



Post-Failure Success: Sensemaking in Problem Representation Reformulation

Marta Morais-Storz , Nhien Nguyen , and Alf Steinar Sætre 

Failure is an inevitable feature of innovation, and management research promulgates the importance of learning from it. Key to excelling at an innovation-based strategy is understanding the processes that can turn failures into successes. However, post-failure success remains elusive. Although failure signals that the innovation journey is off course, shifting trajectory is difficult, because it may require revising assumptions and reformulating the project's problem representation. Using comparative case studies, this study set out to understand how problem representations are reformulated. Employing case method and comparing data versus theory iteratively, the important role of sensemaking and of leadership behaviors in driving post-failure success became salient. Findings show that problem representations post-failure require a process of problem formulation characterized by sensemaking and that innovative solutions are enabled by the reformulation of problem representations that spring from prospective sensemaking. Furthermore, this article identifies leadership change behavior as the linchpin driving a problem formulation process characterized by prospective sensemaking that catalyzes innovative solutions and explains why some projects thrive post-failure and others do not. This article provides empirical support to the theoretical work of the literature on problem formulation, while extending the learning-from-failure literature by emphasizing and demonstrating the process driving post-failure success. The major implication of our study is that different leadership behaviors may foster different types of sensemaking (retrospective or prospective), and that, in turn, the type of sensemaking matters for how a problem is reformulated. Ultimately, this article concludes that in the context of project failure, problem reformulation that springs from prospective sensemaking enables innovative solutions post-failure.

Practitioner Points

- Managers must learn from and capitalize on innovation failures because the penalty for not doing so can be high.
- Turning failure into success requires first, a culture of normalizing of failures when innovating, and, second, a process of problem formulation characterized by sensemaking that is both retrospective and prospective.
- A project's problem representation post-failure must be socially constructed and creatively reformulated to help turn failures into success. Leadership behavior that emphasizes change is particularly important in this process.

Address correspondence to: Marta Morais-Storz, Department of Industrial Economics & Technology Management, Norwegian University of Science and Technology (NTNU), Alfred Getz Veg 1, NO-7491 Trondheim, Norway. E-mail: marta.morais-storz@ntnu.no.

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Introduction

When innovating, failures are inevitable. The consensus is that failure is “an important experience from which learning can take place” (Shepherd, Patzelt, and Wolfe, 2011, p. 1229). Widespread avoidance of failure has been replaced by a focus on learning from it (Sitkin, 1992), with an emphasis on demystifying and codifying the processes that facilitates identification and analysis of failures (Cannon and Edmondson, 2001, 2005). Given the prominence of failures in innovation, understanding the processes that facilitates identification and analysis of failures is certainly important; however, it is insufficient. The key to excelling at an innovation-based strategy is understanding the processes that can turn failures into successes.

Failure in innovation projects occurs for many reasons. A failure refers to a “deviation from expected and desired results” (Cannon and Edmondson, 2001, p. 300) or to “performance which falls short of the level of aspiration” (Starbuck, 1963, p. 51). Shepherd,

Covin, and Kuratko (2009) defined innovation project failure as “defined relative to performance expectations, the locus—i.e., the place where failure occurs—is the project or the entrepreneurial initiative” (Shepherd et al., 2009, p. 591). The aspiration level (expectations) can be “the smallest outcome that would be deemed satisfactory by the decision maker” (Schneider, 1992, p. 1053). An innovation project failure event increases ambiguity and triggers sensemaking (Maitlis and Christianson, 2014; Weick, 1995). When it occurs during an innovation project, project team members make sense of the situation and socially construct (Berger and Luckmann, 1966) a “verbal expression”

(Dillon, 1982, p. 103) of the problem based on their collective understanding, seeking to drive corrective action.

The process of formulating a verbal expression that could be the driver of action is *problem formulation* (Lyles and Mitroff, 1980; Nutt, 1993), and the outcome of this process is *problem representation* (Biazzo, 2009; Pretz, Naples, and Sternberg, 2003). When the trajectory of the innovation project becomes unfavorable or untenable, the formulation of a new problem representation is necessary. This new problem formulation becomes a springboard for action (Taylor and Van Every, 1999). However, when failure occurs, inertia (Hannan and Freeman, 1984), superstitious learning (Levitt and March, 1988), path dependence (Sydow, Schreyögg, and Koch, 2009), competency traps (Levitt and March, 1988), myopia of learning (Levinthal and March, 1993), and escalation of commitment (Brockner, 1992; Staw, 1981; Whyte, Saks, and Hook, 1997) are powerful cognitive and psychological challenges. How new problem representations that can be springboards for successful action are collectively reformulated despite these challenges is not clear. Furthermore, the tendency to apply or adapt existing solutions from past problems that are engrained in rules, norms, and standard operating procedures (Cyert and March, 1992; Gavetti, Greve, Levinthal, and Ocasio, 2012) to new problems can curb innovation efforts. The process of framing new problem representations starts with sensemaking.

Sensemaking is the process of “making something sensible” (Weick, 1995, p. 16) or “the process through which people work to understand issues or events that are novel, ambiguous, confusing, or in some other way violate expectations” (Maitlis and Christianson, 2014, p. 57). The need to make sense can be triggered by events that are discrepant from predictions or expectations and interrupt the flow of experience (Weick, 1995). While sensemaking is arguably pervasive in teams that experience failure, the findings of this study show that the ability of teams to turn failures into successes depends on whether the process of sensemaking results in a reformulation of the original problem, or whether it results in the development of different solutions. A reformulation of the project problem representation is key to shifting the trajectory and developing solutions that prove innovative and ultimately successful. While sensemaking is primarily retrospective, whereby reality emerges “from efforts to create order and make retrospective sense”

BIOGRAPHICAL SKETCHES

Dr. Marta Morais-Storz is an Associate Professor at the University of Southeastern Norway (USN) and at the Norwegian University of Science and Technology (NTNU). She was part of the Norwegian Research School in Innovation—Program in Innovation Management and Strategy (NORSI-PIMS) cohort and has a PhD in Industrial Economics and Technology Management from the Department of Industrial Economics and Technology Management of the Norwegian University of Science and Technology, Norway. Her doctoral dissertation was the winner of the International Society for Professional Innovation Management 2019 dissertation award. Her research interests center on innovation management, strategic problem formulation, sensemaking, strategic resilience, and psychological safety. She has a Master Degree in Architecture from the Massachusetts Institute of Technology (MIT).

Dr. Nhien Nguyen is an Associate Professor at the Norwegian University of Science and Technology (NTNU) and a senior researcher at Nordland Research Institute. She earned a PhD in Industrial Economics and Technology Management from NTNU, funded by the Norwegian Research School in Innovation's Program of Innovation Management and Strategy (NORSI-PIMS). Nhien has been leading and coordinating several research projects focusing on innovation strategies, both at the organizational level and the national/regional policy level. She has also taken key roles in other H2020 research projects related to additive manufacturing, digital transformation, circular economy, and regional innovation policy. Her research interests include innovation management, innovation system and policy, responsible research and innovation (RRI), smart specialization strategy, and organizational learning. Nhien Nguyen has guest edited several special issues on topics related to innovation and learning organizations.

Dr. Alf Steinar Sætre is a Professor at the Department of Industrial Economics and Technology Management at the Norwegian University of Science and Technology in Trondheim. His research interests include organizational search and discovery, ambiguity in the innovation process, abduction and the process of discovery, strategic problem formulation, learning and perception in innovation processes, strategic resilience, innovation management, and organizational design. Alf Steinar founded and led the NORSI-PIMS doctoral program. He works closely with companies in several industries and currently runs the PIMS Executive Program. Alf Steinar Sætre earned his PhD at the University of Texas at Austin, where he was a Research Associate at the Innovation, Creativity and Capital (IC2) Institute.

of what occurred (Weick, 1993, p. 635), the findings of this study show that problem reformulation, i.e., the reformulation of the opportunity or problem that the project intends to address, depends on sensemaking that is prospective. Prospective sensemaking is characterized by a “conscious and intentional consideration of a probable future impact of certain actions, and especially nonactions” (Gioia, Thomas, Clark, and Chittipeddi, 1994, p. 378). Prospective sensemaking is not automatic, but requires deliberate effort.

Analyzing four case studies, this article demonstrates that, in the face of failure, deliberate sensemaking of how actions today affect an expected future or how actions create a desired future (Gioia and Mehra, 1996) depends on specific leadership behaviors that support this effort. It finds that prospective sensemaking in the reformulation of problem representations is important for post-failure success. In addition, leadership behaviors that foster change are identified as salient factors of the inflection point between retrospective and prospective sensemaking.

This article discusses how failure is a source of learning and a catalyst of innovation, and the findings outline a process to make this happen. Furthermore, this article (1) extends the research paradigm of learning from failure to include identifying, analyzing, and capitalizing on failures; (2) it demonstrates a link between problem formulation and sensemaking within the context of innovation and failure; and (3) it suggests a descriptive process model that highlights important managerial factors to facilitate post-failure innovation.

Theoretical Background

This section reviews the literature on problem formulation, learning from failure, sensemaking, and the role of leadership behaviors in the face of innovation project failure.

Problem Formulation

The problem formulation process is the process of devising a representation that can serve as a blueprint for fruitful action and is well recognized in management and strategy literature (Baer, Dirks, and Nickerson, 2013; Lyles and Mitroff, 1980; Nickerson, Yen, and Mahoney, 2012; Smith, 1989a, 1989b; Volkema, 1986). Similarly, the role of failure

in driving change is well researched (Edmondson, 1999; Miner, Kim, Holzinger, and Haunschild, 1996; Sitkin, 1992). With the exception of studies that highlight failures that result in solving wrong problems (i.e., Type III errors), presumably resulting from inadequate or misguided problem formulation (George, 1994; Kilmann and Mitroff, 1979; Mitroff and Silvers, 2010), the link between failure and problem formulation in driving innovation is understudied.

The problem formulation process is discussed in the literature under various guises. Within management strategy literature, it is often referred to as problem formulation (Lyles, 1981; Lyles and Mitroff, 1980; Thomas and Schwenk, 1983; Volkema, 1986), problem diagnosis (Mintzberg, Raisinghani, and Théorêt, 1976; Ramakrishna and Brightman, 1986), problem definition (Mitroff, Emshoff, and Kilmann, 1979), and problem setting (Schön, 1983). In creativity literature, problem formulation is often referred to as problem discovery (Runco and Okuda, 1988), problem finding (Getzels, 1979, 1982; Okuda, Runco, and Berger, 1991), and problem construction (Reiter-Palmon, Mumford, Boes, and Runco, 1997). Within each literature stream, models have been suggested that describe the process, and these largely correspond to the front-end of problem solving. The models are described as processes set in motion when a problem arises (Nutt, 1993; Volkema and Evans, 1995) or when a problem must be found or defined (Lyles and Mitroff, 1980). The outcome of problem formulation is a problem representation (George, 1994), from which problem-solving activities follow (Biazzo, 2009).

When failure occurs during a project, it may be necessary to reconsider the project’s problem representation (Walinga, 2010), or it may be necessary to frame (Fairhurst and Sarr, 1996; Kaplan, 2008; Nutt, 1998) a new representation of the problem based on the knowledge gained by the failure event. Revising the project’s problem representation is key to setting the project on a different trajectory, which can enable the project to become successful (Ormerod, MacGregor, and Chronicle, 2002). Aside from few exceptions (McComb, Cagan, and Kotovsky, 2015; Smith, 1988), the research literature on the role of post-failure problem formulation is lacking.

Various individual-, team-, and organizational-level biases (Hurmelinna-Laukkanen and Heiman, 2012) and impediments (Baer et al., 2013)

can complicate the process of problem formulation. Additionally, there are obstacles that pertain specifically to the context of failure, such as escalation of commitment (Brockner, 1992; Staw, 1981), perceptual narrowing (Heiman, Nickerson, and Zenger, 2009), and design fixation (McComb et al., 2015), which may be difficult to overcome. Furthermore, given the importance of innovation in a transient advantage economy (McGrath, 2013a, 2013b), failure occurrences will not become less frequent in organizations pursuing a varied portfolio of innovations. Therefore, developing a deeper understanding of the process of post-failure problem formulation is key to extracting and creating value from inevitable innovation failure occurrences.

Many challenges make it difficult to reformulate a problem representation. When a failure occurs, teams are compelled to make sense of the situation. Failure characterized by events that do not meet expectations (Maitlis and Christianson, 2014; Starbuck, 1963) indicates the existence of a problem and should drive a reconsideration of expectations. Weick, Sutcliffe, and Obstfeld (2005) posit that “explicit efforts at sense-making tend to occur when the current state of the world is perceived to be different from the expected state of the world” (p. 409).

Learning from Failure

Typically, failure drives corrective action (Hedberg, 1981), which is propelled by an interpretation of new circumstances brought on by the failure (Sitkin, 1992). How problem representations are formulated post-failure to drive explorative and innovative action is unclear. Given all the potential psychological barriers to explore post-failure processes (Sitkin, 1992), understanding how teams formulate post-failure problem representations is important for generating successful innovations.

Failure is important for effective organizational learning and adaptation for several reasons. Failure helps organizations discover uncertainties, which are difficult to predict in advance (Sitkin, 1992), creates learning readiness and motivates learning and adaptation (Cyert and March, 1992), increases risk-seeking behavior (Kahneman and Tversky, 1979), and act as a shock trigger to draw organizational attention to problems (Van de Ven, Polley, Garud, and Venkataraman, 2008). Extant research on failure focuses on learning from failure (Baum and Dahlin,

2007; Chiesa and Frattini, 2011; Denrell and March, 2001; Edmondson, 2011; Haunschild and Sullivan, 2002; Madsen and Desai, 2010). However, few empirical studies explore how failure triggers learning, and specifically, how failure serves as a catalyst for innovation. It is not clear how organizations develop alternatives or challenge procedures and practices by formulating post-failure problems.

Sensemaking in Innovation Project Failures

Individuals constantly make sense of the world around them (Gephart, Topal, and Zhang, 2010), but sensemaking is particularly pronounced when issues, events, or situations arise where meanings are ambiguous or outcomes are uncertain (Maitlis and Christianson, 2014). Although sensemaking takes place in the present (Wiebe, 2010), individuals make sense largely by referring to past experiences. Retrospective sensemaking entails a combination of several activities: “organizing flux” of ongoing thoughts regarding what went wrong; “noticing and bracketing” or realizing the signs of trouble that occurred; and “labeling” or the process of categorizing the experience to suggest actions (Weick et al., 2005, p. 410). Retrospective sensemaking facilitates understanding of *what happened* in a situation, usually relative to expectations, which answers the question, *what to do now* (Weick et al., 2005). Since action in the present shapes consequences and outcomes in the future, the decision about what to do should entail prospective sensemaking (Gioia et al., 1994).

While individuals spontaneously engage in sensemaking, in an organizational context of innovation and new product development, collective sensemaking is a “social process that involves the interaction of individuals” (Christiansen and Varnes, 2009, p. 504). The purpose of problem formulation is to make collective sensemaking (i.e., problem representation) explicit to team members. The goal of collective sensemaking is to devise a common understanding of the situation (even if opinions differ), so that decisions can be made about how to address the situation, to know what course of action to take, and to confirm which solutions to pursue. Explicit verbal expression of collective sensemaking allows for problem solving. Therefore, sensemaking is one mechanism for problem formulation (Gralla, Goentzel, and Fine, 2016). Baer et al. (2013) discussed mechanisms for extending problem formulation comprehensiveness through selection,

incentives, and structured processes. Selection means that managers should purposefully compose teams with diverse cognitive structures, which “describe the basic mental processes used to make sense of information” (Baer et al., 2013, p. 201). Following Baer et al. (2013), this article views sensemaking as one of several mechanisms to improve problem formulation and problem re-formulation.

Leadership Behaviors

Leadership impacts innovation (Barczak and Wilemon, 1989; Chen, Tang, Jin, Xie, and Li, 2014; Kraft and Bausch, 2016), by motivating and inspiring creative work (Mainemelis, Kark, and Epitropaki, 2015), by encouraging and authorizing overcoming obstacles and confronting resistance (Yukl, Gordon, and Taber, 2002), and by guiding and teaching team members “to become better ‘team players’” (Barczak and Wilemon, 1989, p. 262). Within the context of innovation, leadership “surrounds process, energizes it, facilitates it, and infuses it by getting personally involved, so that people feel inspired to do good things” (Mintzberg, 2002, p. 151). Leadership often entails managing meaning in ambiguous situations (Brun, Sætre, and Gjelsvik, 2008) and is not necessarily tied to a particular role but is behavior any member can exercise. Although the team director or project manager exercises leadership functions, innovation team members can lead with the “ability to decipher and communicate meaning out of complex and confusing situations” (Fairhurst and Sarr, 1996, p. 2). For problem formulation, team member leadership behaviors (Derue, Nahrgang, Wellman, and Humphrey, 2011; Yukl et al., 2002) may be equally as important as leadership roles.

While leadership (Chen et al., 2014; Gumusluoğlu and Ilsev, 2009) is undeniably important for innovation (Barczak and Wilemon, 1989), most organizations gear management tools and efforts toward efficient exploitation within an existing paradigm rather than toward exploration and innovation. As a result, management and team members are more likely to “jump to solutions” (Enders, Koenig, and Barsoux, 2016) than to comprehensively consider and creatively challenge the assumptions behind the problem (Baer et al., 2013). Organizations are adept at managing problem solving, whereby managers are primarily oriented toward exploitation (Kraft and

Bausch, 2016) and will seek to solve problems in the most efficient way by referencing experience. Lacking leadership behaviors (Burke et al., 2006; Derue et al., 2011; Yukl et al., 2002) that can overcome these tendencies, it is difficult to question the status quo, even when necessitated by failure. Leadership literature identifies specific taxonomies of behaviors where variance in team learning is attributed to leadership empowerment behaviors (Burke et al., 2006), creativity is attributed to integrative leadership behaviors (Mainemelis et al., 2015), and increased innovation is attributed to change-oriented leadership behaviors (Yukl, 2012). More research on leadership behaviors is needed to determine which are most effective in turning failures into successes.

Innovation requires a break from the status quo, but organizational inertia (Tripsas and Gavetti, 2000) reinforces business-as-usual. Therefore, problem formulation is undervalued, and its outcome of potentially game-changing problem representations is unrealized.

Research Methodology

The study upon which this article is based is concerned with process (Van de Ven, 1992, 2007), and is focused on “explanations in terms of patterns in events, activities, and choices over time” (Langley and Tsoukas, 2010, p. 409). Researchers studying human behavior in organizations qualitatively know that a linear “narrative suggesting an orderly, standard model of the research process is rather misleading” (Van Maanen, Sørensen, and Mitchell, 2007, p. 1146); as there is a relationship between data and theory that continues throughout the research process (Gephart, 2004). Specifically, we set out studying learning from failure and problem formulation, but as we entered the field, we discovered the important role of sensemaking and of leadership behaviors in driving post-failure success.

Research Context

Given the nature of this study’s inquiry, we used multiple case studies (Eisenhardt, 1989; Yin, 2009), and the sample contains four individual project case studies from three Norwegian firms. The firms include one in the maritime industry (Maricom), one in the industrial chemicals industry (Chemicom), and one in sanitary systems industry (Sanicom); the latter providing two of the innovation project cases. Replication logic is

used (Yin, 2009) when choosing innovation projects to study, and they are chosen for three reasons. First, the three companies have great emphasis on innovation and are proud of their innovation strategy. Second, we had the full support of the top management team in each company to conduct this study. Third, these organizations gave us access to information about their innovation projects in which failure had occurred.

Access to information about innovation failures can be difficult to obtain because people are often reluctant to discuss failures, and organizations are hesitant to disclose them. Therefore, the authors met with leaders from each company to discuss our research interests and the importance of learning from experience, agreeing that experience is varied and learning from experience is important. At the initial introductory meeting, we started by asking the top management teams about the company's recent innovation projects, what was learned, and the level of challenge for the projects. Among the projects discussed, four project cases were selected, because all entailed product development and were deemed by organizational leaders as impactful to the organization and fraught with many "challenges." The term "challenges" rather than "failure" was used initially, because it is often easier for managers to discuss challenges, as respondents may have emotional and cognitive aversions to discussing failures (Shepherd and Cardon, 2009; Shepherd et al., 2011). Top management gave us full access to study projects that experienced significant failures. The failures referred to events along the project trajectory and did not necessarily coincide with the outcome of the project.

As the data collection progressed and trust increased, the respondents became comfortable talking about "failure," and in all four projects, team members openly acknowledged and discussed failures in their projects. The four cases contain different patterns, with two projects deemed by the respondents as post-failure successes, and two projects deemed as on-going failures.

Data Collection

This study uses interviews and archival documents as data sources. It includes case studies built from 25 one-hour-long semi-structured interviews of the primary team members. Twenty informants were interviewed (one case with four informants, two with

five, and one with six), and key informants were interviewed more than once to clarify information and answer follow-up questions (Table 1). All team members, including managers as well as engineers, involved in each innovation project were interviewed, facilitating "saturation" (Strauss and Corbin, 1998) and "a more comprehensive view" (Barczak, Kahn, and Moss, 2006). Together with documents supplied for each project, we assured the triangulation of our research (Denzin and Lincoln, 2008; Yin, 2009). All interviews were recorded, transcribed verbatim, and entered in the NVIVO software. Rather than a rigid interview protocol, a semi-structured interview questionnaire served as a guide (McCracken, 1988), as the sequencing varied across interviews (Appendix A). Other topics that emerged in the conversation were welcomed as additional information. The interview questions were designed to extract detailed information about the process, team members' frames of reference, the failure, and reflections.

In addition to the on-site introductory meetings with leaders of each company, at least two of the authors were present at the first round of interviews, and one of the authors conducted the second round of interviews to clarify information from first-round interviews. We requested and were given access to documents that were either descriptive of the technologies involved or explanatory about the progression of the project. These documents supplemented interviews and clarified the technological progression and timeline of each project.

Data Analysis

This article applies the case method to guide the data analysis (Eisenhardt, 1989; Eisenhardt, 1991; Miles, Huberman, and Saldana, 2014; Yin, 2009), integrating and extending existing theory. Examining extant literature relevant to the subject, we use empirical data to extend the current understanding of the phenomenon. Therefore, we completed many cycles of comparing data and theory, generating additional concepts and theories to guide the collection of additional data. Throughout the process, we "worked with data and theory simultaneously, and theory and data fed off each other into our analysis process" (Sætre, Sørnes, Browning, and Stephens, 2007, p. 141). The nature of our research was "highly iterative" (Eisenhardt, 1989, p. 541), cycling between literature review, data analysis,

Table 1. Summary of Data Collection

Project	Company	Informants	Data Collected
Cases exhibiting retrospective and prospective sensemaking			
1	<i>Vacula</i>	Sanicom 1. VP Research & Development 2. R&D Engineer 3. Sales Manager 4. Service Supervisor Note: Each team member was interviewed once individually, and an additional interview included the VP Research & Development and the R&D Engineer.	Five interviews, product catalogue, company websites
2	<i>Balato</i>	Maricom 1. President and CEO 2. VP of Business Development 3. Business Director of Regulatory Products and Services 4. Business Manager of Technical Services 5. Director of Technical Management Safety Note: Each team member was interviewed once individually. In addition, the President and CEO was interviewed twice.	Six interviews, company internal documents and presentations, company websites, public media
Cases exhibiting only retrospective sensemaking			
3	<i>Catalo</i>	Chemicom 1. Department Vice President 2. Department Project Manager 3. Chief Engineer and Expert 4. Project Manager (current) 5. Team Member/Engineer 6. Principal Engineer (previous PM) Note: Each team member was interviewed once individually. In addition, one interview was conducted with the Department Vice President and the Department Project Manager present, and another interview was conducted with the Department Project Manager and the Chief Engineer present.	Eight interviews, twelve documents illustrating the progression of the projects, company websites
4	<i>Perula</i>	Sanicom 1. VP Research & Development 2. R&D Engineer 3. VP of Market Segment 4. COO of Production and Logistics 5. General Manager (previous PM) Note: Each team member was interviewed once individually, and an additional interview included the VP Research & Development and the R&D Engineer.	Six interviews, product catalogue, company websites

and data collection. Initially, this article did not aim to study differences in sensemaking; however, evidence was ample, and as qualitative researchers we engaged with new themes as they emerged (Eisenhardt, 1989; Graebner, Martin and Roundy, 2012). These emergent themes gained evidentiary strength by virtue of being unsolicited.

Data analysis was iterative and consisted of multiple running exchanges (Burawoy, 1991). Each exchange involved interactions between concepts from theories and data analysis. Analyzing data helped us connect to relevant concepts and theories, while the literature provided conceptual frameworks that simultaneously helped us interpret the data. After analyzing the initial data, additional data were collected to clarify understanding (Burawoy, 1991). In our interpretative analysis (Miles et al., 2014), we looked for instances that

described the project's initial problem representation, the failure event, and problem formulation, which showed how failure occurrence was formulated and the representation was formulated (and/or reformulated). These served as initial "nodes" or coding categories as we individually analyzed the interview data in NVIVO, and we added coding categories as we deemed appropriate when a construct appeared salient in the data. We compared our impressions and recognized that the cases showed a process of post-failure sensemaking where team members sought to understand what had happened relative to assumptions and expectations built into the project's initial problem representation. This compelled us to return to the literature to understand and make sense of the role of sensemaking post-failure, which resulted in new coding categories—retrospective sensemaking and prospective

Table 2. Development of Coding Categories

Initial Core Concepts	Additional Concepts	Additional Concepts
Analysis Phase 1	Analysis Phase 2	Analysis Phase 3
<p>Initial problem representation Description of original goals, expectations, assumptions, criteria, or specifications.</p> <p>Failure event Description of what was thought to have been the moment of failure or the event that questioned the project's initially anticipated trajectory.</p> <p>Problem formulation post-failure Description of instances or attempts to formulate a verbal expression that could be the driver of post-failure action.</p>	<p>Retrospective sensemaking Instances or indication of “efforts to create order and make retrospective sense” (Weick, 1993, p. 635) of what occurred during the process of problem formulation.</p> <p>Prospective sensemaking Instances or indication of “conscious and intentional consideration of a probable future impact of certain actions, and especially nonactions” (Gioia et al., 1994, p. 378) during the process of problem formulation.</p>	<p>Leadership behaviors^a</p> <p>Task behaviors Instances describing short-term planning, clarifying responsibilities and performance objectives, monitoring operations and performances.</p> <p>Relation behaviors Instances describing behaviors of supporting, developing, recognizing, consulting, empowering.</p> <p>Change behaviors Instances describing external monitoring, envisioning change, encouraging innovative thinking, and taking personal risks to implement change.</p>
<p>Problem representation post-failure Verbal expression or description of problem to be confronted or overcome post-failure.</p> <p>Solution Description of how the problem, as formulated in the problem representation, was addressed and whether it was deemed successful.</p>		

^aThe categorization of leadership behaviors into task, relation, and change behaviors follows the framework of Yukl et al. (2002).

sensemaking—that provided a better calibrated lens in which to study the interview data (Table 2).

We wrote narratives of each case to clarify and describe how events unfolded, and selected soundbites illustrative of the concepts we sought to describe. A heavy burden is placed on the academic integrity of the researchers to select soundbites that are representative (Punch, 1986). As qualitative researchers, it is our obligation, to portray informants in the best possible light in terms of fluency (Christians, 2005; Punch, 1986). Informant soundbites were edited for clarity, removing hesitations, false starts, pauses, and disfluencies, being careful not to alter meaning (Sætre, 2003). We also tested the validity of interpretations of the data by checking with informants and requesting feedback.

We went back-and-forth between data and theory multiple times and found that the two cases that were ultimately deemed successful differed from the two that were not. In the former, prospective sensemaking seemed to explain how problem representations came to be formulated, or rather, reformulated post-failure. One question remained why were some teams able to engage in prospective sensemaking while others were not? Prominent in the findings were differences in leadership behaviors. The saliency of the differences in leadership behaviors across the cases prompted our hunch that these differences account for why some teams engaged in prospective sensemaking while others did not. We pursued this hunch by first reviewing the literature. Building on the extensive research on leadership behavior (Burke et al., 2006; Fleishman

et al., 1991; Yukl, 2012), the traditional categorization of leadership behaviors was adopted (Derue et al., 2011; Yukl et al., 2002): task behaviors, relationship behaviors, and change behaviors. These guide us in parsing the data again. The process of emergent coding categories is illustrated in Table 2.

The four cases are: *Catalo* and *Perula*, which exhibited retrospective sensemaking but no prospective sensemaking or leadership change behavior; and *Vacula* and *Balato*, which exhibited both retrospective and prospective sensemaking as well as leadership change behavior.

Project Cases

The *Catalo* project was driven by an opportunity for Chemicom to enter a new market segment. Chemicom believed they had an in-house idea and competency to develop a whole-system solution that performed better than products currently in that market. They believed their technology was “unique” and “would be an improvement over the state of the market.” *Catalo*’s innovation concept was business-driven and required complex technology not previously available. Several challenges occurred, and Chemicom was unsuccessful in producing a component of the product as expected. Ultimately, the *Catalo* project was in development longer than expected. Although the technology was successfully developed four years later, it had not been commercialized, because an unforeseen price slump in the market reduced the attractiveness of the business opportunity.

The *Perula* project was driven by customer interest, and Sanicom saw it as an opportunity to develop an innovative product emblematic of the company. *Perula* was a new product system combining exclusive design, attractive styling, low noise, and easy functionality. Sanicom saw it as an opportunity to launch a new high-end product that competitors did not offer. The system involved several new technologies that required major investment, and the product was plagued by technical issues that were costly to fix. Initially, the product was intended to address one market; however, a change request to include a second market with the same product offering made the solution and requirements more complex. At the time of data collection, the project had been running for almost 10 years, but it had not delivered a final product that satisfied original objectives, despite winning a national design award.

The *Vacula* project came about because Sanicom already had a successful product in one target market, and there was demand from interested customers for a similar product in a different market. Although product introduction for a new market requires changes to make the product cost effective, it was considered an opportunity with great potential for Sanicom. Changes were implemented, and the product was launched in the new market, with more than 200 units sold. However, within a few months, the service department received many complaints from customers because the product was not performing as it should. As the product had launched, there were strict constraints on how the failure could be resolved, because recalling and replacing products would be costly. Ultimately, what was intended as a fix to an urgent problem became an important and innovative component of subsequent successful products at Sanicom.

Maricom’s *Balato* project was driven by a potential opportunity in response to an expected regulatory change. Maricom was the pioneer in the maritime industry and had identified a partner with the needed competencies to address the expected regulatory change. The company determined it could overcome whatever technical challenges could be foreseen. Many customers expecting the regulatory change preordered the product while it was still in development. The product passed the approval test of the industry regulatory association and was expected to be successful. After five years of development, a new project manager discovered that, despite having passed the industry test, the product failed field tests. These tests subjected the product to conditions necessary for meeting regulation requirements, but they were not tested in the original industry compliance. This constituted *Balato*’s failure event. Although it was initially costly and embarrassing for the company, the team’s solution to address this failure ultimately garnered Maricom increased customer loyalty, industry-wide respect for identifying and flagging weakness of the regulatory compliance test, and a post-failure success.

Analysis and Discussion

We analyze the overall sensemaking processes in four projects to determine how prospective sensemaking makes a difference and how leadership change behavior facilitates this process.

Sensemaking and Problem Reformulation Post-Failure

Sensemaking, figures prominently in how problem representations, the explicitly formulated springboards to action, are reformulated post-failure. To devise a plan, the “blueprint” (Simon, 1962), or problem representation for action, teams engage in retrospective sensemaking. However, the differentiating factor for teams that were successful post-failure was the engagement in prospective sensemaking that facilitated the reformulation of the project’s problem representation. The two teams in this study that engaged in prospective sensemaking (*Vacula* and *Balato*) reformulated the initial opportunity, and with that reformulated problem representation they were able to develop novel solutions that proved successful. The two projects where the sensemaking was retrospective (*Catalo* and *Perula*) failed to reformulate the initial opportunity, and the post-failure solutions proved inadequate.

In all cases, instances of retrospective sensemaking were identified as a way of making sense of the failure event (Tables 3 and 4). These instances exemplify a post-failure problem formulation process characterized by retrospective sensemaking. In attempting to determine what happened, teams compared the present situation in which the failure occurred with the expectations or assumptions of the past (as outlined in the projects’ initial problem representation and as manifested in subsequent trajectory pre-failure).

Sensemaking in the Catalo project case. When considering what happened relative to expectations, the *Catalo* project team concluded that they did not possess the knowledge to fabricate the component and contracted an external institute to do so. However, the external institute proved ineffectual. A *Catalo* Project Engineer told us the “external research institute wasn’t able to produce as we were hoping to and as fast as we were hoping to.” Additionally, the business side changed the target customer, resulting in a project scope change, further complicating development. Team members changed for various reasons. Specifically, team leadership changed multiple times, with each attempting to make retrospective sense of the situation. As a result, *Catalo* was in development longer than expected. Although the technology was successfully developed four years later, it had not been commercialized.

Due to an unforeseen price slump in the market, the business opportunity was not as attractive: “That’s also actually a challenge here, because the prices, as it so happens, have gone down dramatically since the business case was defined. They didn’t put that into the business case” (Department Vice President). When the project experienced failure, the team engaged in retrospective sensemaking using the original assumptions as the frame of reference. However, they failed to make prospective sense of the situation, even when it became clear that the attractiveness of the opportunity was deteriorating. Instead, the solution-oriented team worked quickly to address technical challenges. While they were ultimately successful in addressing technical challenges, time delays further diminished the opportunity’s value. (Table 3 provides illustrative quotes).

Sensemaking in the Perula project case. In the *Perula* project, the initial problem representation was a “vision,” but it was a vision without technical or market specificity. The team was confronted with numerous technical challenges, many of which proved difficult to overcome. Responding to a failed project trajectory, to understanding what happened, and to determining what to do next, the solution-oriented team persistently attempted to solve various technical challenges. The team made retrospective sense of things when presented with challenges, but in their haste to find solutions, prior assumptions about expectations for the project went unquestioned. Since the project was based on a lofty vision, it lacked specificity, and as a team member described, the project specification (or representation) was unfocused and seemed insurmountable, in the words of the COO of Production and Logistics: “All kinds of concerns were supposed to be taken care of. In the end, there was a specification that was impossible to meet.”

While the various failures encountered by the *Perula* project team triggered retrospective sensemaking as the team tried to determine what happened, the failures did not drive a reformulation of the project’s problem representation. As such, the team focused on addressing technical problems, considering the project’s original problem representation. While recurring challenges should have driven a reconsideration of the assumptions embedded in the project’s original problem representation, the *Perula* team was unable to do so. Prospective sensemaking was noticeably absent, as the team did not consider future scenarios using new

Table 3. Summary of Illustrative Informant Statements from the Catalo and Perula Projects

Concept	Catalo	Perula
Initial problem representation	<p><i>The initial problem representation was to provide a unique technical and system solution that had not been available in the market before.</i></p> <p>“It was a case where the business really wanted to expand in a new direction...Because of activities in other areas we had an idea that we thought could be turned into a useful product.” (C3)</p> <p>“That really defined our target for this new research project and our target was a 20% reduction in [the use of material] relative to standard material while retaining performance.” (C2)</p>	<p><i>The initial problem representation was an opportunity to develop an innovative product that would be emblematic of the company and place them in the high-end market.</i></p> <p>“My understanding was that the project came about because there was a vision to design a complete, new [product]...I think the idea was to make a unique [product] that would have significantly reduced noise level. That was what really came from, and then it changed into something else, I think.” (P3)</p> <p>“Marketing was pressing for a better model and new development different from the traditional [product].” (P4)</p>
Failure event	<p><i>Catalo’s failure event was the combination of delayed technical progress and changes in target markets.</i></p> <p>“It [the technical solution] was actually fourteen months later than its original schedule... This completely unrealistic schedule, I think, had a terrible impact.” (C4)</p> <p>“Then halfway in the planned scheduled development, our client, our customer, whatever you call it at the business side, decided to change the scope. Change the target market.” (C1) [<i>Here the team member, who is part of Chemicom’s downstream unit, refers to the upstream unit as the “costumer.”</i>]</p>	<p><i>Perula’s failure was that the product was recurrently plagued by long delays and technical issues that were costly to fix.</i></p> <p>“The problem was that it doesn’t work as it should...It had a defect, but it was a complicated defect to understand and to adjust...We had many rounds for improving to adjust this small thing to get it working.” (P2)</p> <p>“At quite an early stage, the project went on the wrong track...It was no good at all, it was unreliable and complicated...It took a long, long, long time to come. I don’t know how many years...not to mention the cost for developing that was horrendous.” (P3)</p>
Retrospective sensemaking	<p><i>A change in project leadership prompted a reevaluation of the project assumptions, and the business side had changed the target customer and project scope. Accordingly, the team decided they needed to help the business unit redefined the technical target.</i></p> <p>“Then this is about where I came into the company and took over lead of the project, and also really defined to a large extent all the plans, and also clarified scope and so on, because things were a little bit fuzzy...As we anticipated, we didn’t really agree with the target, so we kept the doors open for change...We started discussing what would be the difference, and we quite seriously realized we needed to have different approaches based on which business segment they want to attack. That was not clear to the business side.” (C1)</p> <p>“When I came one year after [the previous manager] left, the project was heading into a complicated scale phase...Before I even start thinking of doing anything, I need to know the business case and then get their target for information.” (C6)</p> <p>“How they defined the technical targets related to the business case is not quite clear to me yet.” (C6)</p> <p>“The target is defined by the [downstream] customer, but also there were many parts in the target not clearly stated. In a way, it becomes a question of how to interpret the target... we as researchers have to help them define the [technical] target.” (C5)</p>	<p><i>The team made retrospective sense of technical challenges, but in their haste to find solutions, prior assumptions about the expectations and corresponding specifications for the project went unquestioned.</i></p> <p>“It was a challenge to find a solution for that. It turns out after we finished the development and after some experience for production, it was too complex to assemble the system. We needed to change that.” (P1)</p> <p>“I think it happened because there was not a clear specification when they started, and the specification was allowed to evolve when we were running the project.” (P4)</p> <p>“I think, first of all, we lost track of the main objective... Then instead of using well-known technology, the mechanism, it was decided to go for something completely new, everything. It was not just the cover, but it was also the inside mechanism. Everything was new.” (P3)</p> <p>“The new mechanism was ditched because it was not reliable. It was so complicated...I think it came so long that molds were made for production, but it was not put in production. Prototypes were made, but I think the molds were ordered, and I don’t know where they are now.” (P3)</p>
Prospective sensemaking	N/A	N/A

(Continues)

Table 3. Continued

Concept	Catalo	Perula
Problem representation after failure	<p><i>The problem representation after the failure event was still to provide a unique technical and system solution that ensured 20% material reduction (even though the market potential had changed).</i></p> <p>“That would signal the transition from active development to the next active industrialization...Once it is in the active industrialization, R&D role is more peripheral... we were supposed to be done...According to the targets that were set, we met all those...I would say that it’s pretty close to 100% successful in terms of technical performance, but what seems to be happening is that this business is being hit a little bit by the prices falling. That the margins aren’t as attractive as they looked a few years ago so, business wise, I don’t know!” (C3)</p>	<p><i>No reformulation took place, thus no new problem representation. The team persisted in trying to find solutions to technical problems of an increasingly unwieldy specification.</i></p> <p>“The team was working on...making the mold and working with the people...it’s just time-consuming. The salespeople didn’t want to wait, so they decided [the team] should do it faster...They must do something, and you have a new mold...It was a good thought, but it didn’t function like that when they go to details...There are two different projects. We did not cooperate, so they continued and developed it.” (P5)</p>
Innovative solution	N/A	N/A

assumptions for a reformulation of the project’s problem representation.

Both the *Catalo* and *Perula* cases are characterized by ambitious technological specifications, technological failures in development, and shifts in target markets. Furthermore, they are marked by a management fiat that dictated shifts in the target market, seemingly counter to the project teams’ intentions. Finally, despite the technological failures in development, sensemaking did not lead to a revision of the ambitious technological expectations using new assumptions. Table 3 contains illustrative quotes from our informants in the *Catalo* and *Perula* projects, and Figure 1 illustrates the process.

When it came to determining what to do, the *Vacula* and *Balato* teams engaged in prospective sensemaking by articulating new assumptions about the future trajectory of the project. They were able to reformulate the project’s problem representation.

Sensemaking in the Vacula project case. The *Vacula* service team repaired the faulty product locally, but within two weeks, the problem returned. They tested the product in the factory and encountered the same problem, so they enlisted the help of the R&D department. The project manager assigned a small team to find a solution to the problem and explicitly clarified the objectives. The team attempted to make sense of what happened, to understand the situation, and to determine why the product failed despite rigorous testing prior to shipping. The project team described many instances of retrospective sensemaking where they tried to identify and analyze the problem

by considering the original problem representation and the steps taken to devise a solution in light of that representation (Table 4). They concluded that the problem stemmed from changes to the product to make it cost-effective: “If there are slight differences in the parts, the force can move these parts and is greater or less than we thought. Because of that, our concept didn’t work as we expected” (VP of R&D). The original modifications had an unforeseen impact on material tolerances that affected performance.

Attempting to make sense of what to do, the *Vacula* project team considered a scenario where the product would not be recalled, with the VP of R&D noting: “It was not possible to make adjustments. We had to do something else. We had already launched it into the market, so what should we do?” Considering a scenario, where recalling the product would be costly and impractical, was a prospective sense of the desired future. As such, they reformulated material tolerances as a design criterion (new problem representation) for an innovative solution. The VP of R&D noted: “The tolerance is normal. We accept it. It needs to be like this. The system we put together with this [solution] must work with the [product] as it is.” Given this change in the problem representation, they executed a new problem-solving strategy that enabled Sanicom to develop an innovative solution that made it possible to install in all extant products without replacing the whole system and as expressed the R&D Engineer: “It’s been a great success. Now, we are going to use this [solution]. It will be a line extension in other projects as well.” Having reformulated the product’s objective relative to a reconceived probable future scenario enabled the

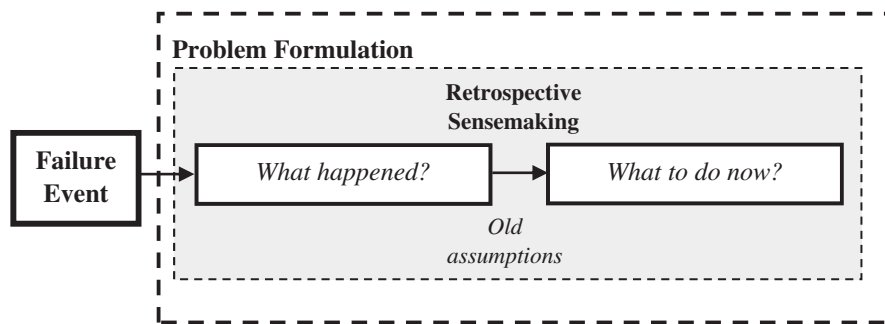
Table 4. Summary of Illustrative Informant Statements from the Vacula and Balato Projects

Concept	Vacula	Balato
Initial problem representation	<p><i>The initial problem representation was to build on a previously successful product and introduce it in a new market that would create a unique value proposition.</i></p> <p>“We wanted to find an easier and cheaper solution that had a lower entry price in the market to compete with the cheaper systems out there.” (V3)</p> <p>“We would like a system that [worked] to lower the cost, of course, and to make it safer for the end user.” (V1)</p>	<p><i>The initial problem representation was to provide a solution to a challenging technical problem that was not yet available in the market.</i></p> <p>“It probably started off somewhere here with an idea of a person in the company that this is a long-term opportunity. This will be big.” (B3)</p> <p>“It was an opportunity. Because it felt natural within the rules and regulations and the safety aspects.” (B3)</p>
Failure event	<p><i>Vacula’s failure event happened when the sold product did not perform as it should and recalling and replacing would be extremely costly.</i></p> <p>“We started to introduce this system...then some customers started to call back and say that it wasn’t working.” (V3)</p> <p>“Yes, because if it’s only one, then it’s not a problem...I think we sold around 200 [units] before we were aware of this problem.” (V4)</p>	<p><i>Balato’s failure event happened when the technical solution, despite passing the industry test, did not provide a cost-effective solution.</i></p> <p>“I cannot take on the responsibility anymore to develop this, because I know so much about the system.” (B3)</p> <p>“I said, ‘This is wrong. We are missing something here.’... Maybe they just missed it, but someone in [the agency] or those who are giving and granting us approval should have seen it.” (B3)</p> <p>“All the technologies we have here, they are working. But we cannot see a cost-efficient solution when installing it in the ship.” (B3)</p>
Retrospective sensemaking	<p><i>Retrospective sensemaking involved mainly looking back at the original problem and the steps they could take to fix it.</i></p> <p>“We did a bad design there because we didn’t realize that this had any effect...if there are slight differences in the parts, the force can move these parts and is more or less than we thought.” (V1)</p>	<p><i>Retrospective sensemaking involved the team realizing that the regulatory test was inadequate and was the main reason for the project’s inability to achieve anticipated success.</i></p> <p>“I think the recognition came a little bit by itself. We were lacking something.” (B2)</p> <p>“This was not the question to start asking them. We were blind...A lot of weak points on the technical side of the system.” (B3)</p>
Prospective Sensemaking	<p><i>Instead of recalling and replacing the product, the team considered a different scenario in which they looked at the problem as addressing a technical failure and how to do it in situ.</i></p> <p>“I have to see what the problem actually is.” (V4)</p> <p>“It was not possible to make adjustments. We had to do something else. We had already launched it into the market, so what should we do?” (V1)</p>	<p><i>Given that the discovered inadequacy of the regulatory test called into question the market’s need for an advanced technical solution, the Balato team revised their prior assumptions for the project’s trajectory.</i></p> <p>“I raised a question, ‘What to do now?’ ... What is my mandate, [technical or commercialization], what am I going to achieve? What is the scope of work I am going to do, and what is out of scope?” (B3)</p> <p>“I would say the reason for not having continued is that the market is not there. Instead of being an early developer, it is better, we think, to be a little bit late now, since we need to own technology.” (B1)</p> <p>“It was a total miss on the market because the market was not there [i.e., the industry regulation was not fully developed yet]... It was an administrative error or judgment error.” (B2)</p>
Problem representation post-failure	<p><i>After revising the assumption from “we have to change the product” to “we have to find a solution for the current product without changing it,” the team reformulated material tolerance issue into a system solution issue.</i></p> <p>“The tolerance is normal. We accept it. It needs to be like this. The system we put together with this [solution] must work with the [product] as it is.” (V1)</p>	<p><i>After reconsidering the project’s assumptions, the decision-maker decided to reformulate the problem from solving a technical problem to how best to address customer expectations.</i></p> <p>“The lesson learned is that we started to sell it before it is ready.” (B3)</p> <p>“We were so afraid when it went to the customer. The customer said it really added pressure here, because next time our sales guy is knocking on their door, ‘Do you remember you? You were the one that told me the truth. You didn’t let me down.’” (B3)</p>

(Continues)

Table 4. Continued

Concept	Vacula	Balato
Innovative solution	<p><i>With the new problem reformulation (fixing the technical issue without replacing the product), the innovation team figured out a way to insert a new part in the current system that solved the technical failure and enhanced product performance. This solution has been successfully applied to other new projects.</i></p> <p>“It’s been a great success. Now we are going to use this [solution]. It will be a line extension in other projects as well.” (V2)</p>	<p><i>Considering the new problem representation, the Balato team decided to use their case as a wake-up call for the whole industry.</i></p> <p>“We pulled the plug, just tell the truth and accept the setback.” (B3)</p> <p>“We have completed a comprehensive performance verification program... and reached a difficult decision to withdraw our current design from the market... The verification program showed that the system at this stage of development will not provide our customers with an effective, fully compliant solution for the varied and dynamic conditions [of the industry]... There is an account that we cannot measure afterwards and that is the extra business, because the customers said [Maricom] is a trustworthy partner.” (B3)</p>

**Figure 1. Process Model of Problem Formulation Post Failure in Catalo and Perula Cases**

team to shift the project trajectory and devise an innovative solution. Table 4 contains quotes illustrating the processes at in the *Vacula* project.

Sensemaking in the Balato project case. As an informant pointed out, the Balato project failure was considerable: “I think this particular project is definitely the most significant and expensive failure we’ve ever had” (Maricom CEO). In seeking to understand what happened, the team attempted to make sense retrospectively by considering the initial project specifications. The Business Director of Regulatory Products noted: “That’s just the test results of what you have, but how your parameters were set in the system?” The project manager realized that the source of the product failure stemmed from the fact that it had been initially specified and designed according to inadequate regulatory requirements. The project team concluded that industry regulators did not understand that there were several dimensions of technical complexity required for the product and the product optimized to the regulatory standard was

faulty as a result. Although *Balato’s* technology was able to meet the regulation’s tests for compliance, in the process of developing that technology, the *Balato* project team realized that the tests were inadequate.

As regulatory tests for compliance would be more stringent than originally anticipated, the initial assumption that technical challenges could be overcome was now improbable. The project manager informed the top management. In the meantime, the product, which presumably met regulatory criteria, had been pre-sold to customers who needed answers and refunds. To make sense of situation prospectively, the team, which now included members from top management, had to determine what action to take, given that a technical solution would not be sufficient or likely. The team reformulated the problem from one requiring a technical solution to one requiring customer appeasement. The project’s problem representation was radically transformed from technical to customer relations. Ultimately, the innovative solution was a strategic redirection that included the decision to stop the project, informing customers and industry

partners of the compliance test's weaknesses refunding deposits, and building customer loyalty.

Maricom refunded and apologized to customers, and the *Balato* project failure served to enlighten the industry, alerting regulatory bodies and industry members that the approval test was not designed for such radical products. The bold strategic redirection increased Maricom's industry respect. The Business Director of Regulatory Products noted: "There is an account that we cannot measure afterwards and that is the extra business, because the customers said [Maricom] is a trustworthy partner." Although the *Balato* project termination caused substantial financial loss in the short term, the team's response to the failure ultimately assured Maricom's leadership position and customer loyalty in the long term, and the outcome was ultimately viewed as a success.

In addition to actions directly addressing the *Balato* project failure, the top management team acted quickly by collecting all relevant information, analyzing why the failure, and determining how to avoid a failure in the future. A new process for innovation projects was applied throughout the organization. This innovation process model has become a useful guide for innovation projects at Maricom. Table 4 contains illustrative quotes from our informants in the *Vacula* and *Balato* projects.

Summary of sensemaking in the four cases. When it comes to devising a course for post-failure action, we found that while the *Catalo* and *Perula* project teams' sensemaking process was primarily retrospective, the *Vacula* and *Balato* project teams' sensemaking process was retrospective *and* prospective. In formulating the problem representation post-failure and determining the course of action, the *Catalo* and *Perula* project teams compared the present situation to assumptions embedded in the project's trajectory pre-failure, and despite failure, the assumptions did not change. However, the *Vacula* and *Balato* project teams compared the failure situation with renewed expectations or assumptions about the future, which required them to devise a new problem representation.

Prospective Sensemaking

Prospective sensemaking is key to the reformulation of problem representations that ultimately drive innovative solutions. The *Vacula* and *Balato* innovation

teams engaged in prospective sensemaking processes and generated a new problem representation based on revised assumptions and expectations. The new problem representation served as a blueprint for an innovative solution, either in the form of product innovation (*Vacula*) or strategic redirection (*Balato*). Prospective sensemaking was important in helping to make sense of "novel, unexpected, or confusing events" (Maitlis and Christianson, 2014, p. 58) and in generating innovative solutions in light of those events. This article extends Gralla and colleagues' (2016) suggestion that "sensemaking is the mechanism of problem formulation" (p. 11) and extends Dougherty, Borrelli, Munir, and O'Sullivan (2000)'s discovery that more innovative firms (or teams) interpret information in a wider context, whereas less innovative firms (teams) have more limited sensemaking of available information. This article suggests that innovative teams (those that conceive innovative solutions) hesitate in jumping to solutions (Enders, et al., 2016) and seek to reformulate the problem or opportunity based on new or revised expectations of the future.

Although Weick et al. (2005) noted that "answers to the question 'now what?' emerge from assumptions about the future" (p. 413), the analysis of the *Catalo* and *Perula* cases indicates that answers can emerge from past assumptions, leaving the would-be innovators stuck in their current trajectory. Failure triggers sensemaking and retrospective sensemaking to understand what happened relative to assumptions about what should have happened; however, failure does not necessarily trigger a revision of assumptions. Rather, it seems that a revision of assumptions requires prospective sensemaking that deliberately seeks to reconsider assumptions about the future that can be made explicit in a new problem representation. While retrospective sensemaking in the process of formulating a representation of the problem post-failure seems to be intuitive, prospective sensemaking is not. Prospective sensemaking must be deliberately encouraged and nurtured.

The finding that past assumptions are used as a basis for action supports bounded rationality and satisficing which are pervasive organizational forces countering change (Cyert and March, 1992). In addition, myopia (Levinthal and March, 1993) may limit the ability to envision a future course of action in the present. Therefore, truly future-oriented prospective sensemaking is restricted when the answer to "now what should we do?" is based on past assumptions.

The analysis presented in this article indicates that prospective sensemaking is a necessary condition for successful problem reformulation. Innovators find it difficult to reformulate the problem without revisiting old assumptions, determining what has changed, and making new assumptions about a possible future. The inflection point for teams that can succeed post-failure is when sensemaking reference comparison stops being retrospective and becomes prospective. Then a question arises: What drives the inflection point? Specifically, why were the *Vacula* and *Balato* project teams able to engage in prospective sensemaking while the *Perula* and *Catalo* project teams were not? Assumptions about the future come with great uncertainty and risk, and sensegiving (Gioia et al., 1994; Mantere, Schildt, and Sillince, 2012) is an important leadership behavior in ambiguous situations. Fittingly, the analysis shows that engaging in prospective sensemaking relies on differences in leadership behaviors among the four teams.

Leadership Change Behavior

Leadership behaviors were salient in all projects; however, only the *Vacula* and *Balato* projects had instances of the kind of leadership behavior that enabled the team to reformulate the problem. Within these two projects, the leaders promoted change and the challenging of assumptions, took personal risk, and encouraged innovative thinking. These behaviors fit well with the change-behaviors of Yukl et al.'s (2002) leadership behaviors framework. Task behavior (planning for the short term as well as clarifying objectives and monitoring the operation process) and relations behavior (providing support and encouragement to the team) were present in all cases. However, change behaviors (proposing innovative strategies and encouraging risk taking) were absent from the *Perula* and *Catalo* projects. Table 5 contains illustrative quotes of leadership change behaviors.

Leaders of the *Vacula* and *Balato* projects engaged in sensegiving (Gioia et al., 1994; Mantere et al., 2012) and in encouraging feedback (Akbar, Baruch, and Tzokas, 2017), initiating the cycles of prospective sensemaking that ultimately enabled these projects to find success. In all cases, technical managers and team members were remarkably competent, fully supported, and in terms of task and relationship behaviors, all cases had instances of self-leadership

(Stewart, Courtright, and Manz, 2011) and leadership in the background (Mintzberg, 2002). Project managers searched for potential solutions with team members and created conditions for team members to drive change. In *Vacula* and *Balato*, managers expressed that to drive change, they had to challenge the organization's status quo. In so doing, they accepted personal risk from inviting suggestions and feedback (Akbar et al., 2017) and giving team members the opportunity to give new meaning (Gioia et al., 1994; Mantere et al., 2012) to the new situation. In *Vacula*, change behaviors were suggested by manager statements that supported innovation, and trial-and-error was tolerated and encouraged. In *Balato*, change behaviors were suggested by manager statements that described a steadfast vision for change and a remarkable tolerance for taking personal risk to realize a vision for change that was counter to the organization's status quo. As noted by the Project Manager of the *Vacula* project: "We have our checkpoints: Have you done this? Have you done that? ... You need to change the overall organization as well because this is a new way of thinking" As noted by the Project Manager of the *Balato* project "My advice is, focus on what you are good at and stand for it. If you disagree, tell!... If you still really, really feel it is a wrong decision and should not be allowed to go further, stick to what you believe in absolutely. Don't give up."

Although the *Catalo* and *Perula* project teams were innovative, they lacked leadership change behaviors relative to innovating and changing the project trajectory. Although the initial assumptions were questioned in the face of failures, the representation of the project's reason for being was not revised adequately to reflect new assumptions. We attribute this resistance to change in the *Catalo* and *Perula* projects to the absence of leadership change behaviors.

Leadership behaviors are generally important, but leadership change behavior is particularly critical to success post-failure, as it encourages innovative thinking (Yukl et al., 2002). Leadership change behavior is the primary driver of the inflection point between retrospective and prospective sensemaking. Leadership change behaviors manifest by encouraging innovative thinking, envisioning change through problem reformulation, and taking personal risks to make changes happen. This aligns with Van de Ven et al. (2008), who argued that employing multiple leadership behaviors increases the likelihood of technological foresights

Table 5. Illustrative Leadership Behaviors from Four Projects, Based on Yukl et al.'s (2002) Taxonomy

Task behaviors (short-term planning, clarifying responsibilities and performance objectives, monitoring operations and performances)	
Vacula	The project manager had a clear <i>plan</i> for how to solve the problems in different situations. For example, when brainstorming was needed to find a solution for the product failure, he assigned the task to a small number of people instead of the whole group: "I wouldn't have had any other people there, because then you lose focus." He also <i>clarified</i> the objective: "You have put something into the market that doesn't work. You must find a solution really quickly. It must work. It's a big risk, but you must do it very quickly."
Balato	The new project manager did his due diligence when <i>monitoring</i> the project and figured out that although it had passed the industry test it was a much more complicated technical problem: "This is wrong. We're missing something here...Where are the test results?...Was it full load at low level? High temperature, low temperature? How were your control systems set to achieve that?" He made the decision after <i>clarifying</i> the reasons: "I presented our technical findings and explained why we cannot continue with it."
Catalo	The new technical manager was very skilled in both technical know-how and <i>planning</i> activities. Team members commented: "A very, very experienced project manager. That was why he was brought in... He came up with an extremely <i>detailed plan</i> , far superior to anything we have ever saw before, superior in terms of details. That has been quite instructive for us." He also played an important part in <i>clarifying</i> the objectives for the project: "I think [he] has quite the role... in terms of having a clear target... the ideas were clear before, but what the success criterion was precisely was formulated when he came in."
Perula	The project manager <i>clarified</i> the objective as improving the current part of the product system instead of developing a whole new one, and thus he demonstrated <i>management effectiveness</i> : "The [part] we use today... is the same [part] as before. We have done some adjustments of course... The lifetime now is five times longer than it was before. Then we had control over the existing [part] with really low risk. Much better solution... We decided to skip the new [part] development with a lot of money involved to go for the safe one" (i.e., the old one).
Relation behaviors (supporting, developing, recognizing, consulting, empowering)	
Vacula	The project manager showed his <i>support and encouragement</i> to team members: "I trusted him. I'm not angry at him. It is not like that. I believe that he knew this better than I." He also <i>consulted</i> with members when making decision and <i>acknowledged</i> their contribution: "We discussed the problem together, and then [one of the team members] and I developed this after the discussion."
Balato	The project manager provided guidelines for discussion in the team to create a safe environment, showing <i>support and encouragement</i> : "Create an open and constructive discussion. Get all the issues out in the open. Seek to capitalize on the experience gained."
Catalo	The leadership relation behaviors were exercised in the background. One member of the team was highly praised by his colleagues: "He is very accessible...Very much involved in <i>training</i> [i.e., developing] new employees or getting [them] up to speed on the science or the challenges." The technical manager also received <i>support</i> from different sources: "I did not know what to do. So, I needed all the help... to get things going. That was very helpful from them." "There are lots of support functions that ensure the ideas are transferred into value in the team."
Perula	One member involved in the project made a comment about the culture, emphasizing they are <i>empowered</i> to take initiative in problem solving: "The atmosphere and culture are very good... It is a mentality here to find the best solution no matter what position you have."
Change behaviors (external monitoring, envisioning change, encouraging innovative thinking, taking personal risks to implement change)	
Vacula	Change behaviors are present The team members were <i>encouraged to work on innovative ideas</i> : "Be patient. Try and try because success and failure are very close all the time. Try hard enough to get success and believe in a good idea." The project manager gave an example how his team <i>proactively changed the way it used to be</i> for years in the company: "I don't think the company has done anything about it. But we [did]... we test them so much as it has ever been before to come up with new solutions. We have our checkpoints: Have you done this? Have you done that? ... You need to change the overall organization as well, because this is a new way of thinking." This change behavior triggered the prospective sensemaking process that led to problem reframing and strategic redirection for <i>Vacula</i> project.
Balato	The project manager <i>took personal risk</i> when he decided to declare the project failure and <i>proposed new change</i> : "I went to my boss, then to the top management team and said, 'I cannot take on the responsibility anymore to develop this, because I know so much about the system. If we continue, I think it will be a huge disaster. There will be 50 more contracts waiting for signing. They will just get worse'....We are not mature yet, we need to really think about this and that, more and more." He demonstrated the <i>risk-taking attitude to promote necessary change</i> : "My advice is, focus on what you are good at and stand for it. If you disagree, tell!... If you still really, really feel it is a wrong decision and should not be allowed to go further, stick to what you believe in absolutely. Don't give up." This behavior ignited the prospective sensemaking process that led to problem reframing and re-formulation.

Table 5. Continued

Catalo	Change behaviors are absent	<p>There were conflicts between the technical and business sides of this project; however, no action was taken to change the situation or resolve the dissidence: “To be honest, I don’t think they will share [the market information].” This is due to the restricted information nature of the project: “It was also extremely confidential if we were going on or off to this business at all.” As a result, things were difficult when the market changed unexpectedly: “Nobody foresaw it... We just had to throw away the business case because the market projections were all wrong.” On the technical side, although “the planning seemed exemplarily detailed,” they could not respond according to this situation, because “what we did not have was contingency time built into the plan.”</p> <p>In reflection, one of the project members retrospectively shared the lessons learned: “I think at an earlier stage, we have to be more open. I think this very high level or degree of secrecy was, perhaps, not necessary and has caused some problems for us.” This could have been done if <i>leadership change behavior</i> was initiated to reframe the nature of the project. This reframing would have helped facilitate the collaboration between the technical and business sides and trigger the prospective sensemaking process to reformulate the problem.</p>
Perula		<p>The <i>change behavior was lacking</i> as confirmed by the project members: “Seen from an organization point of view, it was a lack or there was a missing point of the strategic things... It was the leadership... If I look back at these six years, I would really like this project to disappear, because this is one of these projects that is going on and on and on and on and on. They will never stop. When I was really frustrated some years ago, I asked, ‘Should we stop? Should we close the lid for this project and pull it out from the market?’ He said, ‘No.’ I’m sorry about that.” As a result, the project ran for nearly ten years without delivering the product that satisfied the original objectives. There was <i>no leadership change action</i> taken to initiate the prospective sensemaking process.</p>

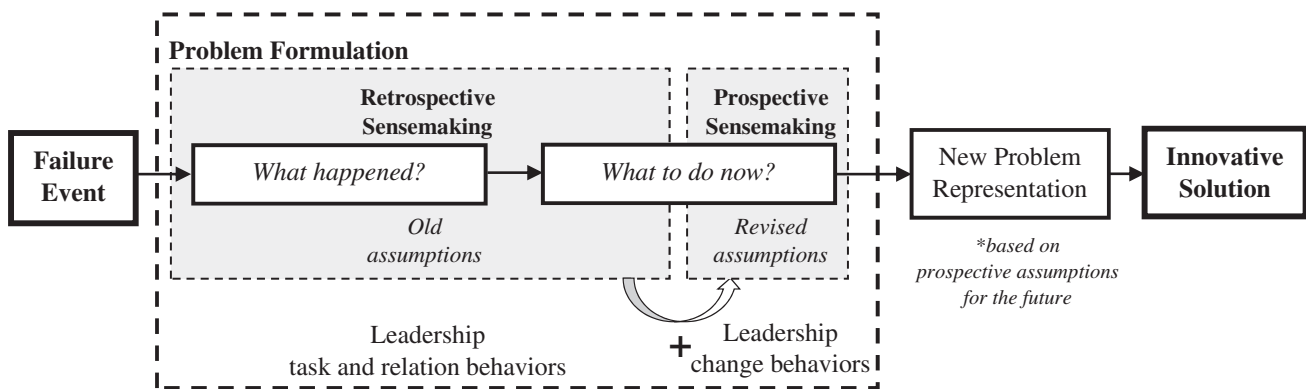


Figure 2. Process Model of Problem Reformulation Post Failure

and decreases the chances of oversights. Without leadership change behaviors, the prospective sensemaking mechanism of problem formulation is not fully realized. When confronted with the question of “now what?” absent leadership change behaviors, the answer remains based on previous assumptions rather than on revised assumptions that project into the future. As a result, failures were not exploited to their full potential, and did not ultimately lead to innovative solutions.

The finding that only leadership that promotes change behaviors can turn failure into success extends the understanding of what is needed to learn from

and capitalize on failures. Managers and organizations want to learn from failure and to profit from it. Findings are summarized in Figure 2 above illustrating the gap between retrospective sensemaking and prospective sensemaking, which requires leadership change behaviors to be bridged.

Finally, this article suggests that a problem formulation characterized by retrospective and prospective sensemaking (using new or revised assumptions) is necessary for reformulating problem representations to guide a new project trajectory. Although innovative solutions are not necessarily the outcome of a shift in project trajectory, we posit that in the face of failure,

the inability to reformulate the project's problem representation is why innovation projects that experience a significant failure event are not turned into subsequent successes.

Conclusion

In this article, we explored innovation project failures, problem formulation post-failure, and how problem representations may or may not lead to productive outcomes. Several results emerged from the study. First, sensemaking is an important mechanism of problem formulation post-failure. Second, a reformulated problem representation, which is the outcome of problem formulation characterized by retrospective and prospective sensemaking, is a necessary antecedent of innovative solutions. Third, process factors impact project teams making the transition from retrospective to prospective sensemaking. Specifically, leadership change behaviors were salient factors in two case studies that turned failure into success.

This article shows that without a problem formulation process that includes future-oriented prospective sensemaking, a project runs the risk of continuing along a path where problem representation remains inadequate, because it is based on outdated or obsolete assumptions. Innovation or redirection is unlikely, and these projects can drain company resources and project team morale. This article also shows that post-failure product development success can be defined by an innovative technological solution and by innovative redirection. Finally, by shedding light on a process that can facilitate success in the face of failure, we contribute to the understanding of how teams and organizations learn from failure and how failures, via the process of problem formulation, can drive innovation.

The findings presented in this article extend literature on innovation processes in organizations (Langley and Tsoukas, 2010; Van de Ven et al., 2008) and contribute to the literature on problem formulation (Baer et al., 2013; Lyles and Mitroff, 1980) by showing how reformulation of the problem drives successful innovation. This article contributes to the literature on sensemaking in organizations (Gioia et al., 1994; Weick, 1995) and on learning from failure (Edmondson, 2011; Sitkin, 1992) by highlighting the importance of prospective sensemaking in the face of innovation project failures. This article also contributes to the literature on leadership behaviors in organizational change and innovation

(Burke et al, 2006; Derue et al., 2011; Yukl et al., 2002) by demonstrating the importance of leadership change behaviors in organizational innovation projects. Finally, our study provides insight into how organizations can better use failures to achieve success and provides a potentially fruitful direction for future research.

The analysis shows that, within the phase of problem formulation where teams sought to understand *what happened* relative to expectations of *what should have happened*, the four project teams engaged in retrospective sensemaking. Here, leadership behaviors were characterized by encouragement while focusing on short-term-planning, objective clarification, and process monitoring. The two ultimately successful post-failure projects diverged from the other two within the phase of problem formulation where teams sought to understand *what to do*, with the successful teams engaging in retrospective and prospective sensemaking.

These findings clarify the importance of the process of formulating problem representations that lead to innovation and competitive advantages. While we set out to understand problem formulation post-failure, we were confronted by the importance of sensemaking and leadership behaviors within the context of failure. Therefore, the findings extend the emergent literature concerning the importance of prospective sensemaking in innovation teams (Stigliani and Ravasi, 2012) and the literature concerning the importance of leadership, particularly leadership behaviors, in new product development (Barczak et al., 2006; Barczak and Wilemon, 1989; Gumusluoglu and Ilsev, 2009).

Future Research

This study reveals areas for further research. First, the research context is limited to Norwegian companies. Compared to other contexts such as the United States or Israel (Senor and Singer, 2009) where failure is often viewed as a "badge of honor," in Norway, failure has traditionally been viewed as a stigma to be avoided. Therefore, the conditions that facilitate shifting trajectory post-failure might be different in other settings. Additionally, if innovation project failure events can be overcome in a context where failure has been stigmatizing, it provides hope for the future of innovation.

Second, although leadership behaviors were a particularly prominent condition of prospective

sensemaking, other conditions merit further research in relation to linkages between failure, problem formulation, and innovation. Factors such as psychological safety (Edmondson, 1999), attribution bias (Weiner, 1986), negative emotions (Shepherd and Cardon, 2009), superstitious learning (Levitt and March, 1988), shared mental models (Denzau and North, 1994) and cross-understanding (Huber and Lewis, 2010), would provide insight into how failures can be turned into successes.

Third, although our lens is that leadership change behaviors drive prospective sensemaking and is “unidirectional,” it is possible that leadership processes in innovation teams are “interactive” (Yukl, 1989, p. 279). An alternative explanation, although less likely, could be that team members’ prospective sensemaking sowed the seeds of leadership change behaviors.

Fourth, future research should examine how and to what extent innovation team members’ commitment to the original course of action (Staw, 1981) affect the teams’ ability to engage in prospective sensemaking, subsequently embracing a new course of action. Future research should investigate the nature of sensegiving as a factor in driving innovation projects forward post-failure. Who are the people that engage in sensegiving and prospective sensemaking; team leaders, team members, organizational leaders, or other stakeholders? The findings lead us to posit prospective sensemaking as a necessary (but perhaps not sufficient) antecedent for problem reformulation after experiencing an innovation project failure event.

Managerial Implications

The findings presented in this article provide insights into a process for turning failure into success. This article contributes to the normalizing of failures in organizational life, particularly when it comes to innovation, and highlights the importance of a process of problem formulation characterized by sensemaking that is retrospective and prospective. While not all failures are bad (Cyert and March, 1992; Edmondson, 2011; Sitkin, 1992), it is insufficient to host post-failure parties and claim to have learned from failure. Rather, managers need to capitalize on failures because the penalty for not doing so can be high.

One important lesson for innovation project managers and team members is to continually check the assumptions upon which the innovation project is founded. In innovation projects, the assumption to

knowledge ratio is higher than for other projects in organizations, and assumptions expire. Assumptions should be revisited continually, not only after failure. This study shows that the inability to shift trajectory post-failure can hinder organizational learning, and this can have dramatic consequences. Post-failure pivoting hinges upon managers’ ability to engage in and to enable conditions for leadership change behaviors that help turn failures into success. Doing so requires an understanding that failure may present itself explicitly, but its representation and subsequent solution are not obvious. A project’s problem representation post-failure must be socially constructed and creatively reformulated, so that it is expressed strategically accounting for anticipated and desired outcomes for the future.

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Appendix A.

Summary of questions for semi-structured interviews

1. Can you please describe your role in this project?
2. How did the project come about? What were the symptoms that triggered the project? Had the organization experienced these symptoms before? Was the project initiated because there was a problem to be solved, a crisis to be addressed, or a new opportunity?
3. How was the project defined? Who was it defined by (management, customer, or the team)?
4. Can you please describe the environmental circumstances (internal and external pressures) in which the organization or team found itself?
5. What made this project an ultimate success or failed? Please tell us about the failure event and what followed.
6. What are the key lessons from this project?
7. How were these lessons shared in the organization?
8. How did these lessons impact your behavior and the organization (system, structure, strategy, culture, leadership behavior)?
9. How do you learn from other teams and other organizations?