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## **Your fault or mine? The Impact of Organizational Learning from Product-related Failure on Innovation Strategy**

**Annika Lorenz**

Technische Universität Berlin  
Chair of Innovation Economics  
annika.lorenz@tu-berlin.de

### **Abstract**

Organizational learning has been an important topic for the field of organization theory scholars but it is somewhat underexplored in the innovation management literature. I provide a typology to analyze organizational learning from product-related failure experience and its impact on strategic decision making.

I include and combine different theoretical approaches from organization theory literature focusing on learning from experience, learning from failure and learning from rare events. Although the literature review reveals that several barriers to effective learning from failure exist, I show that firms will learn more from others' product failure experience in the short-run than from their own product failure experience. This paper provides two insights. Firstly, firms incorporate own and others' product failure experience in their strategic decision making. Secondly, they will adapt their innovation strategy based on a preliminary conscious reflection, sensemaking and cause analysis of the failure. I also discuss a practical application of dealing with and avoiding failure. Furthermore, my findings have implications for practitioners and scholars in innovation management. Hence, the paper identifies promising future research directions in the field of organizational learning within the area of innovation management.

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**Keywords:** organizational learning; learning from experience; learning from failure; learning from rare events; product failure; imitation; innovation strategy

*'You can bet no one makes that mistake any more!'*

(CEO of a mechanical contractor)<sup>1</sup>

## INTRODUCTION

Organizations face many minor as well as major problem and failure situations – whether externally or internally caused – in their daily operations. Furthermore, firms are continuously exposed to success and failure experiences right from the foundation and throughout their life cycle. Some of these experiences associate with more severe consequences for the organizations' routines, employees and performance. A recent well-known example of product-related failure is the Boeing Dreamliner battery systems incident. The batteries caught fire and were the reason for a three months grounding of the 787 aircraft which caused severe security and reputation consequences for the Boeing company. Similar examples are product recalls of car manufacturers or consumer goods producers which – depending on the reason for the recall – can damage a good reputation and lead to a decline in the brand's market share and the long-term sales on a larger scale. These prominent examples show how firms deal with and learn from such failure experiences can significantly influence whether they persist and succeed. Thus, for surviving or developing a competitive advantage, firms increasingly depend on improvement and change calling for a continuous learning process from any new and unfolding innovation journey (van de Ven et al., 1999).

Two questions arising from these examples are: How do firms effectively deal with product-related failure experience? Are there any long-term impacts, such as the change or new alignment of the firm's innovation strategy? Because failure involves the alignment – or misalignment – of the organization and its environment, it is, by definition, about strategy (Sheppard and Chowdhury, 2005). Thus, failure and strategic change are inextricably linked.

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<sup>1</sup> Make no mistake, Inc. Magazine, June (1989), p. 105.

Although there are various frameworks, concepts and theories on organizational learning, three major streams of literature have emerged from prior research dealing with learning from experience, learning from failure and learning from rare events. Extant research is mainly based on studies of particular industries (railroad, mining, airlines or banking industries) (e.g. Baum and Dahlin, 2007; Haunschild and Sullivan, 2002; Kim and Miner, 2007; Madsen, 2009) or links different aspects and dimensions of the experience concept such as learning from prior alliance experience, heterogeneity and recency of an experience to various performance or outcome indicators implicitly assuming that organizational learning occurs.

A growing amount of learning studies show that organizational failures, such as product-related accidents and incidents are an important promoter of organizational learning and change (Greve, 1998; Miner and Anderson, 1999; Sitkin, 1992). Some studies use rare and severe disastrous events to show that organizational learning is taking place (Christianson et al., 2009; Starbuck and Milliken, 1988).

Notwithstanding, extant research reveals that there are several barriers to effective learning from failure (Baumard and Starbuck, 2005; Cannon and Edmondson, 2005). Organizations may fail to learn from failure as a consequent failure analysis does not happen or is ineffective – even in complex organizations like hospitals, where human lives are at stake (Edmondson, 2011). This notion is supported by some scholars who are doubtful about whether companies (e.g., airlines) can learn from their prior product-related failure experiences (e.g., crashes and accidents) (Haunschild and Sullivan, 2002). Nonetheless, safety records show that accident rates have significantly reduced in the past decades (Haunschild and Sullivan, 2002). This suggests and underlines the ability of organizations to learn from product-related failure experience.

In sum, prior literature shows that failure may induce learning on the one hand but several barriers simultaneously impede learning to happen on the other hand. Organizations may

even be prone to do the same mistake again if no learning has occurred or the failure is ignored (Cannon and Edmondson, 2005). Therefore, it is questionable whether companies adjust and improve their decision making processes and innovation strategies due to product-related failures. Furthermore, an important question remains regarding the conditions under which failure experience will be beneficial and lead to valuable learning outcomes. Particularly vicarious learning (i.e. learning from other firms' failure) and industry regulation play a major role in the context of learning from product failure.

In innovation management, these issues remain underexplored and in addition there is a lack of an analytical framework for this process of organizational learning from product-related failure in the context of innovation strategy.

In this paper, I investigate how organizations learn from prior product-related (product recall and product imitation) failure experiences and incorporate them into their decision making regarding their innovation strategy. I develop a typology to analyze the impact of product-related failure experience on company behavior and shed more light onto the black box of organizational learning reflected in firms' adaptation of innovation strategies. This study informs innovation management scholars as it investigates product-related failure as further driver of organizations' decision making in innovation contexts. I would like to provoke reflection in researchers as well as practitioners. For the former, I would like to encourage and stimulate future work on organizational learning in the innovation management literature and for the latter, I will identify opportunities for managerial action regarding effective failure detection, cause analysis and adaptation. This framework can be used as an analysis tool to improve decision making processes and action plans after an organization has experienced a product failure situation.

The remainder of this article is structured as follows. First, I provide an overview of current and relevant concepts and frameworks in organizational learning to develop a

typology and an analysis tool for analyzing the relationship between product failure experience, organizational learning and decision making in innovation settings. The article concludes by describing and discussing the results of the theoretical analysis and by providing implications for management and research.

## **LITERATURE REVIEW**

Organizational learning mechanisms inside organizations have become very well researched topics due to practical importance and the availability of better research methods (e.g., Argote and Todorova, 2007). Moreover, knowledge transfer, the ability to learn and be innovative is critical to the performance and long-term success of organizations (Argote and Miron-Spektor, 2011).

Prior work on learning from experience, e.g., learning from managerial experience (Holman et al., 1997; Kayes, 2002; Kolb et al., 1986), learning from alliance experience (Gulati, 1995; van de Vrande et al., 2009; Vanhaverbeke et al., 2002; Villalonga and McGahan, 2005; Wang and Zajac, 2007; Zollo and Reuer, 2010), learning from acquisition experience (Haleblian and Finkelstein, 1999; Hayward, 2002; Zollo, 2009), learning from contracting experience (Mayer and Argyres, 2004; Vanneste and Puranam, 2010), learning from entrepreneurial experience (Bruneel et al., 2010; Corbett, 2005; Holcomb et al., 2009) and learning from experience regarding organizational change (Hendry, 1996) has received considerable attention. These studies usually assume and find a positive relationship between learning from experience and various performance indicators.

Another stream of literature deals with learning from failure, e.g., business failure (Shepherd, 2003; Thornhill and Amit, 2003; Ucbasaran et al., 2011), alliance failure (Ariño and de la Torre, 1998), project failure (Shepherd et al., 2011), automotive product recalls

(Haunschild and Rhee, 2004), aircraft incidences (Haunschild and Sullivan, 2002) and train crashes (Baum and Dahlin, 2007).

Researchers have investigated organizational learning from failure in diverse areas like the vehicle industry (Haunschild and Rhee, 2004; Madsen and Desai, 2010), natural disasters (Meyer, 2012), the bank industry (Kim and Miner, 2007), health care (Tucker and Edmondson, 2003), the newspaper industry (Muehlfeld et al., 2012) or mechanical engineering (Davidson and Labib, 2003). In contrast to the literature on learning curves and learning from experience, failures trigger more non-monotonic learning processes (Kim et al., 2009).

Learning from rare events has been a third major research concept – acknowledged by a special issue in *Organization Science* in 2009. Studies focusing on rare events demonstrate that rare events can initiate a learning process in various research settings such as the Fukushima nuclear power disaster, mining accidents and terrorism attacks. The actual effect however depends on the organization's perception of the rare event and its willingness and ability to incorporate this event into change. The potential relevance and impact of the rare event will drive the magnitude and scope of the learning process that follows from it (Lampel et al., 2009).

In sum, learning from experience rather associates with learning curves and as a result, organizations' performance improvements whereas learning from failure or rare events does not necessarily entail better or improved performance but for example changes in cognition, routines or processes.

Particularly, product failure is a major topic in management science (Chao et al., 2009; Thirumalai and Sinha, 2011) and marketing studies (Chen et al., 2009; Kalaignanam et al., 2013; Zhao et al., 2011) but has not, yet, attracted research in innovation management as another source of innovativeness and change. Furthermore, a few studies have investigated

product recalls and product failure as a trigger for organizational learning (Haunschild and Rhee, 2004; Kalaignanam et al., 2013; Zhao et al., 2011). Learning from product failure is important as it associates with severe reputation and image consequences for the affected firm and can harm the firm in the long-run. Particularly product defects (e.g. in the automotive industry) can lead to serious harm or accidents. Moreover, product-related failures associate with substantial present and future costs for a company which necessitate a deeper understanding of how to deal with own and others' product failure experiences. Learning from other firms' failure (i.e. vicarious learning) and industry regulation play a major role in the context of learning from product failure.

As a result, firms may have the goal to learn from own as well as others' prior product-related failure, adjust processes and routines accordingly to eventually prevent the recurrence of the failure. For the purpose of this paper, I explicitly focus on two types of product failures: product recalls and product imitation. Product recalls refers to the (in)voluntary process of firms to call back products due to (potentially) safety or health jeopardizing defects or missing compliance with mandatory or voluntary standards (Chen et al., 2009) whereas product imitation associates with a defect that unintentionally facilitates the unauthorized usage of product technology, brands, features or design.

A few studies emphasize the fact that organizations do learn from prior product failure experience (e.g., Haunschild and Rhee, 2004; Kalaignanam et al., 2013; Zhao et al., 2011). In the case of product-related failure successful learning thus implies the prevention of a similar failure experience (increased reliability) as well as the adaptation of the innovation strategy. In other words, a change of the innovation strategy in the case of product failure refers for example to a change in the cooperation strategy for imitation or an adaptation of product development processes for product recalls. The impact of product-related failure on firms' innovation strategy has not explicitly been investigated, yet.

However, anecdotal evidence reveals the opposite highlighting that barriers to effective learning from product failure may exist. In the U.S. market between 2005-2010, Toyota encountered several product recalls across a number of car models due to reoccurring problems with for example the floor mats or the accelerator pedals<sup>2</sup>. Particularly, the Toyota case shows that similar mistakes can reoccur. Although, the notion that organizations and individuals working in them should learn from failure has large support, yet, organizations that systematically learn from them are rare. Organizations frequently fail to transfer these failures into knowledge or behavior and hence, no learning occurs (Tucker and Edmondson, 2003). In the case of product-related failure, the causes of the failure may be ambiguous preventing a systematic failure analysis and rectification.

Not necessarily limited to product failure, the same is true for organizations in financial services, pharmaceutical, health care and aerospace which fail to learn from failure (Edmondson, 2011). In a well-publicized case of failed learning in a major hospital, two women died in quick succession due to a massive overdose of a chemotherapy drug in one of the world's most prestigious cancer hospitals. One patient died, and the other suffered permanent heart damage.<sup>3</sup>

Taking these examples, it is questionable whether companies adjust and improve their decision making processes and innovation strategies due to failure experience and particularly product-related failure experience.

Edmondson (2011) argues that managers think about failure the wrong way ('as something bad') which is the reason that no learning takes place. Obviously, problems also arise if organizations ignore the experience or learn too late.

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<sup>2</sup> <http://pressroom.toyota.com/safety-recall>, accessed on 01/22/2014.

<sup>3</sup> <http://webmm.ahrq.gov/perspective.aspx?perspectiveID=3>, accessed on 12/29/2013.  
<http://www.nytimes.com/1995/03/24/us/big-doses-of-chemotherapy-drug-killed-patient-hurt-2d.html?pagewanted=all&src=pm>, accessed on 12/29/2013.

The literature review shows that on the one hand there is no clear evidence whether and how organizations learn from failure in general and product-related failure in particular. Moreover, the relationship between learning from product-related failure and decision making in an innovation context is underexplored. This paper tries to close this gap by developing a typology to analyze how learning from product-related failure transforms a firm's innovation strategy. I apply different frameworks and theories from organization theory and innovation management to shed more light onto the black box of organizational learning from product-related failure.

Despite conflicting evidence, I show that organizations – if they systematically and rationally analyze product failure experiences and ultimately learn from it – should be able to adapt their innovation strategy

## **THEORETICAL BACKGROUND**

The following paragraphs provide an overview of current concepts and frameworks adapted from organization theory which form the basis for the typology and the following practical decision making tool developed in the next paragraphs of this paper.<sup>4</sup>

### **Organizational Learning**

Organizational learning does not occur in a vacuum (Glynn et al., 1994); it takes place in an organization and the broad context the organization is embedded in. Although there is no overarching definition of organizational learning, yet, it is commonly understood as a 'process whereby knowledge is created through transformation of experience' (Kolb, 1984, p.

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<sup>4</sup> As the focus of this paper is on product-related failure, I explicitly concentrate on learning from experience, learning from failure and learning from rare events as these concepts are closely linked to each other as well as to the concept of product failure. Furthermore, I would like to further disentangle these different streams of research from a vast amount of literature on organizational learning in general.

38). Taking a cognitive approach to learning, it has been defined as changes in knowledge (Fiol and Lyles, 1985) or changes in individuals' cognitive structures (Grant, 1996). In other approaches, learning is described as changes in the range of potential behaviors (Huber, 1991), as changes in organizational routines (Levitt and March, 1988; Nelson and Winter, 1982) or as changes in performance (Argote, 2013). Although these definitions share that some change in the organization occurs they differ regarding where the change manifests itself. According to Levitt and March (1988), organizations learn when they encode 'inferences from history into routines that guide behavior' (p. 319). Hence, organizational learning is a change in the organization that bases on experience.

Research on organizational learning does not directly measure any changes in cognition and behavior<sup>5</sup>, but investigates whether experience systematically changes organizational routines, processes or outcomes (e.g., performance). Thus, in line with Zheng et al. (2013), I do not claim that all learning processes generally lead to beneficial results; superstitious or erroneous learning, for example, can lead to poor results (Levitt and March, 1988; Zollo, 2009). Nonetheless, in this study, I build on prior research examining the link between experience and valuable outcomes. In this context, 'learning' refers to performance improving learning (Zheng et al., 2013).

In general, prior literature on organizational learning reveals that there is a large amount of studies on learning curves which indicates that companies either improve efficiency and productivity or decrease costs due to repeated tasks, the development of routines and/or increasing (frequent) experience. Thus, learning curves usually associate with a positive monotonic relationship between the sum of experience and performance outcomes (Argote et al., 1990; Kim et al., 2009). According to Kim et al. (2009), I focus more on learning from

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<sup>5</sup> Even knowledge in general is difficult to measure. Knowledge has been measured directly with the help of questionnaires, interviews, and verbal protocols or indirectly based on performance indicators. However, this approach cannot capture tacit aspects of knowledge. Therefore, there are many problems recording changes in knowledge, cognition or behavior (Argote and Todorova, 2007).

less linear experiences as these scholars also ‘[...] explicitly consider the specific features of success and failure and propose that this assumption [of monotonicity] does not necessarily apply to learning from experience’ (Kim et al., 2009, p. 958).

Another debate in conceptualizing organizational learning relates to the level of analysis at which it happens. Individuals in organizations usually are the transmitters through which learning occurs however it does not necessarily imply that the organization as a whole has learned (Argote and Todorova, 2007). Thus, organizational learning additionally involves a multi-level spanning component (Levitt and March, 1988).

Because organizational learning begins with an event stimulating experience, organizational experience is discussed first.

### **The Concept of Organizational Experience**

There are different definitions and understandings of the concept of experience in the literature. In general, research discusses experience as something that is not visible a priori, something everybody is surrounded by, something that is always there (Kolb, 1984). Thus, experience rather comprises a novel observable event that just has to be discovered as such. I further define an experience as the state of having been affected by or gained knowledge through direct observation of facts or participation in events (Merriam Webster Dictionary)<sup>6</sup>.

These events are consciously observed eventually leading to a shared understanding of them within the organization. This experience can be perceived as being positive or negative, and even positive deviations present opportunities for learning.

However, in the context of this paper, I explicitly focus on failure experiences because measured against a firm’s whole product portfolio, product-related failures are relatively harmful events with severe consequences. Particularly, failures are assumed to impose a

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<sup>6</sup> <http://www.merriam-webster.com/dictionary/experience>, accessed on 12/28/2013.

disruption of the organization's routines (Lampel et al., 2009). Thus, for this article, experience is reflected in events that are new to the firm, (partly) unknown or a deviation from expected or desired results since it would not be perceived or interpreted as an experience otherwise.<sup>7</sup> Hence, experience can be different for each context.

In line with Cannon and Edmondson (2001), this definition also comprises both avoidable mistakes and the inevitable negative consequences of R&D, daily business and risk taking. There are different forms and contexts in which an organization acts on and makes an experience. After an experience has been made, this experience has to be classified and categorized.

Prior research discusses different dimensions in the context of experiences (e.g., organizational, content, spatial and temporal) which can also interact (Argote et al., 2003; Argote and Todorova, 2007; Mayer and Argyres, 2004) (see TABLE 4).

Experiences can be acquired internally (directly) or externally (indirectly) from other units and firms whereas the latter type is termed 'Vicarious Learning' (Levitt and March, 1988).<sup>8</sup> Experience can also be acquired as a result of a systematic trial and error process or coincidence (Argote and Miron-Spektor, 2011). An experience can be made about tasks or about members of the organization. Experience can be ambiguous or straightforward. Routine tasks as well as new tasks can result in experience. Furthermore, an experience can be acquired within or from similar or different geographical contexts. Another dimension of experience refers to its frequency, pace and timing (prior versus concurrent versus after). Rarity is another dimension of experience, I will discuss in more detail in the last paragraph of this chapter.

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<sup>7</sup> At least part of the experience event has to be new to the firm and the fact that it is new or a part of it is assumed to trigger a learning process.

<sup>8</sup> This form of learning is often referred to as 'knowledge transfer' (Argote and Todorova, 2007).

Insert TABLE 4 about here

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FIGURE 1 gives an overview of the concept of organizational experience, its occurrence across levels and different frameworks and concepts identified and used by prior research to explain the phenomenon of interest.

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Insert FIGURE 1 about here

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In the following paragraphs, I will provide an overview of these frameworks and concepts and show commonalities and differences between them.

### **Organizational Learning from Experience to Knowledge Framework**

Another theoretical starting point for this article is Argote and Miron-Spektor (2011)'s work linking organizational learning to an organization's context. These authors assert that organizational learning is a process that ultimately changes the organization's knowledge base over time as the organization acquires experience (Argote and Miron-Spektor, 2011). Hence, experience is converted into knowledge that in turn may affect future decision making.

The authors differentiate between an environmental context which comprises elements outside the boundaries of the organization such as competitors, clients, institutions, and regulators and an organizational context. According to the framework by Argote and Miron-Spektor (2011), an organization's context (e.g., structure, culture, technology, memory, goals, incentives, strategy, and interfirm relationships) influences the way an experience transforms into knowledge.

This context can be further distinguished into an active element (e.g., organizational members, tools and tasks) through which learning occurs and a latent element (e.g., trust between members, psychological safety or superordinate identity) that in turn shapes the

active context (e.g., employees in an organization behave differently under flat hierarchies compared to strong hierarchies). The latent context influences individual members of the organization, their usage of different tools and their task choice. Thus, active and latent organizational contexts associate with different action patterns: members and tools actively execute and accomplish duties and functions (endeavors, tasks, purposes). Contrasting, the latent context refers to a passive component and thus does not associate with direct action steps but implicitly influences the activities within the active context of the organization.

The organization's latent context, on the one hand, shapes the learning process but knowledge acquired as a product of learning from experience, on the other hand, is integrated in the organizational context and in turn, modifies the context. The active context – organizational members, tools, and tasks and their networks – can store knowledge that thus becomes part of the organizational memory (Darr et al., 1995; Walsh and Ungson, 1991). Moreover, knowledge can also be embedded in the organizational culture or identity and hence, in the organization's latent context (Weber and Camerer, 2003). Hence, the relationship between experience and knowledge describes an interactive, circular process. Knowledge thereby represents the product of learning which is embedded in the organizational context and thus, affects future learning (FIGURE 2).

In sum, this framework predicts that organizational learning from experience manifests in the organization's context and interacts with the environmental context the organization is embedded in.

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Insert FIGURE 2 about here  
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## **Organizational Learning from Failure**

An increase in large organizational failures such as the Columbia and Challenger Shuttle tragedies, the Concorde crash, the Fukushima nuclear disaster, and the Enron scandal justify the need of learning from failure (Cannon and Edmondson, 2001). Failure is a fact of life from which most organizations cannot escape, and the importance of understanding and learning from failure need hardly be stated (Wilkinson and Mellahi, 2005).

A special issue in Long Range Planning has acknowledged the importance of organizations' learning from failure experiences. In general, failure, in organizations and elsewhere, is an outcome below the expected level or a deviation from expected and desired results (Greve, 2003). Deviations from expected results can be positive (success) or negative (failure), whereas both types provide occasions for learning. Yet, I explicitly focus on negative events because they present unique psychological and organizational challenges related with learning from them (Cannon and Edmondson, 2005). Furthermore, causes of organizational failure can be usefully split into two factors: external factors (e.g., catastrophic events and natural disasters such as fires, floods, earthquakes, hurricanes and wars) outside the control of management and organizational factors. However, given the aim and scope of this paper, I focus on organizational and individual-level factors and settings that can be influenced by the organization to avoid and/or learn from failure.

Organizational and management factors causing failure include a narrow management mindset or cognitive failure, protective mechanisms and delusional attitudes, information breakdowns and ineffective leadership practices (Finkelstein, 2006). Studies on learning from failure can broadly be differentiated into two groups: (1) roots of organizational failures and prevention of them and (2) effective learning from failures when they do occur.

A major stream of literature deals with companies learning from own prior failures (e.g. Baum and Dahlin, 2007; Shepherd et al., 2011) while another emphasizes learning from other

organizations' failure experiences (vicarious learning) (Baum et al., 2000; Haunschild and Sullivan, 2002; Kim and Miner, 2007). In the context of airlines, Haunschild and Sullivan (2002) show that organizations acquire new knowledge from prior errors and incidents. A study that focuses on U.S. freight railroad industry leads to similar results (Baum and Dahlin, 2007). There are seminal works dealing with learning from failure in various industries such as automotive, health care, pharmaceuticals and services. Other studies highlight particular topics such as product recalls, business failure or new product development as important opportunities to learn from failure (e.g., Chao et al., 2009; Chiesa and Frattini, 2011; Eggers, 2012; Haunschild and Rhee, 2004; Hlavacek et al., 2009; Hoetker and Agarwal, 2007; Miller and Littlefield, 2010; Shepherd, 2003; Ucbasaran et al., 2011).

In many disciplines such as sciences and engineering, it is widely accepted that organizations learn more and better from failures than from successes (Baum and Dahlin, 2007; Madsen and Desai, 2010; Shepherd et al., 2011). Nonetheless, Sitkin (1992) argues learning from failure is more effective than learning from success because failure motivates deeper search and richer understandings than success.

Nonetheless, there is evidence that many organizations fail to systematically learn from failure (Cannon and Edmondson, 2001). Depending on the size or the timing of identification of the failure it could already be too late to learn from it. Prior research of individual learning proposes that painful or poor outcomes usually stop present behaviors but at the same time do not cause change either, which challenges the assumption that failure necessarily entails behavioral change. Particularly, poorly performing companies generally do not alter their strategic orientations and have a poor habit of communication and hence do not learn from failures (HUSTED and MICHAILOVA, 2002; Starbuck, 2009).

Especially small failures can disclose early or initial weaknesses of a system and thus may point to or even prevent more severe incidences (Cannon and Edmondson, 2001). However,

these are often not recognized. Moreover, there are several social as well as technical barriers limiting or even preventing an effective organizational learning process. Social barriers to organizational learning refer to strong psychological reactions, expectations and inherited instincts to blame others, deny or avoid disclosing mistakes. Technical barriers refer to an inadequate understanding of complex systems or technologies or a lack of the basic scientific 'know-how' and a resulting inability to thoroughly and systematically draw inferences from failures (Cannon and Edmondson, 2001).

In sum, literature emphasizes that organizations may learn from failure events but there are various barriers that impede an effective recognition, analysis and thus the opportunity to learn from failures.

### **Organizational Learning from Rare Events**

Some studies use rare and severe disastrous events with major consequences to show that organizational learning is taking place (Lampel et al., 2009) such as, e.g., the collapse of the roof of the Baltimore & Ohio Railroad Museum Roundhouse (Christianson et al., 2009), U.S. coal mining accidents (Madsen, 2009), and prior corporate acquisition success (Zollo, 2009). However, as these events are so unusual they pose challenges for interpretation (Argote and Miron-Spektor, 2011). Rare events are discontinuities assumed to disrupt current routines, thus expose weaknesses and strengths of an organization and eventually lead to new practices, structures and change (Lampel et al., 2009). As a result, rare events can also reveal unrealized behavioral potential. A rare event is often referred to as a disruptive intervention that unfreezes established patterns and reshapes organizational routines or transforms the organization's structure and strategy (Christianson et al., 2009). Broadly speaking, previous history as well as cognitive heuristics that are adapted to more routine events influence learning from rare events. As rare events happen per definition unpredictably, they also

produce unexpected insights (Meyer, 1982). Therefore, learning from rare events associates with an emergent process of realizing useful lessons from experiences that could not have been predicted. Organizations invest a lot of limited resources and attention investigating disasters to derive ‘lessons learnt’ from these events which can have complex, ambiguous causes and are additionally shaped by selective and biased interpretation of outcomes. Learning from rare events comprises a higher level of uncertainty than learning from more frequent events because organizations have fewer relevant observations to compare them to (Starbuck, 2009). Thus, lessons learnt are highly dependent on how decision makers in different hierarchies of the firm make sense of these rare events (Weick, 1988). Learning from rare events is different from conventional approaches to organizational learning because the experience has not been encountered before, and hence does not fit into a recognized category of experience (Garud et al., 2011). These prominent approaches however define learning as a continuous improvement of knowledge based on enhanced reactions to already known categories of experiences (Argote, 2013; Argote and Todorova, 2007) which in turn renders learning from these unrecognized experience categories ambiguous and difficult.

Rare events are highly context-dependent suggesting that it is the organization or the individual that differentiate and define whether an event is ‘rare’ or not. Thus, they observe or directly experience an event as unusual – being something unique without a close equivalent or a deviation from common experience with a similar type of event. Therefore, an event that is rare for one organization can be ordinary for another (Lampel et al., 2009). Additionally, similar events can generate various lessons for different organizations. Based on the potential impact and the potential relevance of a rare event for an organization Lampel et al. (2009) propose a taxonomy identifying four types of learning; transformative, reinterpretative, focusing, and transitory.

Furthermore, prior literature reveals two views of rare events. The first view defines rare events as probability estimates, usually calculated from the frequency of the event. In this view, learning from such events is driven by the desire to prevent these events from recurring which in turn is contingent on developing an understanding of the causes of the rare event (Lampel et al., 2009). The second view defines rare events as opportunities for unique sensemaking based on the enacted salience of specific features of the rare events (Daft and Weick, 1984). This view emphasizes the importance for experiencing a single event 'richly' (March, 1991), i.e. as a unique experience with no reference to any estimates of probability that the event will recur. Research reveals that firms are prone to experience unusual, rare events when they fail to notice or ignore to act on weak cues that signal potential threats (Ansoff, 1975; Weick and Sutcliffe, 2013) which might be either due to that these weak cues are not recognized as signals of potential problems (Weick, 1995) or because firms do not possess enough capacity of the limited resource of attention to do so (Argote and Greve, 2007; Ocasio, 1997). Moreover, there might be observant individuals who have the capacity to understand the meaning of weak cues, but they do not have the influence, resources, or motivation to either raise their voice or take action themselves (Edmondson et al., 2001; Rerup, 2009).

Consequently, evaluating rare events creates opportunities to learn by transforming this experience into knowledge that can be stored in the organizational memory for future purposes (Garud et al., 2011; Zander and Kogut, 1995; Zollo and Reuer, 2010; Zollo and Winter, 2002). According to Lampel et al. (2009), learning from rare events triggers two reactions of companies: they either focus on forecasting, improvement and prevention of consequences when the event has a negative impact, and on repetition when the event has a positive impact.

## **TYOLOGY OF LEARNING FROM PRODUCT FAILURE EXPERIENCE IN INNOVATION CONTEXTS**

The literature review and the theoretical background presented above reveal that firms face obstacles preventing them to effectively learn from product failure experience.

Therefore, two research questions arise: How do firms effectively deal with and hence learn from product-related failure experience?<sup>9</sup> Are there any long-term impacts, such as the change or new alignment of the firm's innovation strategy? I will particularly investigate these questions in the context of product failure and a firm's connected innovation strategy because such an event may have severe consequences for the firm's reputation, its competitive advantage and hence, long-term performance (Haunschild and Rhee, 2004; Zhao et al., 2011). In the worst case, product recalls may impact the stock market value of publicly traded firms due to a decline in investor confidence and their resulting unwillingness to continue financing the affected firm. Thus, the firm's fundamental existence may be at risk (Chen et al., 2009). Moreover, I assume that firms experiencing a product defect (followed by a product recall) will be more likely to re-evaluate their production processes and try to improve the product at stake resulting in new and better products and processes reflected in a change of innovation strategy. In this section, I therefore address how product failure experience may be reflected in a firm's innovation strategy. To do so, I build on the established distinction between learning from own failure experience and learning from other firms' failure experiences (Baum et al., 2000; Haunschild and Sullivan, 2002; Kim and Miner, 2007; Thornton and Thompson, 2001). In addition, I consider a strategic component in light of short-term versus long-term impact of product failure experience.

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<sup>9</sup> For the purpose of this paper, learning is understood as a change of the organizational knowledge base as reflected in an alignment of the firm's innovation strategy.

Combining these two dimensions results in the matrix depicted in FIGURE 3. Below, I explain the resulting four archetypes of learning from product failure experience and how they influence a firm's innovation strategy. I analyze firms' technological trajectories by focusing on whether a firm intends to create or change to a new path or rely and extend a current one. This typology shows the plurality of learning from product failure scenarios and refers to the perspective of the focal firm.

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Wait & See (Deferral or delay of trajectory change)

As per definition, a product failure event is a deviation from expectation<sup>10</sup>, a firm will not act with precipitation after having experienced such an event. Firstly, the firm will have to perceive, classify and categorize the product failure experience.<sup>11</sup> Thus, the organization will wait before analyzing causes which led to the event. As the categorization and investigations will take time, the firm will not change its technological trajectory on short notice and without concrete proof whether the product failure can be attributed to the firm's current trajectory. Particularly, as failure is usually seen as something exceptional and as firms might expect that the same event will most likely not happen again in the near future, it will not change its current technological trajectory, instantly. Thus, the firm may decide to take a 'wait and see' approach while carefully monitoring the incidence and its consequences.

According to Cyert and March (1963), failure can stimulate behavioral innovation but this takes time and resources. Firms usually have a limited capacity of both which explains why product failure analysis can take up to several months. Depending on the size and causes of

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<sup>10</sup> Nonetheless, in some industries (e.g. automotive) the occurrence of product recalls may already be embedded in the organizations' expectations due to vigorous safety regulations.

<sup>11</sup> A product recall will only be announced after concrete proof of the defect and its consequences. Moreover, a firm may adopt passive strategy in managing product recalls by trying to delay the announcement of a product recall as long as possible (Chen et al., 2009; Dawar and Pillutla, 2000; Laufer and Coombs, 2006).

the product failure event, firms might want to investigate the reasons for this event for themselves and do not want to attract too much attention. Therefore, they will defer any change in their current strategy on the one hand to mislead competitors or other stakeholders and on the other hand, to disguise the product failure as the actual reason for the alignment of the innovation strategy.

Furthermore, decision makers' personal dissociation from failures and their association with successful innovation strategies and practices (correct or not) to their own abilities, further prevent initiation of change of their current trajectory. In extreme cases, especially when the product failure only had few negative results, any of these false or superstitious beliefs or biases that decision makers hold will be reinforced and that their learning will be influenced toward validation (Levinthal and March, 1993). Besides, depending on the strategic decision maker in charge, their personal biases might lead them to interpret the product failure not as a questioning to their chosen strategy but as an indication that they need to pursue it with greater resolve. In sum, in the short-run, this deferral strategy is easier to execute, cost-neutral and gives firms more time to conduct a proper cause-event analysis. Path dependence theory (Sydow et al., 2009) as well as empirical studies provide vigorous evidence that organizations tend to persist in strategies and courses of action they employed in the past (Amburgey and Miner, 1992; Kelly and Amburgey, 1991). As a result, the organization suffers from the so-called competency trap which describes organizations experienced with a given strategy holding on to that strategy, despite proof (e.g., product failure) that they should not (Chuang and Baum, 2003; Levitt and March, 1988).

#### Strategic Alignment (Change of trajectory)

Some failure events such as product defects (followed by a product recall) usually reveal weaknesses in the firm's current business or innovation strategies as described above. Thus, these product failures point out room for improvement and hence induce the firm to develop

new strategies (Starbuck, 2009). After having analyzed and attributed causes for the failure, the organization can then implement new strategic actions leading to the creation of a new trajectory. As a result, product failure experiences can also lead to a competitive advantage especially if a firm is able to learn more effectively from their own failure events than its competitors. When these product failures have a major impact on the firm, there is clear motivation for the affected firm to draw lessons and make the necessary operational and cognitive adjustments.

The firm's decision makers will increasingly react to own product failure events, which they take not only as evidence of the inefficacy of the common strategy but also as proof (rightly or wrongly) of the correctness of their chosen strategy (Chuang and Baum, 2003). Chuang and Baum (2003) for example find support that the failure of a firm's naming strategy is a sign of poor performance that can motivate the firm to reevaluate its strategy.

Consequently, a firm's product failure should lead managers to reexamine the current innovation strategy stimulating exploratory search and leading the company to advance from the old trajectory in favor of new and improved technologies, components and products (Chuang and Baum, 2003).

Hence, prior research suggests that organizational learning from failures yields short-run handicaps but creates long-run benefits as in the long-run failure can be investigated more effectively, causes analyzed and attributed. Causes of product failure can be diverse but taking the Toyota example, defects can usually be traced back to particular parts, components, products, processes or suppliers. Avoiding a reoccurrence of the same or similar failure events requires the long-term effective analysis of causes, learning from them and the adaptation of the current innovation strategy. Depending on the cause of the product failure, Toyota may want to switch suppliers, initiate new external collaborations, invest in R&D to develop new and improved technologies and components which could even lead to patent

applications. Sometimes a product failure can have severe consequences for the firm affected especially when it involves the firm's core or cash cow product. In extreme cases, the concerned firm may not have anything to lose anymore. Thus, a complete turnaround and adaptation of its innovation strategy can be seen as the last chance or resort.

#### Distant Observation (Adaptation of trajectory)

Another firm's product failure experience resulting in a product recall presents the opportunity for the focal firm to observe the affected company and its behavior from the distance.<sup>12</sup> By observing, managers can potentially learn a range of strategies, practices, and technologies produced by the ongoing explorations and failures of others in their industry (Levinthal and March, 1993; Levitt and March, 1988). To minimize the resulting negative impact and avoid high costs associated with product failure companies can actively reduce their chances of having a recall (Berman, 1999) by observing and learning from others' failure experience. Furthermore, firms are more likely to become aware of highly visible and salient product failures experienced by other organizations, and are consequently able to purposefully learn from them (OCASIO, 1997). Thus, high visibility of others' product failures creates attention and implies that it must have been a major failure event.

When examining accidents on U.S. railroads, Cyert and March (1963) find that organizations benefited less from their own direct experience and more from the indirect experience of other firms in the industry. Firms increasingly refer to other firms' experiences and actions for clues about how to interpret their own situation to reduce inherent uncertainty.

Furthermore, it should be emphasized that a firm can learn from external observation of others (maybe even about the causes of others' product failures) but a direct application and transfer to own processes and products as well as how to prevent its own demise is rather

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<sup>12</sup> It should be noted that a firm will compare itself to those firms that it classifies as competing or operating in the same industry.

complex and thus, doubtful (Kim and Miner, 2007). Learning from self-derived inferences of observed product failure gives hypothetical but untried solutions and may lead firms to derive irrational assumptions about the causes and contexts of the observed failures (Huber, 1991). However, observing others' product failure may increase a firm's likelihood to engage in search activities and to actively interpret their observations (Sitkin, 1992). Others' product failure experiences provide a hands-on example to evaluate origins and contexts of failures which in turn give a hint whether the focal firm might be subject to a similar fate (Kim and Miner, 2007). Consequently, a product failure by others can stimulate firms to apply the insights and lessons drawn from their observations assuming to lead to a focus on prevention of the same experience. Of course, this highly depends on the visibility of the event, the size of the firm experiencing the failure, the regulatory environment, the relevance of the failure for the focal firm and other factors.

Therefore, this will lead to minor changes of the innovation strategy or an adaptation strategy without major changes of the current technological trajectory in the short-run. Particularly, in cases of major failures government regulations may further impose the adaptation of a firm's current trajectory. Furthermore, these unaffected firms can also stimulate own trial and error learning or search processes to optimize own processes and products and to avoid similar product defects. However, these will take time and will not be initiated in the short run. Moreover, once the focal firm has full information whether the affected firm was able to successfully cope with the product defect, it will be able to adapt its innovation strategy in the long run. Thus, short-term learning will inform and influence long-term decision making.

Observing other firms, the focal firm focuses on avoiding those experiences and actions that appear harmful, imitating those actions that appear beneficial for other organizations and developing novel activities based on its interpretations of the observed experiences (Chuang

and Baum, 2003; Haunschild and Miner, 1997; Kim and Miner, 2000; Levitt and March, 1988; Miner et al., 1999).

Firms that completely fail due to major product defects provide other firms in their industry with a valuable opportunity to observe and learn and consequently improve their chances of survival by resisting potential threats or by adjusting their current strategy (Haunschild and Miner, 1997; Levinthal and March, 1993). Furthermore, assuming that in the extreme case, firms experiencing product failure are permanently removed from an industry, along with the possibly valuable information associated with their failures, this can increase the difficulty for others to learn from the failures (Huber, 1991; Levinthal and March, 1993).

In sum, theories that stress limited organizational attention or the importance of visibility suggest that others' product failure experience is a better source of learning in the short-run than own product failure experience.

#### Two-stage Learning (Change of trajectory)

Prior research reveals how other firms' product failures served as wake-up calls not only for the firms directly involved but also for the ones indirectly affected leading both involved parties to search for new actions or to develop new routines or craft new long-term strategies (Miner et al., 1999).

A large number of near-failures<sup>13</sup> in an industry provide firms with an occasion to observe others' approach to product failure, indicating situations that can risk their own survival (Miner et al., 1999). From a learning perspective, near-failure experience offers the advantage of rich, complex information embedded in an aggregate set of events from product failure to turnaround. Show case examples of other firms who managed to cope with near-failure render this experience an important source of outcome-based learning in the long-run.

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<sup>13</sup> A near-failure in this context refers to a product recall causing severe consequences but not a complete going-out-of-business or a product defect that was discovered and fixed before the announcement of a product recall.

Furthermore, the accumulated experience by others provides tried and tested successful reactions that a firm can use to deal with potentially similar situations in the future. In this regard, near-failure experience is more likely to provide lessons to be adopted by observing firms than other types of failure-related experiences (Kim and Miner, 2007). Firms and managers that successfully recovered from product failure may even actively describe their turnarounds in light of managerial pride and organizational prestige (D'Aveni, 1990). This notion may qualify others' product failure experiences as a useful source of knowledge but may at the same time be inflated with misleading, not proven or not validated solutions.

Notwithstanding, companies may try to hide their near-failure experience to create an image of healthy operations which renders these near-failures not as visible as 'fully-fledged' failures because they are not widely publicized which makes it more difficult to observe them in the first place (Elsbach and Kramer, 1996; Kim and Miner, 2007). Moreover, other firms may only share information long after the crisis is overcome (Sutton and Callahan, 1987).

In fact, there is a two-stage (simultaneous) learning process taking place. In the first learning process, the directly affected firm, will effectively observe, interpret and derive the lessons learnt and based on its evaluation change its current strategy. The whole turnaround process and its subsequent evaluation (whether it was successful) will take time. The second learning process relates to the firm not directly affected by the near-failure event. Assuming that the focal firm is able to derive correct lessons learnt from the near-failure of others' it will most likely change its current trajectory to avoid similar failure events in the long-run. In sum, theories emphasizing the importance of rich, comprehensive information suggest that near-failure experience has greater impact for firms to learn from in the long-run based on two different but simultaneous learning cycles of directly and indirectly involved firms. Combining the arguments from above lead to the conceptual model depicted in FIGURE 4.

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## DISCUSSION AND IMPLICATIONS

Failure can typically be attributed to either the environment or the organization. To be more exact, as failure is the misalignment of the organization and its environment, it is, by definition, about strategy (Sheppard and Chowdhury, 2005).

The typology developed in this paper emphasizes that the primary source of the failure experience can trigger different learning process in the short and long-run. Firms own product failure experience will for example most likely lead to a change of the current trajectory in the long-run whereas other companies' product failure experience will cause the focal firm to observe the failure and quickly draw lessons from the other companies' behavior to adapt minor aspects of their innovation strategy in the short-run. Depending on the cause of the product-related failure, firms should always see it as a learning opportunity. In the case of a product defects, firms need to have a viable product recall strategy at hand which can reduce costs and minimize a recall's severe consequences for the firm substantially. This can also be valuable when fast reactions need to be executed. Firms can restore their reputations by aspiring to prevent a future recall on the same safety hazard, and by differentiating their new products from those that were recalled (Berman, 1999). In contrast, other firm managers view a recall program as an inconvenience, as a sign of defeat or they take a defensive approach by denying that a problem even exists, or by blaming others as the cause of the product defect. Managers may underestimate or play down the consequences of a recall (Berman, 1999). Firms differ considerably in terms of when they announce a recall and how they handle a recall incident (Laufer and Coombs, 2006). Some proactively announce product recalls whereas others take a defensive approach and wait until they are forced to recall their defected product (Chen et al., 2009). Companies may follow this defensive strategy assuming

that others will observe their behavior and even profit or learn from their product failure experience. Moreover, product-related failures are costly and thus, should be accepted if happened, not ignored in the short-run and rather prevented in the long-run. Firms should also carefully observe others and how they manager failure experiences as these provide very valuable learning occasions where the focal firm can learn more than from own experiences.

The findings of this theoretical analysis have implications for managers and researchers. The literature review shows that there is no clear evidence whether and how organizations learn from failure in general and product-related failure in particular because of several barriers preventing firms to learn from failure. There is a large body of literature on learning curves which suggests that learning in deed is taking place. With the help of the typology and the framework developed in this paper, I emphasize that organizations can also learn from non-routine tasks or product-related failure experiences when they consciously reflect, make sense and analyze the causes of the failure. These experiences will be replicated in the organizations' strategic decision making or their innovation and R&D investments and hence, their innovativeness or performance. Of course, further empirical investigations are needed to verify these theoretical predictions. Although, as emphasized before, quantitative evidence is hard to obtain, I at first encourage further in depth case research to open up the black box of organizational learning and decision making processes in innovation management.

In reality, firms usually get stuck in the early stages of the process introduced and never reach a learning outcome as they might want to forget about the failure or do not consider the failure important enough to learn from.

While their firms remain prosperous, many managers believe that nothing bad can happen and thus, too often overlook cues of a potential dangerous or failure situation. In a case study of a telecommunication firm, Baumard and Starbuck (2005) identify further problems impeding effective learning such as perceptions of idiosyncrasy and external influence,

reluctance to foreclose experiments prematurely, employee turnover, and poor communication. Furthermore, organizations tend to look for external causes when failure events have a significant impact and thus it is questionable whether they will learn anything from these experiences (Starbuck, 2009).

Organizations further inhibit the learning from failure process by rewarding success and punishing failure. With the help of a failure accepting culture, organizations can adjust and improve decision making processes to avoid the negative and repeat the positive experience which ultimately leads to a successful, prosperous organization. Thus, a transition from a performance-based culture<sup>14</sup> to a learning-based culture may be necessary. Small steps to be taken in this direction are the installment of systematic failure reporting and analyses tools that clearly describe steps and tasks on how to proceed with any kind of failure experience. Organizations can e.g., set up a special task force and or teams that are specifically prepared to deal with and react to any unforeseen (major) experiences. With the help of a so called failure mode and effect analysis (FMEA)<sup>15</sup> tool, potential sources of failure can be analyzed ex-ante as the failure introduced and discussed in this paper are only detected ex-post. A good pre-failure analysis helps firms to more efficiently deal with these potentially relevant errors and any other (similar) failure experiences after they happen. However, an effective way to detect, deal with and analyze failure is still not a common practice in many organizations (Edmondson, 2011). Therefore, there is a growing need for context-specific and highly effective learning strategies. Another problem why learning is underrepresented in so many organizations is due to the fact that there is no failure acceptance culture which leads people to avoid admitting or even publicly acknowledging failure. Hence, a sophisticated analysis of

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<sup>14</sup> In general, failures may have consequences for individuals' or teams' performance evaluations. Therefore, people have a deeply rooted and inherited instinct to deny, distort, ignore, or disassociate themselves from their own mistakes (Cannon and Edmondson, 2001).

<sup>15</sup> FMEA comprises a risk analysis and optimization process based on the potential failure, the potential cause of failure, the recommended corrective action and the designated preventive measure.

failures and their contexts is necessary to avoid the blame game as Edmondson (2011) calls it.

Once having dealt with any product-related failure experience, the coping and problem solving strategies and the solution found can be recorded and serve for future purposes. Later on, the solution, strategy or the decision should also be looked at again to see if the measures undertaken were successful in that matter (feedback loop). Usually, major product failure experiences require a really quick decision. This short-term reaction should also inform and be aligned with the long-term innovation strategy.

While this work has many interesting implications, several limitations exist. This paper gives some intuitive reasons; however, I am not able to empirically test my argumentation. Still, such research is very valuable as it reveals information about the organization's potential reactions. As the typology mainly bases on and provides theoretical assumptions, further empirical works on organizational learning are needed to test and verify this framework. Thus, it might be beneficial to use the techniques shadowing or long-term observation of a firm over a longer period of time to see what caused the experience though most of the time this might not even be that obvious for the organizations themselves. Longitudinal investigations might be necessary to gain a full picture to what led to the experience. Taking into consideration the conceptual ideas I have developed, I argue that the source of the experience is not of major importance as the reflection about the experience reveals a call for action.

## **CONCLUSION AND FURTHER RESEARCH**

The question whether and how organizations learn from product failure remains unclear as several barriers to effective learning from failure exist. Moreover, the impact of product-related failure on a firm's innovation strategy has not been explored, yet. Therefore, in this

article, I provide a typology for learning from product-related failure experience. In doing so, I integrate and combine extant concepts and frameworks to explore how learning from product-related failure experience influences an organization's strategic decision making in innovation contexts.

Furthermore, previous studies mainly analyze learning from failure within a single industry such as railroad, mining, airlines or banking industries. I provide a framework that applies to firms from various industries. In the typology I explain the interdependency of different types of experience (own versus others' failure experience) with organizations' strategic decision making. Adopting the typology reveals that product failure associates with different reactions in the short and long-run depending on whether the focal firm or other firms have made the initial failure experience. I further identify current and emerging themes in research on organizational learning from failure experience.

Whether firms learn from product-related failure and change their behavior (to repeat or avoid a certain experience) depends on a systematic and conscious analysis process. I have described a research design to further test and explore the ideas I developed.

The initial theoretical assumptions derived from the framework have clear implications for management and future research. I have pointed out promising future avenues of research to stimulate further work on organizational learning from experience and to raise the discussion among scholars about this topic. While I must take care generalizing the findings here, the evidence presented is a step towards understanding the importance of product-related failure experience as a concept in innovation management (literature), here captured via learning, on strategic decision making in an innovation context. Product-related failure events are to some degree unavoidable in a turbulent world. Being able to cope and manage them to some extent, is a necessary prerequisite for firms in their struggle to prosper and survive. In order to better

understand internal microchanges of behavior once failure hits a complex system such as an organization, we still have a lot to learn.

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APPENDIX

FIGURE 1: The Concept of Organizational Experience

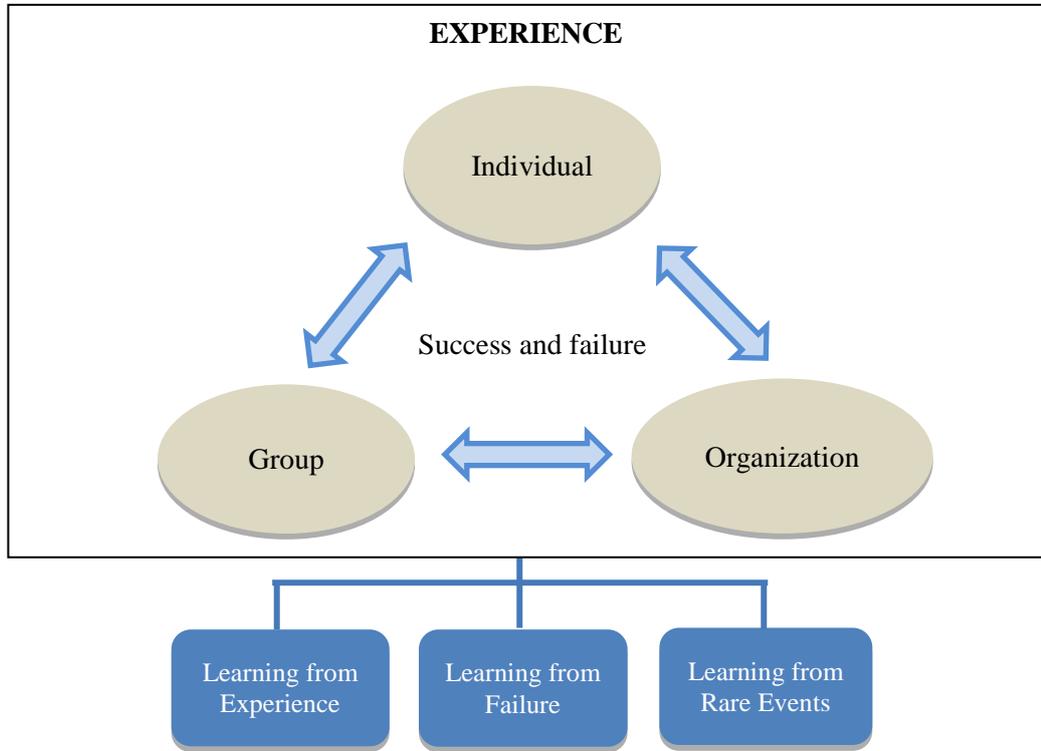
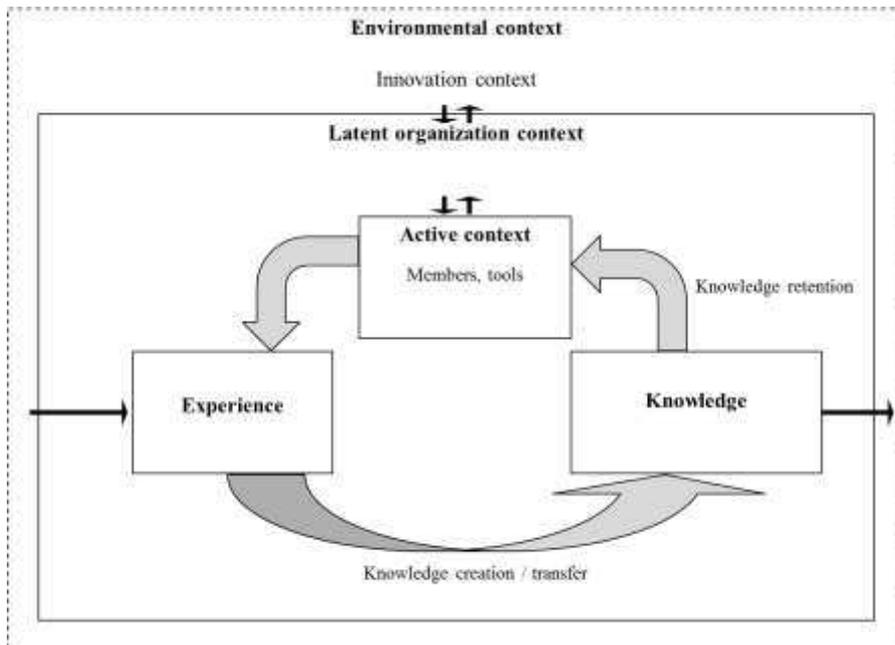
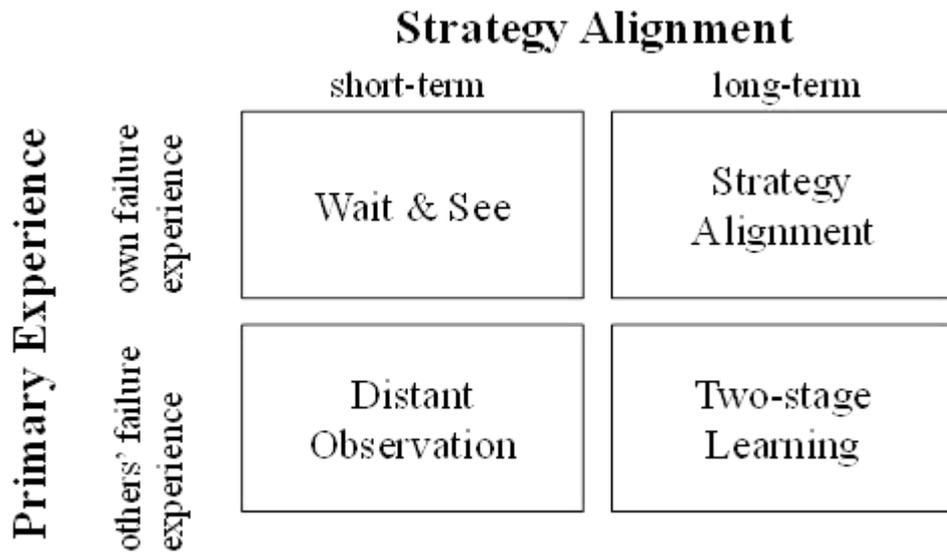


FIGURE 2: Learning from Experience to Knowledge Framework (Argote and Miron-Spektor, 2011, p. 1125)



**FIGURE 3: Typology with Archetypes of Strategic Learning from Failure Experience**



**FIGURE 4: Conceptual Framework for Analyzing Learning from Own Failure and Others' Failure and Strategic Behavior** (learning processes are indicated by a dotted line)

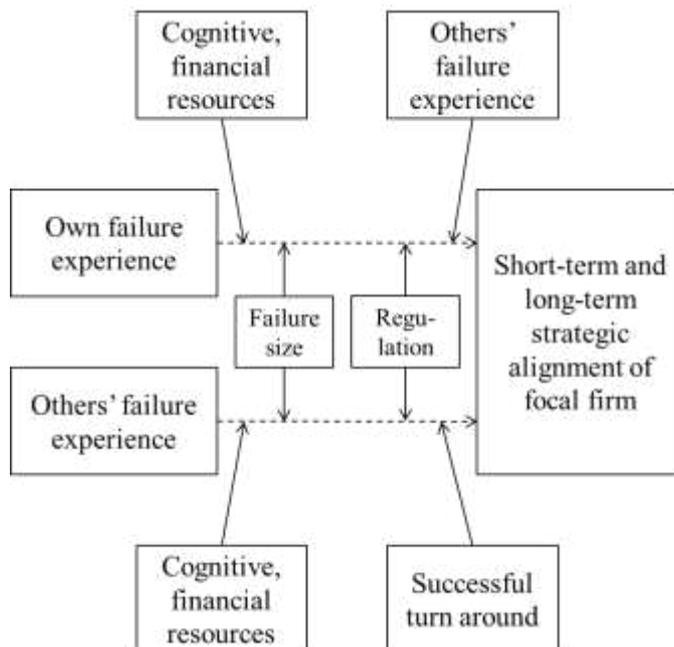


TABLE 4: Dimensions of Organizational Experience

Success (positive) and failure (negative)			
Dimensions			
Spatial	Temporal	Content	Organizational
Geographically concentrated or dispersed	Frequent or <b>rare</b>	Tasks, members	Direct or indirect
	Before, during, after task performance	Ambiguous or easily interpretable	Internal or external
	Fast or slow	Novel or repeated tasks	Naturally occurring or through experiments