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How failure size affects learning in innovation

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Abstract

How Size of Failure Affects Learning from Failure in Innovation

ABSTRACT

Learning is the only process that can turn failure into success. There are multiple of studies about failure and learning from failure, but the literature has remained silent concerning how size of failure affects learning by individuals, groups and organizations. To help fill this gap, we review the extant literature of learning from failure and explore how failure magnitude affects the learning process, the degree to which small failures and large failures entail learning. This is an important issue since the magnitude of failure leads to different learning behaviors under two types of learning: learning from self-experience and vicarious learning (learning from the experience of others). The theoretical contribution made by this paper is an analysis of organizational learning that explicates the linkage between size of failure and learning from failure in innovation activities. The practical contribution, meanwhile, is to help organizations understand the barriers as well as facilitators of learning from failures, and to aid the design organizational mechanisms for learning from failure, thus enhancing innovation in the long run.

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ABSTRACT

Learning is the only process that can turn failure into success. By reviewing extant studies about failure and learning from it, we found that the literature has remained silent concerning how size of failures affect learning by individuals, groups and organizations. To help fill this gap, we explore how failure magnitude affects the learning process, and the degree to which small failures and large failures entail learning. This is an important issue since the magnitude of failure leads to different learning ability under two types of learning: learning from self-experience and vicarious learning (learning from the experience of others). The theoretical contribution made by this paper is the analysis of the linkage between size of failure and learning from failure in innovation activities. The practical contribution, meanwhile, is to help organizations understand the barriers as well as facilitators of learning from failures, and to aid the design organizational mechanisms for learning from failure - thus enhancing innovation in the long run.

Keywords:

Organizational learning, learning from failure, innovation, strategy.

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“Failure is instructive. The person who really thinks learns quite as much from his failures as from his successes.”

John Dewey

INTRODUCTION

Common wisdom teaches us that learning from failure is a fundamental step to success. Cyert and March (1963) argued that firms learn mainly by solving problems rather than from their triumphs. Yet not many organizations learn systematically from failure (Cannon & Edmondson, 2005). In the investigation of Baumard and Starbuck (2005), the focal firm learned surprisingly little from its failures, defying the common expectation. In the context of innovation, where failure rates can be as high as 80% (Pombriant, 2006), failing to learn from failure can be very costly since the lessons associated with failure are a key source of value to be derived from the sunk costs of innovation. Therefore, figuring out why firms fail to learn from failure while innovating would be a beneficial contribution to the understanding of innovation management.

Organizational learning is an important topic in organizational studies and plays a critical role in the innovation process. Learning is one of the pivotal components of innovation activities and is the only process that can turn failure into success. Firms cannot benefit from failure unless they learn from it. However, the mechanisms of learning from failure in innovation activities have not been studied thoroughly and systematically in the literature. There are multiple studies of failure and learning from failure (e.g: Edmondson; 1996; Eggers, 2012; Madsen & Desai, 2010; Miner, Kim, Holzinger, & Haunschild, 1999; Sitkin, 1992), however, it is still unclear how the magnitude of a failure affects the learning derived from it. We plan to fill this gap by reviewing the extant literature on learning from failure; including how individual-level and contextual predictors at group- or organization-level work in concert to create the conditions leading to—or impeding—learning from failure in organizations. At the same time, we will explore how the size of failure affects the learning process, the degree to which small failures

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and large failures entail learning. This is an important issue since we found that the magnitude of failure leads to different learning behaviors under two types of learning: learning from self-experience and vicarious learning (learning from others). Observing this difference can enhance the understanding of how to design organizational learning mechanism in order to enhance learning from failure.

The theoretical contribution made by this paper is a synthesis and integration of organizational learning, applied psychology and innovation literature that facilitates exploring the linkage between failure and innovation. The paper also contributes to learning literature by providing a fine-grained analysis of learning from failure at different levels and exploring the linkage between failure's magnitude and learning from it. The practical contribution, meanwhile, is to help organizations develop a better attitude towards failure in the innovation process. It also helps organizational practitioners to understand the barriers as well as facilitators of learning from failure so that they can design appropriate learning mechanism for learning.

The structure of this paper is three parts: First, we review literature and define what failure means. We also examine how to categorize failure and learning from failure. Next, we summarize factors that impede learning from failure and propose how the size of failure affects learning. Finally, we include a discussion about how to design organizations for learning from failure systematically.

LITERATURE REVIEW

Organizational Learning

Organizational learning theory is as an important topic of organizational theory (Argote & Miron-Spektor, 2011) and has been examined by many intellectual traditions (Fiol & Lyles, 1985; Hedburg, 1981; Huber, 1991; Shrivastava, 1983). Fiol and Lyles (1985) observe that no theory of organizational learning is widely accepted, thus we decide to choose the definition which is best suited for our research topic: "Organizational learning as a process in which an organization's members actively use data to guide behavior in such a way as to promote the ongoing adaptation of the organization" (Edmondson & Moingeon 1998, p. 28). This framing

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implies that organizational learning is a process and this process can be initiated, developed, and practiced by its members, i.e. individuals or groups.

Organizational learning occurs at different level of analysis, from individual to organizations (Edmondson & Moingeon, 1998). Although organizational learning is clearly mediated by its members' individual learning, it cannot be said that organizational learning is simply an aggregation of individual learning. Popper and Lipshitz (2000) provide a good comparison between these two levels of learning and propose the conditions under which models of individual learning can describe organizational learning. The similarity between individual learning and organizational learning is that they both comprise the same phases of information processing: collection, analysis, abstraction and retention. However, they are different in two aspects: (1) the information processing activities take place at different structure and systemic level, and (2) organizational learning has one more phase compared to individual learning: dissemination phase. Dissemination here means "the transmission of information and knowledge among different persons and organizational units" (Popper & Lipshitz, 2000, p. 41) which is a very important mechanism to transfer learning from organizational memory across the organization.

Group learning acts as a bridge between individual learning and organizational learning. On the one hand, it is the context and the setting where individual learning takes place. On the other hand, it is the key source to generate lessons to store in the organization memory. Therefore, learning in teams do not only develop knowledge and skills of individuals who compose the team, but also benefit the whole organization. (Edmondson, Dillon, & Roloff, 2007).

Learning from Failure

In their theoretical framework, Argote and Miron-Spektor (2011) depict organizational learning as an ongoing cyclical process through which experience from task performance is converted into knowledge, which in turn changes the context and affects future experiences of the organization. In brief, organizational learning is regarded to as "change in the organization's knowledge that occurs as a function of experience" (p. 1124) and this knowledge may entail changes in cognition or behavior and can be embedded in individual and transactive memory systems and routines. The framework and definition highlight the central role played by

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experience as both the starting point and the end point of organizational learning. Examining learning from experience at a more fine-grained level of analysis, and along various dimensions is an emerging theme in the literature on organizational learning (Argote, McEvily, & Reagans, 2003). One advantage of a fine-grained analysis is that it distinguishes different ways of learning from experience. For example, learning from success is different from learning from failure in terms of cognition and behavior. In their article “The myopia of learning”, Levinthal and March (1993) address three limitations of organizational learning including overlooking failure which points out that organizations tend to focus on analyzing success and translating it into knowledge rather than examining failure and learning from that. Organizational experience tends to over-sample success, and under-sample failure (Levinthal & March, 1993). But since organizational experience will over time regresses to the mean (Harrison & Bazerman, 1995) and organizational innovators and learners are likely to experience post-decision disappointment (Harrison & March, 1984). In this paper, we focus on learning from failure with an attempt to ameliorate the myopia of learning and contribute to a greater understanding of the processes by which failure can enhance learning.

Table 1: Benefit of failure

Level of analysis	Benefit of failure	Source
Individual / Team /Organization level	Draw attention to potential problem	Sitkin (1992)
	Provide clear signal that facilitate the recognition and interpretation.	
	Stimulating search processes for potential solutions	
	Produce a learning readiness and motivation to adapt	
	Increase risk tolerance	
	Create more variety in personnel and procedures	
	Facilitate practicing that is relevant to future unforeseen problems	
Interorganizational level	Imitation of successful practices	Miner et al (1999)
	Inferential learning (about the causes of failure, to develop theory for success)	
Population level	Removal of routines (unsuccessful routines)	
	Industry consolidation (mergers and acquisitions)	
	Compensating action (from government activity and industrial-level cooperation effort)	
	Creation of new entity	
	Alerting effect	
	Second-hand legitimacy (promote the new practices)	

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Learning from failure as a theme has emerged in recognition of the fact that “failure is an essential prerequisite for effective organizational learning and adaptation” (Sitkin, 1992, p. 231). Miner and her colleagues (1996) also emphasize “organization failure as a potential engine for learning on an interorganizational or population level” (p. 239). The potential benefits of failure at different levels are summarized in Table 1. Sitkin (1992) claims that small failures which provide small doses of experience are even more effective for organizations as a source of learning than is success because it help to discover uncertainties unpredictable in advance. On the other hand, Miner and her colleagues (1999) look at failures at the other end of the spectrum, large-size failures which lead to the collapse of organizations, and find that they are actually beneficial at the interorganizational and population levels.

Among those benefits, we choose to analyze the benefits of failure which potentially drive innovation in organizations. In a nutshell, there are several ways that failure can benefit innovation:

a. By stimulating search processes:

Failure to meet aspiration levels triggers problemistic search (Cyert & March, 1963). If the failure is large enough it acts as a shock trigger (Van de Ven et al., 2008) to draw organizational attention to problems and stimulate the search for potential solutions, and this search process can lead to innovation. There are two possible ways of innovating: either by search (Cyert & March, 1963; Gavetti & Levinthal, 2000; Levinthal & March, 1981) or by unintentionally discovering innovative solutions (Cohen, March, & Olsen, 1972). Since the first category is the only one that is possible to control directly, it has been the focus of most of the literature. Search can have different depth and scope. Depth is tied to the intensity of exploitation the firm is performing, while scope is tied to how wide a scope the search involves (Katila & Ahuja, 2002; Laursen & Salter, 2006). The depth of the search tells how aggressive the firm is at performing exploitative behavior, while scope refers to explorative behavior. While depth search is important for finding new ways of combining existing innovations and knowledge, scope search is crucial for finding new innovations and knowledge.

b. By producing learning readiness and motivation to change:

The experience of failure creates a learning readiness and motivation to adapt which organizations hardly possess under normal circumstances. The ability to adapt and to change has long been considered to be crucial for the long-term survival of the firm. While most

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organizational ecologists would argue that firms are mostly immutable after their creation, other branches of organizational theory agree that despite of most firms are indeed slow to change, some are able to do so and remain competitive through turbulence and over time. Dynamic capabilities is a concept closely tied to the ability to change, even if there is an ongoing discussion on even the basic assumptions underlying the concept (Peteraf, Di Stefano, & Verona, 2013). The original idea behind dynamic capabilities originates from Nelson and Sydney's (1982) work on capabilities, resources and routines in general, and deals with the mutability of them. Since being successful in innovation activities is inherently about changing one's resources for competition by leveraging capabilities and routines, having dynamic capabilities is crucial for innovative firms. Central to this dynamism is being able to react to changes, and failure is one such change. Only failure, not success, can trigger the motivation for change and this motivation helps firms produce a learning environment to prepare for the surrounding change.

c. By increasing risk tolerance:

Prospect theory (Kahneman & Tversky, 1979) proposes that experience of failure is associated with risk-seeking behavior and success is tied to risk aversion. This risk-taking attitude is beneficial for innovation: tolerance for risk and failure spurs corporate innovation, willingness to take risk will help catching valuable opportunities (Tian & Wang, 2011). Another benefit of risk-taking is the willingness to experiment when facing complex problems rather than choosing the safer route of risk avoidance (Wildavsky, 1988). The willingness to experiment will help firms to explore new alternatives, thus come up with new solutions and innovation.

d. By facilitating practices that will help solve future potential problems:

The willingness to learn by trial and error that organizations develop after experiencing failure offers them the opportunity to practice solving problems, which may also be useful for future unforeseen problems. The slogan "Fail often in order to succeed sooner" was coined by IDEO, a leading design firm, to emphasize the benefit of small failures that can help them fail small and fail fast in the practice process in order to test out many possibilities before coming up with an innovation (Zuber, Alterescu, & Chow, 2005). In the process of testing and failing, firms can strengthen their procedures, ability for problem setting and problem solving, thus increase their adaptation and innovative capability. Failure helps firms draw the attention to previously

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overlooked problems and conflicted norms in the organization, thus challenges the current procedures and practices which is an essential step for change and innovation.

- e. By generating signaling effects and facilitating vicarious learning:

Unlike the above benefits that organizations can attain from their own failures, this type of benefit is tied to indirect learning, or learning from others. Information about the dramatic downturn of a major firm can trigger others to figure out whether they also have similar issues. Also, firms can conduct inferential learning to find out the causal mechanisms behind others' failures and thus develop a theory of success, which they then try to put into action (Miner et al., 1996). This inferential learning of an organization from others' experience is conditioned by the organization's performance relative to aspiration, and findings show that organizations benefit more from the experience of other firms in the industry and less from their own experience when their performance deviates from aspiration levels (Baum & Dahlin, 2007). The implication is that learning from others' experience, and especially others' experience of failure, will foster non-local search (Siggelkow & Levinthal, 2005) and might lead to more exploratory activities, which in turn induces innovation.

Fail to Learn from Failure

Despite the numerous benefits that failure can provide, learning from failure might not happen in practice, thus creating a double loop failure: failure and failing to learn from the failure. At the end, the subject who failed not only loses the resource and effort spent but also dismisses all the possible benefits that failure can bring. There are several reasons why learning from failure is so difficult, first and foremost is learning barriers. Schilling and Kluge (2009) develop a theoretical foundation to describe and explain impediments to organizational learning. Including factors that impede learning, which prevent us from recognizing errors and thus from correcting mistakes. In this section, we focus on factors that impede learning from failure. These are, although failure has happened and been recognized, factors that impede individuals, groups or organizations from learning from that failure. We categorize those factors into four groups: psychological factors, technical and social barriers, contextual factors and failure characteristics. These factors are not independent but interact with one-another which makes learning from failure even more complicated.

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Psychological Factors: These are factors referring to thoughts, feelings or cognition can affect people's attitudes, behaviors and decisions. Negative emotional response and cognitive bias toward failure are psychological factors that impede the learning from failure.

Negative emotional response refers to uncomfortable feelings aroused by dissatisfaction with failure outcomes such as grief, trauma or fear. Learning from failure occurs when individuals use information available to analyze why failure happens in order to revise their original assumptions about the consequences of their previous assessments and decisions (Shepherd, 2003p. 320). Grief is a negative emotional response to failure, some symptoms of grief are anger, guilt and self-blame, distress and anxiety (Shepherd, 2003). Those negative emotions "interfere with individuals' allocation of attention in the processing of information" (Shepherd, 2003, p. 320) that hinder the ability to learn from a negative event. Trauma is another dissatisfactory response that deprive individuals from their ability to learn from the potentially experience (Välrikangas, Hoegl, & Gibbert, 2009), for example, innovation trauma is "an inability to commit to new innovations due to severe disappointment from previous innovation failures... that inhibits the personal and emotional investment necessary to achieve high innovation performance henceforth" (p. 226). Trauma breeds disillusionment, causes cynicism and spreads demotivation to others. Fear of blame and punishment is observed in Baumard and Starbuck's study (2005): "individuals do not freely and openly share knowledge about the mistakes they have made" (p. 283) because of a fear of blame and punishment, more than that, "painful outcomes generally stop existing behaviors without stimulating efforts to change". Thus, learning from failure cannot be realized if one is immersed in those negative emotions.

Cognitive bias refers to systematic and frequent deviation from standard judgment or a norm due to tendencies to think or inference in certain ways (Caverni, Fabre, & Gonzalez, 1990). There are many phenomena that qualify as cognitive bias; however, we focus on two prominent types of cognitive bias that prevent us from learning from failure: attribution bias and escalation of commitment. Attribution bias originates from the psychology literature. In social psychology, attribution is a process of referring to the perception or inference of cause (Kelley & Michela, 1980). Attribution theory explained that individuals generally ascribe failure to external factors which they classify as idiosyncratic and exogenous causes (Weiner, 1985), and thus they do not question the validity of their core beliefs. One example can be found in Baumard and Starbuck's

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article (2005) which investigate 14 strategic failures over a period of two decades at Eurocom. The empirical findings show that learning from failure might not happen because managers tend to dismiss small failures as random events and do not change their basic assumptions. On the other hand, they also write off large failures as having idiosyncratic and exogenous causes since they see no relation between new large failures and previous ones and because large failures develop over long periods and are concealed until they can no longer be hidden and are therefore considered as past events with ex-post accountabilities. Escalation of commitment is the behavior that describes the action of individuals proceed consistently to commit a greater amount of resource for decisions they are personally responsible especially when receiving negative results (Staw, 1981). There are two processes producing the escalation effect: firstly, decision-makers who initiate course of action and feel personally responsible for the decision outcomes become psychologically committed to the chosen course of action; secondly, receiving negative performance feedback invokes a self-justification process in which decision-makers attempt to turn the situation around or to demonstrate their ultimate rationality (McCarthy, Schoorman, & Cooper, 1993). These processes prevent decision-makers to learn from their failures.

Technical and Social Barriers: Cannon and Edmondson (2005) found that even if companies commit to learning from failure by significant investment of money and effort, they still struggle to overcome the barriers embedded in technical systems and social systems. Individuals who have inadequate understanding of the scientific method and inability to engage in rigorous analysis due to limited cognition find it very difficult to understand the complexity of technical systems, which can be considered technical barriers, hence unable to figure out why they fail and could not learn the lessons entailed. Barriers embedded in social systems refer to the stigma of failure in which others hold negative attitude toward members who experience failure. It is not easy to reveal failure since organizational structures, policies and procedures discourage people from identifying, analyzing and sharing their failure. Discussion about failure “can easily degenerate into opportunities for scolding, finger-pointing or name-calling. Public embarrassment or private derision can leave participants with ill feelings and strained relationships rather than learning” (p. 303). As a result, organizations could not learn systematically from failure and the managers do not even have a clear understanding of how a proactive process of learning from failure should be. This finding explains why in some cases firms can learn from failure in innovation activities while in other cases they fail to learn.

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Contextual Factors: Contextual factors refer to organizational factors (e.g, strategy, structure, culture and system) which are designed for single-loop learning and thus, inhibit the double-loop learning (Argyris & Schön, 1978). In their book *Organizational learning: A theory of action perspective*, Argyris and Schön found that most organizations learn well in single-loop but face great obstacles in double-loop learning because of the inhibitory loops. They explained that the inhibitory learning loops are self-reinforcing processes that provoke behaviors which reinforce errors and conditions for errors, i. e. properties of organizational information such as inappropriate rules, norms and standards, operating procedures, which make errors uncorrectable. These inhibitory loops which inhibit learning about organizational problems come from original design of organization which was calculated ahead of time about what organization needs to accomplish its task effectively in a single-loop learning way. Due to limited human cognition, the organizational designs were imperfect and incomplete which need continual reflection and monitoring to meet challenges from the external environmental changes as well as internal counterproductive environment. This requires second-loop learning, i.e. reflect on the errors and change the norms accordingly, a competency that unable to develop in the original design.

Failure Characteristics: Failure characteristics are other important factors that make learning from failure complicated. Failure events provide infrequent data (March, Sproull, & Tamuz, 1991) that are hard for managers to interpret correctly, thus they cannot reach consensus on the causes of failure, especially in fast-changing environments (Eggers, 2012). One important aspect of failure characteristics is its magnitude, and this factor has a different impact on different types of learning. The size effects of failure on learning which are produced together with psychological factors, technical and social barriers as well as contextual factors will induce different behaviors on learning. We will present this effect of failure magnitude later in this paper.

FAILURE AND SIZE OF FAILURE

Failure Definition:

There is no clear consensus on a precise definition of failure in the literature (Mellahi & Wilkinson, 2004). Sitkin (1992) describes five criteria for “intelligent failure” (p. 243) of small or moderate sizes, Mellahi and Wilkinson (2004) use exit, death, mortality and failure

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interchangeably at the organizational level when depicting large-size failure. Cannon and Edmonson (2005) define failure as “deviation from expected and desired results... This includes both avoidable errors and unavoidable negative outcomes of experiments and risk taking” (p. 300), covering both large and small failures. Despite the lack of a definitional consensus, definition of failure generally rest upon two shared traits:

- (1) Failure generally has negative consequences, even though the final outcomes of failure may be positive, i.e. firms may learn from failure (Miner et al. 1996);
- (2) the definition does not specify the causes of failure, and it takes into consideration both organizational and environmental factors (Mellahi & Wilkinson, 2004, p. 22).

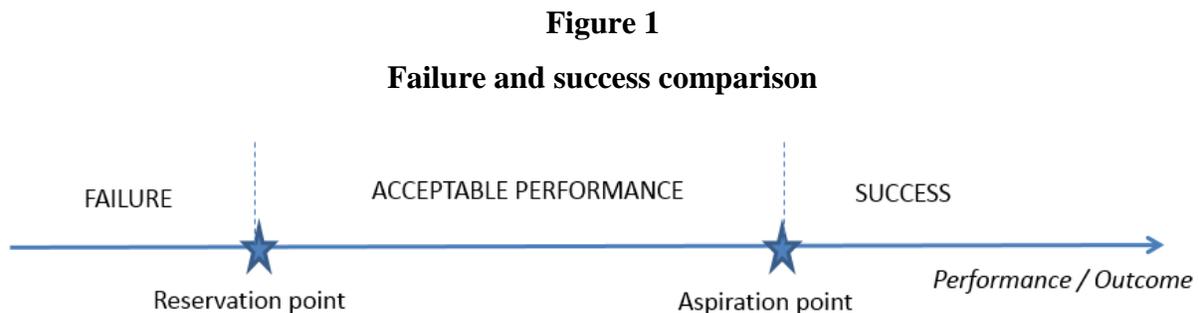
A common definition of failure is to not achieve a desirable or intended goal. However, in many situations it would be excessive to consider not meeting an intended goal a failure. For example, if a student gets grade B rather than grade A as desired, this arguably should not be considered a failure but a moderate level of performance; if a sales department does not meet the organization’s yearly sales stretch target, this is not a case of failure but simply of low performance; if a company misses an internal deadline for developing a new product but successfully launches the product soon afterwards, the missed deadline does not represent failure but merely delayed success.

In order to define what failure really is, we borrow the term reservation point from negotiation literature (Raiffa, 1982). Reservation point represents “the minimum or maximum acceptable settlement price within the current negotiation, depending on whether the negotiator is a seller or a buyer, respectively” (White & Neale, 1991, p. 380). Failure is determined when the outcome is worse than reservation point, i.e. unacceptable result. Therefore, we define failure as not meeting a reservation point of performance, which is the lowest acceptable outcome, of an individual, a group or an organization. Not being able to pass an exam is considered a failure by a student, negative profit is considered a failure for a sales department, going out of business is considered a failure for a company.

There are several noteworthy points to discuss in this definition of failure. First of all, failure is outcome-based event which is different from mistake which is considered an input. Schoemaker (2011) defines a mistake as “a decision, an action, or a judgment that is less than optimal, given what was possible to know at the time” (p. 13) in which he emphasizes the input side of mistakes

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rather than the end result. Failure is also different from error, defined as “unintended deviations from rules or procedures... that can potentially result in adverse organizational outcomes” (Goodman et al., 2011, p. 152), which emphasizes the process side. Second, failure as an outcome is, although often objectively measured, subjectively interpreted and context dependent. For example, the grade of a student, which is measured based on grading scale with objective criteria, can be interpreted in different ways. If the student only wants to pass the exam, which is the reservation point in this case, B is a moderate success. However, if his or her reservation point is to get accepted into the prestigious university which recruits only students with A results, B can be considered failure. This example also illustrates the context-dependent feature of subjective interpretation: in the context of the subject, that student does not fail; yet in the context of university entrance, getting a B is a failure. Third, the notion of reservation point is used to determine failure should be distinguished from the aspiration point which is used to define success. Aspiration level is commonly regarded as subjective goal for performance and serves as the reference point for feelings of success or failure (Starbuck, 1963). If we use this aspiration point to decide failure, it fails to account for near-misses or good-enough answers (Schoemaker, 2011). For example, the soccer ball that glances past the goal or the actual growth in GNP was 3.05% instead of 3.1% as desired. Thus, between reservation point and aspiration point, between failure and success, there are still acceptable performances that should not be evaluated as failure. Figure 1 illustrates how this continuity of performance outcome is transformed to discrete measures of success, acceptable performance and failure by reservation point and aspiration point. Fourth and finally, similar to aspiration level, reservation point used to define failure changes with experience. The more experience accumulated with the task, the more reservation point moves toward aspiration point as a result of learning.

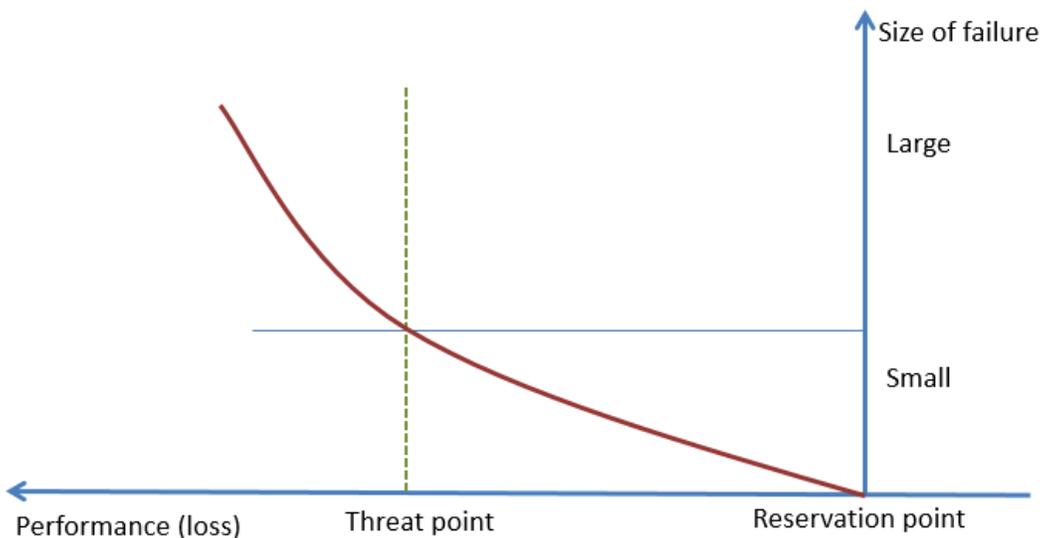


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Size of Failure Definition:

The magnitude of failure is another controversial issue. It is not always easy to tell if a failure is small or large. Size of failure is different according to industry, business, organization and individual. Most importantly, the size of the failure is not always immediately apparent. Kodak's decision not to lead the development of digital photography was OK for several decades, but utterly devastating in the end. This temporal aspect of failures, makes the assessment of failure size tricky business indeed. One study that provides important insight for defining whether a failure is small or large is Shimizu (2007). In this study, he combines prospect theory, behavioral theory and threat-rigidity theory to predict organizational reactions to different degrees of loss. He introduces two different reference points: "one that determines losses and gains, and another that determines ruinous and non-ruinous losses" (p. 1498). His first reference point is similar to the reservation point we addressed above. The latter reference point is referred to as "threat point" which we find useful to imply the large size failure. According to prospect theory, when performance of an individual is below the reservation point, he or she becomes more risk-seeking. However, threat-rigidity theory suggests that once potential losses reach a threat point, that person would behave rigidly and thus, not be able to act. Combining these two perspective, we suggest that when performance ranges from reservation point to threat point, the failure associated is considered small. When performance is below threat point, the failure is considered large. This concept is illustrated in figure 2 below:

Figure 2: Size of failure in terms of reservation point and threat point



Types of Failure and Learning from Failure in the Literature

Failure phenomena have been studied in many industries as can be seen in Table 2: health care (Edmondson, 1996; Goodman et al., 2011), hotel chains (Ingram & Baum, 1997), airlines (Haunschild & Sullivan, 2002), nursing home chains (Chuang & Baum, 2003), automotive industry (Haunschild & Rhee, 2004), telecom (Baumard & Starbuck, 2005), railroads (Baum & Dahlin, 2007), banking (Kim & Miner, 2007), global orbital launch vehicles (Madsen & Desai, 2010), flat panel displays (Eggers, 2012). Miner and her colleagues (1999) have examined 50 failure events in 33 industry histories to assess the effects of failures on other organizations and industry wide practices. With such a variety of industries, the validity and reliability of common findings in those papers are highly generalizable. Two common typological themes of failure and learning can be observed from the literature and will be presented below.

The first theme relates to the size of failure. Most of the papers in our literature review distinguish between two types of failure: modest-scale failure with small losses and large-size failure with big losses. While only Sitkin (1992) focuses on small losses, there are five papers that specifically focus on large-size failures that can lead to the termination of organizations. For example, cessation of hotel services and permanently being delisted from the Redbook of hotel list (Ingram & Baum, 1997), organizational death and poor financial performance or being acquired by another firm (Miner et al. 1999), de-licensing of nursing homes (Chuang & Baum 2003), liquidation or merging of banks (Kim & Miner 2007), and exit or death of organizations (Mellahi & Wilkinson 2004). The other five articles choose a balanced approach and discuss both small and large failures. The implication of separating failures in terms of magnitude is that “not all failures are of equal value in promoting organizational learning. Specifically, theorists have argued that the magnitude of a failure impacts organization members’ abilities to learn effectively from it” (Madsen & Desai, 2010, p. 457).

This leads to the second theme: types of learning from failures. The common typology for learning from failures distinguishes between learning from one’s own failures (direct learning) and learning from the failure of others (vicarious learning). From Table 2, we can see that articles related to large failure also point to direct learning, and articles related to both types of failure refer to both types of learning. This observation infers that small failure facilitates learning from one’s own experience while large failure is beneficial for learning from others. Sitkin (1992) focuses on small failures for that reason, and he argues that organizational

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TABLE 2 Types of failure and learning from literature review

Article	Level of analysis	Industry	Failure as IV/DV	Definition	Type of failure			Type of learning				
					Small failure	Large failure	Other	Learning from own's experience	Learning from others' experience	Other	n/a	
Sitkin (1992)	Organization	-	IV	Intelligent failure: those are most effective at fostering learning (5 criteria)	x			x				
Edmondson (1996)	Group	Health care	DV	Failure = patient adverse drug events.			Preventable, nonpreventable, potential, interception					x
Ingram & Baum (1997)	Interorganization	Hotel chain	DV	Failure = cessation of hotel services (permanently delisted from the Redbook)		x			x			
Miner et al. (1999)	Interorganization & Population	Cross-industry	IV	Failure = organizational death; near failure = poor financial performance or acquired by another firm		x			x			
Starbuck & Hedberg (2001)	Organization & Population of organizations	-		Moderate failure = "intelligent failure" (Sitkin 1992); chronic failure = dramatic reorientation	x	x		x	x			
Hauschild & Sullivan (2002)	Organization	Airlines	DV	Failure = accident & incident (errors)			Homogeneous cause & Heterogeneous cause	x (specialist)	x (generalists)			
Chuang & Baum (2003)	Interorganization	Nursing home chains	IV	Failure = de-licenced nursing home		x		x	x			
Tucker & Edmondson (2003)	Organization	Health care	DV	Failure = errors or problem			Process failure & problems				First-order problem solving and second-order problem-solving	

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Article	Level of analysis	Industry	Failure as IV/DV	Definition	Type of failure			Type of learning				
					Small failure	Large failure	Other	Learning from own's experience	Learning from others' experience	Other	n/a	
Mellahi & Wilkinson (2004)	Organization	-	DV	Failure = exit, death, mortality		x						x
Hauschild & Rhee (2004)	Organization	Automotive	DV	Failure = recall of automakers			Voluntary recall and involuntary recall	x			Voluntary learning and involuntary learning	
Baumard & Starbuck (2005)	Organization	Telecom	IV	Failure = unsuccessful venture	x	x		x				
Baum & Dahlin (2007)	Organization	Railroad	DV	Failure = railroad accidents	x	x		x	x			
Kim & Miner (2007)	Organization & Population of organizations	Banking	DV	Failure = liquidated or merged		x				x		
Madsen & Desai (2010)	Organization	Global orbital launch vehicle	DV	Failure = failed launch	x	x		x	x			
Goodman et al (2011)	Multi-level	Health care	DV	Failure = organizational errors (consequences are death, costs, reputation)		x						x
Edmondson (2011)	Organization	Cross-industry		Failure is not always bad			Preventable; unavoidable; intelligent					x
Eggers (2012)	Organization	Flat panel display	IV	Failure = losing / failed technology			Strategic failure	x			Learning from failure vs learning from success	

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responses to large and potentially threatening losses are more likely to be protective than exploratory, therefore, “large failures are less likely than modest ones to be effective in translating that attention into the activation of search processes” (p. 238). However, large failures are very good at drawing attention, so they are valuable for learning at the population level. This implies organizations have different learning behaviors for each type of failure. This is one of the reasons why learning from failure is not easy: organizational learning mechanisms are not designed optimally for learning from all types of failures, they might focus on only one type and ignore the other. We will discuss this point further next part.

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We have addressed the benefit of failure if organizations capture the lessons to be learned from it. On the one hand, learning from failure becomes an emerging theme to which academic researchers and practitioners pay close attention and many works have been produced with instructions on how to learn from failure step by step. On the other hand, failing to learn from failure is also pointed out in many studies (Baumard & Starbuck, 2005; Cannon & Edmondson, 2005; Tucker & Edmondson, 2003). In this section, we will explore the interaction between failure sizes and learning from failure in order to explain why failure can be learned in some cases and not in other cases. Learning behavior is examined at the granular level of analysis: individual level. Individual learning serves as a micro-foundation for group learning as well as organizational learning and thus, it is essential to analyze size effect of failure on individual level before we can move on to organizational level. We define individual learning as learning occurs as a result of an experience which leads to change in a person’s knowledge or behavior. As observed from Table 2, we divide learning behaviors into two categories: direct learning and vicarious learning.

Direct Learning

Learning takes place when the observation of experience entails change in actions or rules of action (White & Neale, 1991). Direct learning means learning from own experience and direct observation. This is a mechanism to improving fit of individuals or organizations to the environment they face. Experiential knowledge is seen as a necessary component of human

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claims to intelligence. Source of direct learning can come from many, including success and failure.

The process of learning from direct failure can be explained as follow. Failure sends signal to the individuals that the situations are problematic or threatening which motivates them to take actions to remedy their current situation. The failed events usually include errors which individuals detect by comparing actual outcomes with expected outcomes (Allwood, 1984). Errors help the individual to discover the misunderstandings and thus develop thoughtful strategy to learn and to alter one's mental models that is supposed to lead to new solution (Ellis & Davidi, 2005).

However, individuals do not always learn from failure because of the abovementioned barriers: psychological factors, technical and social barriers and contextual factors. Therefore, plenty of empirical studies have addressed the issue of the inability to learn from failure (Baumard & Starbuck, 2005; Cannon & Edmondson, 2005; Edmondson, 1996; Tucker & Edmondson, 2003).

The question posed here is that, under which circumstances individuals learn from failure and under which circumstances they do not. Our explanation is that individuals learn when experiencing failure by comparing actual with expected outcome (Ellis & Davidi, 2005); however, when size of failure increases to a significant point, individuals cannot overcome the barriers of learning from failure and stop to reflect on their failures. The barriers of learning have been mentioned above: psychological factors, technical and social barriers, contextual factors.

The result is that, the individuals learn directly from their own experience of small failures but fail to learn from their own large failures. This means, size of failure plays a significant role in learning behavior.

In addition, the size of small failure should be sufficiently noticeable that it can cause individuals to change decision-making behavior (Eggers, 2012). If the size of failure is too small, individuals might choose to ignore that failure and treat it as random events, hence they do not challenge the basic assumption and would not learn from it as we can see in the case of Eurocom (Baumard & Starbuck, 2005). Combining these behaviors, the relationship between direct learning and size of failure is reflected in the following proposition:

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Proposition 1. Above a certain threshold of failure size, learning from a direct failure increases with the size of failure up to a point upon where further increases in failure size decreases learning (inverted U-curve relationship).

Vicarious Learning

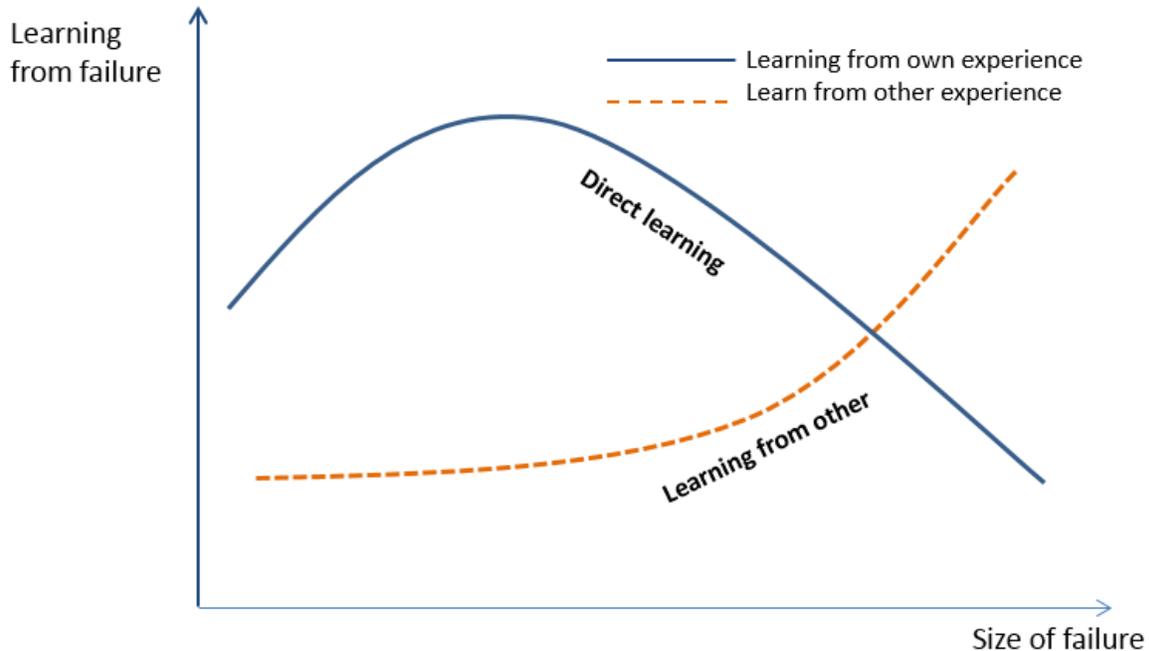
There is a growing literature arguing that vicarious learning from others' experiences is an important way to acquire knowledge. Normative theories and management advice frequently emphasize finding "best practices" as a means of learning from currently successful organizations, sometimes through "benchmarking" procedures. Therefore, individual and organizations can also learn from the failures of others. (Kim & Miner, 2007). Firms can observing failures of others and evaluate their current contexts in order to determine if they can be under similar situation. By avoiding failed strategies and actions, firms can increase their chance of survival as a result of vicarious learning.

It is entirely possible to learn from the large failures of others as information about such failures is normally available from public sources (Miner et al., 1996). In order to prevent oneself become trapped in similar failed situations, individual will use such available information to analyze the causal mechanism of failure, to relate to his or her own experience and to reflect on oneself in order to capture the lessons from such incidents. However, it is difficult to learn vicariously from small failures of others because details about them are not widely publicized or available. Without detailed information and being in similar contexts, individual could not interpret the results correctly and thus, it is difficult to learn from small failures of others. Therefore, we offer the following proposition:

Proposition 2. Vicarious *learning from others' failures* increases with the size of failure.

Proposition 1 and proposition 2 are illustrated in figure 3 below.

Figure 3: Relationship between learning and size of failure at individual level



From Individual Learning to Organizational Learning:

We have discussed how learning behaviors of individuals differ when size of failure changes. Another concern is whether organizations manifest similar learning behaviors as individuals. This section will focus on such issue.

Popper and Lipshitz (2000) comment that individual learning is similar to organizational learning as they both comprise the same phases of information processing: collection, analysis, abstraction and retention. However, organizational learning has one more additional phase that is dissemination. Learning builds on past knowledge and experience which stored in organizational memory, and disseminates in the organization through organizational learning mechanisms.

There are two approaches to learn from success and failure in theories of learning: behavioral approach and cognitive approach (Starbuck & Hedberg, 2003). Behavioral approach “portrait learning as a mechanistic and involuntary process over which learners can exert little control” (p.330), actors behave without allowing for conscious thought so learning automatically

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arises from performance feedback. As a result, environments which generate feedback have strong influence on what is learned. Although ignoring the rationality of learners, this approach can explain how actors can learn effectively despite their perceptual errors. The second approach, cognitive learning, “describes learners as cognitive beings that perceive, analyze, plan and choose... Learning modifies cognitive maps that form the bases for analysis, and analysis guides action” (p.333). Even if this approach cannot explain how learners can improve although sometimes they misunderstand the concept, it gives explanation to how people and organization can act in novel ways and find opportunities, threats, shortcuts and conceive innovation. The two contrasting approaches are complementary to each other, and it is difficult to disentangle the combination of both approaches that occur concurrently in daily life.

Organizational learning mechanisms are “institutionalized structural and procedural arrangements that allow organization to systematically collect, analyze, store, disseminate and use information that is relevant to the performance of organization and its member” (Popper & Lipshitz, 1998, p. 170). An organizational learning mechanism can also be a tool to integrate the two above approaches. On the one hand, members in the organization can learn behaviorally and vicariously by following structure and procedure arranged by the mechanism. On the other hand, the mechanism will enable them to learn cognitively as it will create an environment that encourage members to understand, analyze and disseminate the knowledge of learning from failure. Therefore, we suggest that organizational learning mechanism is an effective tool to disseminate knowledge which helps transfer learning from individual level to group level and to organizational level. Thanks to learning mechanisms, organizational level learning from failure will increase when its members increase their learning from failure. However, when its members learn little from failure, organizations learn little from failure as well. Although information stored in routines, which means standard procedures and scripts would not be loss despite of turnover, the ability to learn from failure of organizations will decrease if its members do not learn from such incidents. Therefore, we propose that:

Proposition 3. Given that organizations implement systematically learning mechanism, organizational learning from failure increases when individual learning from failure increases, and decreases when individual learning from failure decreases.

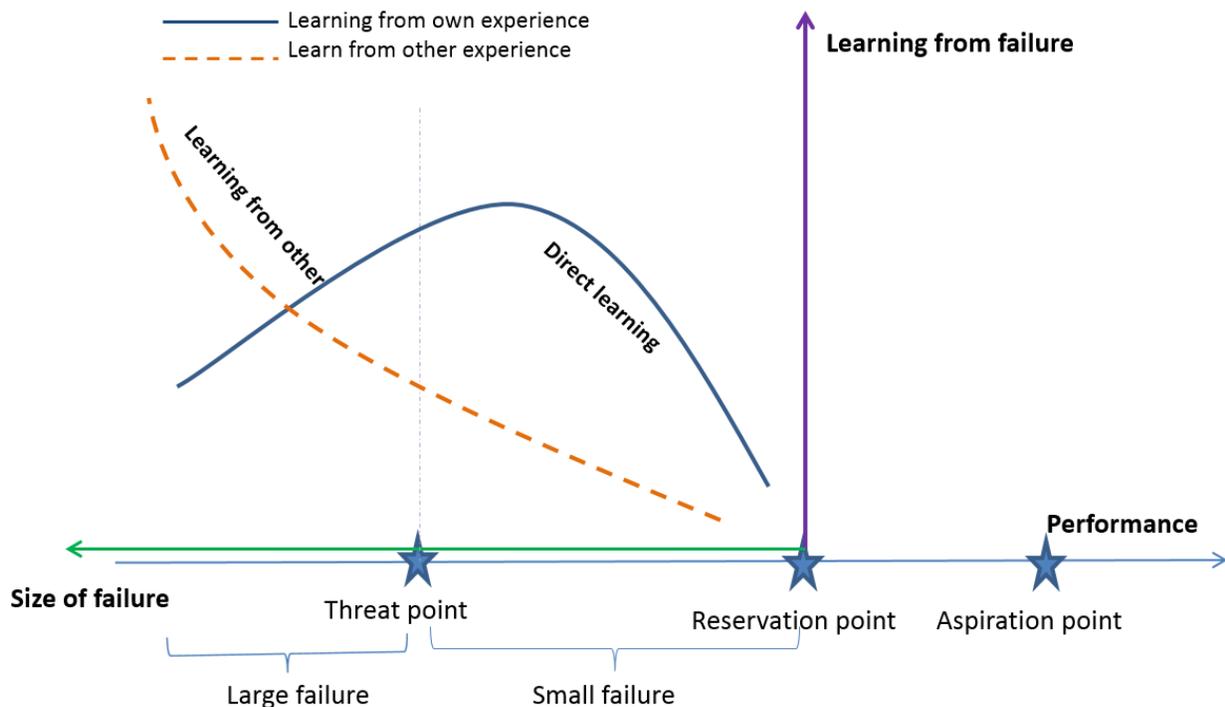
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There are two implications in this proposition. First, it implies that if a learning mechanism designed for learning from failure is built properly in organizations, proposition one and proposition two can be applied at organizational level. Second, the amount of organizational learning is dependent on how effective the learning mechanism is. Therefore, it is very important to design and apply the learning mechanism properly in organizations.

DISCUSSION

This paper discusses how individual learning changes when failure varies in size. This learning behavior is different between source of failure, own failures or others' failures. In brief, the relationship between learning and size of failure can be summarized in Figure 4 below:

Figure 4: Combination of figure 1,2 & 3



The focus of paper is on the learning behavior of individual and organization when failure happens. Proposition 3 has mentioned the systematic learning mechanism from failure that organizations need to implement if they want to transfer the lessons from individual level to

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organizational level. This part will shed light on how to design organizations for learning from failure.

The effects of failure on organizational learning are contested. On the one hand, organizational learning comes effectively from organizations under crisis since any failure can be a threat of extinction. Organizational learning in this case does not allow any errors. On the other hand, innovative organizations, which is an option to cope with environmental uncertainty, cannot avoid failure in their process. They try to fail small and fail early to avoid costly potential errors. The question raised here is when organization can fail and when they cannot fail. How should an innovative organization institutionalize organizational learning from failure in order to capture the lessons at the stage failing is acceptable so that organizations can avoid the tragic failure later? How should an innovative organization build learning mechanism that can capture both learning from own failure and learning from others' failure given that these two types of learning lead to different behavior when size of failure change?

To answer these questions, we suggest that organizations should understand they need to learn from both sources of failure: learning from their own failures help them to improve performance and innovation, and to learning from others' failures help them to reduce the likelihood of future disasters of similar nature happening to itself. Regarding size of failure, own large failures need to be avoided at all cost for two reasons: (1) it hurts organization's performance badly and (2) it is very difficult to learn from it as explained in proposition 1. On the other hand, learning from others' large size failures are highly recommended. Therefore, a good mantra for learning from failure is "learning from own small failure and others' large failure". Of course organizations should also learn from its own large failure if it happens, however, they should do their best to prevent it from happening. Our recommendation for designing organization for learning from failure is based on the concept of learning from own small failures and others' large failure which includes three components: strategy, leadership and organizational learning mechanism as in Table 3. By strategy, we mean the way organizations need to implement to realize their objectives. By leadership, we mean the behaviors of top management team and middle managers. By organizational learning mechanism (OLM), we mean the procedures and arrangements in organizational structure and culture that spread the lessons across the whole institution.

Table 3: Organizational design for learning from failure

		Learning from own failures	Learning from others' failures
Objective		- Improve performance - Increase innovativeness	- Avoid tragic failure - Facilitate distant search
Strategy		- Strategy of small losses (Sitkin, 1992) - Discovery-driven planning (McGrath, 1995)	- Inferential learning (Miner, 1999) - Collective learning (Miner, 1999)
Leadership		- Show clear commitment to support learning from failure. - Share personal experience of learning from failure.	- Analyze the lessons and find implication for current business. - Decide future direction.
OLM	System & structure	- Transfer learning across the organizations: <ul style="list-style-type: none"> ▪ Codify the lessons and embed into organizational memory ▪ Modify inappropriate routines and practices 	
	Culture & Practices	- Enable psychological safety (Edmondson, 1999) - Offer dabble time for experimenting. - Reward intelligent failures.	

Learning from own small failures

The objectives of learning from organizational own small failures are improving its own performance and increasing innovativeness. In normal operation, small failures trigger organizations to realize the problem and to find out its root cause, thus help companies to incrementally improve their performance by fixing such problems. In innovation activities, small failures in research and development stage will help innovators to figure out the right combination of products and services, thus it facilitates innovation activities.

Aligning with this goal is the strategy of small losses (Sitkin, 1992) and discovery-driving planning (McGrath & MacMillan, 1995) that organizations need to understand and implement in innovation activities. The strategy of small losses refers to the systematic approach to learn from “intelligent failures” which satisfy five criteria: “(1) they result from thoughtfully planned actions that (2) have uncertain outcomes and (3) are of modest scale, (4) are executed and responded to with alacrity, and (5) take place in domains that are familiar enough to permit effective learning” (Sitkin, 1992, p. 243). By legitimating intelligent failures and learning from

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them through organizational culture and design, this systematic approach aims to improve process rather than outcome and to emphasize failure management system rather than individual failure. Another strategy that maximizes learning from failure with minimized cost which McGrath and MacMillan (1995) suggested is discovery-driving planning. This strategy systematically tests implicit assumptions associated with uncertainty in innovation activities and converts them into knowledge. Small failures help to reveal flawed assumptions and thus prevent the organizational commitment to actions that might lead to future big losses.

Top management leaders and middle managers need to make a clear public commitment to supporting staff who are willing to undertake intelligent failures then learn from them and share with others. It is a big encouragement for employees if their leaders agree to share their personal experience of how to learn and what they learn from their own intelligent failures as well.

Learning from others' large failure

The objective of this learning is to prevent fatal mistakes, to engage distant search and to find future directions for the company. Miner and her colleague (1999) suggested inferential learning and collective learning as two strategies for learning from others' large failure. Inferential learning refers to several tactics: firms can actively look for incorrectly blamed practices for prior failure and take advantage of that since others will avoid those practices, they can compare failed with successful practices from other organizations to make correct inferences of what went wrong, they can also "stay alert to the likelihood that other firms disguise failures and avoid imitating popular practices that are not in fact producing good outcomes" (p. 215). Collective learning refers to the idea that collections of firms can pool information from failure together to get more complete data on the failed events and use failure as a device to detect collective threats and as a source of collective learning.

It is very important task for leaders to make correct inferences, analyze the lessons in order to find out the implications of these failed events for their organizational current business as well as future direction. Top management team should not simply avoid routines, practices, technologies or strategies associated to failed firms but to question what the real causes could be so that they can learn the right lessons.

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Organizational learning mechanisms

Together with strategy and leadership, organizational learning mechanisms which comprise institutionalized structure and culture are also important for learning from failure.

By structure, we mean the designed system for transferring lessons learned across the organizations. Firms need a system to codify the tacit experiences from failure and embed them into organizational memory so that other teams or individuals can access them later. At the same time, firms should modify inappropriate routines, practices, norm and behaviors that either p

By culture, we mean the norms, values, behaviors and practices at the working environment that facilitate learning from failure. The most important component in enabling a culture that promote learning from failure is psychological safety (Edmondson, 1999). Psychological safety refers to the tacit shared belief that it is safe for interpersonal risk taking. It is the sense of confident that other will not embarrass, reject, or punish someone for speaking up which stems from mutual respect and trust among his or her members. In order to create this psychological safety, organizations can send clear message that risk-taking and task-related failure will not hurt career one's career aspects if he or she shares the lessons associated. Organizations can consider publicize intelligent failures with lessons learned and innovation successes through taking risk and failure-driven learning. At the same time, firms can offer "dabble time" for employees to work on their own initiative idea, assuming that they are fulfilling their duties. This dabble time can be 10% of their working time and should be used for experimenting innovation which can lead to failure, yet it is a great way to learn and to improve innovative work. Not only that, firms can reward intelligent failures in innovation to encourage employees to try out new idea, even if they fail.

CONCLUSION

We have argued that different types of failure facilitate different mechanisms of learning: small failures facilitate firms' search for solutions, help them become more adaptive to change and increase their risk tolerance, which are important factors for innovation; large failures foster firms' nonlocal search for new strategies and solutions. As a result, a firm needs to build learning mechanisms for both types of failure: learning from its own failures to improve innovativeness

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and learning from others' tragic failures so that the firm can prevent similar disasters from befalling itself. This paper contributes to learning literature by providing a fine-grained analysis of learning from failure at different levels and exploring the linkage between failure's magnitude and learning from it. It also helps organizational practitioners to understand the barriers as well as facilitators of learning from failure so that they can design appropriate learning mechanism for learning.

We acknowledge our limitation that our observations and recommendations are not tested empirically. It would be preferable to extend the argumentation to a proper causal model which could consequently be empirically tested. Although this limitation make the mechanisms we have constructed tentative, we believe they are a useful step towards an integrated study of learning from failure in organizations. There are several future directions that we think this research stream can be benefit from. First, empirical studies to test suggested propositions in this paper are highly encouraged. Second, future research can also look at how learning from three types of performance differs from each other: learning from success (performance over aspiration point), learning from failure (performance below reservation point) and learning from acceptable performance (performance between reservation point and aspiration point). This would be an interesting issue for organizational learning since the motivational perspectives and learning process are not the same for those three types of performance. Third, the question of how organizations can share lessons learned from failure and success effectively from teams to teams, from projects to projects is particularly necessary, especially for multinational companies which seek to avoid the failure and replicate the successful practices from one to another location globally.

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