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Team resilience as an emergent phenomenon: an empirical study of the relationship between team resilient behaviors and IT project success

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Abstract

Organizations and societies are turning to Information Technology to help safeguard the future, yet most IT projects reportedly fail due to increasing complexity. Resilience research offers promising insights into how teams can influence their capacity to positively adapt to challenges and achieve greater project success. Definitional debate has extensively focused on individual-level abilities and recently shifted towards exploring team-level resilience as an emergent phenomenon. Due to the recency of theoretical development, there is a lack of empirical studies that have validated and assessed team resilience. Alliger et al. (2015) define team resilience as a three-dimensional construct in the framework of team behaviors that occur either before (to mitigate), during (to manage) and/or after (to recover from) an adverse event. This study empirically explores the relationship between these three dimensions as they relate to project success using an online-based survey of 59 IT professionals. The results reveal that all three dimensions of team resilient behaviors positively correlate with IT project success. However, further exploring the variables using stepwise regression, the analysis indicates that the most important team resilient behaviors for our sample are those that occur during (to manage) adversity. The present study is one of few empirical studies on the framework expanding the research on team resilience in IT projects. Implications for studying team resilience as an emergent phenomenon, along with recommendations for future research are discussed.

Keywords: resilience, IT projects, project success, team resilience, emergence

Thank you!

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Team resilience as an emergent phenomenon: an empirical study of the relationship between team resilient behaviors and IT project success

Resilience is described as an essential characteristic for organizations to not only survive, but to succeed and thrive, despite increases in complexity, disruptions, and challenges (Miceli et al., 2021). Due to the contemporary increases in economic instability, leaders and organizations across private and public sectors appear to be turning to technology to safeguard the future (Guarini, 2022). According to market research, the total global Information Technology (IT) spend is growing year-on-year and is forecasted to reach approximately 4.4 trillion USD in 2022, with a projected growth of 5.1% in 2023 (Gartner, 2022). However, up to 84% of IT projects reportedly fail. The Standish Group (2015) researched 50,000 IT projects over a period of 25 years finding that only 16.1 % of projects succeed. However, little research has investigated projects that have failed or identified why certain projects fail (Alami, 2016). Research suggests that IT projects are increasingly impacted by unexpected frequent changes, uncertainty, unknowns and complexity (Alami, 2016). This aligns with reports indicating complexity as one of the primary reasons for project failure along with lack of "gifted" teams (The Standish Group, 2015). For this purpose, resilience offers a promising approach to enable teams to deal with complexity and achieve greater levels of project success. There is an ongoing definitional debate that has led to diverse conceptualizations of what resilience actually is. Within work- and organizational psychology, resilience is described as a positive adaptation to adversity. Whilst scholars tend to agree on this fundamental notion, they differ in whether it is an ability, an outcome, a process and/or an emergent phenomena. Traditionally resilience has focused on the individual- or organizational-level, with little focus on the level that projects usually work on, i.e. the team-level. Alliger et al.'s (2015) seminal article proposed and defined team resilience as a distinct construct, serving a crucial function for teams to maintain performance in the face of adversity. In the short time following this definition, research has developed the construct further, asserting that resilience is a dynamic emergent phenomena (Maynard & Kennedy, 2016). Whilst a number of scholars have aimed to harmonize definitional confusion (Hartwig et al., 2020; Stoverink et al., 2020; Ungar, 2021), presenting several multi-level and mult-dimensional models (Bowers et al., 2017; Gucciardi et al., 2018), there is a lack of empirical studies that validate the construct and explore resilient behaviors at team-level as Alliger et al. (2015) initially set out. We

contribute to this discussion by empirically exploring the relationship between team resilient behaviors and perceived project success within IT projects.

Resilience

Research on resilience has developed across diverse fields with various conceptualizations as a result. The word resilience stems from the Latin word “resiliere”, meaning to “bounce back” (Bowers et al., 2017), typically referring to the idea of bouncing back from adversity. The construct is explored and applied across a range of disciplines, from engineering to social sciences, with little overlap as to what defines the term or a consensus on which theories and models are to be used to explain resilience (Ungar, 2021). Within the field of psychology, the American Psychology Association (APA) defines resilience as “the process and outcome of successfully adapting to difficult or challenging life experiences, especially through mental, emotional, and behavioral flexibility and adjustment to external and internal demands" and refers to research suggesting that resources and skills can be cultivated and practiced to achieve greater resilience (APA, n.d.).

Interest in resilience in the workplace has also grown, promising organizations insight into how to support employees that are increasingly faced with adverse conditions. Within work- and organizational psychology, resilience has been studied extensively at the individual level. However, there is definitional debate surrounding what a resilient individual is. According to Bowers et al. (2017), researchers mostly agree on the fundamental conceptualization of individual resilience as a positive adaptation to adversity. However they differ in whether it should be considered broader than simply adapting but also maintaining stability or perhaps even growing when faced with adversity.

Resilience has also been researched at the organizational level, developing a plethora of concepts serving to help organizations survive in increasingly competitive environments (Zahoransky et al., 2015). Organizational-level resilience stemmed from high-reliability organization literature (Weick & Sutcliffe, 2007). Similar to the ongoing debate on individual resilience, organizational resilience definitions make similar distinctions. Vogus and Sutcliffe (2007) defined resilience as “the maintenance of positive adjustment under challenging conditions such that the organization emerges from those conditions strengthened and more resourceful” (p. 3418) and argued that understanding how organizations adapt to adverse conditions empowers organizations to achieve desirable outcomes.

Whilst the emphasis on individual- and organizational level resilience has highlighted the growing importance of resilience, prior conceptualizations do not acknowledge that today most work is being conducted in teams (Bowers et al., 2017). Commissioned by the National Aeronautics and Space Administration (NASA), Alliger et al. (2015) defines resilience as "the capacity to withstand and recover from challenges, pressure, or stressors. Observable only when challenges occur, resilience operates at both the individual and team level. Individual resilience, however, is not synonymous with team resilience" (p.176). Based on 25 years of experience in the field, they argue for the importance of resilience research on team-level. Given that firstly, teams exist everywhere today, secondly, most of them face challenges that adversely affect performance and well being, thirdly, team resilience is crucial for sustainable team performance and fourthly, a group of resilient individuals does not make up a resilient team. Along with the shift towards teamwork within organizations in the industrial sector, developments within academic research has led to the emerging area of research introducing team resilience as a distinct construct.

Team resilience

Since Alliger et al.'s (2015) paper, a number of publications have contributed to the definitional debate outlining team resilience as either an ability, process, outcome or emergent phenomenon. Scholars have highlighted that definitional confusion and diverse conceptualizations hinders the assessment of research findings (Bowers et al., 2017). With the aim to synthesize various conceptualizations, several researchers have conducted systematic literature reviews (Hartwig et al., 2020; Stoverink et al., 2020). According to Meneghel et al. (2016) team resilience definitions all include a degree of "exposure to significant threat or adversity" (p. 507) and in 22 of 35 articles reviewed by Hartwig et al. (2020) team resilience definitions include some kind of "team-level capacity to respond and bounce back from adversity" (p. 176). Even within a more narrow definition of team resilience, Stoverink et al. (2020) identified 13 different ways to define the concept of team resilience. With all these definitions in mind a greater divide exists within the field of resilience research, the question is whether to view resilience as an ability, an outcome, or perhaps something less predefined and as something more emergent during the processes of a project.

Team resilience as an ability and outcome

Team resilience is often described as some form of ability to positively adapt, cope or recover from a challenge or adverse event. Aligned with the notion of bouncing back from adversity, Sharma and Sharma (2016) define it simply as "the ability of the teams/groups to bounce back and sustain in the facade of adverse conditions" (p. 37). While others highlight the unexpected nature of the adverse event such as Furniss et al. (2011) as an "ability to recover from some unexpected event" (p. 1) or as Lundberg and Rankin (2014) as the "ability to adapt to circumstances outside of plans made in advance" (p. 143). Sutcliffe and Vogus (2003) additionally highlight an element of learning and growth "the ability of individuals, groups, and organizations to absorb the stress that arises from these challenges and to not only recover functioning back to a "normal" level but also learn and grow from the adversity to emerge stronger than before" (p. 98). Whilst these definitions focus on resilience as an ability, they often include an emphasis on the outcome that these abilities achieve. Other scholars have described resilience predominantly by its functional outcome, whereby individual-level abilities serve as inputs that convert into a successful outcome on team level (Datzer & Razinskas, 2022; Gucciardi et al., 2018; Maynard & Kennedy, 2016; Stoverink et al., 2020). However, many of these definitions are reminiscent of the historic focus of resilience research on an individual level, whereby resilience is a static inborn trait or skill that varies in strength between people to achieve different levels of success. Simply applying individual-level based definitions onto other levels such as team- or organizational-level is problematic because it does not consider the dynamic processes of teams who interact interdependently as a group of individuals (Bowers et al., 2017). Furthermore, viewing resilience as an outcome doesn't come without its problems. A qualitative study at Cornell University sought to answer the question of how teams develop resilience and adapt to adversity (Edson, 2012). The results of the study showed that teams which could withstand adversity did so to varying extents. Some teams showed greater results than had they not been affected by adversity, which leads to the question of what leads to different teams being more resilient than others. Edson (2012) argues that it is due to how different teams manage adversity and due to the appearance of different emergent categories, (e.g. organizational culture, nested adaptive cycles, leadership, and innovation). Yet does not address these categories and how they may impact team adaptation in organizations. The study argues that there needs to be a greater focus on the diverse process leading up to resilience rather

than just the outcome of a resilient team. Similarly Gucciardi et al. (2018) define team resilience as "an emergent outcome characterized by the trajectory of a team's functioning, following adversity exposure, as one that is largely unaffected or returns to normal levels after some degree of deterioration in functioning" (p. 735). Both Stoverink et al. (2020) and Gucciardi et al. (2018) go a step further suggesting that it is a future oriented capacity that emerges over time. Scholars increasingly acknowledge that there is a dynamic interaction between the individual and its environment, situation, and context and that adaptation occurs gradually over time as a process (Bowers et al., 2017). As such, resilience defined exclusively as an internal ability or just by its outcome cannot capture parts of the processes important for the resilience of a project team.

Team resilience as a process and emergent phenomena

State of the art team resilience researchers call for a shift towards defining team resilience as an emergent dynamic team process (Bowers et al., 2017; Datzer & Razinskas, 2022; Gucciardi et al., 2018; Hartwig et al., 2020; Maynard & Kennedy, 2016; Stoverink et al., 2020). Resilience as an emergent state was initially proposed by Maynar and Kennedy (2016), inspired by Marks et al. (2001) coining the term "emergent state" as "cognitive, motivational, and affective states of teams, as opposed to the nature of their member interaction" (p. 357). Marks et al. (2001) challenged at the time the existing bodies of works on team processes and the operationalization of team process variables used in testing the relationships between input-process-outcomes. Instead they introduced the idea that emergent states are not simply actions/inputs that lead to specific outcomes, but rather both inputs and processes that are dynamic and intertwined and lead to a product of a team's experiences.

One of the most recent propositions to expand resilience research beyond the individual level is to introduce a theoretical model on team resilience as a second-order emergent state (Bowers et al., 2017). Team resilience is then defined as "a critical team level capacity that facilitates the rebound of teams after an adverse event" (p. 2). This comprehensive model takes a new approach to resilience to better reflect the evolving dynamic nature of teams and performance. First inputs are defined that enable resilience (e.g. explicit communication), then processes associated with resilience are introduced (e.g. adaptability). These first lead to a combination of team-level emergent states (i.e. cohesion, collective efficacy, culture, shared mental models, familiarity, and adaptability), and importantly lead to outcomes of resilience (such as maintenance of performance). This model challenges resilience as a process, describing

it as a kind of result that emerges following a number of inputs on individual-, team- and organizational-level that end up enabling resilience.

The shift away from exploring resilience simply as an ability or trait of individuals and towards a more realistic view that reflects contemporary organizations, in which individuals are increasingly working together in teams, is likely to continue. As well as the shift towards exploring resilience as an emergent phenomenon. For example, Datzer and Razinskas (2022) conducted a three-wave study of 58 teams with 169 individuals to explore how individual resilience influences innovation team performance by enabling team resilience emergence over time. Their findings suggest that the timing of when individuals and teams experience adversity during project phases influences to what extent their resilience capacity is translated to team resilience and team performance. The team members' average resilience capacity is inhibited if faced with intense setbacks early in the project. This rhymes well with Alliger et al.'s (2015) theorizing that resilient teams are observed to differ from "brittle" teams in that they demonstrate three different approaches to dealing with common team challenges over time. Firstly, they take actions to minimize adversity before it occurs, secondly, they manage challenges that are unavoidable when they occur and thirdly, they take actions after they occur to mend and learn from the experience. Their framework outlined a set of forty specific behaviors associated with occurring either before, during or after adversity. They also adapted the behaviors to fit business teams and argued that all teams (regardless of subindustry) can increase resilience by developing the behaviors that enable mitigating, managing and mending.

Inspired by Alliger et. al. (2015), we define team resilience as a collective team's capacity to mitigate, manage and recover from adversity and as a phenomenon that emerges over time. We take the approach that individual resilience is not the equivalent of team resilience and that team resilience can only be observed when the team is faced with a challenge, pressure or stressor i.e. an adversity. Although there is a lack of consensus on the conceptualizations of team resilience and which measures should be used, the recent theoretical models presented have something in common: in some form or other a set of behaviors are observed. We argue that the prevalence of team resilient behaviors may be used as an indicative variable reflecting to what extent team resilience has emerged in practice. In other words, if team resilient behaviors are present, we assume that regardless of the multi-dimensional factors that led to these team resilient behaviors emerging, we can capture that team resilience has occurred. Whilst

researchers have suggested directions for future empirical work, few have been applied empirically. Most current researchers cite Alliger et al. (2015) seminal article to some extent, however Alliger et al.'s (2015) framework and particular set of behaviors have yet to be empirically tested to see if all behaviors are equally important. Additionally, they have not yet been applied specifically to see their impact on performance within IT projects.

Evaluating Team Resilience

In order to evaluate team resilience we need to investigate a team's resilient behaviors in relation to performance-related outcomes. Few studies have attempted to do this with temporal consideration such as Alliger et al.'s (2015) framework of behaviors that occur before, during and after adversity. Fey and Kock (2022) investigated how project teams deal with adversity and conceptualized project success as a performance metric in relation to resilient behaviors. Their project success measurement was derived in part from a study by Hoegl and Gemuenden (2001) who interviewed 575 employees in software teams and identified a subset of questions that largely predicted team performance. While there is an extensive debate of what constitutes project success in the field of project management research, this subset has later been used in many studies as a measurement for project success. Fey and Kock (2022) operationalized these according to three dimensions: project management success, product success and learning success. Their study is the first empirical study exploring resilience on project team-level and as an enabler to project success. They systematically reviewed and identified innovation projects within a large multinational German logistics service provider. 200 questionnaires were completed by 87 different projects (median of 2 participants per project). Their results showed a significant positive relation between innovation resilience behavior (IRB) and project success ($b = .54$, $p < 0.01$), with 16% explained variance in project success. Controlling for project innovation, individual resilience, agile methods and team size, they found that only project innovativeness had a significant relationship with project success ($b = 0.24$, $p = 0.006$). They also operationalized Alliger et al.'s (2015) list of adversity examples and used it to investigate mediating effects. Results indicated that the relationship strengthens and becomes more critical when adversity increases. However, although Fey and Kock's (2022) study focused on team-level resilience, they explored innovation resilience behaviors arguably specific to innovation projects, and not team resilient behaviors. They argued that their behaviors covered resilient behaviors that occur *before* and *during* adversity in partial support of Alliger et al.'s

(2015) framework, and further acknowledged that they did not account for behaviors occurring *after* the adverse event within a project. This will be taken into consideration in our second hypothesis. Considering that the desired outcome of project-based teams is for the project to succeed, and its use in an empirical team-level study, we view it as a reasonable performance metric to be used in evaluating team resilience in IT projects. However, as we are studying team resilient behaviors and not innovation-specific behaviors, we leveraged Alliger et al.'s (2015) team resilient behaviors in this study.

Present study

Aims

The present study focuses on empirically evaluating team resilience as an emergent phenomenon in IT projects. Team Resilience is conceptualized according to Alliger et al.'s (2015) three dimensions (before, during and after) indicating resilience and will be evaluated using Fey and Kock's (2022) concept of Project Success. The main aim is to investigate the research question: is there a relationship between team resilient behaviors and project success in IT projects? If so, does the strength of the relationship vary depending on whether the behaviors are associated to occur before, during or after adversity?

In order to explore the research question we developed a survey that was completed by a sample of IT professionals that recently had been a part of team-based IT projects which had experienced adversity. The variable and measurement development was grounded in existing literature with the item pools taken from Alliger et al.'s (2015) forty team resilient behaviors to measure team resilience. Specifically, mitigating behaviors that are associated with occurring *before* an adverse event was measured as TRB 1, managing behaviors that occur *during* adversity was measured as TRB 2, and mending behaviors that occur *after* an adverse event to recover from it was measured as TRB 3. Item pool covering project management success, product success and learning success was taken from Fey & Kock's (2022) to measure project success.

Hypotheses

According to Alliger et al. (2015), all team resilient behaviors positively relate to project success. Therefore we propose hypothesis 1: team resilience behaviors will positively relate to project success. Specifically, all three dimensions, before (measured as TRB 1), during (TRB 2) and after (TRB 3) will individually positively relate to project success. Furthermore, according to Fey & Kock (2022), team resilience behaviors that occur *before* and *during* adversity are more

important within a standalone project than behaviors that occur *after* adversity. Considering that the present study will focus on team resilience within standalone IT projects, we expect that behaviors that happen after adversity has occurred may have a stronger impact on subsequent future projects than within the standalone projects that are measured here. We therefore propose hypothesis 2: team resilient behaviors before (TRB 1) and during (TRB 2) should more strongly predict project success than after (TRB 3).

Method

Participants

A convenience sample of IT professionals was gathered primarily by posting an invitation to participate on social media to our personal networks on LinkedIn. The invitation included a link to the survey on the Qualtrics online-based platform with a further request to share the survey with their network. We further filtered direct contacts by current title and industry in Information Technology and sent these individuals a direct message with the post and request to share with their network or people that may be interested in participating. Several replied and confirmed that they had either participated or shared the survey either via email, direct message, text message or repost on social media, confirming that our sample also was a snowball sample. The link to the survey was also shared on other social media platforms such as Facebook via personal connections and within IT professional groups as well as via direct message on Messenger and Discord. The survey was also shared with one of Sweden's leading IT infrastructure and service providers which has approximately 7,500 employees across the Nordics and Baltics. We contacted a regional steering committee member who supported this research by distributing the survey within the organizations. Background to this study and link to the survey was emailed to the project management office and all other respective regional steering committee leaders requesting that the survey be shared with their project team employees. The survey was also posted on an online survey-sharing platform, PollPool, which contributed to eight of the questionnaire responses. Due to the assured anonymity and data privacy protection we cannot be certain of the number of respondents that came from each respective source.

In order to participate, respondents must have worked as part of a core IT project team that consisted of more than two team members within the last three years and that faced adversity

which had affected their team or project (see requirements to participate in Table A1 in Appendix A). We received a total of 62 survey responses. Upon examining the data, three responses did not meet the criteria to be able to participate in the study, two respondents did not consent and could not complete the survey and one respondent did not follow the instructions of the task and was therefore excluded. The final sample size contained 59 responses.

Considering that project success is dependent on the perception of the assessor (Davis, 2017; 2016), we aimed to include diverse stakeholders to account for differing experiences. In our sample we gathered information about the participants gender identity, years of work experience and role in the project in order to ensure that the sample was representative of workers in the IT field and to gain insight into the distribution of respondents. As per Table 1 below, our sample included one non-binary person and the rest of the sample contained 24% women and 75% men, which is representative of gender identity distribution in the IT industry. As of 2022, women held 27.6% of IT jobs (AnitaB.Org, n.d.). The average work experience of participants was approximately 12.2 years which means that the majority of participants had a relatively high level of experience specialized in IT projects. Participants held a diverse selection of roles and it is noteworthy that roughly half of the participants had some form of leadership role during the course of the IT project.

Table 1

Distribution of respondents

Category	Number of respondents	
	n	%
Gender		
Female	14	23.73
Male	44	74.58
Other	1	1.69
Role		
Developer / Designer	4	7.02
Product Owner	2	3.51
Consultant/Functional lead/Technical lead/Architect	20	35.09
Project Manager	15	26.32
Manager/Team Lead	9	15.79
Director/Executive	5	8.77
Other	4	7.02
Work Experience		
1-4 years	8	13.56
5-9 years	17	28.81
10-19 years	23	38.98
20 years and more	11	18.64

Note. N = 59.

Materials

Variables and item scales that have been proposed by researchers specifically within the field have been used in the development of the questionnaire. Team resilience was measured as a construct with three dimensions following Alliger et al.'s (2015) framework: Behaviors before an adverse event (also referred to as mitigating behaviors, measured as variable TRB 1), behaviors during (managing behaviors, TRB 2), and behaviors after (mending behaviors, TRB 3). The associated forty Team Resilient Behaviors (TRB) were operationalized into questions (see all items in Table B1 in Appendix B). Project success was measured in three dimensions of Project Management; Quality & Satisfaction and Learning. Fey and Kock's nine items were used without revision as they are grounded in the existing literature of project success and encompassed IT project factors proposed by (Sulistiyani & Yulianing Tyas, 2022). All items were responded to on a 7-point Likert scale. The wording of items were adapted to past tense where applicable. The questionnaire was created using the Qualtrics online-based platform.

Scale reliability

Given that the TRB scale used was exploratory and had not been empirically tested, we ran reliability tests in order to evaluate the reliability of the internal scale used for each respective variable in the data collection. The four reliability analyses (results shown in Table B1 in Appendix B), were conducted on variable level to see how strongly the items within each variable were associated with each other and contributed to the model. Variable TRB 1 contained the 16 respective items and generated a Cronbach's Alpha (α) value of .922; variable TRB 2 contained 13 items with a Cronbach's Alpha (α) value of .926 , and variable TRB 3 contained 11 items with a Cronbach's Alpha (α) value of .943. The full scale of Project Success was also tested including its 9 items generating a Cronbach's Alpha (α) value of .855. If we had omitted the items L_1, L_2, or L_3, the project success scale would increase minimally by .009. Removal of any other items would not improve the Cronbach's Alpha for any of the respective scales. Cronbach's alpha for scale and individual items can be found in Table B1 in Appendix B. The measurement scales used for all variables were considered internally reliable as they all exceeded 0.8 (Navarro & Foxcroft, 2022).

Procedure

The survey was conducted in English considering the international pool of participants. Prior to accessing the survey, participants were directed to a welcome page outlining the following: purpose of present study, requirements to participate (see Appendix A), details of how data would only be used for stated purpose, information regarding anonymity and confidentiality of responses, their right to withdraw at any time during the survey, along with contact details in the event of any questions or concerns (see wordings in Appendix C). To ensure informed consent was adequately registered and that data would only be collected from voluntary participants that met the requirements to participate, the survey was configured with a gate entry question whereby only those that confirmed consent were allowed to gain access to the survey. On the following introduction page of the survey, participants were asked to think back to a project within the last three years where their team faced adversities that affected their team and project (see Table C1 in Appendix C). A list of common challenges and adversities were given as examples and were reproduced from Alliger et al. (2015). In order to reduce social desirability bias (Aronson et al., 1998; Podsakoff et al., 2012), we included prompts from Fey and Kock (2022, p. 944): "we value your opinion and support", "we would like to know what you think"

and “there are no right or wrong answers”. The TRB items were divided into three main sections viewed on separate pages in the survey according to time of behavior (before, during and after). Within these sections the items were further divided into subsections (in accordance with Alliger et al.’s (2015) categorization of behaviors). The Before section (TRB 1) had four subsections consisting of 16 questions taken from mitigating behaviors that occur before an adverse event (see Table B1 in Appendix B). During (TRB 2) had four subsections including 13 questions taken from managing behaviors that occur during an adverse event. After (TRB 3) had four subsections including 11 questions taken from mending behaviors that occur after an adverse event. The Project Success items were presented on a single page following the team resilient behaviors sections and divided into three subsections with three respective questions in each subsection. Prior to data collection two subject matter experts with 25+ years of respective experience in the IT industry, project work, and non-native English speakers reviewed the survey to ensure readability and relevance to IT-projects. Minor adjustments such as clarification of instructions were made based on the feedback and included in the final revision before publication. Following submission of the survey, participants were directed to a thank you page and provided with our contact details again in the event of any questions or concerns that may have arisen during the course of the survey.

Data preparation

The scale items were all computed into mean scores for each scale, resulting in four variables (TRB 1, TRB 2, TRB 3, and Project Success). The variables were then used to conduct a correlation analysis and a linear regression. The correlation analysis was conducted in order to check for covariance and potential collinearity issues between the different TRB variables (TRB 1, TRB 2, TRB 3) and to see if they correlated with Project Success. A regression analysis was conducted to evaluate the relationship between the dependent variable Project Success and the independent variables TRB 1, TRB 2 and TRB 3. Jamovi statistical software (Navarro & Foxcroft, 2022) was used for data preparation and analysis.

Ethical considerations

Consideration of participants’ privacy, welfare and integrity is an overarching ethical principle (Svartdal, 2001). In compliance with the Swedish Act (2003:460) on ethical review of research involving humans, the present study did not include procedures (such as study of human biological material) that qualified for review by the Ethics Review Board. In addition to

methodological measures taken to ensure meaningful informed consent and the right to withdraw (outlined in Procedure), further were taken to minimize negative consequences of participation.

Internet-based research introduces challenges to maintain anonymity and confidentiality in terms of data storage and security (Buchanan & Hvizdak, 2009). To minimize this inherent risk, we selected the established Qualtrics platform used for academic research because it is one of the few providers that has the option to not record respondents' IP address, location data and contact information (see applied settings in Table D1 in Appendix D). Furthermore, our study did not handle sensitive personal data that could be used to identify specific individuals in compliance with the Personal Data Act in Sweden (Personuppgiftslagen (1998:204)) and the EU General Data Protection Regulation (GDPR) (Swedish Authority for Privacy Protection, n.d.).

Whilst the survey consisted of statements that posed minimal risk to physical or psychological injury, there was a risk of negative feelings being aroused in connection with taking the survey as it involved recalling adverse situations that are often stressful in nature. However, this was a "minimal risk" considering that the level of discomfort that risked to arise was likely no greater than what participants would experience in their daily work lives (Shaughnessy et al., 2014).

Results

To test our first hypothesis the zero order correlations were computed and indicate that there is a moderate to strong positive correlation between the predictor variables and a weak to moderate positive correlation between the variables predicting project success. The descriptive statistics and correlations for all variables TRB 1, TRB 2, TRB 3 and Project Success are shown in Table 2.

Table 2

Descriptive Statistics and Correlations for Study Variables

Variable	M	SD	Project Success	TRB 1	TRB 2	TRB 3
Project Success	4.99	1.01	—			
TRB 1	3.89	1.01	.324*	—		
TRB 2	4.66	1.12	.469***	.711***	—	—
TRB 3	4.03	1.31	.470***	.686***	.758***	—

N =59. *$p < .05$, **$p < .01$, ***$p < .001$.

We tested our second hypothesis by conducting a stepwise regression analysis, where each independent variable was added to the model sequentially in order to isolate the effects of each respective variable in the temporal order they would arise during the given project. The first model included the predictor TRB 1 and dependent variable Project Success. The second model introduced the additional variable TRB 2, meaning it contained the predictors TRB 1 and TRB 2. Finally, the third model added the variable TRB 3 and thus contained all three predictors TRB 1, TRB 2 and TRB 3. The first model shows that TRB 1 alone is a significant model $F(1, 57) = 6.71$, $R^2 = .105$, $p = .012$, with the p-value below the proposed alpha level of .05 conventionally used (standardized coefficients for each model can be found in Table 3). The second model $F(2, 56)$, 7.92, $R^2 = .221$, $p < .001$ and the third model was also significant $F(3, 55)$, 6.33, $R^2 = .257$, $p < .001$. All models were tested for normality, collinearity and outliers (using Cook's distance), finding no impact of collinearity among the variables (VIF < 5; James et al., 2021), normality was non-significant for all variables, and Cook's Distance was not greater than 1 (Navarro & Foxcroft, 2022).

Table 3

Regression results - coefficients with Project Success for each model

Model	1	2	3	4
TRB 1	.324*	-.0192	-.110	
	[.012]	[.909]	[.530]	
TRB 2		.4832**	.315	.469***
		[.006]	[.111]	[< .001]
TRB 3			.307	
			[.108]	

Total N = 59. Standardized coefficients with p-values in brackets. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Comparing the regression models revealed that the change in R^2 value changed significantly between Model 1 and Model 2 ($\Delta R^2 = .12$, $p = .006$) while there was no significant change between Model 2 and Model 3 ($\Delta R^2 = .04$, $p = .108$). Considering that Model 2 was significant and the effect of introducing TRB 2 nearly doubled the explained variance, and since there was no benefit including TRB 3 in Model 3, we selected model 2 as the regression model with best fit.

Model 2 shows a significant moderate to strong positive relationship between TRB 2 and project success ($b = .483$, $p = .006$). However, following the introduction of TRB 2, the model coefficient dropped and showed no significant relationship between TRB 1 and Project Success ($b = -.019$, $p = .909$). Since TRB 1 does not significantly contribute to Model 2, a fourth model was analyzed that omitted TRB 1 and included only TRB 2 as a predictor in the regression model. The regression results using only TRB 2 as a predictor (Model 4) showed a moderate to strong positive relationship between TRB 2 and Project Success ($b = .469$, $p < .001$). Meaning the effect of increasing one scale point of TRB 2 produces .469 scale points in project success. The model is significant $F(1, 57)$, 16.1, $R^2 = .220$, $p = < .001$, where TRB 2 explains 22% of the variance in project success. Comparing with Model 2 generates a change in R^2 of .001, which motivates that the model containing only TRB 2 as a predictor is a better model.

Discussion

The aim of the present study was to empirically investigate team resilience as an emergent phenomenon and the impact of team resilient behavior on project success within IT projects. A survey item pool of Team Resilient Behaviors (TRB) was generated according to Alliger et al.'s (2015) proposed framework (Before, During and After), in combination with items measuring Project Success from Fey & Kock (2022). The first hypothesis was that team resilience behaviors will positively relate to project success. An empirical analysis of IT professionals' perception of resilient behaviors observed in IT projects indicated support for the first hypothesis, showing a positive relationship between all three dimensions (Before, During, After) with project success. These empirical findings support Alliger et al. (2015) proposed behaviors that resilient teams engage in to sustain and perhaps strengthen performance. The second hypothesis was that team resilient behaviors before (TRB 1) and during (TRB 2) should more strongly predict project success than after (TRB 3), for which we found partial support. While all three variables correlated positively with project success, exploring the strength of association with a stepwise regression, the best model for our sample was one with only TRB 2 as a predictor for project success. As such, the data partially supports that the strength in the relationship between team resilient behaviors and project success may vary depending on whether the behaviors occur before, during or after adversity

Alliger et al. (2015) and Fey & Kock (2022) provide many concrete behaviors to measure team resilience, yet may miss contextual factors particularly important to IT projects. Alliger et al. (2015) argued that the generic behaviors were adapted to fit any business team, however they are yet to be empirically validated as a metric measuring team resilience or whether they actually can be generalized to all teams. In contrast to Alliger et al.'s (2015) assertion, we view the generalizability of the present study as limited to IT projects. Although we tested the internal reliability, there are a number of contextual factors specific to IT projects that could influence both team resilient behaviors and project success. A few examples include but are not limited to: the level of relevant expertise within the team in relation to the objectives of the project, IT project methodology, experience with IT-specific adversity such as technology barriers and so forth. Fey and Kock (2022) attempted to control for factors considered important to innovation projects finding that project innovativeness had an influence, exemplifying that such factors can play a role. Although our use of Alliger et al.'s (2015) behaviors still generated a similar result to

Fey and Kock (2022), indicating a degree of validity in a relationship between team resilience and project success, it does not confirm them as optimal measurements for IT projects. The behaviors may fail to take into account a number of contextual factors and it is further unclear if some of Alliger et al.'s (2015) behaviors could be more important than others.

A major aspect of the validity of the measures is if the method used here is capable of capturing an emergent phenomena after the fact by asking people to remember a previous project. If the phenomena is assumed to be emergent, perhaps recording the event after the fact obscures the effect of temporal factors. The strongest model explaining project success includes only behaviors associated with adaptations *during* the time at which an adverse event is occurring (measured as TRB 2). Similarly to Fey and Kock (2022), behaviors *before* an adverse event (measured as TRB 1) showed a significant correlation with project success. However in contrast to their assertion, behaviors measured as taken place *after* adverse events (measured as TRB 3) showed a significant positive correlation to project success. Arriving at the regression analysis however, behaviors *during* adversity uniquely explained 22.5%, at the expense of both behaviors *before* and *after*. These results agree with the assertion from Fey and Kock (2022) that behaviors occurring after adversity may not be a useful predictor of project success, but disagree in that both behaviors before and after adversity are important predictors. However, conceptualization of team resilience as an *emergent* phenomenon implies that behaviors before and after nonetheless are important. We asked participants to remind themselves of a project where there had been adverse events during its course and most chose one that succeeded. This may have been caused by memory bias or social desirability effects and likely resulted in the observed high average on each of the three predictor variables. Although each predictor was normally distributed, we cannot separate out the effect that perhaps a low result on behaviors before adversity would have on behaviors during adversity, beyond that they covary. Thus, the method used in the present study (and indeed in Fey & Kock, 2022) does not allow for conclusions about temporal causality. Three ways of addressing this issue is, firstly, to follow ongoing projects and measure behaviors, adversity, and project success in a more continuous fashion *as they happen*. While people surely can account for previous behaviors and outcomes, it becomes a question of validity if defining something as emergent requires methodologies that measure the process during its unfolding. Secondly and perhaps more importantly, changes in methodology could allow for insights into temporal causality, for example by comparing

teams/projects that differed initially on behaviors before adversity and then observe if this had an effect on subsequent behaviors (during and after). Lastly, this also applies to attempting to measure the effect of behaviors after adversity, where the way it is measured here can make it seem like its impact begins and ends within the project. In fact, the impact of team resilience does not stop immediately once actions have been taken to manage a particular adverse event within a project. Rather, behaviors after adversity may be able to measure, perhaps even predict, behaviors before adversity in the next project. Taken together, while our results indicate that behaviors expressed during adversity are the strongest predictor alone, due to the aforementioned issues there is a need for more research, using various methods, to test for temporal effects of behaviors before and after adversity on project success.

A greater focus in retrospect on behaviors that happen during the time that an adverse event is occuring picks up on a wider issue within organizations' and their ability to learn from different projects. Both the research literature and organizations share a tendency to focus on projects that succeeded compared to those that failed (Alami, 2016). If the emphasis is placed on the actions taken in order to achieve a greater perceived level of success it risks both inflating the effects of behaviors during adversity and filtering out behaviors that were taken before to mitigate adversity. Similarly, individuals may not be fully aware of to what extent behaviors related to learning (measured by TRB 3) may have taken place until further time has passed or until they encounter a similar adverse event to compare it to. This issue could be addressed by following teams across multiple projects in longitudinal studies. This would likely more accurately represent behaviors observed post-adversity and the overall effects of team resilience overtime. Participants also held diverse roles and high levels of work experience which could further skew results considering that their perceptions of both observed behaviors and project success may differ from the average baseline. On one hand high levels of experience within the sample may offer greater validity given that respondents have a broader spectrum of project experience to compare to when evaluating, on the other hand it may miss to capture the effects of behaviors that they may take for granted. While the inclusion of diverse roles offers a greater inclusive sample compared to research that mostly tends to study from the leader’s perspective, it does not include multiple perceptions of team members within the same project. While adversity often affects a whole project team, they vary as to what extent they affect team members and whose responsibility it is to address it. Thus not all team members will be aware of or in a

position to observe all resilient behaviors demonstrated. These potential error effects could be minimized in two ways, firstly, as previously mentioned observing teams objectively based on predetermined behaviors from the start to finish of a project (where the outcome of the project is unknown from the beginning). Secondly, by including collective teams to aggregate the levels of team resilient behaviors and project success on team level rather than only the perception of a single team member which may be inherently biased from the perspective of the individual. In order to develop this line of research it needs be done not only with multi-dimensional aspects of team resilience, but it is also important to consider the multi-level conceptualizations of team resilience.

In fact, the most recent research literature on team resilience as an emergent state conceptualizes team resilience as both a multi-dimensional and multi-level construct. While the lack of empirical study on team-level motivated the focus of associated team-level behaviors, we acknowledge the limitations of excluding individual and organizational level factors. We cannot rule out the possibility of either having an effect on the results as we did not isolate them as control variables. Researchers including Alliger et al. (2015) asserts team resilience is a separate construct from individual resilience and that a team of resilient individuals does not make up a resilient team. This is however a working assumption with limited empirical support. Fey and Kock (2022) controlled for individual resilience and found individual and team resilience to be distinct yet related (a moderate positive correlation with performance). However, their sample, like ours, did not include all team members meaning that the level of individual resilience of all team members within each team was unknown. Thus, even if we had controlled for individual resilience using a similar model, it is questionable whether we would capture the dynamic relationship between individual- and team-level resilience. Although our sample included participants from various organizations increasing the generalizability, it also presents a problem as we did not isolate the organizational-level characteristics. This further highlights the complexity with studying team resilience as an emergent phenomena. Our discussion has presented a number of suggested methods which could be further broadened to incorporate both the multi-dimensional and multi-level relationships to understand how they potentially covary to produce resilience.

Conclusion

By extending Alliger et al.'s (2015) seminal article where it is proposed that team resilience is crucial to almost any business team in order to bounce back from inevitable challenges and sustain performance, the present study empirically explores team resilience as an emergent phenomenon and its relevance in the IT industry. Findings suggest that team resilient behaviors positively relate to project success. Whilst the sample indicated that behaviors associated with occurring *during* adversity are more important, it does not support rejecting behaviors occurring *before* or *after* considering the basis of emergent phenomenon. The results here rather indicate that capturing emergent team resilience is complex and perhaps require particular methods to do so. Methodological changes such as measuring ongoing projects continuously as the process occurs and comparing teams/projects that initially differ in their behaviors *before* adversity, may allow for greater understanding of temporal effects. Furthermore, longitudinal studies that measure the effects of post-adversity behaviors may allow for insights into the impact overtime, perhaps even as a predictor to projects that follow. Future research is needed to broaden our understanding of emergent team resilience that considers potential multi-dimensional and multi-level relationships that may be a basis for the construct.

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Appendix A

Requirements to participate

Table A1

Requirements to participate

Requirements to participate	Wordings	Examples provided
Participant worked on IT project team	"You have worked as part of a team on an IT project." "Core project team consisted of more than 2 team members."	
Project completed recently	"Project was completed within the last 3 years."	
Team experienced adversity	"Your project team faced adversity that affected your team or project. Examples of adversity include but are not limited to the following challenges, pressures or stressful events: [Examples in column to the right]	"Difficult assignments Time pressure Fluctuating requirements during the project Changes or absence of team members Insufficient resources Conflicts with people inside and/or outside the team Changes in Leadership Barriers against innovation High consequence work "Crisis" events Multiple simultaneous smaller challenges"

Note. The requirements to participate were listed as per the wordings on the first page of the questionnaire. The examples of adversity were taken from Alliger et al.'s (2015) common challenges that resilient teams face. Participants were requested to confirm meeting the requirements as part of the consent to participate.

Appendix B

Items/Questions

Table B1

Result of Reliability Analysis (Cronbach's Alpha) for Study Variables

Item code	Items	Loadings	Cronbach's Alpha
TRB_1	**Minimize (Before)**		.922
	Anticipate challenges and plan contingencies		
ACPC_1	Pinpointed what had most stressed our team in the past and identified ways to avoid or minimize their occurrence in the future	.915	
ACPC_2	Understood any near term pending challenges that were likely to ''stress'' our team (e.g., changes in work demands)	.917	
ACPC_3	Identified the types of situations with which our team would have difficulty coping, and how best to prepare for these	.918	
ACPC_4	Conducted ''what-if'' discussions (or drills) to clarify how to handle likely and/or critical challenges the team might face	.916	
ACPC_5	Anticipated likely potential risks to cohesion or performance	.917	
ACPC_6	Identified ways our team could avoid being surprised (caught ''off balance'') by a sudden demand or crisis	.918	
	Understood current readiness		
UCR_1	Monitored our own personal readiness to meet upcoming challenges, anticipated or unanticipated	.917	
UCR_2	Communicated with one another so we all knew each other's current ''capacity level''	.919	
UCR_3	Maintained awareness of our team's overall readiness and vulnerabilities (e.g., resource availability, expertise levels)	.920	
	Identified early warning signs		
IEWS_1	Voiced early alerts of potential problems	.916	

	including ‘‘heads-ups’’ and ‘‘could be’s’’		
IEWS_2	Ensured that warnings about potential problems were not dismissed prematurely	.917	
IEWS_3	Prepared team members to recognize the signs of a potential challenge or emerging problem	.918	
	Prepared to handle stressors		
PTHS_1	Identified and documented back-up responsibilities (who would fill in or help out if X happens) that we could enact when needed	.915	
PTHS_2	Documented standard operating procedures (SOPs) so that these could be invoked as needed	.921	
PTHS_3	Addressed known vulnerabilities (e.g., insufficient sleep/rest, distrust among team members, lack of resources/expertise)	.915	
PTHS_4	Established a process for assessing and communicating the nature and potential impact of a developing situation/challenge	.917	
TRB_2	**Manage (During)**		.926
	Assessed challenges quickly and accurately		
ACQA_1	Quickly and honestly assessed, communicated about and responded to challenges when they arose	.918	
ACQA_2	Huddled as a team to diagnose unexpected challenges/stressors and consciously generated alternative approaches/solutions	.919	
ACQA_3	Ensured all team members knew when the team was moving from ‘‘normal’’ to ‘‘emergency’’ mode	.923	
ACQA_4	Quickly identified ‘‘what is not working’’ in managing a challenging situation and made real-time adjustments	.918	
	Addressed ‘‘chronic’’ stressors		
ACS_1	Identified any ‘‘chronic’’ or long-standing stressors that could not be avoided, and established plans for managing them as best as possible	.925	
ACS_2	Recognized when a team member needed help (e.g., overloaded, addressing another need) and offered backup/support	.917	

ACS_3	Ensured all team members were comfortable speaking up when they needed help	.921	
ACS_4	Promptly asked for and sought assistance	.919	
	Maintained processes under stress		
MPUS_1	Provided timely ongoing status updates to team members as a challenging situation developed	.918	
MPUS_2	Reduced stressors and addressed threats by using standard operating procedures (SOPs) and known solutions when appropriate	.925	
MPUS_3	Continued constructive routines in the face of stress (e.g., regular meetings or communications)	.922	
	Sought guidance		
SG_1	Deferred to team members with the most relevant expertise and experience	.922	
SG_2	Reached outside of the team when needed to obtain assistance from others who possess valuable knowledge and experience	.921	
TRB_3	**Mend (After)**		.943
	Regained situation awareness		
RSA_1	Clarified whether and how our situation (e.g., mission, resources, viability) had changed	.939	
RSA_2	Did a quick post-event pulse check to identify where the team may need to ‘‘recover’	.937	
RSA_3	Monitored individual team members for signs of post-event stress	.934	
	Conducted team debrief		
CTB_1	Conducted a team debrief to identify lessons learned and how we wanted to work together going forward	.940	
	Addressed concerns or risk points		
ACRP_1	Confirmed follow-up actions and responsibilities to address resource or health concerns and ensure on-going viability	.936	
ACRP_2	Helped individual team members who were adversely affected by the challenging event or stressor	.934	
ACRP_3	Worked through friction points that may have	.936	

	emerged between team members as a result of the stressful experience		
ACRP_4	Re-established relationships with those outside the team that might have been strained by the challenge	.936	
ACRP_5	Made adjustments to processes, procedures, resources, etc. so we felt prepared to handle future challenges	.934	
	Expressed appreciation		
EA_1	Communicated appreciation for helpful actions taken by team members during a stressful event	.942	
EA_2	Thanked people outside the team for their help and support	.941	
PS	**Project Success**		.855
	Project management		
PM_1	Project was on time	.826	
PM_2	Project was in scope	.827	
PM_3	Project was within budget	.837	
	Quality & Satisfaction		
QA_1	The stakeholders were satisfied with the results of the project	.831	
QA_2	The result of this project was of high quality	.831	
QA_3	Based on the results the project can be regarded as successful	825	
	Learning		
L_1	During the project, we gained a lot of valuable insights	.858	
L_2	During this project, we gained a lot of valuable knowledge for further projects	.860	
L_3	This project generated results that were very helpful for our future work	.856	

Note. Reliability analysis conducted on variable level. We loaded variable-specific items within each respective variable. All items were used as questions in the survey (for headings see Table C1 in Appendix C).

Appendix C

Survey Questionnaire

Table C1

Survey questionnaire item wordings not listed in Table B1 in Appendix B.

Section	Wordings
Welcome page	"Hello and thank you for your time and interest in our 15-minute survey on team resilience in IT projects! Resilience is a hot topic these days. Traditionally research has focused on resilience of individuals and organizations. Yet surprisingly very little research has explored resilience of teams. Even less on project teams within the IT industry. This survey is part of a thesis study at Lund University, Sweden, which aims to help close this gap by exploring team resilience in IT projects. Requirements to participate: [as per wordings in Table A1, Appendix A]. Responses: Your response is anonymous and confidential and will only be used for the purpose of this study. Respondents' IP Address, location data, and contact info are not recorded and questions cannot be used to identify you. You may withdraw your participation at any time by not submitting the survey. We are thankful for your opinion and support. For any questions or concerns please contact either: Johannes Gramstad [email address] or Michelle Schelin mi4527sc-s@student.lu.se [email address] Please confirm your consent to participate in this survey. By confirming you also confirm that you meet the above requirements. I consent [selection of this radio button granted survey access] I do not consent [selection of this radio button denied survey access]"
Introduction	"Think back to a project where your team faced adversities that affected your team and project. We would like to know what you think about actions taken by your core project team 1) before 2) during and 3) after your team faced challenges/pressures/stressful events. Please rate on a scale ranging from "not at all" to "to a very great extent"." "What was your role/position during the project?"
Before	"**Before the challenge(s) started.** Think back to the project. To what extent did the **project team** take the following actions to ***minimize*** challenges or stressful events before they arrived or at their earliest onset?"
During	"**During the challenge(s)** Think back to the project. To what extent did the **project team** take the following actions to ***manage*** a challenge or stressful event as it was occuring?"
After	"**After the challenge(s)** Think back to the project. To what extent did the **project team** take the following actions to recover ***after*** a challenge or stressful event?"
Outcome	"**Outcome** Think about the **outcome** of your project and state to what extent you agree with the following statements:"

Demographic	“Last but not least, 2 questions about you:”
	“Your gender identity?”
	“How many years of work experience with IT projects do you have?”

Note. Wordings of sections Before, During, After and Outcome were provided as subheadings at the beginning of each survey section and followed by questions according to the items listed in Table B1 Appendix B. Firstly, section *Before* included all “TRB_1” items. Secondly, section *During* contained all “TRB_2” items. Thirdly, section *After* contained all “TRB_3” items. Fourthly, section *Outcome* contained all Project Success “PS” items. Finally, section demographic with associated questions were at the end of the survey.

Appendix D

Survey Settings

Table D1

Survey settings in Qualtrics online platform

Category	Setting	Setting set to
Anonymize responses	Don't record respondents' IP Address, location data, and contact info	On
Survey Access	Indicate if your survey can be taken by anyone or only people with personal invites.	Available to anyone
Survey availability	You can leave your survey open for responses indefinitely or set a specific start and expiration time.	Leave survey open to collect responses
Incomplete survey responses	Select what to do with incomplete responses and indicate when they should be considered incomplete.	Delete
Incomplete survey responses	How much time should pass before they're considered incomplete?	2 weeks

Note. These settings were set in the Qualtrics online platform prior to publication of the survey to ensure compliance with ethical considerations. Recorded responses contained data only from completed responses. Incomplete responses were deleted automatically within 2 weeks of the participants' last activity.