redundancy, flexibility
(212)	Voss et al. (2009, p. 6)	An increased ability to recover from any potential incident	Supply chains		Incident	Recovery
(213)	Higgins et al. (2010, p. 964)	Resilience is the capacity of a system to recover from disturbance and maintain its structure, function, and controls	Supply chains	Structure, function, controls	Disturbance	Recovery
(214)	Iakovou et al. (2010, p. 316)	Quick to recover from disruption	Supply chains		Disruption	Recovery speed

(215)	Klibi et al. (2010, p. 287 and p. 291)	Resilience is the capability of a SCN to avoid disruptions or quickly recover from failures. The capacity of a system to survive, adapt, and grow in the face of unforeseen changes, even catastrophic incidents	Supply chains		Unforeseen changes, catastrophic incidents, failure	Recovery, avoid
(216)	Kumar et al. (2010, p. 3721)	Resilient supply chain networks need to be built having the ability to maintain, resume and restore operations after any disruption	Supply chains	Operations	Disruption	maintain, resume, restore
(217)	Melnyk et al. (2010, p. 34)	Resilience ensures that the supply chain can recover quickly and cost-effectively from disruptions caused by natural disasters (such as earthquakes), social factors (employee strikes), medical emergencies (epidemics such as H1N1 flu), economic setbacks (the bankruptcy of a critical link in the chain) or technological failures (a software crisis)	Supply chains		Disruptions	Recovery
(218)	Yang and Yang (2010, p. 1903)	An organization's capability to recover to the original operating status before a disruption	Supply chains	Operating status		Recovery
(219)	Zsidisin and Wagner (2010, p. 3)	Supply chain resiliency consists of the ability to return to normal performance levels following a supply chain disruption	Supply chains	Normal performance	Disruption	
(220)	Blackhurst et al. (2011, p. 374)	A firm's ability to absorb disruptions or enables the supply network to return to stable conditions faster and thus has a positive impact on firm performance. [y] We specifically define supply chain resilience as a firm's ability to recover from disruptive events	Supply chains	Performance	Disruptive events	Absorb, return
(221)	Kumar and Sosnoski (2011, p. 5432)	Resilient companies have the ability to withstand the unexpected	Supply chains		The unexpected	Withstand
(222)	Thomsett (2011, p. 49)	This resilience is a sensible business strategy to avoid a single point of failure due to an unanticipated (low-likelihood, high-cost) risk	Supply chains		Unanticipated risk	Avoidance
(223)	Verbano and Venturini (2011, p. 533)	The ability to recover following a loss, is to minimize the consequences of risk situations	Supply chains		Risk situations	Recovery, minimise consequences

(224)	Cabral et al. (2012, p. 4831)	Resilience refers to SC's ability to cope with unexpected disturbances. Supply chain resilience is concerned with the system ability to return to its original state or to a new more desirable state, after experiencing a disturbance, and avoiding the occurrence of failures modes	Supply chains	Original state, more desirable state	Disturbance	Return, avoid
(225)	Ishfaq (2012, p. 216)	A resilient supply chain has the ability to maintain continuity in operations under disruptions	Supply chains	Continuity in operations	Disruptions	Maintain
(226)	Machowiak (2012, p. 280f.)	Resilient supply chains that can withstand the impact of major supply chain disruptions and catastrophes, without impacting the end customer and without incurring excessive recovery costs	Supply chains		Disruptions, catastrophes	Withstand, low recovery cost
(227)	Mandal (2012, p. 46)	Ability to return to its original state of operation after being disturbed	Supply chains	Original state	Disturbance	Return
(228)	Schmitt and Singh (2012, p. 23)	Resilience focuses on the ability of the firm to sustain operation and recovery quickly in the face of a disruption	Supply chains	Operation	Disruption	Sustain, recovery speed
(229)	Xiao et al. (2012, p. 2)	Supply chain resilience can be defined as the supply chain's ability of returning to the original or ideal status when this supply chain system has been disturbed by external interruption, and resilient supply chain shows that this supply chain has the two abilities on adaptability to environment and recovering ability of the system	Supply chains	original or ideal status	External disruptions	Return, adaptability, recovery
(230)	Hearnshaw and Wilson (2013, p. 458)	For supply chain systems, resilience is critical as the success of firms is often determined by the ability of the system as a whole to continue to provide flows despite disturbances	Supply chains	Provide flows	Disturbance	
(231)	Johnson et al. (2013, p. 325)	Resilience is considered to develop over time, enabling an organization, or network, to survive and thrive in the face of adversity and, to further strengthen its capability to make future adjustments	Supply chains		Adversity	Adjustments, survive, thrive

(232)	Wieland (2013, p. 655)	A supply chain can thus be resilient if its original stable situation is sustained or if a new stable situation is achieved as long as the supply chain is able to "bounce back from a disruption." [y] A supply chain is resilient if it uses resources that enable it to cope with change	Supply chains	Stable situation	Disruption	Bounce back, coping
(233)	Wieland and Wallenburg (2013, p. 301)	A supply chain can [y] be resilient if its original stable situation is sustained or if a new stable situation is achieved. In this research, resilience is understood as the ability of a supply chain to cope with change	Supply chains	Original or new stable situation	Change	Coping
(234)	Wu et al. (2013, p. 676)	Resilience is "the ability to respond and recover from a stockout disruption"	Supply chains		Disruption	Respond, recovery
	From (Roberta, Christopher, & Lago Da Silva, 2014)					
(235)	Ates and Bititci (2011)	"The capacity of an organisation to survive, adapt and sustain the business in the face of turbulent change"	Supply chains	Survive	Turbulent change	Adapt, sustain, survive
(236)	Jüttner and Maklan (2011)	"The apparent ability of some supply chains to recover from inevitable risk events more effectively than others"	Supply chains		Inevitable risk events	Effective recovery
	From (Ifejika, Wiesmann, & Rist, 2014)					
(237)	Holling, 1973; Carpenter et al., 2001; Gunderson and Holling, 2002; Walker et al., 2002	The magnitude of disturbance a system tolerates (can tolerate) before moving into a different state space and set of controls.	Ecological systems	State space and set of controls	Disturbance	Tolerate
(238)	(Pimm, 1984, 1991: 3, 13)	Resilience is ''how fast a variable that has been displaced from equilibrium returns to it. Population resilience is the rate at which populations recover their former densities''	Ecological systems	Equilibrium	Displacement	Return
(239)	(Walker et al., 2010)	Resilience as distance to a threshold; this distance is a stock variable, where the level of the stock is equivalent to the systems resilience.	Economic systems	Threshold		Distance to a threshold
(240)	(Resilience Alliance, 2010: 34)	Resilience to a specific disturbance or event involves identifying a particular threshold effect such that the system will not recover its earlier pattern of behaviour if this threshold is crossed.	Socio-ecological systems	Pattern of behaviour	Disturbance	Recovery

(241)	(Cumming, 2011: 13)	Resilience as maintaining identity over time: ‘‘maintenance of key components and relationships and the continuity of these through time’’. ‘‘If resilience is low, identity may be lost and if identity is lost, resilience was low’’ (Cumming, 2011: 13; Cumming and Collier, 2005).	Unspecified/generic	Key components and relationships, identity		Maintaining
	From (Ponis & Koronis, 2012)					
(242)	Gaonkar & Viswanadham (2007)	SCRes is the ability to maintain, resume, and restore operations after a disruption.	Supply chains	Operations	Disruption	Maintain, resume, and restore
(243)	Datta et al. (2007)	SCRes is not just the ability to recover from mishaps, but is a proactive, structured and integrated exploration of capabilities within the supply chain to cope with unforeseen events.	Supply chains		Unforeseen events, mishaps	Recovery, coping
	From 19. (Patriarca, Bergström, Di Gravio, & Costantino, 2018)					
(244)	(Sundström and Hollnagel, 2006)	the appropriateness of stability or change to the requirements of the environment, in terms of planning, enabling or accommodating of change to meet current and future requirements of the operating environment .	Technical systems	Meet current and future requirements	Change	planning, enabling or accommodating
(245)	(Hollnagel and Sundström, 2006)	The ability to return to normal functioning when the alerting or unusual conditions are over, shifting among the so-called different states of resilience.	Technical systems	Normal functioning	Alerting or unusual conditions	Shifting among the so-called different states of resilience.
(246)	(Hémond and Robert, 2012a,b)	The concept of anticipation, maintenance and adaptation of activities, regardless of what may happen, with several consequences on how to define the requested knowledge of the system.	Technical systems		Regardless of what may happen	anticipation, maintenance and adaptation
	From (Olsson, Jerneck, Thoren, Persson, & Byrne, 2015)					
(247)	Walker *et al.* (16)	The more resilient a system, the larger the disturbance it can absorb without shifting into an alternate regime	Socio-ecological systems	Not shifting into an alternative regime	Disturbance	Absorb
(248)	Perrings (3)	Resilience is a measure of the ability of a system to withstand stresses and shocks—its ability to persist in an uncertain world	Socio-ecological systems		Stresses and shocks	Withstand, persist
(249)	Folke *et al.* (20)	The very dynamics between periods of abrupt and gradual	Socio-ecological systems	Persistence	abrupt and gradual change	to adapt and transform

		change and the capacity to adapt and transform for persistence				
	From (Bakkensen, Fox-Lent, Read, & Linkov, 2017)					
(250)	National Academy of Science	The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events	Socio-ecological systems		Adverse events	Prepare and plan for, absorb, recover from, and more successfully adapt
(251)	Inter-government al Panel on Climate Change (27–29)	The ability of a system and its component parts to anticipate, absorb, accommodate or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration or improvement of its essential basic structures and functions.	Socio-ecological systems	Essential basic structures and functions	The effects of a hazardous event	anticipate, absorb, accommodate or recover