



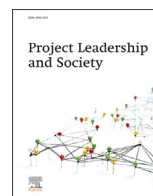
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

Project Leadership and Society

journal homepage: www.elsevier.com/locate/plas

Resilience and projects: An interdisciplinary crossroad

Nader Naderpajouh^{a,*}, Juri Matinheikki^b, Lynn A. Keays^c, Daniel P. Aldrich^d, Igor Linkov^e^a School of Property, Construction and Project Management, RMIT Europe Fellow, RMIT University, 360 Swanston Street, Melbourne, VIC, 3000, Australia^b School of Business, Aalto University, Runeberginkatu 22-24, 00100, Helsinki, Finland^c WU Vienna University of Economics & Business, Witkoppen, 2068, Johannesburg, South Africa^d Department of Political Science, Northeastern University, 215K Renaissance Park, 360,c Huntington Avenue, Boston, MA, 02115, USA^e Carnegie Mellon University, Risk and Decision Science Focus Area Lead, Environmental Laboratory, US Army Engineer Research and Development Center, Vicksburg, MS, 39180, USA

ARTICLE INFO

Keywords:

Resilience, projects
Temporary organisations
Management
Extreme contexts

ABSTRACT

Research communities across multiple disciplines have demonstrated an increasing concern about variations in the performance of social-ecological systems. In response to this concern, holistic research on *resilience* explores explanations for the performance of the systems under both predictable and unknown stressors and shocks. Embedded in broader systems, projects - which often involve a broad range of uncertainty and variability in performance outcomes - provide a fertile context in which to study resilience. On the other hand, projects involve temporary organising that is crucial in the extreme and changing contexts. In this essay, we frame a roadmap for the new theoretical domain of research at the intersection of resilience and projects. This framework intends to spark new research directions and can be used by scholars to investigate resilience at and across multiple levels - individuals, groups/teams, projects, organisations, industries, and societies.

1. Introduction

While transformation has driven much of natural history, the rising volatility, uncertainty, complexity, and ambiguity (VUCA) associated with anthropogenic activities have recently highlighted the need for a paradigm shift in the way humans organise and manage global systems (Helbing, 2013). As the framing and achievement of our goals takes place within established organisations and cultural and institutional structures, these increasing variations are proving challenging not just to societies at large but to organisations and individuals embedded in them (Scott, 2013). Examples of these disruptions include the COVID-19 pandemic, social unrest, political clashes, bushfires across Australia and California, hurricanes, typhoons, cyclones, droughts, sea-level rise, and migration due to climate change and war. Many responses to such shocks and stressors involve emergent and temporary organising in order to address the imminent needs of these extreme contexts, creating a unique opportunity for research on project management and temporary organising (Hällgren et al., 2018; Hynes et al., 2020).

On the other hand, to facilitate creation of new knowledge about more proactive preparation for uncertainty, academic research and

practice have demonstrated increasing interest in exploring a paradigm shift around the broad umbrella term of *resilience* (Baggio et al., 2015; Linkov and Trump, 2019). This reflects the growing desire to explore and understand variation and disruption in ecological, social, and technological systems due to predictable and unknown changes (Hollnagel et al., 2006). The concept of resilience has been used across a wide range of domains from materials science to social and technological systems, focusing on infrastructure, individuals and social collectives, such as communities and societies (Linkov and Palma-Oliveira, 2017). These applications have engaged a range of disciplines, including ecology, engineering, psychology, and general social sciences, as well as management and organisational studies (Baggio et al., 2015; Naderpajouh et al., 2018; Ungar, 2018). For example, there is an extensive body of knowledge on organisational resilience in business and management research (Linnenlueke, 2017).

However, even though the causes and effects of disruptions can be observed at organisational and broader societal levels, the core impacts often emerge from individual, community, or team level disruptions that cascade up through projects and other forms of organising, resulting in system failures. As a result, there is a need to link prior research at the

DOI of original article: <https://doi.org/10.1016/j.ijproman.2020.06.003>.

* Corresponding author.

E-mail addresses: nnp@rmit.edu.au (N. Naderpajouh), juri.matinheikki@aalto.fi (J. Matinheikki), lakeeys@gmail.com (L.A. Keays), d.aldrich@northeastern.edu (D.P. Aldrich), igor.linkov@usace.army.mil (I. Linkov).<https://doi.org/10.1016/j.plas.2020.100001>

Received 30 April 2020; Received in revised form 16 June 2020; Accepted 1 July 2020

2666-7215/© 2020 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

levels of individuals, teams/groups, organisations, networks of organisations, and societies into the project level. At the same time, projects can be effective vehicles of change (Turner and Muller, 2003). Therefore, projects and project-based organising can act as vital action responses to uncertainty and variation as well as means to develop longer term resilience within socio-ecological-technical systems. More specifically, the temporal or dynamic nature of these disruptions and the importance of rapid organising in response to them highlights the importance of projects. In this sense, the established and permanent structure of organisations is not efficient and requires temporary teams or organisations to respond with emergent actions (Hällgren et al., 2018). Therefore, projects as temporary organisations (Lundin and Söderholm, 1995), are well suited to contribute significantly to managing the variations and unexpected changes (Florice and Miller, 2001; Priesmus et al., 2013). For example, temporary organising through projects is essential to ensure continuity of critical societal functions in the face of crisis as well as to mitigate its consequences.

At the level of firm networks, such as supply chains and business ecosystems, projects play an important role in improving the joint-capabilities of firms to withstand crises while remaining operational. For single firms and non-profit organisations, projects have been an essential means to retain continuity by permitting renewal and adaptation to the changing environment, i.e. organisational change (Hornstein, 2015). Projects undergird even the most basic form of operations, thus, “making projects more resilient” becomes an essential task to maintain competitive advantage. Consequently, resilience becomes an important concept relating to and potentially complementing traditional project management knowledge areas such as risk and uncertainty management. Finally, resilience is not just a characteristic of meta-level systems but an important micro-level feature which may help explain how individuals or groups of individuals, such as teams, cope with uncertainty and temporary nature of projects, such as uneven workload and other factors causing psychological stress (Turner et al., 2019).

In this essay, we aim to take the initial steps towards complementing the current debate in project studies by connecting research streams on resilience and projects. That is, we aim to provide new theoretical insights sparking a vivid debate and research activity around projects and resilience, which can potentially yield better understanding. Examples are the role of projects for the resilience of the society (e.g., projects as resilience-adding vehicles); the potential paradigm shift from management of uncertainty and risks to management of resilience in projects; , and the psychological characteristics affecting project-based work (e.g., individual resilience), all which are crucial for effective leadership in project societies. We pursue these new theoretical insights by first introducing the concept of resilience in order to make it more approachable to the project management community. After this, we introduce the multi-level approach to projects, which has become increasingly applied in PM research and explains why resilience and the inherently systems perspective it adopts is relevant to project management research. In addition, we review some of the past PM studies, which have started to use the concept of resilience. Finally, we provide an integrative framework introducing potential future research directions and avenues in which one could start connecting these two domains dealing with the fundamental question of how to best organise for the uncertain and unknown.

2. Concept of resilience

2.1. Resilience as an inherently inter-disciplinary concept

Resilience has been extensively used as a fundamental concept across many fields to explore responses and preparation to variations and change (Hollnagel et al., 2006; Davoudi et al., 2012; Baggio, 2015). In business and management disciplines, the concept of resilience has been applied to explore psychological resilience of employees, resilient businesses (i.e. organisational resilience), and the resilience of loosely

coupled systems such as supply chains (Linnenlueke, 2017; Golan et al., 2020). More recently, isolated research streams include utilising the concept to better understand management in extreme contexts (Hällgren et al., 2018) as well as bridging the separate streams to understand the management of critical infrastructure systems (Naderpajouh et al., 2018).

While a range of definitions have been used across disciplines (Baggio et al., 2015; Linnenlueke, 2017), resilience in academic research most commonly refers to (in line with its dictionary definition) the ability of a system to perform under variety of conditions including disruptions and shocks (Holling, 1973; Bruneau et al., 2003; Folke, 2006; Hollnagel et al., 2006; Weick and Sutcliffe, 2011; Aldrich, 2012, 2019; Fletcher and Sarkar, 2013; Giustiniano et al., 2018; Choi et al., 2019). In this sense, the disruptions can be chronic (stressors) or abrupt (shocks) (Hellbing, 2013; Sagara, 2018). *Organising for resilience* is then defined as the actions to plan, absorb, recover, and adapt to the variations in the performance of the system under the range of conditions (Sutcliffe and Vogus, 2003; Naderpajouh et al., 2018). *Management of resilience* refers to actions to ensure and control the desired performance of the systems in the face of variations (Walker et al., 2002; Naderpajouh et al., 2018). However, the widespread yet siloed application of the concept of resilience still needs more engaged and integrated interdisciplinary research to bridge across fields (Baggio et al., 2015; Brown, 2012; Davoudi et al., 2012). We believe the interdisciplinary nature of the field of project management and the inherent characteristics of projects to deal with uncertainty, risks, and temporariness provide fertile ground to bridge the scientific fields of resilience and projects as explained more in detail in the remainder of this essay.

2.2. Shift of discourse in resilience research

Several vital themes need to be considered in the discourse of resilience: (i) the shift of discourse from risk to resilience (Aven, 2019), (ii) the process or attribute approach to resilience, and (iii) the descriptive (and non-normative) approach to resilience. On the psychological level, the shift from risk to resilience includes moving from external disruption to the life of an individual towards the internal strength of the individual in the face of these disruptions (Richardson, 2002). The shift of discourse from risk to resilience is well documented in engineering resilience with the call to integrate broader risk governance with resilience governance, i.e., the analysis of anticipation of external threats with the analysis and management of internal strength and resilience building. Therefore, the findings in the resilience stream in project management can complement project risk management research and practice.

This shift entails several dimensions including: (i) the move from minimisation of failure to adaptation, (ii) from minimisation of probability to minimisation of consequences, (iii) from strengthening and resistance to flexibility, diversity and adaptability, (iv) from security to recovery, and (v) from quantitative analysis to possible qualitative consequence analysis of scenarios with unidentified causes (Park et al., 2013; Aven, 2018). It should be noted that in organisational resilience, the discourse was inherently focused on adaptation and constant monitoring and simulation of the response to variations within the organisations (Vogus and Sutcliffe, 2017). As a result of this shift, engineering resilience is also further aligned with this approach by considering adaptation within the usual engineering mindset of anticipating and “no error” design in engineering resilience (Park et al., 2013; Aven, 2018).

Furthermore, there is a common misconception of resilience as a normative attribute of the system, implying its favourability for the system and its context (Olsson et al., 2015). However, resilience, in essence, is not normative, as, for example, an unfavourable trait of a system can be also persistent or resilient. We believe future research on resilience must pay a special attention to this common misconception and avoid assumptions that do not imply neutrality in the analysis and critical examination of the under-studied phenomena. In addition, while resilience is seen as both a process and an attribute (Richardson, 2002;

Fletcher and Sarkar, 2013; Hollnagel, 2014), we see the concept of resilience as an attribute or ability of the system (or more accurately its performance) to sustain and thrive in the face of variations. This debate is specifically observed in psychological resilience as several authors have conceptualised resilience as a process to illuminate its evolving nature (Ungar, 2008). However, we argue that the demarcation of resilience as an attribute of the system and the processes that impact these variations is necessary. This demarcation is already observed in resilience engineering, where the variation of the attributes over time is discussed extensively with clear distinction of the processes that impact resilience from the variations of the attribute itself (Bruneau et al., 2003; Hollnagel et al., 2006).

3. Projects and the concept of resilience

In this section, we will briefly explain the overarching view on projects, by which a project is not just viewed as a temporary one-off production function but as a more complex system consisting of multiple sub-systems, interlinked to other systems within its ecosystem. Hence, we draw insights from current stream of project studies (see Geraldi and Söderlund, 2018) as well as general systems theory. We justify why such a wide perspective to projects is necessary when adopting resilience concept into the PM domain. In addition, we will briefly summarize the past research on resilience and related topics on projects. These efforts form the basis for framing the future research on resilience and projects, which is detailed in the following section.

3.1. Projects as nested systems

Projects are ubiquitous phenomena *per se* as well as highly interlinked with multiple social, technological, and natural phenomena, and thus some scholars argue that we live in the age of projectification of business (Midler, 1995), the society at large (Lundin, 2016) and individuals or human-beings (Jensen et al., 2016). Project management has increasingly extended the level of analysis from one project to link individual (micro) and societal (macro) phenomena to projects and project organising, which has resulted in a research direction under the broad label of *project studies* (Geraldi and Söderlund, 2018). By definition, projects are temporary organisations created to achieve a certain predefined goal or end-state (Lundin and Söderholm, 1995). Hence, projects are vehicles of organising change (Turner and Muller, 2003) often described as a series of required activities to undertake such change (e.g., defined through planning and tools of project management) within an organisation or between organisations (e.g., business networks) or a wider institutional environment (Tukiainen and Granqvist, 2016).

On the other hand, the project itself often consist of multiple, yet interdependent, specialists who have chosen to undertake the specific job (Bakker et al., 2016). Such a temporary organisation spans across the boundaries of multiple organisations representing an inter-organisational network (Hellgren and Stjernberg, 1995; Matinheikki et al., 2016). The need for inter-organisational division of labor grows even more significant as task complexity increases (Geraldi et al., 2011). Such complex organisational entities are often labelled as megaprojects (Flyvbjerg, 2017), with a high impact beyond the change object (e.g., railway network) and the organisations undertaking the project. That is, the impact also spills over to the project-based industry as well as the whole context in which the project is conducted such as the society, resembling what is sometimes called project ecologies (see e.g., Grabher and Ibert, 2011). Therefore, a project is not just a single entity or object of research but a phenomena within a highly stratified system consisting of multiple levels (or strata) ranging from individual(s) (e.g., project manager), project (e.g., as a series of tasks or as a temporary organisation), permanent organisation(s) or project-based firm(s), project-based industry and society as a whole (Artto and Kujala, 2008; Sydow et al., 2004). The focus of analysis can also be expanded on horizontal connections at a single-level, e.g., multiple firms participating in a joint project forming a

project network (Ahola, 2009), a programme (Steinfart, 2017), or a portfolio of projects (Hall et al., 2015).

Systems theory defines projects and their complexity at different levels with a focus on the project components and their interactions as a loosely coupled system (Klir, 2013; Orton and Weick, 1990; Baccarini, 1996). In this sense, we propose that a system boundary should consider the component of the systems, their interaction, and the holistic behaviour of the system. The systems within and around projects can be stratified at different levels as it will be further discussed in section 4. This kind of nested or systems thinking rooted perspective resonates strongly with the past research on resilience which revolves around how well a system can withstand external shocks and stressors (ecological, social, technical or their integrated and interdependent system of systems). Furthermore, this approach is also applied in project studies specifically under the topic of project complexity (cf. Davies and Mackenzie, 2014).

3.2. Past project management research incorporating resilience

The interest in combining resilience and projects seems to be trending recently. To showcase this trend, a title-abstract-keyword search from the top three Web of Science listed PM journals of International Journal of Project Management (IJPM), Project Management Journal (PMJ) and International Journal of Managing Projects in Business (IJMPiB) results in 17 hits (by using both Web of Science and Scopus search engines). From very little research prior to 2010, there has been a moderate rise of interest in the past decade resulting in a large number (6) of papers published recently in 2019. Examples of past research include the role of projects in disaster management and the research stream on resilience in project management (e.g. a 2017 IJPM special issue, see Chang-Richards et al., 2017). Prior to that, another special issue focused on the core project management concepts of risk and uncertainty to explore dimensions of risk, resilience and potentially anti-fragility in projects (see Bredillet and Tywoniak, 2016).

More recently, Nachbagau and Schirl-Boeck (2019) combined systems theory and resilience in the domain of megaproject management and argued that past PM research has neglected risk and uncertainty while taking a hierarchical planning and control focused approach. They propose an alternative, more resilient approach based on self-organising. Other resilience focused PM research includes an examination of supply chain resilience in inter-organisational projects (Thomé et al., 2016; Naderpajouh et al., 2015); psychological resilience and wellbeing of leaders, communities, and small teams (Zemba et al., 2019) as well as individual project employees (Turner et al., 2019). A slightly more specialized sub-set of articles focuses on innovative (Oeij et al., 2017; Todt et al., 2019) and explorative projects (Wied et al., 2020), all dealing with the dilemma of flexible organising and creative manoeuvring.

Besides research explicitly on the topic of resilience, a plethora of studies on projects has explored resilience-related phenomena more indirectly. In this sense, best practices in risk management (Kutsch and Hall, 2010), or how to create value through risk management (Willumsen et al., 2019) can be extended to resilience management. Past project management research has also explored different forms of flexible organising, that is, the capability to adjust projects to uncertain circumstances (Olsson, 2006). One way to achieve such flexibility especially in the information systems development is through iterative and collaborative development between customer and developer, often under the label of “agile project management” (Conforto et al., 2014). In more traditional industries such as construction, examples of flexible and agile project organising include use of modular product architecture combined with strong co-operation with multiple project parties (Gil and Tether, 2011) and the use of reduction lists to maintain project scope on desired level when incorporating new features (Cui and Olsson, 2009). All in all, the common denominator with all these flexible forms of organising is the better capability to cope with sudden and unexpected changes, i.e., uncertainty or variations, which is the hallmark of a resilient system.

We see that further efforts are required to weave the multiple levels of stratified project context and resilience concepts together and form a holistic yet tight web between multiple concepts and empirical phenomena. One could start to pinpoint the most significant threats and vulnerable spots in our contemporary societies or propose systematic and balanced solutions and remedies avoiding potential zero-sum situations in which different vertical (e.g., individuals vs. organisations) and/or horizontal (e.g., multiple projects or organisations) levels compete against each other for resources and living space when facing disruptions and shocks. There is a need for resilience-oriented research from multiple levels of projects and related systems as well as research focusing on various levels of resilience conducted or closely linked with project-based contexts. In the following section we will tie these ideas into a framework and suggest a few of the potential topics on different levels of analysis.

4. Framing future research on resilience and project

So to guide the research stream on resilience and projects, we propose a conceptual framework for mapping project management needs with

resilience science that is informed by systems theory. The framework posits an understudied phenomena as a social organisation with focus on the components of the system and their interactions (Boulding, 1956; Weber and Waeger, 2017; Soderstrom and Weber, 2020). The components of the system can be then framed at different levels of analysis, including individual, group/team, project, organisation, industry, or society. We use the term framework to refer to the structure of the concepts and their language to guide future research (McGinnis and Ostrom, 2014). Therefore, we first present the consolidated framework in a table format (see Table 1) to summarize the different levels, potential research streams, and questions for future research. We then summarize the core message of the framework in a figure format (see Fig. 1), which illustrates the interdisciplinary crossroad through which one can approach different system levels to provide a more nuanced understanding of *resilience projects* and *project resilience*. Therefore, further understanding around these topics may be achieved through studies: (i) focusing on one level, (ii) interlinked studies with the focus on parallel analysis of multiple levels, as well as (iii) more integrative and holistic efforts to combine the insights and discrepancies observed on different levels of the system and

Table 1
Framework for interdisciplinary quest to ground and enrich the research stream on resilience and projects.

Level of analysis in project context	Resilience concepts and focus	Research Questions
Individual Project manager Project employees Stakeholders	Psychological resilience (Shin et al., 2012; Fletcher and Sarkar, 2013)	<ul style="list-style-type: none"> • How do external shocks and stressors affect members of project teams and project managers? • How does discontinuous project-based work affect resilience of teams and organisations? • How does project leadership impact resilience of project teams? • How do the diverse temporal orientations of individuals in projects affect the resilience of teams?
Team/Group Project team or sub-discipline	Team/Group resilience (Zemba et al., 2019; Chapman et al., 2020)	<ul style="list-style-type: none"> • How can teams/groups respond to disruptions and how resilience can be enforce? • How lack of team resilience impact project and organization? • How can resilient individuals improve resilience of a project team? • What is the impact of resilience on the performance of the teams? • What kinds of project team constellations facilitate resilience? • How does high turn-over of teams (typical of projects) affect resilience?
Project Temporary organisation Series of tasks and activities Project processes Project structure	Resilience projects (Chang-Richards et al., 2017; Steinfort, 2017; Choi et al., 2019), Project resilience (Kutsch et al., 2015), vulnerability and uncertainty (Florice and Miller, 2001; Priemus et al., 2013; Wang, 2019)	<ul style="list-style-type: none"> • How should project sub-systems (e.g., individuals) or parent-systems (e.g., organisation, society) be designed to be/not to be resilient? • How can engineering tools and methods for building resilience be utilised in projects? • What is the importance of resilience at different phases in the lifecycle of a project? • What are the most significant properties of resilience in projects and their ecosystem? • How can resilience be developed and maintained at the project level? • What is the implication of the typology of the projects, e.g., agile projects, on their resilience? • What kind of implications does autonomy of projects have on resilience? • What kind of organising solutions in projects facilitate resilience?
Permanent/parent organisation(s) Project-based firm	Organisational resilience (Vogus and Sutcliffe, 2007; Wood et al., 2019)	<ul style="list-style-type: none"> • How do projects affect the resilience of the permanent organisation and vice versa? • How should organisations design project teams to assure business continuity? • How do decision making and governance structure impact the resilience of the organisations?
Network of organisations/ Industry	Supply chain resilience (Naderpajouh et al., 2015; Kochan and Nowick, 2018), Resilience of a sector/industry (Baylis et al., 2015)	<ul style="list-style-type: none"> • How do network/supply chain structures affect resilience in the project context? • How can individual projects enhance resilience of such networks?
Societal context Industry State Global environment	Business continuity (Hiles, 2010), Social and political resilience (Aldrich, 2012, 2019), Ecological resilience (Holling, 1973), Engineering resilience (Hollnagel et al., 2006), Institutional resilience (Barin Cruz et al., 2016)	<ul style="list-style-type: none"> • How do the societal factors (e.g. governance, social networks) affect resilience of and in projects? • How can project change the macro structures supporting resilience and affect society?

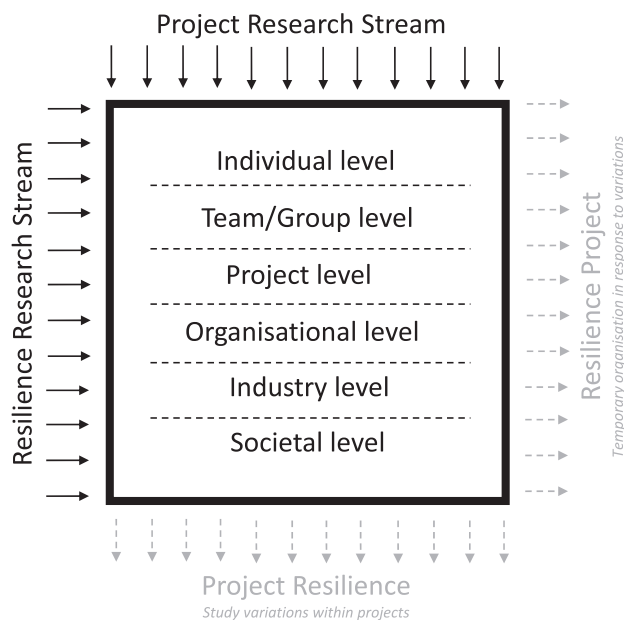


Fig. 1. Inter-disciplinary crossroads for multi-level analysis of resilience in and around projects.

at their cross-sections. These suggestions will guide potential research and not act as limiting constraints because they encompass a pluralistic and instrumentalist view (see Dewey, 1938; Laudan, 1977; Olsson et al., 2015).

4.1. Key concepts of resilience on different levels within and around projects

Resilience at the individual level initiated from works of Werner et al. (1971) and Gramezy (1973) as the shift from outward look on risks towards the inward look to strengths of the individuals (Richardson, 2002). The concept of psychological resilience focuses on the adaptive strength of the people to face disruptions and variations in their life and careers (Fletcher and Sarkar, 2013). This stream of research is very well studied and established broadly across different disciplines. At the same time, it has been used very occasionally within the project studies (for one recent example, see Turner et al., 2019). There is considerable potential to use the concept of psychological resilience across topics that focus on individuals as their level of analysis. These studies can focus on (i) the symbiotic relationship of individuals, project teams and larger project organisations and how resilience of one can impact the other, (ii) the dynamics at the same level such as interactions among individuals with a focus on their psychological resilience, and (iii) a chronological study of the psychological resilience in project-based industries.

Unlike psychological resilience, the application of the concept of resilience at the team level is broadly an understudied topic (Chapman et al., 2020). This gap in the scholarly conceptualisation creates an opportunity for project studies to engage in knowledge creation. In a similar pattern, the resilience of teams is defined as their ability to perform under a variety of conditions and towards the team goals (West et al., 2009; Edson, 2012).

The concept of organisational resilience is rather well-established with a focus on shocks to the organisations as well as the role of organisations in response to shocks at the societal level (Williams et al., 2017). These focal areas include themes such as business continuity and organisational reliability, including both creating resource buffers and capabilities to deploy them under crisis (Vogus and Sutcliffe, 2008), and the adaptability of the business models, and organisational responses to extreme contexts (Linnenluecke, 2017). Organisations that operate in

high-risk contexts are explored in the research stream of high reliability organisations (HRO) (Roberts and Bea, 2001; Vogus and Sutcliffe, 2017), which can be extended to temporary organising in high risk contexts. Furthermore, the role of temporary organising in business continuity can be explored at this level. It should be noted that temporary organising is often seen as the typical pattern of action in extreme contexts (Hällgren et al., 2018), which indicates the importance of projects in response to disruptions.

At the project level, the core yet underdeveloped concept should be project resilience and resilience projects. By building on the past work by Kutsch et al. (2015) we define “project resilience” as the capacity to organise under a variety of scenarios, including disruptions in the form of shocks or stressors. Naturally, this is not a new domain to project manager scholars and practitioners as risk and uncertainty management are central domains in any modern project management curriculum and management system. However, the traditional project risk management revolves heavily around identifying and mitigating risks and is, therefore, perhaps too much rooted in the assumption that one can manage risks. The basic tenet in resilience research deviates from this while accepting that risks are potentially unknown in advance and therefore unmanageable (resembling so called unknown unknowns, cf. Pich et al., 2002). This stresses the importance of inherent vulnerability of projects to external shocks requiring yet again a systems perspective when dealing with response strategies (Wang et al., 2019). Ultimately, we see that project resilience as a concept and research direction indeed needs an in-depth examination of the corresponding sub- and parent-systems identified in the framework. Another important concept for future research touching also other levels of framework is the so-called *resilience project*. We define the resilience project as a form of temporary organising to respond to disruptions and build long term resilience at the level of individuals, teams, projects, organisations, supply chains, or ecosystems.

At the network level of organisations (e.g., supply chain or ecosystem level), resilience refers to the ability of a loosely coupled system of firms to respond to the variations in its overall performance, often a final value to the end-user (Christopher and Peck, 2004; Ponomarov and Holcomb, 2009). Disruptions can be exogenous (Adobor, 2019) such as the case of the 11 March 2011 tsunami in Japan (Revilla and Saenz, 2017; Li et al., 2019; Aldrich, 2019), 2019/20 Australian Bushfires (Resilience Shift, 2020), and the COVID-19 pandemic (del Rio-Chanona et al., 2020; Haynes et al., 2020). They can also be endogenous such as the case of counterfeit, fraudulent and suspect items (Naderpajouh et al., 2015). The research paradigm on supply chain resilience revolves around these issues and emphasizes the importance of early detection of signs of crisis, flexible organising of supply chains, buffering and relational capital as potential remedial mechanisms towards increased resilience (Kochan and Nowicki, 2018). From the project management perspective, supply chain-related disruptions can impact the outcome of the projects creating the need for resilient projects. At the same time, projects can also enhance resilience of the supply chain through ensuring the need for the flow of the material and components (i.e., through resilience projects).

Resilience at the highest order level of societies involves actions across the community and public and private domains (Naderpajouh et al., 2018). This stream of research can focus on projects for temporarily enhancing the community resilience, humanitarian contexts such as projects associated with organising for refugees, and projects for collective actions and collaborations in the face of disruptions. The essential concept on this level is the so-called institutional resilience (cf. Barin Cruz et al., 2016), which deals with the idea of how well the formal institutional structures can sustain shocks but also support recovery. Examples of institutional structures include judicial and political systems, and informal institutional structures such as local norms, conventions, and practices. Institutional resilience links directly with institutional change and past research on the role of projects in achieving such change (cf. Tukiainen and Granqvist, 2016). A framework developed for management of resilience at the level of societies can provide insights for future research (Naderpajouh et al., 2018).

Importantly, due to the nested structure of systems, the focal system can serve as a sub-system or as a parent-system of other systems. For the sake of simplicity, we have deliberately set the boundary of the framework as an individual being the lowest and the nation-states as the highest level. While doing so, we do accept that resilience can and should be approached from perspective of ecological systems (referring to organisms as a system and should not be confused with project ecologies) in which social systems function. However, we see that even the given framework opens so many unanswered questions that narrowing the scope here is advised for the sake of theoretical parsimony considering the disciplinary focus of project management.

4.2. Temporal dimension as an additional glue between the two streams

In addition to the proposed framework, the temporal dimension of projects can further help in formulating a nested view on resilience across interrelated levels in the proposed framework. This temporal or process-oriented element is inherent to projects which, as mentioned, are often viewed as temporary organisations (Lundin and Söderholm, 1995) and/or sets of activities and phases taking place over the lifecycle of a project (Aaltonen and Kujala, 2010). In other words, projects can be seen as processes with high uncertainty that unfold as time passes before, during, and after the project lifecycle (Söderlund, 2013; Arto et al., 2016). The temporality of projects is also context-specific and may lead to diverging perceptions of time, which may further complicate temporary and project organising (Dille and Söderlund, 2011).

In a similar vein, the variations of system performance over time are notable in the literature of resilience (Bruneau et al., 2003). Scholars may study how the system responds to a shock and how the recovery process unfolds. Therefore, the inherent dynamism in resilience may be at least partly explained through project lifecycle models and or process theories of temporary organising (see, e.g., Bakker et al., 2016). Indeed, project-oriented theorizing that takes into account the institutional differences in temporary organising (e.g., diverging timing norms) may provide a vital contingency perspective on resilience management (see Dille et al., 2018). Hence, addressing this temporal dimension can provide a fruitful avenue for further theorizing in the studies across projects and resilience.

While we do see the temporal dimension of projects and resilience as a significant domain of future theorizing, it is not directly linked to the proposed framework. We leave it out because temporality, in fact, touches all of the levels at the same time when projects are conducted in their social settings, and, thus we embed temporality at all levels of analysis. We settle for stressing the importance of the topic and leave the actual theorizing for future research (interested readers can refer to insightful reviews on time and temporality in projects by Söderlund (2013) and Biesenthal et al. (2015) and in organization studies by Langley et al. (2013)).

5. Conclusions

In this essay, we have developed a framework as a meta-theoretical roadmap for future research across the concepts of resilience and projects. The theoretical underpinning of the framework is adopted from the general systems theory, positing resilience as the study of how systems at each level perform under a variety of conditions, including disruptions. Individual, team/group, organisation, project, industry, and society levels are demarcated as distinct layers of the proposed framework. We propose this framework as a starting point to explore resilience at each level and across levels or scales and within two main streams of project resilience that focus on variations in temporary organising and resilience projects as temporary organising in response to disruption. While the focus here is on the project management which implies presence of the project within the analysis, the framework can be used as an interdisciplinary guideline to explore resilience of a range of systems. These systems span individuals to communities or industries as well as the role of projects either as means to cope with disruptions and improve resilience

(e.g., a resilience project) or even as causes of disruptions (e.g., psychological stress caused by temporary nature of project).

The goal of the proposed framework is to direct the future of resilience-oriented research in the project management (or project studies) domain. The use of this framework hopefully will open novel multi-level theorizations on projects and resilience as and complement more traditional project management topics such as management of uncertainty and risk in projects. We believe the proposed framework across multiple levels reflects the interdisciplinary nature of both the concept of resilience and the discipline of project management. Therefore, in the fashion of the Kuhnian cycle (Kuhn, 2012), we would like to encourage PM scholars towards a paradigm shift. We to encourage the use of the proposed framework for a gradual and iterative development scholars to revise, extend, and elaborate the proposed framework to eventually lead to a new resilience informed paradigm in project management. This can better facilitate our knowledge about projects as important social systems within the society.

Declaration of competing interest

Authors declare no conflict of interest.

References

- Aaltonen, K., Kujala, J., 2010. A project lifecycle perspective on stakeholder influence strategies in global projects. *Scand. J. Manag.* 26 (4), 381–397.
- Adobor, H., 2019. Supply chain resilience: a multi-level framework. *International Journal of Logistics Research and Applications* 22 (6), 533–556.
- Ahola, T., 2009. Efficiency in Project Networks: the Role of Inter-organizational Relationships in Project Implementation. PhD dissertation. Helsinki University of Technology (Aalto University, Helsinki Finland).
- Aldrich, D.P., 2012. Building Resilience: Social Capital in Post-Disaster Recovery. University of Chicago Press, Chicago.
- Aldrich, D.P., 2019. Black Wave: How Networks and Governance Shaped Japan's 3/11 Disasters. University of Chicago Press, Chicago.
- Arto, K., Ahola, T., Vartiainen, V., 2016. From the front end of projects to the back end of operations: managing projects for value creation throughout the system lifecycle. *Int. J. Proj. Manag.* 34 (2), 258–270.
- Arto, K., Kujala, J., 2008. Project business as a research field. *Int. J. Manag. Proj. Bus.* 1 (4), 469–497.
- Aven, T., 2018. The call for a shift from risk to resilience: What does it mean?. *Risk Analysis* 39 (6), 1196–1203.
- Baccarini, D., 1996. The concept of project complexity—a review. *Int. J. Proj. Manag.* 14 (4), 201–204.
- Baggio, J., Brown, K., Hellebrandt, D., 2015. Boundary object or bridging concept? A citation network analysis of resilience. *Ecol. Soc.* 20 (2), 2–12.
- Bakker, R.M., DeFillippi, R.J., Schwab, A., Sydow, J., 2016. Temporary organising: promises, processes, problems. *Organ. Stud.* 37 (12), 1703–1719.
- Barin Cruz, L., Aguilar Delgado, N., Leca, B., Gond, J.P., 2016. Institutional resilience in extreme operating environments: the role of institutional work. *Bus. Soc.* 55 (7), 970–1016.
- Baylis, J., Grayson, M., Lau, C., Gerstell, G., Scott, B., Nicholson, J., 2015. Transportation Sector Resilience. National Infrastructure Advisory Council, Washington, D.C.
- Biesenthal, C., Sankaran, S., Pitsis, T., Clegg, S., 2015. Temporality in organization studies: implications for strategic project management. *Open Econ. Manag. J.* 2 (1), 197–208.
- Boulding, K.E., 1956. General systems theory—the skeleton of science. *Manag. Sci.* 2 (3), 197–208.
- Bredillet, C.N., Tywoniak, S., 2016. Genesis of the special issue: uncertainty, risk & opportunity, resilience & anti-fragility. *Int. J. Proj. Manag.* 7 (34), 1322–1327.
- Brown, K., 2012. Policy discourses of resilience. In: *Climate Change and the Crisis of Capitalism*. Routledge, pp. 46–59.
- Bruneau, M., Chang, S.E., Eguchi, R.T., Lee, G.C., O'Rourke, T.D., Reinhorn, A.M., von Winterfeldt, D., 2003. A framework to quantitatively assess and enhance the seismic resilience of communities. *Earthq. Spectra* 19 (4), 733–752.
- Chang-Richards, Y., Rapp, R., Wilkinson, S., von Meding, J., Haigh, R., 2017. Disaster recovery project management: a critical service. *Int. J. Proj. Manag.* 35 (5), 783–787.
- Chapman, M.T., Lines, R.L., Crane, M., Ducker, K.J., Ntoumanis, N., Peeling, P., et al., 2020. Team resilience: a scoping review of conceptual and empirical work. *Work. Stress* 34 (1), 57–81.
- Choi, J., Naderpajouh, N., Yu, D.J., Hastak, M., 2019. Capacity building for an infrastructure system in case of disaster using the system's associated social and technical components. *J. Manag. Eng.* 35 (4), 04019013.
- Christopher, M., Peck, H., 2004. Building the resilient supply chain. *International Journal of Logistics Management* Vol. 15 (2), 1–13.
- Conforto, E.C., Salum, F., Amaral, D.C., Da Silva, S.L., De Almeida, L.F.M., 2014. Can agile project management be adopted by industries other than software development? *Proj. Manag. J.* 45 (3), 21–34.
- Cui, Y., Olsson, N.O., 2009. Project flexibility in practice: an empirical study of reduction lists in large governmental projects. *Int. J. Proj. Manag.* 27 (5), 447–455.

- Davies, A., Mackenzie, I., 2014. Project complexity and systems integration: constructing the London 2012 Olympics and Paralympics Games. *Int. J. Proj. Manag.* 32 (5), 773–790.
- Davoudi, S., Shaw, K., Haider, L.J., Quinlan, A.E., Peterson, G.D., Wilkinson, C., et al., 2012. Resilience: a bridging concept or a dead end? "Reframing" resilience: challenges for planning theory and practice interacting traps: resilience assessment of a pasture management system in Northern Afghanistan urban resilience: what does it mean in planning practice? Resilience as a useful concept for climate change adaptation? The politics of resilience for planning: a cautionary note: edited by Simin Davoudi and Libby Porter. *Plann. Theor. Pract.* 13 (2), 299–333.
- del Rio-Chanona, R.M., Mealy, P., Pichler, A., Lafond, F., Farmer, D.F., 2020. Supply and Demand Shocks in the COVID-19 Pandemic: an Industry and Occupation Perspective. INET Oxford Working Paper. No.2020-05.
- Dewey, J., 1938. *Logic: the Theory of Inquiry*. Holt, Rinehart and Winston, New York.
- Dille, T., Söderlund, J., 2011. Managing inter-institutional projects: the significance of isochronism, timing norms and temporal misfits. *Int. J. Proj. Manag.* 29 (4), 480–490.
- Dille, T., Söderlund, J., Clegg, S., 2018. Temporal conditioning and the dynamics of inter-institutional projects. *Int. J. Proj. Manag.* 36 (5), 673–686.
- Edson, M.C., 2012. A complex adaptive systems view of resilience in a project team. *Syst. Res. Behav. Sci.* 29 (5), 499–516.
- Fletcher, D., Sarkar, M., 2013. Psychological resilience: a review and critique of definitions, concepts, and theory. *Eur. Psychol.* 18 (1), 12.
- Florice, S., Miller, R., 2001. Strategizing for anticipated risks and turbulence in large-scale engineering projects. *Int. J. Proj. Manag.* 19 (8), 445–455.
- Flyvbjerg, B., 2017. Introduction: the iron law of megaproject management. In: Flyvbjerg, B. (Ed.), *The Oxford Handbook of Megaproject Management*. Oxford University Press.
- Folke, C., 2006. Resilience: the emergence of a perspective for social-ecological systems analyses. *Global Environ. Change* 16 (3), 253–267.
- Garmezny, N., 1973. Competence and Adaptation in Adult Schizophrenic Patients and Children at Risk. The first ten dean award lectures, Schizophrenia, pp. 163–204.
- Geraldi, J., Söderlund, J., 2018. Project studies: what it is, where it is going. *Int. J. Proj. Manag.* 36 (1), 55–70.
- Geraldi, J., Maylor, H., Williams, T., 2011. Now, let's make it really complex (complicated) A systematic review of the complexities of projects. *Int. J. Oper. Prod. Manag.* 31 (9), 966–990.
- Gil, N., Tether, B.S., 2011. Project risk management and design flexibility: analysing a case and conditions of complementarity. *Res. Pol.* 40 (3), 415–428.
- Giustiniano, L., Clegg, S.R., e Cunha, M.P., Rego, A. (Eds.), 2018. *Elgar Introduction to Theories of Organisational Resilience*. Edward Elgar Publishing.
- Golan, M.S., Jernegan, L.H., Linkov, I., 2020. Trends and applications of resilience analytics in supply chain modeling: systematic literature review in the context of the COVID pandemic. *Environ. Syst. Decis.* 40 (2).
- Grabher, G., Ibert, O., 2011. Project ecologies. In: Morris, P.W.G., Pinto, J., Söderlund, J. (Eds.), *The Oxford Handbook of Project Management*. Oxford University Press.
- Hall, N.G., Long, D.Z., Qi, J., Sim, M., 2015. Managing underperformance risk in project portfolio selection. *Oper. Res.* 63 (3), 660–675.
- Hällgren, M., Rouleau, L., De Rond, M., 2018. A matter of life or death: how extreme context research matters for management and organization studies. *Acad. Manag. Ann.* 12 (1), 111–153.
- Helbing, D., 2013. Globally networked risks and how to respond. *Nature* 497, 51.
- Hellgren, B., Stjernberg, T., 1995. Design and implementation in major investments—a project network approach. *Scand. J. Manag.* 11 (4), 377–394.
- Hiles, A., 2010. *The Definitive Handbook of Business Continuity Management*. John Wiley & Sons.
- Holling, C.S., 1973. Resilience and stability of ecological systems. *Annu. Rev. Ecol. Systemat.* 4 (1), 1–23.
- Hollnagel, E., 2014. Resilience engineering and the built environment. *Build. Res. Inf.* 42 (2), 221–228.
- Hollnagel, E., Woods, D.D., Leveson, N. (Eds.), 2006. *Resilience Engineering: Concepts and Precepts*. Ashgate Publishing, Ltd.
- Hornstein, H.A., 2015. The integration of project management and organizational change management is now a necessity. *Int. J. Proj. Manag.* 33 (2), 291–298.
- Hynes, W., Trump, B.D., Love, P., Linkov, I., 2020. Bouncing forward: a Resilience Approach to dealing with COVID-19 and future systemic shocks. *Environ. Syst. Decis.* 40 (2).
- Jensen, A., Thuesen, C., Geraldi, J., 2016. The projectification of everything: projects as a human condition. *Proj. Manag. J.* 47 (3), 21–34.
- Klir, G.J., 2013. *Architecture of Systems Problem Solving*. Springer Science & Business Media.
- Kochan, C.G., Nowicki, D.R., 2018. Supply chain resilience: a systematic literature review and typological framework. *Int. J. Phys. Distrib. Logist. Manag.* 48 (8), 842–865.
- Kuhn, T.S., 2012. *The Structure of Scientific Revolutions*, 50th Anniversary Edition. University of Chicago press, Chicago, IL, USA.
- Kutsch, E., Hall, M., 2010. Deliberate ignorance in project risk management. *Int. J. Proj. Manag.* 28 (3), 245–255.
- Kutsch, M.E., Hall, M., Turner, N., 2015. *Project Resilience: the Art of Noticing, Interpreting, Preparing, Containing and Recovering*. Ashgate Publishing, Ltd.
- Langley, A.N.N., Smallman, C., Tsoukas, H., Van de Ven, A.H., 2013. Process studies of change in organization and management: unveiling temporality, activity, and flow. *Acad. Manag. J.* 56 (1), 1–13.
- Laudan, L., 1977. *Progress and its Problems: towards a Theory of Scientific Growth*. Routledge, London.
- Li, Y., Zobel, C.W., Seref, O., Chatfield, D., 2019. Network characteristics and supply chain resilience under conditions of risk propagation. *Int. J. Prod. Econ.* 107529.
- Linkov, I., Palma-Oliveira, J.M. (Eds.), 2017. *Resilience and Risk*. Springer, Amsterdam.
- Linkov, I., Trump, B., 2019. *The Science and Practice of Resilience*. Springer Nature, Risks Systems and Decisions Series, Geneva, Switzerland.
- Linnenluecke, M.K., 2017. Resilience in business and management research: A review of influential publications and a research agenda. *International Journal of Management Reviews* 19 (6), 4–30.
- Lundin, R.A., 2016. Project society: paths and challenges. *Proj. Manag. J.* 47 (4), 7–15.
- Lundin, R.A., Söderholm, A., 1995. A theory of the temporary organisation. *Scand. J. Manag.* 11 (4), 437–455.
- Matinheikki, J., Arto, K., Peltokorpi, A., Rajala, R., 2016. Managing inter-organisational networks for value creation in the front-end of projects. *Int. J. Proj. Manag.* 34 (7), 1226–1241.
- McGinnis, M.D., Ostrom, E., 2014. Social-ecological system framework: initial changes and continuing challenges. *Ecol. Soc.* 19 (2).
- Midler, C., 1995. "Projectification" of the firm: the Renault case. *Scand. J. Manag.* 11 (4), 363–375.
- Nachbagauer, A.G., Schirl-Boeck, I., 2019. Managing the unexpected in megaprojects: riding the waves of resilience. *Int. J. Manag. Proj. Bus.* 12 (3), 694–715.
- Naderpajouh, N., Hastak, M., Gokhale, S., Bayraktar, M.E., Iyer, A., Arif, F., 2015. Counterfeiting risk governance in the capital projects supply chain. *J. Construct. Eng. Manag.* 141 (3), 04014084.
- Naderpajouh, N., Yu, D.J., Aldrich, D.P., Linkov, I., Matinheikki, J., 2018. Engineering meets institutions: an interdisciplinary approach to the management of resilience. *Environ. Syst. Decis.* 38 (3), 306–317.
- Oei, P.R., Dhondt, S., Gaspersz, J.B., Van Vuuren, T., 2017. Innovation resilience behavior and critical incidents: validating the innovation resilience behavior-scale with qualitative data. *Proj. Manag. J.* 48 (5), 49–63.
- Olsson, N.O., 2006. Management of flexibility in projects. *Int. J. Proj. Manag.* 24 (1), 66–74.
- Olsson, L., Jerneck, A., Thoren, H., Persson, J., O'Byrne, D., 2015. Why resilience is unappealing to social science: theoretical and empirical investigations of the scientific use of resilience. *Sci. Adv.* 1 (4), e1400217.
- Orton, J.D., Weick, K.E., 1990. Loosely coupled systems: a reconceptualization. *Acad. Manag. Rev.* 15 (2), 203–223.
- Park, J., Seager, T.P., Rao, P.S.C., Convertino, M., Linkov, I., 2013. Integrating risk and resilience approaches to catastrophe management in engineering systems. *Risk Anal.* 33 (3), 356–367.
- Pich, M.T., Loch, C.H., Meyer, A.D., 2002. On uncertainty, ambiguity, and complexity in project management. *Manag. Sci.* 48 (8), 1008–1023.
- Ponomarev, S., Holcomb, M., 2009. Understanding the concept of supply chain resilience. *Int. J. Logist. Manag.* 20 (1), 124–143. <https://doi.org/10.1108/09574090910954873>.
- Priemus, H., Bosch-Rekeldt, M., Giesen, M., 2013. Dealing with the complexity, uncertainties and risk of mega-projects: redundancy, resilience and adaptivity. In: *International Handbook on Mega-Projects*. Hugo Priemus and Bert van Wee. Resilience Shift, 2020. The whole system impact of the Australian bushfires. <http://www.resilienceshift.org/bushfires-resilience/>.
- Revilla, E., Saenz, M.J., 2017. The impact of risk management on the frequency of supply chain disruptions. *Int. J. Oper. Prod. Manag.* 37 (5), 557–576.
- Richardson, G.E., 2002. The metatheory of resilience and resiliency. *J. Clin. Psychol.* 58 (3), 307–321.
- Roberts, K.H., Bea, R., 2001. Must accidents happen? Lessons from high-reliability organizations. *Acad. Manag. Perspect.* 15 (3), 70–78.
- Sagara, B., 2018. *Resilience Measurement Practical Guidance Note Series 2: Measuring Shocks and Stresses*. Mercy Corps, Portland.
- Scott, W.R., 2013. *Institutions and Organizations: Ideas, Interests, and Identities*. Sage publications, Thousand Oaks, CA, USA.
- Shin, J., Taylor, M.S., Seo, M.G., 2012. Resources for change: the relationships of organizational inducements and psychological resilience to employees' attitudes and behaviors toward organizational change. *Acad. Manag. J.* 55 (3), 727–748.
- Söderlund, J., 2013. Pluralistic and processual understandings of projects and project organizing: towards theories of project temporality. In: *Novel Approaches to Organizational Project Management Research: Translational and Transformational*. Copenhagen Business School Press, Copenhagen, pp. 117–135.
- Soderstrom, S.B., Weber, K., 2020. Organizational structure from interaction: evidence from corporate sustainability efforts. *Adm. Sci. Q.* 65 (1), 226–271.
- Steinfurt, P., 2017. Community and post-disaster program management methodology. *Int. J. Proj. Manag.* 35 (5), 788–801.
- Sutcliffe, K.M., Vogus, T.J., 2003. Organizing for resilience. *Positive organizational scholarship. Found. New Discip.* 94, 110.
- Sydow, J., Lindkvist, L., DeFillippi, R., 2004. Project-based Organisations, Embeddedness and Repositories of Knowledge, pp. 1475–1489.
- Thomé, A.M.T., Scavarda, L.F., Scavarda, A., de Souza Thomé, F.E.S., 2016. Similarities and contrasts of complexity, uncertainty, risks, and resilience in supply chains and temporary multi-organisation projects. *Int. J. Proj. Manag.* 34 (7), 1328–1346.
- Todt, G., Weiss, M., Hoegl, M., 2019. Leading through innovation project setbacks: how authentic leaders keep their innovators resilient. *Proj. Manag. J.* 50 (4), 409–417.
- Tukiainen, S., Granqvist, N., 2016. Temporary organising and institutional change. *Organ. Stud.* 37 (12), 1819–1840.
- Turner, J.R., Müller, R., 2003. On the nature of the project as a temporary organisation. *Int. J. Proj. Manag.* 21 (1), 1–8.
- Turner, M., Scott-Young, C., Holdsworth, S., 2019. Developing the resilient project professional: examining the student experience. *Int. J. Manag. Proj. Bus.* 12 (3), 716–729.
- Ungar, M., 2008. Resilience across cultures. *Br. J. Soc. Work* 38 (2), 218–235.
- Ungar, M., 2018. Systemic resilience: principles and processes for a science of change in contexts of adversity. *Ecol. Soc.* 23 (4).

- Vogus, T.J., Sutcliffe, K.M., 2007. Organizational resilience: towards a theory and research agenda. In: 2007 IEEE International Conference on Systems, Man and Cybernetics. IEEE, pp. 3418–3422.
- Vogus, T.J., Sutcliffe, K.M., 2017. Commentary on mindfulness in action: discovering how US navy SEALs build capacity for mindfulness in high-reliability organizations (HROs). *Acad. Manag. Discov.* 3 (3), 324–326.
- Walker, B., Carpenter, S., Anderies, J., Abel, N., Cumming, G., Janssen, M., et al., 2002. Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Conserv. Ecol.* 6 (1).
- Wang, A., 2019. A framework for assessing project vulnerability to crises. *Int. J. Manag. Proj. Bus.* 12 (4), 1079–1096.
- Weber, K., Waeger, D., 2017. Organizations as polities: an open systems perspective. *Acad. Manag. Ann.* 11 (2), 886–918.
- Weick, K.E., Sutcliffe, K.M., 2011. *Managing the Unexpected: Resilient Performance in an Age of Uncertainty*, vol. 8. John Wiley & Sons.
- Werner, E.E., Bierman, J.M., French, F.E., 1971. *The Children of Kauai: A Longitudinal Study from the Prenatal Period to Age Ten*. University of Hawaii Press.
- West, B.J., Patera, J.L., Carsten, M.K., 2009. Team level positivity: investigating positive psychological capacities and team level outcomes. *J. Organ. Behav.: Int. J. Ind. Occup. Organ. Psychol. Behav.* 30 (2), 249–267.
- Wied, M., Koch-Ørvad, N., Welo, T., Oehmen, J., 2020. Managing exploratory projects: a repertoire of approaches and their shared underpinnings. *Int. J. Proj. Manag.* 38 (2), 75–84.
- Williams, T.A., Gruber, D.A., Sutcliffe, K.M., Shepherd, D.A., Zhao, E.Y., 2017. Organizational response to adversity: fusing crisis management and resilience research streams. *Acad. Manag. Ann.* 11 (2), 733–769.
- Willumsen, P., Oehmen, J., Stingl, V., Gerald, J., 2019. Value creation through project risk management. *Int. J. Proj. Manag.* 37 (5), 731–749.
- Wood, M., Wells, E., Rice, G., Linkov, I., 2019. Quantifying and mapping resilience within large organizations. *Omega* 87, 117–126.
- Zemba, V., Wells, E.M., Wood, M.D., Trump, B.D., Boyle, B., Blue, S., et al., 2019. Defining, measuring, and enhancing resilience for small groups. *Saf. Sci.* 120, 603–616.