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## Unexpected Events in IT Projects: A Conceptual Review and Research Agenda

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## Accepted Manuscript

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### Abstract:

When unexpected events occur, IT project teams need to react appropriately in order to limit the potentially negative, and sometimes disastrous consequences of such events. Yet, while past research has identified unexpected events as being an important aspect to consider when managing projects, the existing literature does not provide a clear conceptualization of this concept which limits the development of new theories and thus the ability to guide practitioners. Based on a literature review and to advance our understanding of unexpected events in IT projects and their effective management, and facilitate future theoretical developments on IT project management, the present paper develops a conceptualization that clearly distinguishes this concept from other closely related ones, as well as proposing a research framework that links it to IT project team responses and their consequences. A detailed research agenda, integrating current advances in different fields, is developed to highlight future research avenues.

**Keywords:** Unexpected Events, IT Project Management, IT Project Dynamics, Conceptual Review, Research Agenda.

# 1 Introduction

Organizations that undertake information technology (IT) projects, define as “temporary endeavors undertaken to develop and/or implement information technologies in organizations” (adapted from PMI, 2021), face major challenges, and researchers have invested considerable efforts in order to improve the success rates of IT projects. While considerable advances have been made in this regard, IT projects continue to be challenging, with over 70% being either cancelled, or delivered very late or significantly over budget (Standish Group, 2020). A key reason for these difficulties is the highly complex nature of IT projects that generates considerable uncertainty leading to numerous risks. While risks are inherent in every project (Huff & Prybutok, 2008), identifying and controlling them has been considered for decades, by both scholars and practitioners, fundamental to improve IT project performance (Barki et al., 2001; Oehmen et al., 2014; Pimchangthong & Boonjing, 2017; Raz et al., 2002). However, some researchers advocating for more practice-oriented research on risk management (e.g. Fabricius & Büttgen, 2015; Kutsch et al., 2014; Kutsch et al., 2013; Taylor, 2006), have highlighted two main problems associated to these rational and prescriptive processes: (1) in reality, project managers behaviors often tend to “*deny, avoid, ignore and delay*” when dealing with risks (Kutsch & Hall, 2010; Moeini & Rivard, 2019) and, (2) project uncertainties make it difficult to anticipate all project risks (Gerald et al., 2010; Söderholm, 2008). On the latter, uncertainty can be epistemic, i.e., related to the ignorance of knowable information but whose knowledge exceeds a project team’s capacities (Packard & Clark, 2020). Uncertainty can even be aleatory, i.e. immitigable, when related, for instance, to human choice (Packard & Clark, 2020). All of the above indicates that being able to address appropriately unexpected events, i.e. realized events that were not anticipated, is critical to improve IT project success.

It is interesting to note how the project management literature on unexpected events is very scarce compared to the literature on risk management (e.g. Gerald et al., 2010; Hällgren & Söderholm, 2010; Kutsch et al., 2021; Piperca & Floricel, 2012; Wied et al., 2021). Agile approaches have surely emerged as a result of the need to embrace change and, as opposed to traditional approaches, certain types of events may not be considered “unexpected”. However, other types of events, such as a solution provider going bankrupt, have the potential to disrupt the team and require team members to react outside of their established framework. On the other hand, a research trend emerged recently on complexity management and on project resilience in general (see for instance Naderpajouh et al. (2020)). This trend mainly focuses on “systems” (in this case, projects, and how to make them more robust, see for example Floricel and Miller (2001)), while very few researchers focus on the events that occur and the subsequent team reactions. Yet, unexpected events often tend to be key phenomena and potential tipping points, with project team members often caught off guard and in need to react appropriately in order to mitigate their potential negative consequences (Hällgren & Wilson, 2007; Kutsch et al., 2021). As such, identifying and implementing an appropriate strategy for responding to an unexpected event often becomes an important aspect of IT project managers’ reality. Researchers examined the processes used by project teams to respond to unexpected events and observed major difficulties in this area in which no methodology, training and best practices exist to guide project teams when unexpected events occur (Pavlak, 2004; Söderholm, 2008). When such events occur, project team members move from a formal management mode, following project management procedures and methodologies, to informal strategies (Hällgren & Maaninen-Olsson, 2009) often based on intuition (Hällgren & Wilson, 2007).

The present study’s analysis of past research identified several limitations, that makes it particularly difficult to clearly answer the questions “What is an unexpected event in an IT project?” and “How do IT project teams deal with unexpected events?” The first limit is the lack of (1) a clear conceptualization of unexpected events as a core concept; (2) clear definitions of the various terms that are used; and (3) clear distinctions between unexpected events and their antecedents and consequences. The second limitation is a certain fragmentation that exists in current research which makes it difficult to develop theories that clearly link unexpected events to IT project team responses and their consequences, or to provide clear recommendations to practitioners. To start addressing these limitations, the goal of the present study is twofold. First, we intend to develop a clear conceptualization of unexpected events in IT projects that also clarifies the links between these events, the potential team responses, and their consequences. Our second objective is to integrate current research results, in the light of the proposed framework, and to identify promising research opportunities.

To achieve these goals, a rigorous and comprehensive literature review, focused on the concept of unexpected events, was undertaken in order to clarify and integrate existing results by examining the

various terms that have been used as synonyms of unexpected events. The methodology used and the main findings are presented in the following sections. Identifying and underscoring their key differences, the paper then proposes a conceptual definition of unexpected events and develops a framework that explains the linkages between such events, IT project team responses, and their potential consequences. The article continues with a discussion on the links between the concept of unexpected events and other related concepts. A framework that explains the links between these concepts is presented, and a research agenda, integrating current advances in different fields, is suggested to highlight several future research avenues.

## 2 Unexpected Events in IT Projects: Conceptualization Issues

Conceptualization issues in past research have motivated the present study. While researchers have examined the processes used by IT project teams and the challenges they face when they try to respond to unexpected events (Hällgren, 2007; Hällgren & Wilson, 2007; Kutsch et al., 2021; Morkan et al., 2017; Tukiainen et al., 2010; Wied et al., 2021), they have also often focused on phenomena that may not necessarily be the same, such as “unforeseen events” (Sommer & Loch, 2009), “unexpected disruptions” (Herroelen & Leus, 2004; Kao et al., 2006; Leonardi et al., 2012; Pavlak, 2004), “surprises” (Florice & Miller, 2001; Pina e Cunha et al., 2006), “deviations” (Hällgren, 2007; Munthe et al., 2014), “unexpected changes” (Latta & Myers, 2005), and “unexpected crisis” (Choi et al., 2010). A careful examination of how past research has defined these concepts suggests that, while some of them may be similar, many seem to refer to different concepts. For example, while “deviations” and “surprises” pertain to outcomes of events, they also are different concepts. Indeed, when an unexpected event occurs in a project, it may or may not lead to “deviations” from project plans, and it can lead to a varying level of “surprise” for project team members. Similarly, “unexpected change” and “crisis” need to be viewed as different concepts in project contexts: a crisis is a situation that arises after the occurrence of one or more particular events; but these events may not always be “unexpected changes”. As such, a lack of clarity between various concepts that might be related to each other has created a certain fragmentation in the extant literature which makes it difficult to generalize its findings, to develop theories that clearly link unexpected events to IT project team responses and their consequences, and to provide clear recommendations to practitioners.

Further, it is important to note that researchers are interested in the concept of “unexpected events” mainly because of their potential negative consequences on project success. Focusing on these consequences can lead to a negatively connoted use of the concept and prevent future research from considering potentially positive consequences and their management. Moreover, existing conceptual definitions of unexpected events often include their antecedents or consequences, e.g. some definitions specify that unexpected events, “pose major challenges or even threaten the survival of the project” (Florice & Miller, 2001, p. 447), “alter project plans in terms of time, cost or scope” (Hällgren & Söderholm, 2010, p. 352) or “develop opportunities for learning” (Rerup, 2009, p. 876). While constructs are the foundations of theories, incorporating antecedents or outcomes into their definition renders it tautological and impedes the development of theories that explain the phenomenon in question (Suddaby, 2010). As Wacker (2004) further mentions, conceptual definitions should not contain hypotheses to avoid making the related theory circular.

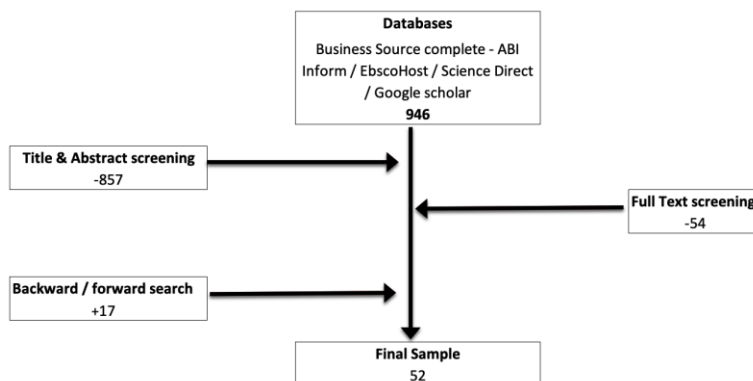
Finally, researchers studied unexpected events at different levels, such as individuals (e.g., Galdi et al., 2010; Kutsch et al., 2021; Tukiainen et al., 2010), teams (e.g., Moore & Andrew, 1999; Walker et al., 2017), projects (e.g., Florice & Miller, 2001; Wied et al., 2021) or organizations (e.g., Pina e Cunha et al., 2006), as well as for different types of situations, such as crises, and in different contexts, such as international projects (Aaltonen et al., 2010), IT projects (Wu et al., 2011), complex projects (Piperca & Florice, 2012), and large-scale engineering projects (Florice & Miller, 2001). In addition, some researchers also observed the management of unexpected events in other fields, such as police intervention teams (Bechky & Okhuysen, 2011), TV movie industry (Manning, 2005) or the medical field (Faraj & Xiao, 2006), with the idea that these results could be adapted. This diversity is a richness that can help us better understand a phenomenon. Yet, as Suddaby (2010) points out, organizational concepts are often very sensitive and contingent to contextual conditions and particular consideration should be given when adapting a concept to different contexts (Barki, 2008). This is also true for the level of analysis chosen to study a phenomenon. Indeed, the definition of the concept can vary according to the chosen level of analysis and relations can emerge between concepts of different levels of analysis (Klein &

Kozlowski, 2000). Problems such as misspecification, where a researcher draws conclusions at a different level from the phenomenon being observed, may then arise (Rousseau, 1985).

### 3 Methods

We conducted a conceptual review (Paré et al., 2023) of relevant research in order to examine the nature of unexpected events in projects, as well as their impacts, issues, and management. A systematic and transparent search strategy that is aligned with the initial objective of our review was developed (Paré et al., 2016; Templier & Paré, 2018). First, to identify a comprehensive set of relevant studies, we consulted librarians at our university and followed Gusenbauer and Haddaway (2020) advice to use specialized databases that provide high coverage of the topic being investigated as well as generic resources that have broad coverage. Hence, we relied on a variety of search systems including two proprietary platforms (EbscoHost and ProQuest), one proprietary database (ScienceDirect), and one web search engine (Google Scholar). The selected platforms allowed us to access the EconLit database (EbscoHost) and the ABI/INFORM Global database (ProQuest). These complementary resources were selected because they are commonly used in business research, they cover many publishers, and they meet quality requirements in terms of comprehensive, transparent, and reproducible search (Gusenbauer & Haddaway, 2020).

The searches in the different systems started with the keyword “unexpected event”, but after observing that researchers had used several synonyms of this concept, we discussed and expanded the list of search terms by adding the following ones: “unexpected event”, “surprise”, “disruptive event”, “turbulence”, “unforeseen event”, “emergent event” and “deviation”, with no restriction regarding their publication dates (Paré et al., 2016). Given the limited amount of research studying unexpected events in the field of IT project management, we decided to extend the search to other types of business or organizational initiatives (e.g. new product development, organizational change initiative, etc.). The search was limited to the business fields by using appropriate database filters. For example, while the economics literature has studied the impacts of unexpected events on stock markets, this bulk of research was excluded because it is not concerned with or related to initiatives that are conducted in organizations. As depicted in Figure 1, this process helped identify an initial list of 946 papers.



**Figure 1. Flow diagram of the literature review process**

In the second step, studies that were considered appropriate for further analysis were selected (Tranfield et al., 2003). To do so, the titles and abstracts of all identified papers were screened, with 857 papers being excluded from the sample because 1) the concept of unexpected events was not a central or important part of the study it reported, or 2) the study was outside the broad field of management and did not investigate organizational initiatives. The remaining 89 papers were carefully read, and 35 of them were kept in the sample as they met the same eligibility criteria. Then, the backward and forward search strategies prescribed by Webster and Watson (2002) were carefully applied, helping the identification of 17 additional relevant papers, and yielding a final sample of 52 articles that are listed in Appendix A.

The last step of the review process aimed to extract and make sense of the available data (Tranfield et al., 2003). Several analytical tactics were used to make sense of the data (Tranfield et al., 2003), provide a critical account of past studies on this topic, and develop a clear and precise conceptualization of “unexpected events” in IT projects. First, reflective remarks (not shown here) were entered into the original



pdf files within brackets. As suggested by Paré (2002), these remarks were ways of getting ideas down on paper and of using writing as a way to facilitate reflection and analytic insight. Second, while structured data extraction forms can be particularly useful tools in reviews where a large number of data items need to be collected from each study, where there are hundreds of studies in the sample, and where quantitative analysis will be used (Paré et al., 2016), such tools are less useful in conceptual reviews where authors usually recognize good or relevant data when they see it. As researchers have used different synonyms when referring to the concept of “unexpected event”, we coded all the terms that had been used and their definitions and stored them in Nvivo software. The use of this software facilitated the analysis of the results by allowing to extract, gather and synthesize the different codes. Further, to clearly distinguish unexpected events from their consequences, the different impacts attributed to the occurrence of unexpected events were also extracted and stored in Nvivo. Excerpts of coded data are available in Appendix A (concept definitions) and B (consequences of unexpected events). Third, the adoption of displays such as matrices, tables, and conceptual maps (some of which are shown below) was also useful during data analysis. These displays made ideas visible and permanent and helped us to iteratively develop insights and draw valid conclusions.

Researchers agree that unexpected events are those that have actually occurred, and that they differ from potential undesirable events which may or may not occur (Hällgren & Maaninen-Olsson, 2005). It is also generally agreed that unexpected events are those that IT project teams had not anticipated. While the risk management and unexpected event management literatures are related, a brief explanation of the differences between them can be beneficial. Hence, the present study first clarified the differences between the concepts of unexpected event and risk factor. Further, in contrast to potential undesirable events which may occur in the future, unexpected events that actually occur have consequences for which an IT project team has no available management practice (Hällgren & Maaninen-Olsson, 2005). As can be seen in Figure 2, the key differences observed in the project risk literature between an “unexpected event” and the notion of “undesirable event” pertain to distinctions that exist between potential *versus* realized events, and unexpected *versus* expected events.

	Potential	Realized
Expected	Undesirable event	Realized undesirable event
Unexpected	-	<b>Unexpected event</b>

Figure 2. Distinction between Unexpected Events and Expected Undesirable Events

Next, a critical analysis of the extant literature (Paré et al., 2015) on unexpected events provided insight into the conceptual problems that seem to hamper knowledge development. A better understanding of these issues will allow us to effectively address them by proposing a clearer conceptualization.

## 4 Results

### 4.1 Terminology Issues

As can be seen in Table 1, the term “unexpected event” was explicitly used in only 16 of the 52 papers in our sample, while the others used different synonyms, such as “unforeseen events” (Sommer & Loch, 2009), “unexpected disruptions” (Herroelen & Leus, 2004; Kao et al., 2006; Leonardi et al., 2012; Pavlak, 2004), “surprises” (Florice & Miller, 2001; Pina e Cunha et al., 2006), “deviations” (Hällgren, 2007; Munthe et al., 2014), “unexpected changes” (Latta & Myers, 2005), and “unexpected crisis” (Choi et al., 2010).

Table 1. Terminology Issues

Concept	Authors
Unexpected event (16)	Aaltonen, Kujala, Lehtonen, & Ruuska, 2010; Garcia-Fernández & Garijo, 2010; Geraldini et al., 2010; Klenk, Molineaux, & Aha, 2013; Latta & Myers, 2005; Laufer, Hoffman, Russell, & Cameron, 2015; Magni & Maruping, 2013; Magni, Maruping, Hoegl, & Proserpio, 2013; Mark & Mellor, 1994; Mazursky & Ofir, 1990; Patriotta & Gruber, 2015; Piperca & Floricel, 2012; Redaelli & Carassa, 2014; Söderholm, 2008; Tukiainen et al., 2010; Zwikael & Gonen, 2007
SYNONYMS OF UNEXPECTED EVENTS	
Unforeseen event (2)	Sommer & Loch, 2009 / Jaśkowski & Biruk, 2011
SUB-CATEGORIES OF UNEXPECTED EVENTS	
Disruptive event / discrepant event (4)	Klastorin & Mitchell, 2013 / Morgeson, 2005 / Morgeson & DeRue, 2006 / Leonardi et al., 2012)
Unexpected change (5)	Dvir & Lechler, 2004 / Moerschell & Lao, 2012 / Moore & Andrew, 1999 / Steffens, Martinsuo, & Arto, 2007 / Sun & Meng, 2009
Unexpected critical incident (1)	Oliver & Roos, 2003
Non-routine event / exception (2)	Orr & Scott, 2008 / Waller, 1999
Unforeseen, unpredictable events / Unforeseeable events (1)	Loch, Solt, & Bailey, 2008
CONSEQUENCES OF UNEXPECTED EVENTS	
Deviation (7)	Alsakini, Wikström, & Kiiras, 2004 / Hällgren, 2007 / Hällgren & Söderholm, 2010 / Hällgren & Maaninen-Olsson, 2005, 2009 / Hällgren & Wilson, 2007 / Munthe et al., 2014
Unexpected disruption (4)	Burnard & Bhamra, 2011 / Herroelen & Leus, 2004 / Kao et al., 2006 / Pavlak, 2005 / Leonardi et al., 2012
Surprise (5)	Bechky & Okhuysen, 2011 / Pina e Cunha et al., 2006 / Floricel & Miller, 2001 / Ramiller & Wagner, 2009 / Stanley, 2009
Unexpected crisis (4)	Choi et al., 2010 / Powley, 2009 / Rerup, 2009 / Sutcliffe, 2005

Six papers used the terms “surprise”, “surprising event” or “strategic surprise”. These terms were defined as events that were either unexpected (Floricel & Miller, 2001), or unplanned (Bechky & Okhuysen, 2011), and hence they essentially referred to the concept of an unexpected event. Indeed, Ramiller and Wagner (2009) point out that a surprise, as it is usually understood, is an unexpected event. Yet, using the term “surprise” as being equivalent to an unexpected event can lead to a lack of clarity since the former has also been conceptualized as “how people react to an event that violates their presuppositions” (Ramiller & Wagner, 2009, p. 37), which suggests that a surprise is a consequence of an event. As such, certain unexpected events may not be a surprise for some team members who, even though they may not have anticipated the event, might have already observed this type of event to occur in other projects (Hällgren & Maaninen-Olsson, 2005).

Researchers have also used the terms “disruption,” “disruptive event” and “schedule disruption” (8/52 papers), which can lead to a lack of clarity between an event and its potential consequences. A “disruption” or interruption reflects an event’s consequence which does not necessarily occur after all events or may even not be the potential consequences of some unexpected events. It is important to note that, according to Klastorin and Mitchell (2013), when a disruptive event occurs, all activities are stopped



for an uncertain time, a characteristic that is unlikely to apply to all unexpected events but only to a subcategory of them.

The same reasoning applies to the concept of “unexpected change,” with four papers referring to “unexpected crises” and one to “critical unexpected events”. It is important to note that unexpected changes also pertain to a subcategory of unexpected events: the plans and objectives of many projects can change (Dvir & Lechler, 2004), and such changes are often unexpected. However, other types of unexpected events, e.g., technical problems, can also occur, but they are not necessarily “changes”. As the terms “unexpected crises” and “critical unexpected events”, their use may also create some confusion. Indeed, a crisis is not an event per se, since it rather reflects the status in which a project or organization finds itself after an event has occurred, and a crisis status refers to a potential consequence of an unexpected event. While it might be appropriate to view some unexpected events as being critical because they are likely to have disastrous consequences for a project, other unexpected events might have more limited impacts (Geraldi et al., 2010). Thus, by studying “critical unexpected events”, researchers would be focusing only on one particular type of unexpected events, i.e., only those that are critical. Finally, one paper referred to “nonroutine events” while another referred to “exceptions,” but without defining them explicitly.

Furthermore, some researchers have used the term “deviation” as a synonym of “unexpected event” (8/52 papers), referring to situations that deviate from initial project plans, i.e., from what was expected (Hällgren, 2007; Hällgren & Maaninen-Olsson, 2005, 2009; Hällgren & Söderholm, 2010; Hällgren & Wilson, 2007). As the term “deviation” reflects an unexpected event’s consequence, e.g., an unexpected event may result in a deviation from initial project plans, using it as a synonym for an unexpected event may also contribute to conceptual ambiguity.

Based on the above considerations, we suggest that researchers should use the various terms cautiously, clearly defining the subject under study. In essence, except for “unforeseen events”, using the above mentioned terms as synonyms of “unexpected events” can be misleading and hamper future theory-building efforts (Barki, 2008).

## 4.2 Attributes of “Unexpected Events”

Based on the definition of the word “unexpected,” an essential property of the concept of unexpected event is its lack of having been anticipated, a view that has been underscored by all definitions. Some definitions have specified that the event had not been anticipated by an entity, which in some cases referred to IT project participants (Piperca & Floricel, 2012) or, more generally, to individuals (Ramiller & Wagner, 2009). Other definitions also noted that the event had not been anticipated in project plans (Hällgren & Maaninen-Olsson, 2005; Hällgren & Wilson, 2007) or in IT project risk management plans (Piperca & Floricel, 2012). While the property of not having been anticipated seems self-evident, Pina e Cunha et al. (2006) make an important distinction, noting that an event can be unexpected in terms of its type and/or form. In the first case, a project team may not have foreseen that such an event could occur (Pina e Cunha et al., 2006), e.g., a project team not anticipating that the system supplier would go bankrupt. In the second case, a project team may have foreseen that a given type of event could occur, but it may not have expected the form that the event could take (Pina e Cunha et al., 2006), e.g., a project team may have expected that the users of a new information system could request changes, such as additional functionalities, but they might not have expected a request to change a key system functionality. In both cases, whether the event itself is unexpected or only certain aspects of it, a significant difference must be perceived between what was anticipated and what is realized. In short, while the attribute “unexpected” is an essential property of the concept of unexpected event, two elements seem necessary to further clarify this notion: (1) the entity responsible for this anticipation or lack of it (e.g. project team, project manager, etc.), and (2), a baseline to define the term, i.e., in relation to what this event or certain aspects of it is(are) unexpected. Discrepancies on these two elements have been found in the extant literature.

Another essential property of an unexpected event is that it is an event that has already happened. This property is common to all definitions observed in the present review, either by a direct use of the word “realized” (Steffens et al., 2007), or via terms such as “occurred” (Floricel & Miller, 2001), “happened” (Geraldi et al., 2010; Pina e Cunha et al., 2006; Stanley, 2009) and “emerged” (Tukiainen et al., 2010).

A third essential property of the concept is that not all unexpected events lead to negative impacts on projects, but can also have positive effects (Alsakini et al., 2004; Hällgren & Maaninen-Olsson, 2005),

e.g., the unexpected departure of an ineffective project manager may have positive consequences on a project's dynamics. However, most definitions either do not consider positive impacts, or give the concept of unexpected event only a negative connotation by using terms such as "threat" (Choi et al., 2010; Floricel & Miller, 2001; Rerup, 2009), "alter" (Hällgren & Söderholm, 2010; Sun & Meng, 2009), or "requires troubleshooting" (Orr & Scott, 2008).

Existing definitions also incorporate several properties that are not essential for defining it but relate to specific characteristics of unexpected events. Six definitions include the scope of an unexpected event, including "poses major challenges for the project" (Floricel & Miller, 2001), "a major impact" (Oliver & Roos, 2003), and "a threat on the viability of organizations" (Rerup, 2009). Yet, all unexpected events do not necessarily have major or significant impacts on projects (Gerald et al., 2010; Hällgren & Maaninen-Olsson, 2005). Similarly, since it may be possible to predict some unexpected events while others may be unpredictable, it would also be better not to use the notion of unpredictability as a key property of the concept.

In sum, as summarized in Table 2 we identified three essential properties of the concept of "unexpected event" which constitute its core, i.e., elements that are necessary and sufficient for its definition to convey the concept's meaning. However, non-essential properties identified above are not erroneous or contrary to the meaning of the concept, but they represent other aspects of the concept that tend to be secondary. Researchers can use these non-essential properties to limit the scope of their study (e.g., examining issues inherent in major unexpected events or examining unexpected events that have positive consequences).

**Table 2. Properties of Unexpected Events**

Properties of the concept	Explanations
<b>ESSENTIAL PROPERTIES OF THE CONCEPT</b>	
<b>Unexpected</b>	A property found in all definitions: its lack of having been anticipated (based on the definition of the word "unexpected"). Researchers sometimes identify the entity that did not anticipate the event (the project manager or team) and sometimes the place or the benchmark (project plans or risk management plans)  Form: An event may take several forms (Pina e Cunha et al., 2006). The type of an event or its form may be unexpected, e.g., one type of event may be expected, but in may take an unexpected form when it happens.
<b>Realized</b>	An unexpected event is one that has occurred (whereas an undesirable event may or may not occur).
<b>Consequences can be positive or negative</b>	An unexpected event may have positive or negative consequences for a project.
<b>NON-ESSENTIAL PROPERTIES OF THE CONCEPT</b>	
<b>Impact</b>	The impact of an unexpected event can vary, depending on the event's consequences.
<b>Unpredictable</b>	An unexpected event is not necessarily unpredictable: it can be predictable, but not predicted by a project team (Piperca & Floricel, 2012).

### 4.3 Unexpected Events and their Consequences

As noted earlier, given the importance and usefulness of distinguishing a phenomenon from its consequences (Suddaby, 2010), the present study also examined the consequences of unexpected events reported in the extant literature. Among the 52 papers that were analyzed, 17 suggested that various consequences followed unexpected events. As summarized in Table 3, most of them noted that unexpected events affected project schedules (n=14) and budgets (n=8), with some also suggesting impacts on the quality of project deliverables (n=4). Also, five papers identified other types of consequences, such as stakeholders losing confidence in a project team (Aaltonen et al., 2010; Coulon et al., 2013; Sun & Meng, 2009), disturbances in team functioning, including a deteriorating climate

(Aaltonen et al., 2010; Coulon et al., 2013; Latta & Myers, 2005; Sun & Meng, 2009), team conflicts (Coulon et al., 2013; Latta & Myers, 2005; Sun & Meng, 2009), and stress (Latta & Myers, 2005).

**Table 3. Consequences of Unexpected Events**

Consequences of unexpected events	Authors
Delays	Aaltonen et al., 2010; Alsakini et al., 2004; Coulon et al., 2013; Hällgren, 2007; Hällgren & Maaninen-Olsson, 2005, 2009; Hällgren & Söderholm, 2010; Herroelen & Leus, 2004; Jaśkowski & Biruk, 2011; Kao et al., 2006; Klastorin & Mitchell, 2013; Orr & Scott, 2008; Sun & Meng, 2009; Tukiainen et al., 2010
Increased costs	Aaltonen et al., 2010; Coulon et al., 2013; Hällgren, 2007; Hällgren & Maaninen-Olsson, 2005, 2009; Hällgren & Söderholm, 2010; Klastorin & Mitchell, 2013; Sun & Meng, 2009
Lower quality	Coulon et al., 2013; Hällgren & Maaninen-Olsson, 2005, 2009; Hällgren & Söderholm, 2010
Confidence loss by external stakeholders	Aaltonen et al., 2010; Coulon et al., 2013; Sun & Meng, 2009
Disturbance in team functioning	Aaltonen et al., 2010; Coulon et al., 2013; Latta & Myers, 2005; Morgeson & DeRue, 2006; Sun & Meng, 2009

In essence, the extant literature suggests that the occurrence of unexpected events can be followed by different project consequences which can be direct or indirect. Direct consequences, such as delivery delays, increased costs, and lower-quality deliverables, affect a project's objectives. Indirect consequences, such as diminished confidence among external stakeholders or deteriorating work climates, do not necessarily influence a project's initial objectives directly, but may have an indirect influence over the longer term. For example, when top management loses confidence in a project or a project team, it can lead to a lack of support for the project, which in turn can be detrimental to its progress. It is important to note that none of the papers included in our sample focused specifically on the consequences of unexpected events.

## 5 A definition of Unexpected Events in IT projects

The present review identified several limitations in existing conceptualizations of unexpected events in IT projects. In order to ensure a concept's clarity, which is critical to building a common language that facilitates communication among researchers and the development of new knowledge, Suddaby (2010) recommended that its definition needs to: (1) capture its essential properties, (2) avoid tautology and not be circular, and (3) be parsimonious. As the extant literature does not provide a definition of unexpected events that satisfies all three criteria, the present paper proposes its own definition.

It is interesting to note that no paper which defined "event" could be found. The term was either repeated in a definition ("an event is an event that..."), or was replaced by another term, such as "a situation that..." (Choi et al., 2010; Hällgren & Maaninen-Olsson, 2005), "deviation" (Hällgren, 2007), or "occasion" (Orr & Scott, 2008). Our work builds on Morgeson et al. (2015) who propose that events are "external (events constitute observable actions or circumstances); bounded in time and space (events have a beginning, and an end and evolve in a specific setting), and involve the intersection of different entities (events result from the actions of a single entity on another entity or can occur when the actions of multiple different entities converge)" (p. 520).

In short, the above synthesis of the literature identified three key properties that are useful for defining an unexpected event in IT projects as an event that (1) happened, (2) was not anticipated either before the project started (e.g. initial planning phase) or during the project, and (3) can have negative or positive consequences on the IT project. Further, such events can be either entirely unexpected or have certain unexpected aspects (Pina e Cunha et al., 2006; Piperca & Floricel, 2012). Hence, the following conceptual definition is proposed:

*An unexpected event in an IT project is an occurrence that happens during the project and that a project team notice as having potentially positive or negative impacts on the project, and whose nature or development was not anticipated.*

While this definition features the specific properties of the concept of unexpected events, it is generic enough so that it applies to a wide variety of IT project methodologies (e.g. agile, waterfall, DevOps) and IT project types (e.g. web development, software development, network configuration, IT emergency recovery).

## 6 A conceptual framework of unexpected events in IT projects

To develop a clear definition of the concept of unexpected event, particular caution was taken to distinguish it from other related concepts. Indeed, existing research shows that the unexpected event, the context in which it occurs, and the team's response are elements that are intertwined and lead to different types of consequences for a given project. To clarify the concept of unexpected event and the emergence process of its consequences, a conceptual model is proposed.

### 6.1 Unexpected events trigger unexpected situations

All unexpected events occur in particular contexts that reflect the situational settings in which workplace phenomena take place (Cappelli, 1991). This represents an initial state that will be altered by the occurrence of an event (Van de Ven & Huber, 1990), in this case, unexpected. For instance, an unexpected event may occur during a certain stage of an IT project, and if the project is already running late, it could cause budget overruns, or may be negatively viewed by the organization. As such, the context of a project can significantly influence the consequences of an unexpected event.

To better understand unexpected events as well as their contexts and consequences, we propose to rely on the concept of “unexpected situation” with a situation being defined as “all of the facts, conditions, and events that affect someone or something at a particular time and in a particular place”. Hence:

*An unexpected situation represents the state of a project that was not anticipated by a project team in the project plans, and which develops after an unexpected event happens.*

In sum, unexpected events will tend to happen in particular contexts and trigger unexpected situations. An unexpected situation is therefore a temporary state of a project following the occurrence of an unexpected event. Two examples are provided in Appendix C to help illustrate why unexpected events and unexpected situations must be conceptually distinguished.

### 6.2 The project team's response to unexpected situations and the emergence of consequences

In process theory, actions and events occur in a process and both modify the state of the system under study (Van de Ven & Huber, 1990). In a project, unexpected events might happen independently of the team's actions, shifting the project into a new state (i.e. unexpected situation) and triggering the project team to perform a number of actions (referred here as a team response). Following Niederman et al. (2018) actions are “activities performed by an actor with the intention of bringing about a new state relative to the phenomenon of interest” (p.8). Yet, to clarify the links between the unexpected event, the resulting situation, the project team's response and the following consequences, a distinction is suggested between potential and realized consequences. Indeed, an unexpected event that occurs in an IT project and the situation it creates tend to have potential consequences which can later become realized consequences, depending on the project team's response. The following example is based on a real project and details are provided in Appendix C (Example 1 adapted from Sicotte and Paré (2010)). Following an unexpected event (the system users stating, during the initial test, that they needed an additional functionality), the potential consequences included delays in the project's schedule, demands to increase the project's budget, and the rejection of system users. The project team decided to mitigate the impacts on budget and schedule by not implementing the functionality, but then the users decided to stop using the system. The project team finally decided to make changes to the system, resulting in significant delays in the project's delivery date, which became the actual consequence that resulted from the project team's second decision.

The occurrence of an unexpected event is thus typically followed by the project team's assessment of the situation and its potential consequences based on their knowledge and expertise. In the present study, this process is labeled “team assessment” and defined as:

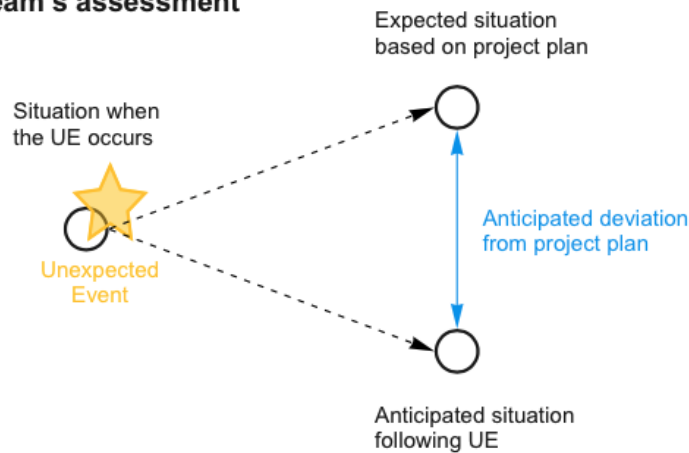
*A team assessment is a process by which project team's members evaluate the nature of an unexpected event, the causes of its occurrence, and the context in which it occurs, to better understand the unexpected situation and its potential consequences for the IT project.*

The result of a project team's assessment is a certain understanding of the situation that includes some or all potential consequences of an unexpected event for their IT project, since a team's lack of expertise or lack of information may render their assessment process incomplete, resulting in their inadequate or partial evaluation of the situation. By referring to the project plan, the project team can then identify an anticipated deviation in terms of scope, schedule, and budget, as illustrated in Figure 3.

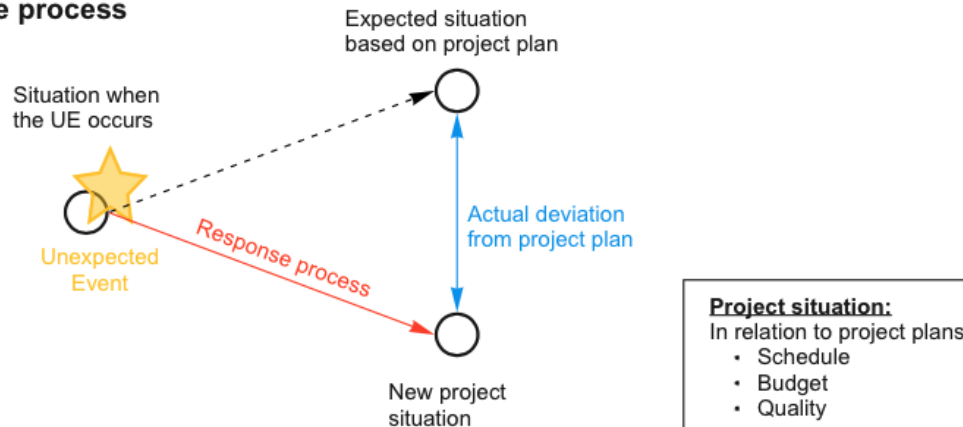
The potential consequences of the situation become actual consequences only later, after the team reacts or responds to the unexpected event. A project team's response generally attempts to mitigate the negative potential consequences of the unexpected situation or strengthen its positive potential consequences. As described in the above example, the choice of an appropriate response to an unexpected event may sometimes prevent certain potential consequences from occurring, while allowing other types of consequences to ensue. The project team may also decide not to react, which in itself must be considered a form of response, and simply acknowledge the emerging consequences. As a new situation emerges, the actual deviation from the project plan materializes (see Figure 3). Hence, a project team's response is defined as follows:

*A project team's response includes its decisions and behaviors that are made in response to an unexpected event to mitigate the negative potential consequences of the unexpected situation or to strengthen its positive potential impacts.*

### Project team's assessment



### Response process



**Figure 3. Project Team's Assessment and the Response Process**



Having distinguished between the potential and actual consequences of unexpected events, it would also be useful to distinguish between their direct and indirect consequences. Past research has mostly identified unexpected events' negative consequences, essentially including project delays, additional costs, and reductions in project scope. These reflect project management issues (Nelson, 2005) that are planned at the beginning of a project and are often used to assess its success. Thus, unexpected events typically have direct consequences for projects, as they generally cause deviations from projects' initial plans or targeted objectives.

On the other hand, while limited, the extant literature also suggests other types of negative consequences, such as diminished stakeholder confidence in the project team (Aaltonen et al., 2010; Sun & Meng, 2009) and problems in team functioning (Aaltonen et al., 2010; Latta & Myers, 2005; Morgeson, 2005; Sun & Meng, 2009). Such negative consequences are indirect, as they do not directly influence a given project's objectives, but they still need to be considered since they can also create risks for a project's remaining efforts. For example, if an organization's leaders lose confidence in a project or its team, it can weaken the team's ability to deal with future issues or problems.

### 6.3 The Importance of Response Dynamics

The chain of events described in previous sections is not necessarily sequential, since a project team's response is a process that tends to iteratively evolve over time. Thus, to mitigate the potential negative consequences of an unexpected event, a project team may begin by carrying out several actions based on their response strategy. Then, depending on the team's strategy, certain consequences are likely to emerge, which in turn might encourage the team to adjust its strategy or even to change it completely, which can also lead to other problems. The main reason is the varying degree of complexity in understanding the unexpected event itself and the potential consequences of the resulting unexpected situation, both on the project outcomes and the implementation process (see Figure 4). In a highly uncertain context, the information needed to understand the situation is not always available or is obtained gradually (Weick, 1995). In some extreme cases, the situation may be chaotic and the team may not be able to identify the relationships between cause and effect (Snowden & Boone, 2007). Furthermore, the urgency to remedy the situation may lead a project team to act quickly and readjust. On the other hand, the situation may also be much easier to understand, and the team may come up with an obvious solution to implement. More research is needed to understand how factors such as the degree of uncertainty and urgency influence the number and length of iterations from initial assessment to team response.

In Example 1 (see Appendix C), the project team first decided not to develop the functionality that the users had requested to avoid any further project delays (potential consequence). However, after the emergency physicians' boycott (an actual consequence), the team opted for a change of strategy and developed the requested functionality, which added another four months to the initial project schedule (an actual consequence). Thus, actual consequences need to be viewed as emerging throughout the response process, with the project team revising its strategy as needed. In essence, the relationship between unexpected events, team reactions, and the consequences of team reactions have a dynamic nature such that, when an unexpected event occurs and a team reacts to it, certain relatively rapid consequences are likely to occur, then a team might assess those consequences and react to them, and this process can be repeated several times during a project's life cycle.

The conceptual framework in Figure 4 depicts the relationships between unexpected situations, the response process (including team assessment and team response), and the different types of consequences discussed above. On the latter point, two types of consequences are suggested, those related to the project outcomes (or direct consequences, e.g., delivery delays, increased costs, etc.) and those related to the implementation process (or indirect consequences, e.g., top management lack of support, deteriorating work climate, etc.) It is also worth noting that, in many cases, unexpected events occur in sequence, i.e., the unexpected situation resulting from the occurrence of an unexpected event leads to the occurrence of another unexpected event that subsequently impacts this situation again, and so on. As such, an IT project team would need to continually reassess its situation so that it can adapt its response throughout their project's life cycle. For clarity purposes, Figure 4 depicts only a single unexpected event's occurrence and its consequences.



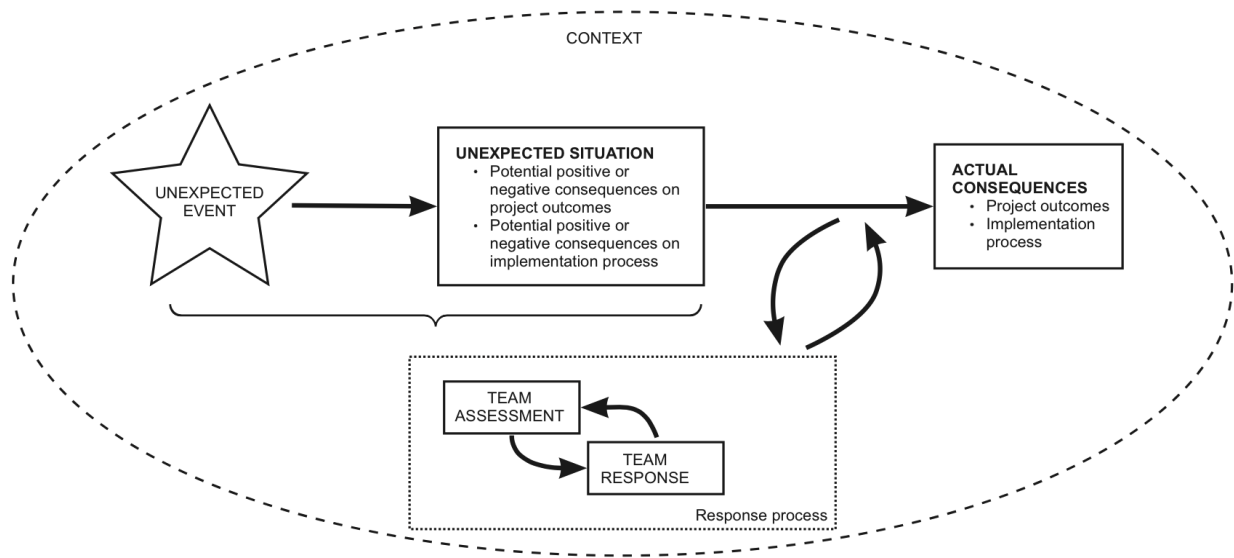


Figure 4. Conceptual Framework

## 7 A Research Agenda

A primary goal of studying unexpected events in IT projects is to help project teams become more resilient and respond more effectively to unexpected events they may encounter. Past research suggests that when an unexpected event occurs, project team members tend to shift from a formal to an informal management mode (Hällgren & Maaninen-Olsson, 2009), and their response process is often based on intuition (Hällgren & Wilson, 2007), which can lead to different responses, depending on the decision makers' experience, knowledge and personal characteristics (Tukiainen et al., 2010). As such, the current understanding of how team responses are chosen and developed is still limited, whereas errors that can be made when deciding how to respond to unexpected events can have severe consequences in IT projects.

Importantly, the emerging literature on the management of unexpected events is complementary to the risk management literature and is also developing in the broader field of management. Existing concepts and theories (e.g., crisis management, mindfulness, sensemaking, intuition, heuristics, improvisation) could be considered to refine our understanding of the response process to unexpected events. The remainder of the article aims to integrate the results of prior research conducted in different fields, highlighting possible links with the management of unexpected events. Several promising suggestions for future research are made to guide researchers and students interested in this area.

### 7.1 Managing Unexpected Events: The Context

Based on the premise that there is no "one fits all approach" to deal with unexpected events and to develop a contingency approach, it is important to first understand what kind of unexpected events occurs in IT projects, in which context and for what consequences.

#### 7.1.1 The Nature and Timing of Unexpected Events in IT Projects

A better understanding of the types of unexpected events that can occur in IT projects would be useful for better understanding what is likely to happen in a project when an unexpected event occurs and prepare the project team accordingly. For example, based on a case survey methodology, Coulon et al. (2013) observed that the sources of unexpected events can be an information system, the project team, and/or the stakeholders, and that such events can vary in terms of their potential severity, the rapidity of the needed response, as well as in their predictability and controllability. Given the preliminary nature of these findings, investigating them further is likely to be relevant and important. The three event characteristics proposed by Morgeson et al. (2015), i.e., its criticality, novelty and disruption, as well as the two characteristics the present paper suggested, i.e., its foreseeability and whether it is a positive or negative event, can also provide a useful lens for analyzing unexpected events that can occur in many IT projects.

One avenue for future research would consist of clarifying the different dimensions of the concept of unexpected event to better understand how they influence the project team's response and the emergence of negative or positive consequences.

To develop resilient teams and prepare them for adequately handling future unexpected events, it might also be useful to know when such events tend to occur in project lifecycles, considering different contextual aspects, e.g., some types of events may occur more often during certain project stages and/or in certain project types, such as IT development projects or projects that implement a mature/immature technology. The project management approach employed (e.g., waterfall, hybrid, agile) is likely to be an important element to consider when examining unexpected events. In agile approaches, some changes are welcomed and might not even be considered unexpected (Lappi et al., 2018). Nevertheless, other events may occur (e.g., a developer leaves suddenly, a supplier goes bankrupt, etc.) and require a team response. It would therefore be relevant to observe the nature of unexpected events in light of the project management approach used.

In essence, developing a more complete portrait of unexpected events is likely to be a useful first step in research efforts that try to provide a better understanding of the relationships between unexpected events, different project situations, and potential consequences for IT projects, so that teams can be better prepared. Hence:

**Research question 1: What is the nature of unexpected events that occur in IT projects? When do they tend to occur in a project's lifecycle, and why? Are there significant differences across IT project management approaches?**

### 7.1.2 The Characteristics of the Contexts in which Unexpected Events Occur

As the context in which an unexpected event occurs also plays an important role in understanding the situation it is likely to create in an IT project, researchers need to examine the contextual characteristics that can influence the development of an unexpected situation. As explained earlier, we define an IT project broadly with its many variants (e.g. software development, ERP implementation, digital transformation, etc.), each of which could provide novel insights on IT project team responses and their effectiveness.

The project stage during which an event occurs may influence the unexpected situation that results, but the project's status in terms of its original objectives could also play an important role, since a project team typically has less room to maneuver when their project is already behind schedule and over budget. Project managers usually plan a funding contingency and when possible, a certain redundancy in the team members' skills, to ensure flexibility. Yet, this safety net might gradually reduce as the project progresses. It is also possible that the confidence and commitment levels exhibited by top management can also be an important contextual characteristic. For example, when an unexpected event occurs, a project team might find itself in a delicate situation due to some earlier project issues which may have upset the organization's management team, such as finding it more difficult to obtain a budget increase for the project. As described in Example 1 (Appendix C), another important contextual characteristic is the power wielded by IT users. In the example, an important contextual characteristic was the fact that the users were emergency physicians who had considerable power in the hospital. Given that a wide variety of contextual aspects can play key roles in different IT projects, developing a comprehensive portrait of project contexts is likely to be useful. A reasonably complete coverage of different project contexts that are possible could help IT project teams better understand different contextual elements, enabling them to better interpret a given situation and to better assess the potential consequences of an unexpected event. Hence:

**Research question 2: What contextual elements of unexpected events are likely to influence unexpected situations in IT projects, and how?**

### 7.1.3 Potential Consequences of Unexpected Events and Project Team Responses

According to our conceptual framework, an unexpected situation entails potential consequences for a project, and we observed that the occurrence of both direct and indirect consequences has been identified as having negative impacts on IT projects. As there can be many potential consequences, and since a project team's role is to try to prevent negative potential consequences from occurring, having a good understanding of what types of consequences can occur can be useful for developing an appropriate response. The extant literature has identified consequences that are essentially direct, such as higher

costs, extended deadlines, and lower-quality systems. Other project success criteria include the learning that comes from a project and a project's value in terms of organizational benefits (Nelson, 2005). As such, it can be valuable to examine whether other types of actual consequences can also occur and a significant contribution can be made to theory and practice by developing a more complete classification of the direct consequences of unexpected events and their links to IT project outcomes. Moreover, the definition suggested in this article implies that the consequences can be positive. This aspect, neglected in current research, represents another promising research avenue. Hence:

**Research question 3: What are the different types of direct consequences that unexpected events can have on IT projects? What is the influence of those direct consequences on project outcomes?**

Similarly, the present review also found that only a few studies have examined the indirect consequences of unexpected events on IT projects. As such, it would be beneficial not only to develop a taxonomy of the different types of indirect consequences that can occur in IT projects following an unexpected event, but also to help better understand how such consequences can have adverse effects on these projects. The literature suggests that unexpected events can lead to negative consequences in terms of how a project team functions and the confidence of external stakeholders, which can lead to conflicts, a damaged climate, or a weakening of team members' confidence in the project manager, all of which can affect team performance and ultimately, project success (Kozlowski & Ilgen, 2006). Similarly, when top executives lose confidence after an unexpected event happens, they may become less involved or committed, which is another key factor in IT project success (Young & Jordan, 2008). Finally, it has also been suggested that an unexpected event can positively or negatively impact a project team's momentum (Coulon et al., 2013, 2021), which in some cases, can weaken after an unexpected event occurs, while in other cases it can strengthen if a team decides to deal with the event as a priority. A detailed analysis of the various potential indirect consequences that unexpected events can have on IT projects could help professionals better assess unexpected situations and their overall impact. A potential risk of focusing only on the direct consequences of unexpected events is that project teams may neglect to consider an important factor of their situation, which in turn can expose them to adverse effects. In essence, indirect consequences represent risk factors for IT projects and a new assessment of project risks needs to be made following the occurrence of an unexpected event. Hence:

**Research question 4: What different types of indirect consequences do unexpected events have, and how do they impact IT project success?**

After developing a better understanding of the different types of unexpected events that are possible, as well as the different contexts and potential consequences that can occur, it would also be useful to investigate their relationships. For example, Coulon et al. (2013) suggested that the types of unexpected events that occur in IT projects can influence project teams in terms of their motivation, climate, conflicts, and involvement. As such, different types of unexpected events are likely to have different consequences on IT projects, and hence they need to be managed differently. Thus, another interesting and promising research avenue would be to better understand the relationships between unexpected events' characteristics, their context, and their potential consequences, helping project teams to better prepare their responses. Hence:

**Research question 5: What characteristics of unexpected events and the context in which they occur influence the potential consequences for IT projects, and why?**

## 7.2 Managing Unexpected Events: The Response Process

### 7.2.1 The Different Response Strategies

Some researchers observed that, when an unexpected event occurs, most IT project teams tend to switch from a formal mode of management, in which they follow project management practices and methodologies, to informal strategies (Hällgren & Maaninen-Olsson, 2009; Tukiainen et al., 2010), with their response choices often being based on intuition (Hällgren & Wilson, 2007), improvisation (Leybourne, 2007) or bricolage (Bechky & Okhuysen, 2011). In contrast to these strategies, other researchers have suggested setting up a dedicated team, such as a Tiger team (Pavlak, 2004) or a Cheetah team (Engwall & Svensson, 2004), that follows a formal and rational approach (e.g. defining the problem, proposing potential solutions, identifying the best solution, implementing) and uses tools such as root-cause analysis, fishbone diagrams, constraint analysis, etc. (Engwall & Svensson, 2004; Pavlak,

2004). Hence, the strategies for responding to unexpected events seem to be on a continuum with, on the one hand, strategies based on the project manager's intuition and, on the other hand, a strategy based on a rational approach with a dedicated team and the use of dedicated tools. Thus, it would be relevant to observe more closely the actions taken by a project team to categorize them and better understand the different types of response strategies. This would then allow a better understanding of what influences the choices made to develop responses to unexpected events. For example, a very short response time may hinder the use of a more formal approach (Hällgren & Maaninen-Olsson, 2009), while a high criticality may promote a more rational approach when an inadequate response could have disastrous consequences (e.g., aviation, high-risk organizations, medical). As Hällgren and Maaninen-Olsson (2005) mention, the project team's knowledge related to an unexpected event, in terms of causes and consequences, and the response to be provided (whether or not there is an obvious response or one that must be developed) influences the type of response. As mentioned above, it would also be important to consider the project management approach adopted (e.g., waterfall, hybrid, agile) to better understand how it influences the project team's response. Hence,

**Research question 6: What actions does the project team take in response to an unexpected event? What factors influence the IT project team's response when an unexpected event occurs?**

It would be particularly meaningful to consider instances in which making sense of the event and the unexpected situation is challenging. In this context, a better understanding of the team assessment process (see Figure 4) can lead to relevant recommendations for practice. For this purpose, the theoretical lens of sensemaking would be a good starting point (see for instance, Kutsch et al., 2021; Sandberg & Tsoukas, 2015, 2020; Weick et al., 2005). In addition, it would be particularly relevant to consider the concept of improvisation more closely. Indeed, improvisation is particularly suitable in uncertain and time-constrained situations, where no prior plans can be applied (Leybourne & Sadler-Smith, 2006; Mendonça et al., 2001). Improvisation is broadly defined as "the conception of action as it unfolds, drawing on available material, cognitive, affective and social resources" (Pina e Cunha et al., 1999, p. 302) and refers to the process of trying to achieve something in a new way (Vera & Crossan, 2005). When an unexpected situation is urgent and uncertain, the IT project team might decide to rely on improvisation. While researchers have long recognized the role of improvisation in project management (Klein et al., 2015; Leybourne & Sadler-Smith, 2006) and in organizations in general (Levallet & Chan, 2022; Levallet & Chan, 2018; Vera & Crossan, 2005), the term is often negatively connoted in practice because it reflects a lack of anticipation and planning. Nevertheless, the questions of whether and under what conditions improvisation represents a valid strategy to cope with unexpected events in IT projects remain unanswered. Thus, it would be both important and relevant to investigate the extent to which and how IT project teams improvise following the occurrence of unexpected events. Hence:

**Research question 7: To what extent do IT project teams improvise in the face of unexpected events? How and when? How effective is improvisation in such context?**

## 7.2.2 IT Project Team Dynamics

In this article, the reference entity is the project team which is taken in a broad sense, with the assumption that every IT project has a project team in charge. Kozlowski and Ilgen (2006) defined teams as two or more individuals who socially interact; possess one or more common goals; are brought together to perform organizationally relevant tasks; exhibit interdependencies with respect to workflow, goals and outcomes; have different roles and responsibilities; and are embedded together in an encompassing organizational system, with boundaries and linkages to the broader system context and task environment.

In this light, future research could unpack this concept in the particular context unexpected events. Indeed, teams may be decomposed or recomposed when facing unexpected situations. New expertise may be added temporarily, while responsibilities and power relationships may change. For instance, Bechky and Okhuysen (2011) observed that SWAT team members are able to quickly switch roles to adapt to a changing situation. For their part, Jacobsson and Hällgren (2016) discuss the notion of impromptu teams, temporarily assembled on a voluntaristic basis, that emerge following the appearance of unexpected events. Hence:

**Research question 8: What effects do unexpected events have on project team dynamics? To what extent are project teams decomposed and recomposed when facing unexpected situations? How effective are these adaptation strategies?**

### 7.3 Key Success Factors to Manage Unexpected Events

Another important avenue for future research would be to investigate the key success factors that influence the effectiveness of the response strategy. Indeed, a better understanding of what influences project team performance in managing unexpected events would allow the development of practical recommendations.

#### 7.3.1 Team Level Success Factors

While it may seem contradictory to prepare for things that cannot be predicted, it would be interesting to understand what factors can help project teams to detect and deal with unexpected events as they arise. Hence, future research can benefit from studying the links between project team responses to unexpected events and different team characteristics, such as team robustness (Florice & Miller, 2001), anti-fragility (Taleb, 2012), and mindfulness (Turner et al., 2016; Weick et al., 2008). For example, mindfulness has been studied at the individual, group and organizational levels, and according to Weick et al. (2008), it has five key dimensions: preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, and underspecified structuring. Moreover, Weick et al. (2008) have also suggested that mindfulness is likely to be related to the capability to discover and manage unexpected events in high reliability organizations (HROs).

In addition, researchers have mentioned several important factors to successfully manage unexpected events or crises, such as effective communication (Hällgren & Wilson, 2007; Loosemore, 1998; Weick et al., 2005), team expertise (Bechky & Okhuysen, 2011; Burke et al., 2006; Geraldi et al., 2010; Hällgren, 2007), interpersonal trust (Geraldi et al., 2010; Pavlak, 2004), capacity to handle stressful situation (Geraldi et al., 2010), team orientation/team proximity/team perspective (Burke et al., 2006; Driskell et al., 1999), team coordination (Bechky & Okhuysen, 2011; Faraj & Xiao, 2006), shared task knowledge, or common workflow expectations (Bechky & Okhuysen, 2011). Finally, leadership in crisis situation has been studied in depth in the literature on crisis (Baran & Scott, 2010; Burke et al., 2006; King, 2002; Useem et al., 2011) and parallels might be made with the role of project manager. Hence:

**Research question 9: What factors influence the capability of IT project teams in managing unexpected events in IT projects? How?**

#### 7.3.2 Organizational and Project Level Success Factors

Different organizational and project level factors might also influence IT project teams' capabilities to manage unexpected events, but there is a scarcity of research in this area. For instance, organizational culture is often suggested as an important facilitator (Geraldi et al., 2010; King, 2002; Volkema et al., 1996), especially the one that fosters productive conflict (Pavlak, 2004), communication openness and nonpunitive response to error (Weick, 1998). It may also be appropriate to explore the relevance of developing response plans for managing unexpected events, either at the organizational, the project office, or the project level. Although the design of such a plan may seem counterintuitive, it may facilitate collaboration between various organizational entities, by specifying, for instance, who should be involved, how authority should be distributed, where resources and skills should be located, etc. In complex situations, access to information, skills and key resources can shape the ability to respond to the unexpected event. Hence:

**Research question 10: What organizational factors influence the response capabilities to unexpected events of IT project teams? How?**

Finally, when unexpected events occur, the project team must often react quickly and make decisions in a context of limited information, and good communication, knowledge sharing, availability of information are important factors influencing the response process. An interesting avenue would be to explore the use of IT as a support for responding to unexpected events. For instance, in the organizational context, L Levallet and Chan (2018) identified two digital capabilities, a flexible IT infrastructure and a well-developed information management, allowing organizations to better improvise in the face of unexpected events. In the context of emergency response operations, Mendonça et al. (2001) discussed the use of decision support systems to improve the process of emergency response, Mendonça et al. (2001) discussed systems, while Mendonça and Fiedrich (2006) studied the use of IT in the design of training programs for emergency management. The use of IT tools could also support the development of response plans or strategies. Hence:



**Research question 11: How can the use of IT influence the process of responding to unexpected events?**

Table 4 summarizes the research questions to be explored:

**Table 4. Research Agenda**

<b>The context</b>	<i>Nature and timing of unexpected events</i>	What is the nature of unexpected events that occur in IT projects? When do they tend to occur in a project's lifecycle, and why? Are there significant differences across IT project management approaches?
	<i>Characteristics of the contexts</i>	What contextual elements of unexpected events are likely to influence unexpected situations in IT projects, and how?
	<i>Potential consequences</i>	What are the different types of direct consequences that unexpected events can have on IT projects? What is the influence of those direct consequences on project outcomes?
		What different types of indirect consequences do unexpected events have, and how do they impact IT project success?
<b>The response process</b>	<i>The different response strategies</i>	What actions does the project team take in response to an unexpected event? What factors influence the IT project team's response when an unexpected event occurs?
		To what extent do IT project teams improvise in the face of unexpected events? How and when? How effective is improvisation in such context?
	<i>IT project team dynamics</i>	What effects do unexpected events have on project team dynamics? To what extent are project teams decomposed and recomposed when facing unexpected situations? How effective are these adaptation strategies?
<b>Key success factors</b>	<i>Team level</i>	What factors influence the capability of IT project teams in managing unexpected events in IT projects? How?
	<i>Organizational and project level</i>	What organizational factors influence the response capabilities to unexpected events of IT project teams? How?
		How can the use of IT influence the process of responding to unexpected events?

## 8 Limitations

This review article proposes a conceptualization of unexpected events to facilitate future theoretical developments on IT project management. The review method adopted in this research was beneficial in achieving our research objectives. Nevertheless, despite a thorough search strategy, some studies on the topic of interest may not have been identified. Further, the observed limitations in the scarce research on this phenomenon represented a challenge in terms of synthesizing the various contributions. Indeed, our analysis revealed many inconsistencies in terms of methods, level of analysis and study context, which led to a necessary level of abstraction required to provide an aggregate perspective of the phenomenon. The different concept definitions and the conceptual framework (Figure 4) suggested in this paper represent a comprehensive foundation for addressing this phenomenon in different contexts and from different perspectives. The research agenda explores and proposes ways to build on this work and further refine our understanding of unexpected events in IT projects. Furthermore, the methodology used allowed the analysis to be based on a relevant, but possibly not exhaustive, sample of articles. This should have a very limited influence on the results obtained. Finally, it is important to note that the literature review revealed many gaps in the literature and that the suggested research agenda is a proposal that the authors make. Due to the lack of information, some of the elements discussed in the research agenda are extrapolated and should therefore be considered as attempts to guide future research.



## 9 Conclusions

The present review suggests that research on unexpected events appears to be constrained due to a lack of clear conceptualization. In particular, the notions of “event”, “context”, “consequences” and “team responses” are intertwined and render theory development rather difficult. When unexpected events occur, IT project teams need to react appropriately in order to limit the potentially negative, and sometimes disastrous consequences of such events. Having resilient project teams can significantly help improve IT project success rates in organizations (Reich et al., 2008). Given the above limitations, the present study focused on developing a clear definition of unexpected events in IT projects and proposing a conceptual framework that presents the relationships between unexpected events, the responses of project teams to such events and their consequences. Clarifying these interrelated notions can help integrate existing results and facilitate theory development, as well as helping IT project managers better understand and manage the phenomenon of unexpected events in IT projects. The proposed framework can also be useful for practitioners who can use it as a guide when reacting to unexpected events. This article underlines the importance of differentiating the potential consequences of an unexpected event from the actual consequences to plan an effective response strategy. Another important element is the dynamic nature of the response process, which, depending on the complexity and urgency of the unexpected situation, may require several iterations of response. The final contribution of this paper is a detailed agenda for future research on this topic. The proposed research questions highlight several important and promising research avenues, including the study of unexpected events and situations in IT projects. We hope that our ideas will encourage graduate students and researchers to investigate unexpected events and lead to the development of new theories and practical recommendations on how to effectively manage such events in IT projects.

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## Appendix A: Literature Review Articles

Authors	Concepts	Definition	Main findings
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Aaltonen et al. (2010)	Unexpected events	Any event that can be considered as a deviation from original project plans	Local stakeholders are an important source of unexpected events, which emerge from diverging practices, misunderstandings, and challenges in building relationships.
Alsakini et al. (2004)	Schedule deviations	-	The authors recommend developing continuous planning methods throughout the project to prevent unexpected events from happening.
Bechky and Okhuysen (2011)	Surprises	A break in expectations that comes from situations that have not been anticipated or do not advance as planned	In the face of UEs," individuals engage in organizational bricolage, restructuring their activities by role shifting, reorganizing routines, and reassembling the work."
Burnard and Bhamra (2011)	Disruptive event	-	The concept of organizational resilience is developed. Two critical phases, detection and activation, lead to a resilient response.
Choi et al. (2010)	Crisis	A situation that incorporates the following three conditions: (a) a surprise to decision makers, (b) a threat to high-priority goals, and (c) a restricted amount of time available for a response.	"90% of crises arose from outside the team boundary, and about two-thirds of crises involved technological/economic rather than human/organizational problems." Managing team-level crises requires an external focus rather than an internal one.
Cunha et al. (2006)	Surprises	Events that happen unexpectedly or expected events that take unexpected shapes	A typology of surprises is proposed around 2 dimensions: the (un)expectedness of the issue and the (un)expectedness of the process.
Dvir and Lechler (2004)	Changes	Changes that have an impact on project plans and goals	Goal changes and plan changes during a project override the quality of planning
Florice (2008)	Surprising events	-	Found that UEs usually occur late in projects "when the stream of action no longer consists just of planning and analysing but starts confronting the concrete physical and socioeconomic reality". When the UE comes late in the project, the managers have less flexibility to tackle the event.
Florice and Miller (2001)	Strategic surprises	Events that were totally unexpected or had some unexpected aspect and that occur during the lifecycle of a project and pose major challenges or even threaten the survival of the project	Governability is a group of properties that enables the project to react to unexpected events. Those properties are cohesion, resources, flexibility, and generativity.
Garcia-Fernández and Garijo (2010)	Unexpected events	-	Framework to develop a dynamic planning capability in order to manage a project with unexpected events
Geraldi et al. (2010)	Unexpected events	Events that may have been predicted (or not), but are not expected to happen.	Three pillars to successfully respond to UEs: (1) responsive and functioning structure at the organizational level, (2) good interpersonal relationships at the group level, and (3) competent people at the individual level.

Hällgren (2007)	Deviations	Deviations from expectations	At some point, an UE needs to be addressed immediately and contributes to a neglect of formal methods as actions become forced. As a result of the abandonment of formal procedures, the actions are sanctioned after the deviation is rectified, rather than before.
Hällgren and Söderholm (2010)	Deviations	Events that alter a project plan in terms of time, cost or scope	Two types of practice for managing deviations: a “good enough” practice, where flexibility initially dominates, postponing stabilization of the situation until later, and a “carefully assessed” practice, which is initially dominated by creating a stable situation, with flexibility required in the search for a solution.
Hällgren and Maaninen-Olsson (2005)	Deviations	A situation, regardless of the consequence—positive or negative, large or small—that deviates from any plan in the project	The tools and methods suggested in the literature are rarely used when a project faces a UE. The response is based on informal methods. Four types of solution tactics: evident, controlled, diffuse and development.
Hällgren and Maaninen-Olsson (2009)	Deviations	Events that are not according to the expectations of one or several people	The management of deviations is primarily informal because there is not enough time to use formal procedures and the window of opportunity would be lost.
Hällgren and Maaninen-Olsson (2009)	Deviations	Events considered as unplanned deviations from project plans	Muddling patterns were observed in the management of UEs: "The decisions made may not have been the best decisions, but they were good (enough) decisions at the time."
Herroelen and Leus (2004)	Schedule disruptions	-	Method of reactive project scheduling to revise and re-optimize the schedule when a UE occurs
Jaśkowski and Biruk (2011)	Unforeseen events	-	Method to construct robust schedules through buffer allocation, in order to cope with disruptions
Kao et al. (2006)	Schedule disruptions	-	Development of a trade-off decision framework for project portfolio scheduling and rescheduling
Klastorin and Mitchell (2013)	Disruptive event	-	Model to develop optimal project planning
Klenk et al. (2013)	Unexpected events	-	Development of a model to improving the goal-reasoning capacity of agents facing UEs.
Latta and Myers (2005)	Unexpected events	-	Unexpected events have different impacts on change initiatives, especially on the cultural and capacity-building aspects of the strategic vision.
Laufer et al. (2015)	Unexpected Events	-	The research found that “successful project managers assume four roles that help them cope with unexpected events” The four roles are: develop collaboration, Integrate planning and review with learning, prevent major

			disruptions, maintain forward momentum.
Leonardi et al. (2012)	Discrepant events	Unforeseen disruptive occurrences during the regular course of work	Managers with positional power use different types of communication compared to managers without positional power.
Loch et al. (2008)	Unforeseen, unpredictable events / Unforeseeable events		Identifying knowledge gaps to identify unknowns. Manage these areas differently (learning and experimentations)
Magni and Maruping (2013)	Unexpected events	-	Empowering leadership positively influenced the relationship between improvisation and team performance, while overload attenuated it.
Magni et al. (2013)	Unexpected events	-	Team improvisation positively influenced project team performance. Team dispersion attenuated this relationship.
Mark and Mellor (1994)	Unexpected events	-	The authors mention the limits of Mazursky's reversal of the hindsight bias (see Mazursky & Ofir, 1990).
Mazursky and Ofir (1990)	Unexpected events	-	The paper identifies limits to the hindsight bias, which suggest "individuals' recall of predictive judgments is typically distorted by knowledge of the outcomes of the event predicted." The authors observed that individuals who faced a UE recalled predictions opposite to their judgments of the event after its occurrence.
Moerschell and Lao (2012)	Unexpected change events	-	Leadership flowed from change rather than the opposite. "This study exposes that an individual in a formal leadership position does not necessarily possess the behaviors of emergent leader in chaotic environments"; "in the face of unexpected and emergent change, formal leadership failed and unofficial leadership stepped up."
Moore and Andrew (1999)	Unexpected change events	-	Suggest the development of more integrated teams. However, cultural and professional interfaces impair team performance. The role of the manager is to pull the diverse functions together.
Morgeson (2005)	Disruptive event	-	Leader preparation and supportive coaching were positively related to team perceptions of leader effectiveness.
Morgeson and DeRue (2006)	Disruptive event	-	Event criticality, urgency and duration were related to team disruption. Event urgency was related to "the amount of time leaders spent managing the event."
Munthe et al. (2014)	Deviations	Something that is not going as planned	A typology of deviations is proposed: Component, Interface, Concept, Scope.
Oliver and Roos (2003)	Unexpected critical	Unexpected events with a major impact on the potential	Team characteristics needed to respond to UEs: increased presence; creating a context

	incidents	survival of the team and/or its intentions	for a shared and emotionally grounded identity; developing a shared set of guiding principles for action, behavior, and decision-making.
Orr and Scott (2008)	Institutional exceptions	An occasion when knowledge devoid of pertinent institutional elements interferes with task completion, and requires troubleshooting.	Model of how institutional exceptions emerge and are resolved
Patriotta and Gruber (2015)	Unexpected Events	-	The paper contributes to better understand the sensemaking process in 3 areas: "the effect of time-based dynamics on the control and coordination of work, the interaction of routine and mindful processes in response to unexpected events, and the structural influences of expectations and typifications on sensemaking."
Pavlak (2004)	Unexpected disruptions	-	Review of reactive problem-solving tools used to manage UEs and description of tiger teams, which are used to help project teams solve problems.
Piperca and Floricel (2012)	Unexpected events	Perceptual discrepancy with respect to project participants' expectations, in particular with respect to anticipated risks	Two dimensions are proposed to distinguish UEs: event predictability and locus of generation
Powley (2009)	Unexpected crisis	-	The authors present a model of resilience described by 3 social mechanisms: liminal suspension ("how a crisis temporarily undoes and alters relational structures and opens a temporal space for organization members to form and renew relationships"); compassionate witnessing ("how organization members' interpersonal connections and opportunities for engagement respond to individuals' needs"); and relational redundancy ("how organization members' social capital and connections across organizational and functional boundaries activate relational networks that enable resilience").
Ramiller and Wagner (2009)	Surprising events	Events that violate people's presuppositions	"Surprise appears to be quite prevalent in IT-related projects." Actor-network theory is suggested as an effective approach for recognizing and understanding UEs.
Redaelli and Carassa (2014)	Unexpected events	-	Plans and planning are important for managing UEs. Plans might be designed to face uncertainty.
Rerup (2009)	Unexpected rare crisis	Rare events that can threaten the viability of organizations but also provide opportunities for learning	The authors develop the concept of attentional triangulation based on 3 dimensions: stability, vividness and coherence. The objective is to understand why the crisis occurred in order to prevent it from reoccurring.
Söderholm (2008)	Unexpected events	-	Four strategies are suggested for dealing with UEs: innovative action, applying detachment

			strategies, setting up intensive meeting schedules and negotiating project conditions.
Sommer and Loch (2009)	Unforeseen events	-	Development of a model of incentives to guide project team member efforts when UEs occur.
Stanley (2009)	Surprises	A special event that happens to people where the surprising event may be thought of as a good or a bad experience	The author develops a perspective where "surprise can be something that is not desired, something suppressed or controlled for. Or, it can be something that is embraced, sought out or encouraged." This distinction might depend upon the "nature of the organization."
Steffens et al. (2007)	Changes	Realized situations with significant divergence from the project scope or plan	Different change management approaches were observed.
Sun and Meng (2009)	Changes	An alteration to design, building work, project program or other project aspects caused by modifications to pre-existing conditions, assumptions or requirements.	Development of a taxonomy of causes and effects of change in construction projects
Sutcliffe (2005)	Unexpected crisis	-	Culture plays an important role in the occurrence and development of unexpected events (focus on bureaucratic accountability, etc.).
Tukiainen et al. (2010)	Unexpected events	Events that have not been planned for emerge during the project lifecycle.	The sense-making process following a UE can be highly subjective and can lead to divergent responses.
Waller (1999)	Nonroutine events	-	The frequency of information collection activities was positively associated with response performance, but the amount of time taken to engage in adaptive responses was negatively associated with performance.
Zwikael and Gonen (2007)	Unexpected events	-	Development of a game to learn how to execute projects and manage UEs.



## Appendix B: Consequences of Unexpected Events: Excerpts from Coded Data

Code	Citation	Reference
Delays	“Overall, surprising challenges related to quality, commitment and interaction with subcontractors were experienced. This in turn led to significant delays, and, ultimately, Localizer was forced to change some of its subcontractors.” (p.576)	Aaltonen et al. (2010)
Increased costs	“The wait incurred high costs, even though as many other activities as possible were rearranged and finished in the interim.” (p.363)	Hällgren and Söderholm (2010)
Lower quality	“A European firm decided to implement an ERP system in its Chinese subsidiary. During the implementation stage, the team realized that the system could not support the Unicode system and therefore Chinese characters. Many users did not speak English very well and some customers required documents in Chinese only.” (p.5)	Coulon et al. (2013)
Confidence loss by external stakeholders	“one local subcontractor resisted the use of certain site acceptance procedures and processes promoted by Localizer. The battle over the use of these processes continued, until the local subcontractor finally bowed to Localizer’s wishes.” (p.575)	Aaltonen et al. (2010)
Disturbance in team functioning	“Working overtime and/or managerial pressure are usually required to get the project back on track. One of the consequences of this is the damage on staff morale and staff fatigue, which in turn results in low productivity and poor quality of work” (p.568)	Sun and Meng (2009)
	“The situation was however not less disturbing as it created confusion and anxiety among the project members at the site and at the corporate office.” (p.59)	Hällgren and Maaninen-Olsson (2009)

## Appendix C: Unexpected Events Examples

### Example 1 adapted from Sicotte and Paré (2010)

The context: a project to implement a clinical information system designed to share laboratory and test results. Many problems were encountered during the project: the budget had to be increased, deadlines were missed and the team was forced to reduce the number of system interfaces. These problems created increased skepticism among various stakeholders. In this context, the project team decided to make an initial test of the system before full deployment. Against all expectations, the first users (emergency physicians) were not satisfied with the system's configuration because the system could display updated data only when a user was logged in, i.e., in order to update the data, users had to log off and then log in again. This problem was much more pressing in the hospital's emergency department, where time was of the essence. Thus, in order to avoid delaying the project even further, it was decided not to provide the functionality of data refreshment, but this made the physicians stop using the system. Given the situation, it was decided to meet the users' needs, which then delayed the project four more months.

#### Analysis of Example 1: the event and the unexpected situation

In Example 1, the unexpected event was the system users stating that they needed an additional functionality, i.e., the ability to quickly refresh the data. The context in which the unexpected event happened was the final implementation phase of a clinical information system that was already behind schedule and over budget in terms of initial plans. Further, the system was implemented in the emergency department of a hospital and its users were physicians. This event created an unexpected situation in this context: the project was in its last few weeks before deployment and the system did not meet the needs of users who wielded significant power in the organization. In this case, the situation was relatively severe, but in another context, e.g., earlier in the project, the situation created by the unexpected event might have been quite different.

### Example 2 adapted from Paré et al. (1997)

Approximately 18 months after the introduction of a patient records system in a hospital, the system vendor suddenly announced that support would no longer be provided and that system updates would no longer be provided. The project team was disappointed and realized that the system had been at the end of its useful life when they had purchased it. The vendor made its announcement when the system had been operational for some time and the physicians and nurses were becoming familiar with its use. Despite having already invested a significant amount in the system (half a million dollars), given the vendor's announcement, the project team decided to purchase a latest-generation system and implement it to replace the existing one, and hence it began to search the market for a new system.

#### Analysis of Example 2: the event and the unexpected situation

In Example 2, the unexpected event was the vendor's announcement that it was ending its technical support for the system. The event happened when the system was already up and running, and thus created an unexpected situation. Even though the system was working when the event happened, the project team had to face the fact that there might be system maintenance problems in the future. In this context, the team was not under pressure to find a quick solution and proceeded to search and acquire a new patient records system. According to the medical director, if the vendor had delivered this news during system implementation, the situation would have been different and the project would have likely been cancelled.

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