CAPÍTULO 8

Organizational resilience: a review of definitions and measures

Raphaela Vidal

Faculty of engineering at Universidade Lusófona de Humanidades e Tecnologias -ULHT (Lisbon, Portugal)

Luiz Felipe De Castro e Silva Vidal

Faculty of Mathematics at Universidade Regional do Cariri- URCA (CRATO, Brazil)

DOI: 10.47573/aya.88580.2.6.8

CAPÍTULO 8

INTRODUCTION

Resilience is a hot topic in the business world and there have been lots of discussions about resilience, particularly after the events of September 11th that caused countless damages to individuals, community and companies. Additionally, changes in environment caused natural disasters and so lots of harms. Then, how recover from these situations? For organizational perspective, there are many implications and it turns into an interesting matter to academics and practitioners that focus on Resilience as the capacity to resist, absorb and respond to changes quickly. For Duchek (2020), although the interest in resilience has steadily grown in recent years, the author points a little consensus about definitions of resilience.

Over the years, natural and man-made hazards have forced organization to build resilience to face threats against continuity of their business processes (SAHEBJAMNIA; TORABI; MANSOURI, 2018). The most studies about resilience is associated to risk management, emergence management and natural hazards and are developed strongly in New Zealand and Australia due to high natural impacts suffered by communities and companies. However, Resilience is not only related to high impact events, but any event that causes organizational disruption. Seville (2009) argues each organization has its own critical state. It may be the failure of a key supplier, contamination on the production line, a disgruntled employee wreaking havoc, thus organizations need to be able to rebound from changes. Gunasekaran *et. al.* (2015) add supply chains are subjected to dependency on suppliers, inability to react quickly to uncertainties and various other constraints such as artificial and/or natural calamities.

Turbulent business environment in which organizations work pushes them to follow a change that affects wherever it occurs, in local area or another part of planet. More than ever, organizations seek for strategies to keep them competitive. To thrive in highly competitive marketplace, to find strategy for uncertain environment is crucial. Erol *et al.* (2010, p. 1) state “the concept of resilience has been frequently discussed as an essential strategy for the success and survival in today’s turbulent business environment”. Then if organizations seek to be resilient, it is a priority to identify what is its level of resilience. In other words, it is important to know how resilient

organizations are; Its strength and weaknesses; where allocate resources to improve itself. Someone could ask: how? Where? Thus it is relevant to ask about available tools to measure organizational resilience. Therefore, this study aims to present an updated review of literature that concerns about definitions and measures of organizational resilience. Firstly, the methods used to elaborate this study are presented. Secondly, it addresses the concepts of resilience: individual, organizational and supply chain; strategic or operational resilience, followed by the section that reports some attempts to assess organizational resilience describing major models. Lastly, practical implications are discussed.

METHODS

This is an exploratory and descriptive study that attempts to present definitions of resilience and the current status of the models to assess resilience, main ideas of the researchers, identifying similar and contradictory ideas. The study used systematic methods to identify, select, and analyze previous published articles in journals or conferences with peer review, aiming to develop the organizational resilience field.

The search strategy: The search was performed in Google Scholar and Web of Science to guarantee the capture of papers published from 2004 until 2020. The terms “resilience,” and “organizational resilience” were used as initial search keywords, followed by other keyword combinations such as “resilience AND assessment”, “resilience AND model,” and “resilience AND measuring” as well “framework”, and “metrics” to guarantee accessing a robust set of materials. The next step was identifying the material directly related to the subject through analysis of titles and abstracts. After collection of the search results, it was possible to identify which materials were pertinent to be included to the present research. The evaluation of the material showed the scope and breadth of the research, which enabled a deep analysis that highlighted the main contributions, as well as management and categorization by thematic field. The overall aim was to capture the essence of ideas and research results in the area of organizational resilience assessment and main contributions.

CAPÍTULO 8

CONCEPTS OF RESILIENCE

Although “resilience” seems more one fashionable business term that everyone is interested such practitioners as academics, truly, it is far from this. The first studies about Resilience come from physics. Academics observed some materials have properties to bounce back to their natural state even after suffering pressure and be modified. Over the years, this concept was adapted to many fields. Ponomarov and Holcomb (2009) noticed resilience in fields such as sociology, ecology, economics, psychology and management.

Resilience concept has been very developed in psychology discipline (DUCHEK, 2020) that studied children´s behavior after a critical stress situation. These studies come from 70´s and it was the start-up to individual resilience perspective analysis. From this, the concept of resilience was adapted to group and organizations. Cho, Mathiassen and Robey (2006, p. 1) report: “Resilience is commonly portrayed as a positive capability that allows individuals, groups, and organizations to thrive in dynamic contexts”.

There are three perspectives to approach resilience: individual, organizational and Supply chain resilience. Margolis and Stoltz (2010) assert resilience in individual perspective is the ability to respond quickly when adversity strikes. Rutter (2007) says it is the capacity to withstand risk environment and recover from stress and adversity.

Individual Resilience may be noticed by the way people face their problems, unforeseen events and adversities. A resilient person has a good reaction to crises situation and challenges. Eventual problems are faced as opportunities both personally or professionally. He/she has optimism, good willpower, not regretting about the past. Besides, resilient ones have no fear to change and are decision maker. Furthermore, Earvolino-Ramirez (2007) added some other resilient characteristics: recover capacity, sense of humor, familiar relationship, self-steem, efficacy and flexibility. Everly (2011) points individual resilience as the only alternative to thrive during dramatic changes.

Since organizations are made of people and groups, whose personal attributes and experiences contribute to strategies, resilience arises as a factor at the

organizational level. Lengnick-Hall and Beck (2003), for example, state that individual abilities when used by a group contribute to organizational resilience.

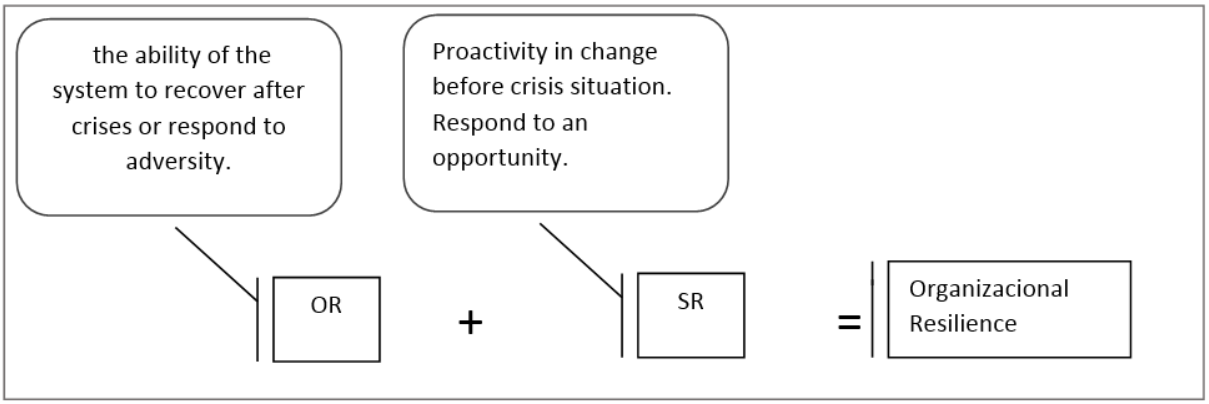
Firms have to cope with unpredictable events that can range from material shortage until extreme weather conditions affecting the production system. In severe cases, firms can stop their productions for weeks causing financial losses. Indeed, for enduring these incidents, they need to be resilient. In organizational perspective, Denhardt and Denhardt (2010) define resilience as the ability to recover from challenges, in order to turn organizations more flexible and capable to adapt to future challengers. McCann, Selsky, and Lee (2009, p. 45) define resilience as the "capacity to resist, absorb and respond, even reinventing if required, in response to fast and/or disruptive change that cannot be avoided."

In organizational perspective, others authors (GALLOPIN, 2006; EROL *et al*., 2010) considered the term "enterprise resilience" and focused their studies on articulating how well enterprises can decrease the level of its vulnerabilities to expected or unexpected risks.

"Resilience refers to a capacity for continuous reconstruction" (HAMEL; VALIKANGAS, 2003, p. 3). It is the capacity to withstand systemic discontinuities and adapt to environment (STARR; NEWFROCK; DELUREY, 2003). "It requires innovation with respect to those organizational values, processes, and behaviors that systematically favor perpetuation over innovation" (HAMEL; VALIKANGAS, 2003, p. 3). Additionally, Duchek (2020, p. 238) states that "resilience is a fundamental organizational ability that is directed toward organizational advancement".

Resilience is a capacity to apply in uncertain times (DUCHEK, 2020), in crises situations, but it does not disappear when the danger ends (REINMOELLER; BAARDWIJK, 2005). Resilience is an organizational ability to get ready to respond to unpredictable situations, even before, during and after disruptions. *Before disruption* organizations seek to get strong and flexible at same time, trying to prevent some risks; *during disruption* they use their skills to respond quickly and use abilities to change through innovation and *after disruption* they seek to learn about the past and constantly improve themselves. Additionally, organizational resilience can be understood in two dimensions: operational resilience (OR) and strategic resilience (SR). (fig 1).

Figure 1: Dimensions of organizational resilience.



Source: adapted Vidal, Carvalho and Cruz-Machado (2014)

Operational resilience (OR) can be defined as a system property that confers the ability to remain intact or functional despite the presence of threats (PATRIARCA *et. al*., 2018, p. 266). it is related to the capacity of operational system to fight, absorb problem and recover quickly avoiding losses by stopping production. It is the ability to turn a system in turbulence into a stable system. It can be defined as the ability of the system to recover after crises or respond to adversity. McDonald (2006) states: for operational system becomes resilient one it needs to be susceptible for changes and improvements.

Some authors consider resilience as a subject of engineering (HOLLNAGEL, 2006; GRØTAN; STØRSETH; RØ; SKJERVE, 2008; WOODS, 2015), and the concept of resilience engineering has become hyper popular (WOODS, 2015). The focus of resilience engineering is operational resilience, which allows the operations of organizations to continue during a crisis situation. For Woods (2005), resilience engineering helps people cope with complex cases under pressure in order to succeed. For Hollnagel (2006) resilience is the ability of an organization to react and recover from disorder at a premature level, with minor effects on organizational stability.

For organizations, anticipation is fundamental in order to survive in highly volatile and uncertain environment. Resilience involves recognizing risks and being proactive (SOMERS, 2009). Strategic resilience (SR) is the capacity to turn threats on opportunities before it is late. Getting ready for responding adversities involving improvement of organizational defenses, while response to an opportunity involves exploration and experimentation to build a portfolio of options to the future

(VALIKANGAS; ROMME, 2012). Hamel and Valikangas (2003, p. 2) adds: “Strategic resilience is not about responding to a onetime crisis. It’s not about rebounding from a setback. It’s about continuously anticipating and adjusting to deep, secular trends that can permanently impair the earning power of a core business. It’s about having the capacity to change before it becomes desperately obvious”.

Vidal (2014) states that strategic resilience refers to the capacity of an organization to be aware of the market, noticing signs of changes and anticipate continually, modifying its strategies. The author adds resilient organization is not stuck in the past. It involves proactivity and adaption. Organization keeps taking advantage of opportunities, maximizing gains and minimizing problems.

Strategic resilience is considered basis for getting operational resilience and from that, organizational resilience. McDonald (2006) remembers “strategic resilience is aligned to organizational policy to assure its recovery from adversity”. It is supposed to say that the organizational resilience starts up by developing strategic resilience that leads to operational resilience.

The types of risks and challenges that organizations have to face today are changing because of globalization, technological complexity, interdependence, and even the speed of change. The effects of an accident can spread quickly among organizations and across society. In consequence, the supply chain is one of the issues that organizations are more concerned about. A supply chain is a set of organizations that has relationships in the productive process, such as a chain of suppliers, retailers, distributors, manufacturers, and including clients which can impact the whole productive process. Barroso *et al.* (2014) highlight supply chains as vital issue to the competitiveness of many organizations.

From early 2000s, Supply chain resilience has been studied (PETTIT; CROXTON; FIKSEL, 2019), with a rapid growth in scholarly works on supply chain resilience since 2011 (BIEDERMANN *et al*., 2018). Supply Chains are susceptible to get disruptions during their operations. Tang (2006) adds business world is getting more vulnerable day-by-day. The author states that supply chains that are highly impacted tending to get unstructured, spending long time to restore. Hence, Dalziel and McManus (2004) comment there are lots of economics implications for

organizations that are not ready for high impact events and state those implications are enormous and cause effects in entire supply chain.

Supply chain resilience refers to a capacity of enabling a broken supply chain to reconstruct itself and become stronger than before (BRUSSET; TELLER,2017). “Resilient Supply Chains are more capable to cope with uncertainties in business environment” (CARVALHO; DUARTE; CRUZ MACHADO, 2011). When a disruption occurs, organization can be capable to respond quickly and it depends on organizational structure, manager and operational system deployed and its state of resilience (DALZIELL; MCMANUS, 2004).

There are two important ways to create a resilient supply chain: flexibility and redundancy (RICE and CANIATO ,2003). Redundancy is an option to mitigate a disruption (GRANDI *et al*., 2018), however, it involves costs. Therefore, many scholars (DALZIELL; MCMANUS, 2004; TANG, 2006; CARVALHO; DUARTE; CRUZ MACHADO, 2011) have focus on benefits that resilience can bring to business.

Moreover, to achieve a resilient supply chain, Wreathall (2006) stresses the role of top management; Pettit (2008), emphasizes the involvement of the entire organization; and for Aleksic *et al*., (2011), it is cooperation among all supply chain partners that is critical.

Resilience is an extensive matter to discuss and explore. The table 1 shows others authors contributions. After discussing about the concepts, it is notorious the relevance of resilience as competitive strategy and its benefits, but organizations need to know how resilient they are and make arrangements to get / improve its ability. Therefore, it is relevant to find a tool to assess resilience in organizations. The next section will present measures.

Table 1 - Authors´ contributions

Perspective	Dimensions	Authors	Application
Individual		Corkindale (2009)	seen as encompassing leadership and individual resilience
		Metzel (2009)	described as positive adaptation
		Margolis and Stoltz (2010)	emphasized as capacity to respond quickly and constructively to crises
		Paton (2011)	encompassed individual resilience as a way to achieve organizational resilience
Organizational	Operational	Valikangas and Romme (2012)	ability to recover after a crisis situation or to respond to adversity.
		Caralli, Allen and White (2011)	It is about the organization adapting to operational risk.
	Strategic	Valikangas and Merlyn (2005); Hamel and Valikangas (2003)	ability to renew before a crisis forces the organization to change
		Somers (2009)	involves identifying potential risks and taking proactive steps
		Vidal (2014)	refers to the way to gain competitive advantage.
		Rice and Caniato (2003)	highlighted flexibility and redundancy to become resilient supply chain
Supply Chain		Christopher and Peck (2004)	considered organization as a system
		Aleksic *et al. (*2011)	considered cooperation among all supply chain partners
		Fiksel *et al*. (2015)	Refers to the capacity for an enterprise or set of business entities to survive, adapt, and grow in the face of turbulent change
		Brusset and Teller (2017)	enables a disrupted supply chain to reconstruct itself and be stronger than before.

Source: authors

MAJOR MODELS TO ASSESS ORGANIZATIONAL RESILIENCE

Measuring resilience is a challenging task (PATRIARCA *et. al*., 2018) because there are several approaches to measure this concept, across several application domains.

CAPÍTULO 8

It is common sense that it is necessary to measure for improving (BARROSO *et al*., 2014). There are some attempts to measure resilience because it became condition "*sine qua non*" for organizations that seek for resilience as strategy. If organizations do not know how resilient they really are even what they need to improve, how allocate resources to resilience policy? Although Erol *et al*. (2010) suggest there is still a lack in literature to explore.

From an extensive literature review, some models were identified and will be discussed following: In his research, Somers (2009) seeks to create a reliable tool to measure resilience potential. The author believes there are resilience characteristics that can be measured to describe if organization will have more or less success. He uses factors proposed by Mallak (1998) and added a scale to measure resilience: *Low Resilience, Mid-point e High Resilience,* as table 2 demonstrates.

Mallak (1998) developed his work aimed to organizational resilience and remembers the concept of resilience was first studied in children psychology and few issues were used with workers. The author (p. 149) defines resilience as "the ability of an individual or organization to expeditiously design and implement positive adaptive behaviors matched to the immediate situation, while enduring minimal stress". In this aspect, he developed a model to measure resilience, considering six factors to analyze: *Goal-directed solution seeking; Avoidance; Critical understanding; Role dependence; Source reliance e Resource access.* His model encompasses almost in totality characteristics of individual resilience.

Other proposal to assess resilience was developed by McManus *et al*. (2007) that consider resilience according to three aspects: *Situation awareness,* organizations realize about operational environment noticing what happens around; *Management of Keystone Vulnerabilities,* operational and management aspects are defined that can impact in crises situations; *Adaptive capacity,* it encompasses corporative culture, knowledge management and decision making.

Stephenson *et al*. (2010) propose web-based survey tool to develop a model to measure and compare organizations, identifying resilience strengths and weakness and assess the whole organizational resilience. It attempts to quantitatively measure organizational resilience and compare organizations. The researchers adapted and developed their model based on McManus *et al.* (2008) model. They took McManus *et*

al. (2008) assumptions, considering the dimensions proposed and added six indicators and cultural factor called *Resilience Ethos.* It applied a questionnaire to staff including three questions per indicators. Additionally, it applied it to senior manager with extra questions about business performance. This model encompasses an external, operational and internal dimensions and it is relevant for considering the whole aspects of resilience. On the other hand, Stephenson *et al.* (2010) do not consider that dimensions and the indicators might have different contribution, different weights/relevancy to resilience (table 3).

Table 2 - Somers Model adapted

		Scores Low resilience	Mid-point	high resilience
Mallak´s contribuition (1998)	Factor 1 Goal-directed Solution seeking	Work teams expected to follow standard operating procedures	Ability to adjust procedures within established guidelines	Teams systematically trained to improvise solutions
	Factor 2 RiskAvoidance	Employees avoid taking any significant risks	Employees seek specific direction from supervisors	Employees address problems with minimal supervisor intervention
	Factor 3 Critical Situation Understanding	System and process information is access protected	Employees given access; must put problem into context	Employees gather information; consider consequences of alternative fixes
	Factor 4 Ability to fill multiple roles	Key positions are highly specialized	Cross training/job rotation are systematic	Key positions are generalists
	Factor 5 Reliance on information sources	Supervisors alone define direction	Employees given structured decision-making tools	Employees given knowledge; minimal supervisor intervention
	Factor 6 Access to resources	Work teams have access to central supply cache	Work teams have access to multiple source of materials	Work teams have authority to purchase materials as needed
		Added		

Source: Vidal (2014, p. 38)

Table 3 - Stephenson *et al*. model adapted.

Resilience Ethos						Added
Commitment to Resilience						
Network Perspective						
Organizational Resilience Factors						McManus et. al. (2008) Model
Situation Awareness		Management of Keystone Vulnerabilities		Adaptative Capacity		
AS		KV		AC		
1	Roles & Responsabilities	1	Planning strategies	1	Silo Mentality	
2	Understanding & Analysis of Hazards & Consequences	2	Participation in exercises	2	Communications & Relationships	
3	Connectivity Awareness	3	Capability & Capacity of internal resources	3	Strategic Vision & Outcome expectancy	
4	Insurance Awareness	4	Capability & Capacity of external resources	4	Information & Knowledge	
5	Recovery Priorities	5	Organizational connectivity	5	Leadership, Management & Governance Structures	
6	Internal & External Situation Monitoring & reporting	6	Robust Processes for identifying & Analysing vulnerabilities	6	Innovation & Creativity	Added
7	Informed decision making	7	Staff Engagement & Involvement	7	Devolved & Responsive Decision Making	

Source: Vidal (2014, p. 38)

Additionally, there are other models researched that aim to measure operational and strategic resilience before or after disruption. Considering after disruption, Dalziell and McManus (2004) propose metrics according to the vulnerability and adaptive capacity within a time frame; Rose and Liao (2005) assess capacity of recovery through a mathematic model; Erol *et al.* (2010) present metrics to measure enterprise resilience relating with recovery time from disruption and level of recovery.

Considering before disruption, it can be analyzed a couple models: Sheffi and Rice (2005) and Westrum (2006) propose maps of vulnerabilities to categorize the probabilities of events occurrence. Clearly, they are operational models. Wreathall (2008) relates his study with risk management (processes) and adaptive capacity to

get over. Ultimately, Stolker, Karydas and Rouvroye (2008) developed a model to assess operational resilience, considering attributes based on *High Reliability Organizations* (The British Standard 25999) and it uses weights for attributes that are given by stakeholders in each company.

On the other hand, Vidal (2014) developed a model to assess strategic resilience through a quantitative research. The author has made a comprehensive approach, validated 12 components and 66 attributes, considering weights for components and it´s attributes. This model provides organizations an opportunity to evaluate how strategic resilient they are. From metrics, it is possible to indicate four levels: (1) Department without Strategic Resilience; (2) Department has Strategic Resilience practices - moderate using (3) Department seeking for Strategic Resilience (4) Strategic Resilient Organization – organizations are aware about strategic resilience practices and have corporative policies to achieve it.

Table 4 - Components identified in Vidal´s model (2014)

Components	Weights (w)
Changing Capacity	0,08
Communication and Information System	0,09
Leadership	0,09
Creativity and Innovation	0,08
Organizational Culture	0,08
Empowerment and Organizational Policy	0,10
Strategic Vision	0,09
Risk Management	0,08
People Management	0,08
Leadership and Decision Autonomy	0,07
Strategic Resilience Investments	0,09
Positive Social Relationships	0,07

Source: Vidal (2014)

CAPÍTULO 8

PRACTICAL IMPLICATIONS

The concept of resilience has been getting relevancy in past decade (MAMULA-SEADON, 2009). Visionary people perceived why crave resilience into their business. Firstly, resilience´s considerable importance is due to countless threats that can affect the entire supply chain (SHEFFI, 2005) and resilience can be the key to respond indeed. Secondly to have resilience as competition factor to survive in this environment.

It is also important to point that the search for competitive strategies based on operational efficiency are not good enough to survive in turbulent business world. Some researches (HAMEL; VALIKANGAS, 2003; REINMOELLER; BAARDWIJK, 2005; SHEFFI, 2005) consider strongly resilience as useful strategy in times of crises. Hence, it is important to explore definitions to resilience.

In corporative world based on pragmatism, investments in new ideas, concepts or strategies are implemented more easily if it is possible to measure the current state of organizations. Stephenson *et al*. (2010, p. 27) state that the organizations “often struggle to prioritize and allocate resources to build resilience, given the difficulty of demonstrating progress and success”. Hence, it is notorious how matters to develop models to assess resilience into organizations. Metrics are necessary to manage people, resources and processes towards organizational´ s goals.

This paper identified a range of models to evaluate resilience in different perspectives and help organizations to develop. However, Somers (2009) highlights “there is still a gap in terms of research”. Researches that propose quantitatively measure resilience has been limited.

Ultimately, in terms of strategic resilience, for future work it is indispensable a deep investigation to extent the knowledge because it was identified only one model to assess strategic resilience. Furthermore, we recommend the application of model in a depth longitudinal case studies in order to answer these questions: Does the application of the model in long terms is feasible? What is the cost-benefit trade-off of investing in strategic resilience?

CAPÍTULO 8

REFERENCES

ALEKSIC, A., ARSOVSKI, S., STEFANOVIC, M., TADIC, D. & DAPAN, M. (2011). Resilience in Supply Chains. *5th International Quality conference Center for Quality***,** Faculty of Mechanical Engineering University of Kragujevac.

BARROSO, A.P., MACHADO, V.H., CARVALHO, H. & CRUZ MACHADO, V. (2015). Quantifying the Supply Chain Resilience. In H. Tozan and A. Erturk, *Applications of Contemporary Management Approaches in Supply Chains*, IntechOpen, DOI: 10.5772/59580. Available from: https://www.intechopen.com/books/applications-of-contemporary-management-approaches-in-supply-chains/quantifying-the-supply-chain-resilience

BRUSSET, X. & TELLER, C. (2017). Supply chain capabilities, risks and resilience. *International jopurnal of production economics*. V.184, pp. 59-68

CARVALHO, H., DUARTE, S. & CRUZ MACHADO, V. (2011) Lean, Agile, Resilient, and Green: divergencies and synergies. *International Journal of Lean Six Sigma*, 2(2).

CHO, S., MATHIASSEN, L., & ROBEY, D. (2006) Dialectics of Resilience : a multi-level analysis of telehealth innovation. *Journal of Information technology*, 22, pp. 24-35.

DALZIELL, E. P. & MCMANUS, S. T. (2004). Resilience, vulnerability and adaptive capacity: implications for system performance*. International Forum for Engineering decision making*. Switzerland.

DENHARDT, J. & DENHARDT, R. (2010) Building Organizational Resilience and adaptive management. In J. W. Reich, A. J. Zautra, & J. S. *Hall, Handbook of Adult Resilience*. New York: The Guilford press.

DUCHEK, S. (2020) Organizational resilience: a capability-based conceptualization. *Business* Research,13, 215–246 . https://doi.org/10.1007/s40685-019-0085-7

EARVOLINO-RAMIREZ, M. (2007) Resilience: a concept analysis. *Nursin Forum*, 42(2), pp. 73-82.

EROL , O., HENRY, D., SAUSER, B., & MANSOURI, M. (2010) Perspectives on Measuring Enterprise Resilience. *4th Annual IEEE International Systems Conference*. San Diego, California, USA.

EVERLY, G. (2011). Building a Resilient Organizational Culture. Avaiable in:< HBR Blog Network: http://blogs.hbr.org/cs/2011/06/building_a_resilient_organizat.html> Accessed in 10 Jan.

FIKSEL, J., POLYVIOU ,M., CROXTON, K. L. & PETTIT, T. J.. (2015). From Risk to Resilience: Learning to Deal with Disruption. *MIT Sloan Management Review* 56 (2): 79–86

CAPÍTULO 8

GALLOPIN, G.C. (2006). Linkanges between vulnerability, resilience and adptive capacity. *Global Environmet Change*, v. 16, p.293-303.

GRANDI, B.B., SILVA, A.L., MORAES, C.C. & LIMA, F.R.P. (2018). Resiliência na cadeia de suprimentos: o caso de uma empresa de cosméticos. In*: XXV Simpósio de Engenharia de Produção* (SIMPEP), 2018, Anais...Bauru: 2018.

GRØTAN, T. O., STØRSETH, F., RØ, M. H. & SKJERVE, A. B. (2008). Resilience, Adaptation and Improvisation – increasing resilience by organising for successful improvisation. *3rd Symposium on Resilience Engineering.* Antibes, Juan-Les-Pins, France.

GUNASEKARAN, A., SUBRAMANIAN, N. & RAHMAN, S. (2015). Supply chain resilience: role of complexities and strategies, *International Journal of Production Research*, 53:22, 6809-6819, DOI: 10.1080/00207543.2015.1093667

HAMEL, G. & VALIKANGAS, L. (2003) The quest for resilience. *Havard Business Review*, pp. 1-13.

HOLLNAGEL, E. (2006). The challenge of the unstable. In E. Hollnagel, D.;Woods, D. and Leveson,N. Resilience Engineering: concepts and precepts.

LENGNICK-HALL, C. A., & BECK, T. E. (2003). Beyond Bouncing Back: The concept of organizational Resilience. *National Academy of Management meeting.* Seatlte, WA

MALLAK, L. (1998) Putting Organizational Resilience to work*. Industrial Management*, 40(6), pp. 8-13.

MAMULA-SEADON. CDEM, (2009) Integrated planning and resilience: what is the connection? *MCDEM Ministry of Civil Defense & Emergency Management, 22.*

MARGOLIS, J. & STOLTZ, P. G. 2010.How to Bounce Back from Adversity. *Harvard Business Review* 88(1), 86-92.

MCCANN, J., SEISKY, J., & LEE, J. (2009). Resilience and Performance in Turbulent Environments. *People & Strategy,* 32(3), 44-51.

MCDONALD, N. (2006).Organizational Resilience and industrial risk. In E. Hollnagel, D.; Woods D., and Leveson, N. *Resilience Engineering: Concepts and Precepts.* Massachusetts: Ashgate.

MCMANUS, S., SEVILLE, E., BRUNSDON, D., & VARGO, J. (2007). Resilience Management: a framework for assessing and improving the resilience of organizations. . *Report Research*.

MCMANUS, S., SEVILLE, E., VARGO, J., & BRUNSDON, D. (2008). A Facilitated Process for Improving Organizational Resilience. *Natural Hazards Review*, 9 (2), pp. 81-90.

PATRIARCA, R., GRAVIO, G., COSTANTINO, F., FALEGNAMI, A., & BILOTTA, F. (2018) An Analytic Framework to Assess Organizational Resilience. *Safety and Health at Work*, 9, pp. 265-276.

PETTIT, T. J., CROXTON, K. L. & FIKSEL, J. (2019). The Evolution of Resilience in Supply Chain Management: A Retrospective on Ensuring Supply Chain Resilience. *Journal of Business Logistics*, 2019, 40(1): 56–65.

PONOMAROV, S. Y. & HOLCOMB, M. C. (2009). Understanding the concept of supply chain Resilience. *International Journal of Logistics Management*, 22(1), pp. 124-143.

RICE, J. B. & CANIATO, F. (2003). Building a secure resilient supply network. *Supply Chain Management Review* , 22-30.

ROSE, A. & LIAO, S. (2005). Modeling regional economic resilience to disasters: A computable general equilibrium analysis of water service disruption. *Journal of Regional Science*, Vol. 45, No. 1.

RUTTER, M. (2007). Implications of Resilience Concepts for Scientific Understanding. *Annals New York Academy of Sciences*, V. 1094 (1), pp. 1-12.

SAHEBJAMNIA, N., TORABI, S.A. & MANSOURI, A. (2017). Building organizational resilience in the face of multiple disruptions*. International Journal of Production Economics*. 197. 10.1016/j.ijpe.2017.12.009.

SEVILLE, E. (2009). Resilience: great concept...But what does it mean for organizations? *MCDEM Ministry of Civil Defense & Emergency Management*, 22.

SHEFFI, Y. (2005). Building a resilient supply chain. *Havard Business Review Supply Chain Strategy*, 1(8), pp. 1-12.

SHEFFI, Y. & RICE, B. (2005). A Supply Chain view of the resilient enterprise. *MIT Sloan Management Review*, 47(1), pp. 40-49.

SOMERS, S. (2009). Measuring Resilience Potential: An Adaptive Strategy for Organizational Crisis Planning. Journal of Contingencies and Crisis Management, pp. 12-23.

STARR, R., NEWFROCK, J., & DELUREY, M.(2003). Enterprise Resilience: managing risk in the netwoked economy. *Strategy+Business*, pp. 1-10.

STEPHENSON, A., SEVILLE, E. & VARGO, J. (2010).Measuring and comparing organisational resilience in Auckland. *The Australian Journal of Emergency Management*, 25 (2), pp. 27-32.

STEPHENSON, A., SEVILLE, E., VARGO, J. & ROGER, D. (2010). Benchmark Resilience: A study of the resilience of organizations in the Auckland regions. *Auckland Civil Defence Emergency Management Group and the Foundation of Research Science and Technology*.

STOLKER, R. J., KARYDAS, D. M. & ROUVROYE, J. L. (2008). A Comprehensive Approach to Assess Operational Resilience. *3rd Symposium on Resilience Engineering*. Antibes Juan-Les Pins, France.

TANG, C. S. (2006). Robust Strategies for mitigating supply chain disruptions. *International Journal of Logistics: research and applications,* 9(1), pp. 33-45.

VALIKANGAS, L. (2004). Four steps to corporate resilience. *Strategy + business*, pp. 1-2.

VALIKANGAS, L. & ROMME, A. G. (2012). Building resilience capabilities at ‘‘Big Brown Box, Inc.’’. *Strategy & Leadership* Vol. 40, 43-45.

VIDAL, R., CARVALHO, H. & CRUZ-MACHADO, V. (2014). Strategic resilience development: a study using Delphi. *8th International conference on Management Science and Engineering Management* (pp. 1245-1256, 21-22 Julho). Lisboa: Springer.

VIDAL, R. (2014). *Resiliência estratégica: uma contribuição para o desenvolvimento das organizações*.223 f . Tese (Doutorado)- Faculdade de Ciência e Tecnologia, Universidade Nova de Lisboa, Lisboa.

WESTRUM, R. (2006). A typology of resilience situations. In E. Hollnagel, D.; Woods,D. and Leverson,N. Resilience Engineering: Concepts and Precepts. Hampshire: Ashgate Press.

Woods, D.D. (2015) Four concepts for resilience and the implications for the future of resilience engineering. *Reability engineering &System Safety*. V.141, p-5-9.
DOI: 10.1016/j.ress.2015.03.018

WREATHALL, J. (2008). Developing Models for Measuring resilience *3rd Symposium on Resilience Engineering*. Antibes Juan-Les Pins, France.