ELIO KEKO

Essays on Innovation Generation in Incumbent Firms

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Essays over het Generen van Innovatie in Gevestigde Ondernemingen

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Elio Keko
born in Tirana, Albania

Erasmus University Rotterdam

Doctoral Committee

Promotores:	Prof.dr. S. Stremersch dr. N.M.A. Camacho
Small Committee:	Prof.dr.ir. B.G.C. Dellaert Prof.dr. P. Van Kenhove Prof.dr. S.H.K. Wuyts
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Rotterdam, June 2017

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Chapter 1

Motivation, Structure and Summary

Today, innovation is more relevant than ever. Technology innovation has never been more impressive and impactful on society. Thanks to the mobile innovation revolution we have enormous computing and connecting power in our hands whenever we want. Innovation in chemistry allows us to dream of zero-CO^2 mobility. And innovation in genetics and biopharma now make it credible to regrow severely damaged human bone and tissue (a field known as tissue re-engineering).

However, it is rarely technology innovation that drives the so-called disruption our economy is facing. Often the development and application of fundamentally different economic principles (also called, business model innovation) seems more disruptive to the incumbent economic agents. Consider the rise of the sharing economy. Airbnb does not really offer new technologies. Rather, it challenges the hotel industry by offering a new experience (cultural exchange between host and guest), and leveraging existing underutilized assets (a spare room) at an unmatched price point (at least half of what a hotel charges). Incumbents in other industries face similar challenges. For instance, car or ride sharing (BlaBlaCar, Car2Go) challenge the automotive industry and the desires of health insurers and government agencies to only pay for drugs that work (so-called pay for performance), challenges the classic model of the biopharma industry.

In my dissertation, I wanted to take the perspective not of start-ups, but of incumbent firms and how they organize innovation in response to the above challenges and opportunities (see **Chapter 2** for an overview). More in particular, I got intrigued by new organizational forms of decentralized innovation (so-called grassroots innovation), in which employees are given a high level of autonomy to pursue innovation (see **Chapter 3**). Firms sometimes refer to this as bringing the start-up mentality inside. This new form of innovation has the potential to unlock immense innovation power among firms. One its main portrayed benefits is that it overcomes middle management resistance, which is seen as an important source of inertia limiting incumbent firms to respond appropriately to disruption and innovate. On my discovery path on grassroots innovation, I developed an alternate view on such resistance to change among middle management, which I present in **Chapter 4**.

In the present introduction, I first describe more in detail what motivated me to write this thesis. Next, I detail the structure of the thesis, shortly summarizing each of the chapters. I end this introduction by looking forward to future research opportunities that build upon the work presented in this thesis.

1.1 Motivation

I started my dissertation trajectory with a thorough review of the innovation literature and innovation practices. This review was triggered by a request of Deb Mitra and Peter Golder to Stefan Stremersch, my advisor, and myself to contribute a chapter to a new

(edited) book they were planning on innovation involving top scholars in marketing. I included this book chapter as **chapter 2** of my dissertation as it was an essential springboard for me to discover the topics I wanted to empirically investigate. On the one hand, it allowed me to engage in a structured study of the innovation literature. On the other hand, it also allowed me to spot key gaps in the literature.

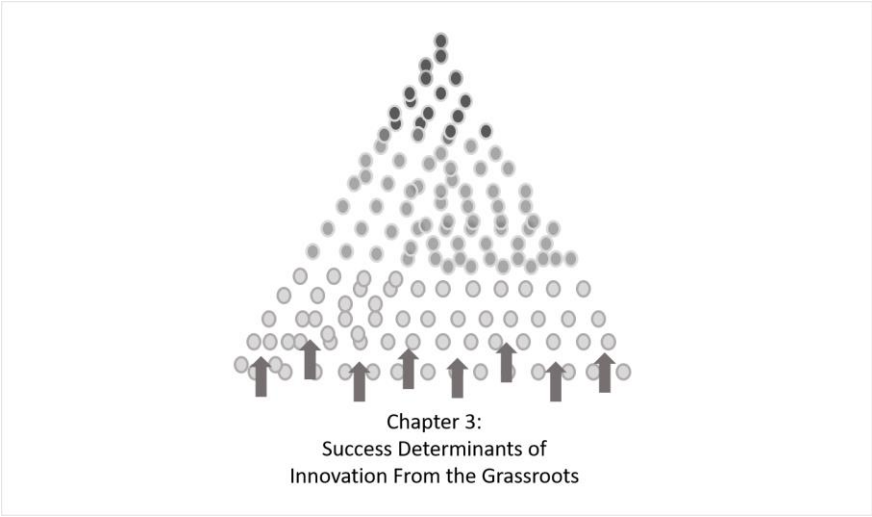
One such gap that I discovered quite quickly is that innovation is increasingly driven by the grassroots of an organization. Grassroots innovation enables employees, irrespective of their function or seniority, to generate innovation ideas and develop them into a commercial offering (Bauman and Stieglitz 2004; Huy and Mintzberg 2003). More and more firms are experimenting with greater employee involvement in innovation (Birkinshaw, Bouguet, and Barsoux 2011; Huy and Mintzberg 2003). This no longer only includes firms such as Google, 3M and W.L. Gore known for giving employees great autonomy, but has grown to include firms such as AirFrance-KLM, BestBuy, Dell, Merck and Michelin, amongst others.

While the prevalence of grassroots innovation in firms has grown substantially in recent years, grassroots as a concept is not new. The term dates back to the Tennessee Valley Authority (TVA), a U.S. federal agency founded in 1933, with the aim of improving the quality of life in a region hard-hit by the Great Depression (Selznik 1949). The agency was especially focused on power and water management challenges and enlisted the help of all citizens in

the region, in a grassroots approach, to discover solutions for their challenges. Thus, grassroots finds it roots in public administration, where it continues to be used (e.g. Neuse 1983; Seyfang and Smith 2007). However, grassroots has also emerged in other fields, namely economics and sociology. In economics, a grassroots (i.e. bottom-up) view is contrasted with a top-down view of economic activity (Easterly 2008; Phelps 2013). The top-down view sees institutions as governed by rules and laws written by political leaders, while the bottom-up view sees institutions as emerging naturally from ordinary citizens. In sociology, researchers distinguish between grassroots and elite-engineered social disruption (Goode and Ben-Yehuda 1994). Authors in the field see the grassroots model as decentralized movements that originate among the general public and progresses up to create social disruption. Elite-engineered disruption is a model where social disruption is deliberately triggered by a small and powerful elite.

In management, one can contrast grassroots innovation similarly with top-down innovation (see Figure 1.1). In top-down innovation, a firm's senior management delegates innovation efforts to a 'lab elite' and subsequently pushes it down through the organization. In grassroots innovation, the responsibility for innovation generation and development resides with all employees, regardless of their seniority or level of expertise.

Fig. 1.1 Innovation from the Grassroots



Firms are increasingly experimenting with this model of 'crowdsourcing from employees' for several reasons. First, improvements in technology have made grassroots innovation more feasible. Digital platforms allow firms to collect, judge and provide feedback on a large number of ideas. These platforms also allow employees to provide feedback, rate each other's ideas, and connect to form teams to further develop the idea. Second, a new leadership style is arising where managers do not simply use coercion towards their people, but take the role of a mentor. This new leadership style aims to motivate employees and provide them with the autonomy to make decisions while guiding them along the way. Third, there is a trend of democratization in society, which is having important consequences on firms. Employees, and especially the most talented and entrepreneurial ones, do not simply want to follow, but want to see their ideas implemented. Fourth, as many large incumbents

struggle against fast-moving startups, they aim to bring a startup mentality inside their organizations. Firms foster such as culture by involving all employees in innovation and making innovation everyone's responsibility.

Despite its prevalence, grassroots innovation among firms has received little academic attention. Therefore, no prior study has empirically examined whether grassroots innovation contributes to overall firm performance or firm's innovation success. Nor, does any prior study examine how to optimally implement grassroots innovation. What are the key characteristics that make grassroots innovation succeed or fail? In our work (as reported in **Chapter 3**), we develop a new theory to explain the success determinants of grassroots innovation and test our theory empirically with more than 2,000 managers in 14 countries. In developing our theory, we look at, on the one hand, what motivates employees to successfully innovate, and on the other, what mechanisms senior management use to steer employee innovation towards the firms' goals. Our theory is grounded in self-determination theory (Ryan and Deci 2000) and controlling theory (Adler and Chen 2011). Self-determination theory distinguishes between three fundamental innate psychological needs, namely the need for autonomy, competence and relatedness, which, when satisfied, boost employee motivation, confidence, creativity and persistence in innovation. Controlling theory discerns between enabling and coercive control. Coercive control relies on formal mechanisms and metrics to demand employees to periodically report on progress. Enabling control relies on

management supporting employees through frequent and transparent feedback.

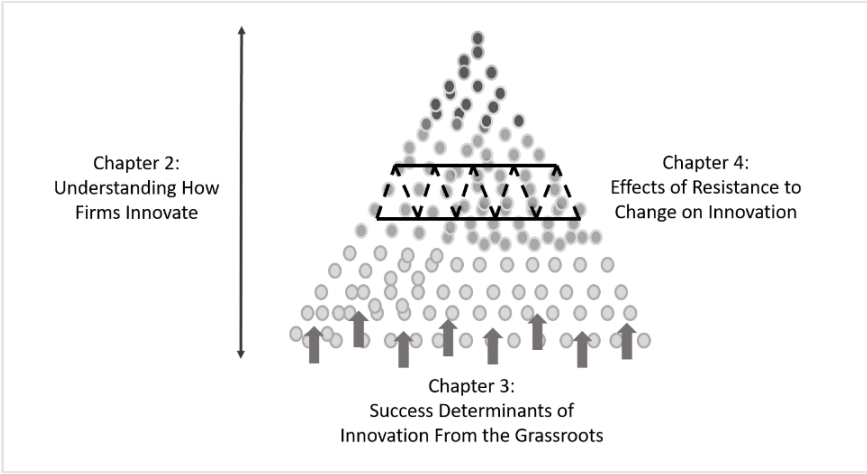
A second gap that I discovered during the literature review as reported in **Chapter 2** was that the resistance to change shown by middle management was universally seen as an important bottle neck to successful innovation in incumbent firms (e.g. Courpasson, Dany, and Clegg 2011; Oreg 2003; Waddell and Sohal 1998). Resistance may occur due to the natural tendency of employees to maintain the status quo (Kotter 1995), because employees believe the change will be detrimental to them (Waddel and Sohal 1998), and due to employees' unwillingness to learn new competencies that come with change. Employees prefer continuing past practices they typically know how to do well over learning new practices they may perform poorly at first. Resistance to change has been linked to negative consequences such as employee disengagement, delay or blocking of change, or reduction in the quality of change (Guth and MacMillan 1986).

However, my study of the literature and study of cases led me to discover also benefits of said resistance (e.g. Ford and Ford 2009, Ford, Ford and D'Amelio 2008; Piderit 2000). First, if employees voice their concerns with change, resistance leads to an open dialogue that allows for better understanding and implementation of the proposed change (Ford, Ford and D'Amelio 2008). Second, resistance to change, by spurring discussion, leads to the adaptation of the proposed change by eliminating unnecessary, impractical or counterproductive elements of change (Ford, Ford and

D'Amelio 2008). Third, resistance to change leads to sharing of diverse opinions, which helps in improving and better implementing change (Piderit 2000).

I felt this two-sidedness of resistance to change was poorly covered in the innovation literature. Thus, the literature clearly shows a gap of understanding how resistance to change helps or hinders innovation. This triggered another empirical study which I report in **Chapter 4**, which aims to understand how employees' reaction to change leads to either positive or negative effects on innovation. Figure 1.2 enriches Figure 1.1 above to provide an overview of the three different parts of my dissertation and where they reside in the firm. **Chapter 2** reviews a broad array of innovation practices involving all layers of the firm. **Chapter 3** empirically studies grassroots innovation practices. **Chapter 4** empirically examines the role of middle management resistance to change in innovation.

Fig. 1.2 Outline of Each Dissertation Chapter



1.2 Structure of the Dissertation

In this section, I elaborate on the structure of my dissertation building upon Figure 1.2 as introduced above. I discuss the main the topics studied, the main findings, and implications of each chapter.

1.2.1 Chapter 2: The What, Who and How of Innovation Generation

While innovation is a top priority in most companies, it poses many challenges to managers. **Chapter 2** provides and overview of the innovation literature and focuses on the what, who and how of innovation. Firms need to decide on what to innovate on, who drives such innovation, and how innovation goes from idea to business. To clarify the challenges managers face and help them navigate the path to market, we provide an ample review of all facets of the innovation generation process. Through this chapter, we aim to gain a better understanding of the innovation generation process of firms before gaining depth in the success determinants of grassroots innovation.

This chapter presents several findings. First, we find that firms can engage in several types of innovation (the *what* of innovation), namely (i) product innovation, (ii) service innovation, (iii) process innovation, and (iv) business model innovation. Furthermore, these types of innovation can vary according to risk and time horizon. More specifically, firms can choose between (i) incremental versus radical innovation, (ii) sustaining versus disruptive innovation and (iii) core versus adjacent versus transformational innovation. Second, we find that innovation can

come from difference sources (the *who* of innovation), namely through (i) top-down innovation, (ii) grassroots innovation, (iii) lead user innovation, (iv) crowdsourcing innovation, and (v) open innovation. Third we find that innovation can be developed through several process (the *how* of innovation), namely a (i) stage-gate process, (ii) spiral process, (iii) lean process, (iv) design thinking process, and (v) systematic inventive thinking process.

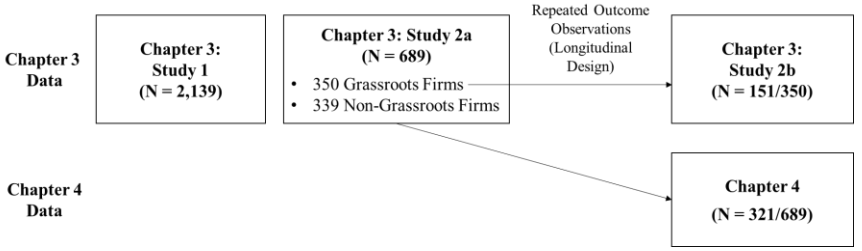
This chapter offers several implications. The chapter provides an overview of literature from a variety of sources that can help other academics guide their research. We synthesize both decades of prior work on well-studied topics such as product innovation and stage-gate processes, and work on more nascent fields such as business model innovation and lean processes. The chapter can serve as a guide to managers on innovation terminology and an introduction to those looking for new ways to innovate. Furthermore, it provides a wide array of cases studies from both start-ups and established companies from which they can draw inspiration for their own initiatives.

1.2.2 Chapter 3: Innovation from the Grassroots: Determinants of Success

With employees from all ranks increasingly being recognized as a primary and sustainable source of innovative ideas, **chapter 3** focuses on the success determinants of grassroots innovation. Figure 1.3 provides an overview of fieldwork completed for both **chapter 3** and **chapter 4**. To test for the success determinants of grassroots

innovation we conducted two studies, a cross national survey among 2,139 firms in 14 countries (**chapter 3**: study 1) and a longitudinal survey among 689 in the US (**chapter 3**: study 2a). Of these 689 firms, 350 had already engaged in grassroots innovation, and were re-contacted (repeated outcome observations), leading to 151 responses (**chapter 3**: study 2b). The 689 firms were also re-contacted for **chapter 4**, leading to 321 responses.

Fig. 1.3 Overview of Fieldwork



Despite the growing importance of grassroots innovation for firms, and the heterogeneity across firms in grassroots innovation success, there has been no empirical study to date that inventories which factors determine the success, or failure, of grassroots innovation. We look, at the one hand, the effects of self-determination theory (autonomy, competence and relatedness) and on the other hand the need for the firm to control the process through the use of enabling and coercive control. Through this chapter we aim to advise managers working with grassroots innovation on how to best set up such initiatives.

This chapter presents several findings. First, we find that firms that adopt grassroots innovation perform significantly better than those that do not. In addition, those firms that perform better at grassroots innovation, are able to reap more financial benefits from innovation overall. Second, we find that intrinsic motivation has a stronger positive effect on grassroots innovation performance than extrinsic motivation. Furthermore, we find support that satisfying employees innate human needs for autonomy, competence and relatedness, boosts intrinsic motivation. Third, we find that depth of control (sum of both enabling and coercive control) has a significant and positive effect on grassroots innovation performance.

This chapter offers several implications. The chapter provides new insights on the relationship between self-determination theory, control and grassroots innovation performance. Taking our findings into account can help managers structure their grassroots innovation processes. First, firms should focus their efforts on boosting participants' intrinsic motivation. This can be achieved by ensuring that participants feel that the process enables them to achieve a high level of autonomy, competence and relatedness. To stimulate perceived autonomy, firms should ensure that the grassroots innovation process is seen as a unique opportunity for employees to work on their own ideas ("own babies"). Furthermore, firms can allow employees to self-assemble their innovation teams. To satisfy their need for competence, firms can aid participants develop their ideas by providing workshops and sharing best-practices. To spur relatedness, firms can enable employees to meet

with colleagues that can aid them in developing their ideas. For example, this can be achieved through a marketplace event where idea owner recruit colleagues for their innovation team. Second, firms should ensure a high depth of control to ensure alignment between employees' innovation efforts and firm-wide goals. To do so, firms should frequently monitor the progress of grassroots innovation teams. This can be achieved by, for example, setting up a steering committee to which team regularly report to, defining clear stage-gates and performance metrics to follow the maturation of innovation projects over time.

1.2.3 Chapter 4: A Look on the Bright Side of Resistance to Change: Effects on Innovation Performance

Recognizing that innovation requires continuous change, in **chapter 4** we focus on the effect of resistance to change on innovation. In the chapter we discuss how high resistance can be beneficial and can be turned into a strength in innovation. Change is often met with resistance, which has traditionally been seen as detrimental to both change and innovation. However, more recent work and brought forth the benefits that resistance can have on the change process and its outcomes. To understand whether and when resistance to change hinders or helps innovation we focus on the reactions employees have when concerned with change. We therefore study how employee reactions manifested by (i) being loyalty and executing the change, (ii) voicing concerns with the change, and (iii) disengaging

from change and letting it passively continue, affect innovation performance.

This chapter presents several findings. First, we find that resistance to change has a u-shaped effect on innovation performance, whereby innovation performance is highest at either low or high levels of resistance. Hence, innovation performance is lowest at moderate levels of resistance to change. Second, we find that at low levels of resistance to change, employees tend to loyally execute change, thereby increasing innovation performance. Third, we find that at high levels of resistance to change, employees tend to voice their concerns, leading to learning within the firm, which in turn positively contributes to innovation performance. Fourth, we find at a moderate levels of resistance to change, disengagement dominates, with negatively effects innovation performance.

This chapter offers several implications. We recommend managers to embrace high resistance to change, whilst a common response has been to squash it. High resistance can lead to great learning by allowing employees to voice their concerns, and thereby improving the proposed change. In order to promote such learning managers have several tools at their disposal. For example, they can create channels to encourage employees to share their concerns in an open dialogue and allow them to criticize the change without the fear repercussions. Furthermore, they can promote divergent thinking by bringing new people in their firm from outside their firm.

1.3 Directions for Future Research

At the end of each chapter, I provide directions for future research that are specific to that chapter. In this section, I take a broader view on the marketing and innovation literature, and provide avenues for research that I find most interesting to explore.

A first area of research relevant to marketing and innovation is the study of business model innovation. In recent years, the success of many firms such as Tesla, Nespresso and Airbnb has been attributed, in no small part, to their innovative business models. Current work from authors such as Chesbrough and Rosenbloom (2002), Osterwlader and Pigneur (2010) and Amit and Zott (2012) provide an important basis upon which other researchers can expand. The need for further research in this area is also exemplified by a 2016 call for papers for a special issue of the Academy of Marketing Science (AMS) review entitled "business models for the digital economy: a marketing perspective". The call for papers brings forward the opportunity for marketing scholars to contribute to this growing field. Overall, still much research remains to be done in this area. First, I believe it is important to establish a more universally accepted definition of what a business model is and what constitutes business model innovation. This would also help to understand what makes a business model successful. Second, it would be interesting to study exactly how influential is an innovative business model to the success of a product or service. Would Tesla be a success if they did not sell directly to consumers without dealerships, did not open their own showrooms in luxury areas, or did not provide free

charging through their superchargers? Would Nespresso be the success that it is if they sold their coffee in supermarkets and did not place so much emphasis on their superior service and exclusivity? Third, as many established firms are being disrupted by start-ups with innovative business models, it would be worthwhile to study how a firm can transition from one business model to another. If Audi or BMW wanted to chase Tesla, how should they do it? How should hotel chains like Hilton or Marriot adapt to Airbnb or taxi services to Uber?

A second area of research with considerable importance to managers is how to manage both ideas and innovation teams in grassroots innovation. First, it would be interesting to study how to best evaluate ideas in a grassroots process. In the case of Michelin for example, which we interviewed for our study, their grassroots initiative generated more than 4000 ideas from employees. These ideas went through several evaluations by mid-to-high level management before being presented to a grand jury that decided on funding. Studies on how to best evaluate ideas and the teams presenting the ideas would be of great value to managers. Some companies rely more heavily on the merit of the idea itself, others with the fit between the idea and their current business, while others on the strength of the team. Second, the optimal composition of teams to bring ideas to market could yield great insights to firms. While diversity has for example been shown to lead to better decision-making (e.g. De Dreu and West 2001; Hong and Page 2004; Page 2007), further work can for example explore what type of

diversity works best (e.g. diversity in function, gender, educational background) and how to foster such diversity in grassroots innovation teams. Third, it would be of great interest to further understand what type of training best aids grassroots innovation teams to bring their ideas to market. This could entail an exploration of both topics to discuss (e.g. business model, go-to-market strategies, etc) and tools that best aid teams in developing their ideas. Fourth, as one of the main tenants of grassroots innovation is the better connection of employees with end-customer, it would be interesting for scholars to further study how companies interact with customers in innovation. While lead user and crowdsourcing innovation has received prior attention (e.g. Bayes 2013; Fuchs et al. 2010 and 2011; Howe 2010; Jeppsen and Lakhani 2010; Lilien et al. 2002; von Hippel 1986 and 2005) future research should focus on how firms can best cooperate with customers or use insights gathered from customers to innovate.

A third area of research that is worthy of further exploration by academics is how companies deal with change. First, one interesting area of research is to understand how resistance manifests itself. For example, what are the mechanisms by which employees voice their concerns or in what ways do they disengage? Second, scholars should focus on studying the long-term effects of change. Should companies continuously change to keep up with changing consumer needs and technology, or is some stability necessary for success? Third, what tools should be used spur constructive resistance to change or minimize disengagement? In

relation to chapter 3, it would be interesting to study how employee participation in innovation helps employees share their voice or allows them to be more engaged in a firms change initiatives.

I can only hope that this dissertation contributes to a better understanding of grassroots innovation and resistance to change. Despite the progress made in the literature, much remains to be discovered. I trust that further research in these promising areas will bring novel insights to both academia and practice.

1.4 Declaration of Contribution

In this section, I declare my contribution to the different chapters of this dissertation and also acknowledge the contribution of other parties where relevant.

Chapter 1: I wrote this chapter independently and incorporated the feedback of my supervisory team.

Chapter 2: This work was invited by the editors of a book on innovation (Peter Golder and Debanjan Mitra). The invitation went out to my supervisor Stefan Stremersch, who then asked me if I would be interested to write the chapter with him and Gert Jan Prevo, a fellow doctoral student whom he is also supervising. We have jointly discussed the structure of the chapter and my supervisor was helpful in setting the structure for such a chapter. Once that structure was set, the other doctoral student and I conducted all the literature review and wrote all the text, with the inclusion of comments from our supervisor. Out of 19 subsections, I wrote 13 subsections independently. At the end, we then looked at the entire

chapter and updated it jointly. Consequently, this chapter is co-authored by myself, Gert Jan Prevo and Stefan Stremersch and will be published in "Handbook of Research on New Product Development (edited by Peter Golder and Debanjan Mitra), Edward Elgar, 2017".

Chapter 3: This was a topic of interest to my supervisory team, which they discussed with me and asked whether I had an interest in the topic. I have independently inventoried all the literature on grassroots innovation and I wrote most of the theoretical background. The data gathering was completely done by myself. Hence, I developed the survey in collaboration with my supervisors and the entire execution in the field was my own work (i.e., programming the survey, coordinating data collection with panel companies, storing data, etc). My supervisors were not greatly involved in gathering the data, although they have substantially audited the data for reliability purposes. With regards to the estimation, I have done all estimation myself and all the preliminary analysis that helped us identify the core findings and submit the paper to the *Journal of Marketing (JM)*. When we resubmitted the paper to *JM*, we believed that Bayesian structural equation modeling was greatly needed because of how we wanted to transform some of the variables. Given that I had no experience with Bayesian structural equation modeling, a very unique area of research, this model was developed in very close collaboration with Nuno Camacho, one of my supervisors. The writing has been done collaboratively. This chapter is co-authored by myself, Nuno

Camacho, Isabel Verniers and Stefan Stremersch and is an invited resubmission to the Journal of Marketing.

Chapter 4: I independently developed the research question and convinced my supervisory team, over multiple rounds, that this research question is sufficiently interesting for scientific inquire. I independently reviewed the literature on this topic and I estimated all the models myself. I have written the chapter, and my supervisory team was greatly helpful in fine-tuning the writing such that it is more amenable to a major journal publication. They were very supportive in challenging me and enriching the chapter.

Chapter 2[1]

The What, Who and How of Innovation Generation

2.1 Abstract

Innovation generation is a top priority for firms, but can be hard to navigate. As a consequence, some managers find it difficult to assess the many ways in which their firm can innovate. To help managers on their journey, this chapter provides an overview of the types of innovation that exist (the *what* of innovation), the primary sources which generate innovation inside and outside the firm (the *who* of innovation), and the process the firm may use to generate innovation (the *how* of innovation). We synthesize prior work, both academic and managerial, on innovation generation and incorporate many illustrations from both startups and multinationals. In this manner, this chapter provides a rich assortment of innovation generation options for managers to consider as they seek to increase the innovation generation potential of their firm.

2.2 Introduction

The majority of companies agree that innovation is one of their top priorities. However, there is much disagreement about what innovation exactly entails, who carries the responsibility for

[1] This chapter is co-authored by Gert Jan Prevo and Stefan Stremersch and will be published in "Handbook of Research on New Product Development (edited by Peter Golder and Debanjan Mitra), Edward Elgar, 2017".

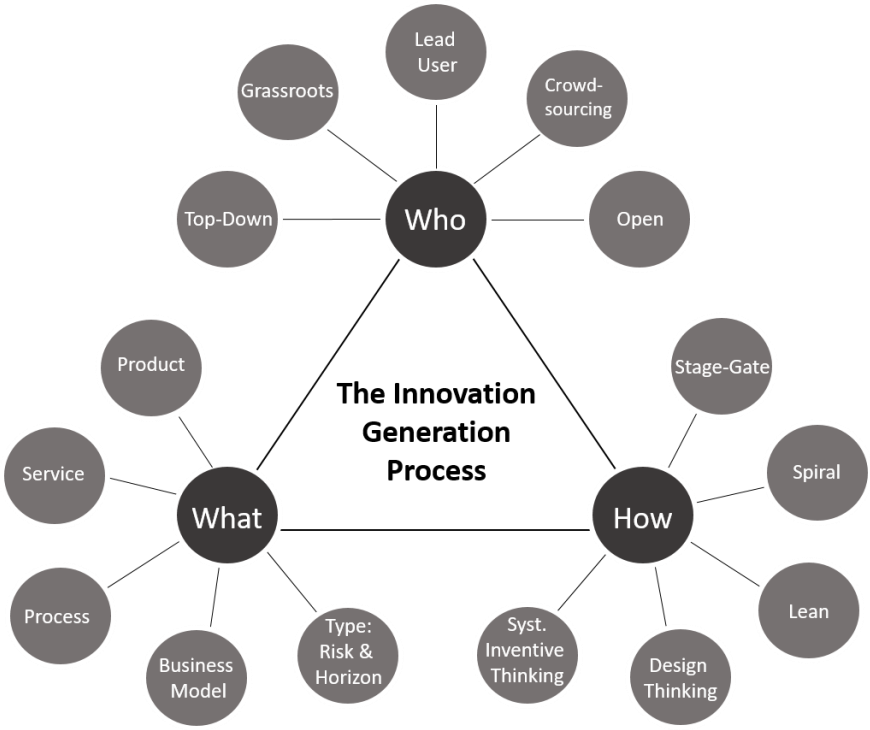
innovation, and how the process of creating innovation is structured. The 'what' of innovation has shifted from a focus on process and product innovation to a focus on service and business model innovation. Companies such as Tesla, Nespresso and Netflix have revolutionized industries with their disruptive business models. The 'who' issue for many companies has shifted from a pure top-down model to a more open and bottom-up approach. Incumbents such as P&G and IBM have embraced new sources of innovation and have welcomed customers to their ideation process. Others, such as Michelin and Merck, have leveraged the immense potential of their employee base through grassroots innovation. Finally, the 'how' of innovation concerns the various processes of creating innovation, which range from structured stage-gates to leaner ones. Startups such as LinkedIn and Dropbox have fully embraced the lean mentality, decreasing the time to develop the product by involving customers in the early development stages.

In this chapter, we provide researchers and managers a comprehensive review of the innovation generation process. We shed light on the different facets of the process by discussing case examples from a wide variety of industries and by drawing insights from both startups and multinationals. This chapter helps managers better understand what it takes to innovate and provides an overview of the tools at their disposal.

This chapter is organized as follows. In section 1, we discuss four types of innovation (what) and how companies can combine them to achieve success. We complement this discussion with a

classification of innovation based on the differences in risk and time horizon. We thus set the stage by reviewing avenues companies can pursue in their innovation agenda. This is followed by a discussion of who then takes responsibility for innovation. Hence, in section 2, we review five methodologies for innovation (who) and the transition from a closed to a more open model of innovation generation. In section 3, we explore five innovation processes (how) and disentangle their advantages and disadvantages. Figure 2.1 provides an overview of the components of the innovation generation process that this chapter explores.

Fig. 2.1 Components of the Innovation Generation Process



2.3 What of Innovation: The Object of Innovation

Innovation research has traditionally focused on new products. However, influenced by the rise of the sharing economy and the distinct impact of startups on mature industries, both managers and scholars are increasingly interested in service and business model innovation. Although less visible than the other three innovation types, process innovation is essential for the long-term profitability of companies. We will discuss these four types of innovation and classify innovation according to the amount of risk and time involved in its development.

2.3.1 Product Innovation

Schumpeter (1934, p. 66) defines product innovation as 'the introduction of a new good […] or of a new quality of a good.' This definition, which is part of Schumpeter's theory of economic development, forms the basis of the rather sizeable literature on new product development. For most firms, successful new products are engines of growth (Cohen et al. 1997). However, in the past few decades, the failure rate of new products has been high, ranging from 35% to 45% (Boulding et al. 1997).

An example of such a failure is Segway, a two-wheel personal transportation vehicle created by the renowned inventor Dean Kamen. Upon Segway's launch in 2002, visionaries such as Steve Jobs and Jeff Bezos were convinced that this product would change the world. However, instead of selling 10,000 machines a week as predicted by Kamen, Segway only sold 30,000 units

between 2002 and 2007. The main reason behind this failure is the lack of a clear need for the product among the target market. Other contributing factors were the $5,000 price tag, the associated regulatory problems (Segway was classified as a road vehicle in some countries), and the numerous Segway-related accidents (Tweney 2009). In fact, the owner of Segway, Jim Heselden, died in such an accident. Heselden reportedly lost control of his Segway and fell down an 80-foot limestone cliff near his home.

Given these high failure rates, one may wonder if investments in new product development pay off. This question has received considerable attention among marketing scholars. Numerous academic studies show that product innovation is positively related with firm performance (e.g., Geroski et al. 1993; Wuyts et al. 2004). Sood and Tellis (2009) estimate that the total market returns on an average innovation project in their sample is $643 million. Srinivasan et al. (2009) find that new product introductions have positive post-launch effects on stock market performance. The impact of product innovation has also been studied in specific industries. For example, Bayus et al. (2003) demonstrate that new product introductions in the personal computer industry positively influence firm profitability, and Pauwels et al. (2004) show that new product introductions increase long-term financial performance and firm value in the automobile industry.

uBeam, a startup founded in 2011 by Meredith Perry while she was an undergrad at the University of Pennsylvania, is a good example of the impact that a single product innovation can have on

a firm. uBeam, currently valued at approximately $500 million, is working on a wireless charging technology that can send energy up to 15 feet away through ultrasound. This technology could eventually replace charging cords. Perry has convinced investors to fund uBeam with over $23 million. While the technology still requires validation, the company has attracted the interest of major airlines, hotels, retail chains, as well as major hardware manufacturers such as Apple and Samsung (Constine 2015). While uBeam is a startup, product innovation can also have a distinct impact on existing firms. Apple for instance spent approximately $150 million developing the iPhone. In the final quarter of 2014 alone Apple sold over 74 million iPhones, worth $51.1 billion (Williams-Grut 2015).

Numerous scholars have tried identifying the antecedents of new product success (e.g., Ayers et al. 1997; Carbonell and Rodriguez 2006; Cooper 1979; Cooper and Kleinschmidt 1995). In their meta-analysis, Henard and Szymanski (2001) find that product advantage, market potential, meeting customer needs, predevelopment task proficiencies and dedicated resources have on average the most significant impact on new product performance. Evanschitzky et al. (2012) update Henard and Szymanki's meta-analysis and provide evolutionary evidence of decreased effects of the success factors over time. They speculate that the potential of success factors decreases as they become widespread among managers. In other words, as many managers learn how to do things

right, doing such things right sets them less apart from their competitors and thus drives success to an ever lesser extent.

2.3.2 Service Innovation

The growing economic importance of services has resulted in increased attention for service innovation in the last two decades. The Marketing Science Institute recognized the importance of service innovation by including it among the top research priorities for the 2008-2010 period. There are several closely related definitions of service innovation. Berry et al. (2006, p. 56) define service innovation as 'an idea for a performance enhancement that customers perceive as offering a new benefit of sufficient appeal that it dramatically influences their behavior as well as the behavior of competing companies.' Dotzel et al. (2013, p. 259) adapt this definition and describe service innovation as 'a new or enhanced intangible offering that involves the firm's performance of a task/activity intended to benefit customers.'

Service innovations can have a distinct impact on industries. For example, new service offerings are rapidly changing the banking sector and startups are increasingly challenging established banks. In Europe, Powa, a mobile payment system, and Funding Circle, a peer-to-peer platform that provides loans to small and medium-sized businesses, are changing the industry. With valuations of over a billion dollars, these two companies are highly successful. In Kenya, Safaricom, the country's largest mobile-network operator, launched M-PESA ("M" stands for "mobile" and "pesa" is Swahili for

"money"). As in many developing countries, in Kenya it is common for a person to have a mobile phone but not a bank account. Vodafone, which owns 40% of Safaricom, realized that Kenyans were not interested in having a bank account, but that they did want an effective way to send money. M-PESA empowered the Kenyans by enabling them to transfer money without a bank account as quickly and as easily as sending a text message (Graham 2010). M-PESA's user base has grown to over 18 million people (Thomas and Manson 2014) spread over countries such as Tanzania, Egypt, Lesotho and Mozambique, and more recently India and Romania (The Economist 2013).

There is a growing stream of research on service innovation. Such research has mainly focused on how service innovation is different from product innovation in a manufacturing environment (see, for example, Ettlie and Rosenthal 2011) and what are the critical success factors of service innovation, assuming they may be different from the success factors for product innovation (see, for example, Van Riel et al. 2004).

2.3.3 Process Innovation

Damanpour (1991, p. 561) defines process innovation as 'new elements introduced into an organization's production or service operations—input materials, task specifications, work and information flow mechanisms, and equipment used to produce a product or render a service.' Ettlie and Reza (1992, p. 796) alternatively define process innovation as the 'changes in throughput

technology for an organization or operating unit, such as a plant, that are new to an industry.'

Process innovations are typically directed within the firm and therefore often are not as well documented for the outside world compared to product or service innovations. There are exceptions, such as the introduction of the assembly line by Henry Ford in December 1913. The first moving assembly line was the beginning of the mass production of automobiles. The introduction of the assembly line reduced the time to build a car from more than 12 hours to 2 hours and 30 minutes. Countless other industries adopted Ford's manufacturing principles. Approximately 60 years later, Toyota introduced Just-In-Time (JIT) manufacturing. JIT manufacturing is a production system based on the idea of 'producing salable items, at a salable point in time, in a salable quantity' (Monden 2011, para. 3). A wide variety of industries adopted this process innovation.

The majority of studies on process innovation focus on the dynamics between product and process innovation. For instance, Utterback and Abernathy (1975) empirically test the frequency of innovation types (product vs. process) during the technology life cycle. They find that firms will initially focus on product innovation and this will ultimately yield a dominant design (the optimal product configuration). Once a dominant design has surfaced, the firm's focus shifts to process innovation in an effort to lower the production costs. By exploring the interaction between innovation choices and consumer demand during the development of a technology, Adner

and Levinthal (2001) offer an alternative explanation for the technology life cycle. The authors claim that during the early stages, innovation is driven by the need to meet market requirements. Once these requirements (e.g., price and performance) are met, competition among suppliers in a mature market focuses on innovation to reduce costs.

Zara, a clothing and accessories retailer owned by the Spanish company Inditex, is a clear example of how process innovation can help a company rise to the top (for an excellent overview, see Ghemawat and Nueno 2003). Zara's philosophy is based on 'fast fashion,' which entails bringing the latest fashion trends to stores as quickly as possible. To do so, Zara adapts trends directly from high-street fashion shows, brings new items to their stores quickly, and sells them at affordable prices (Hansen 2012). Zara's ability to keep up with ever-changing market trends rests on its maintaining control of every part of the supply chain: from design to production to distribution (CNN 2001). Zara does not hire top fashion designers, but instead copies their designs (Thompson 2012). The company then relies on customers' purchase patterns and feedback to change designs and clothing lines that are responsive to customer needs. In order to bring new clothes rapidly to its stores, Zara manufactures a large share of its clothes through its own facilities in Spain and Morocco (Thomson 2012). This allows for fast and controlled production. While competitors may take up to 9 months to bring new lines to stores, Zara is able to do so in just a couple of weeks (CNN 2001). By innovating its process, Zara

consistently is able to offer new and fashionable clothing to its customers at the right time.

2.3.4 Business Model Innovation

Every company has a business model, which may not always be formally articulated, that explains how the organization creates and captures value. Chesbrough and Rosenbloom (2002) define a business model as a set of functions that a business performs. These functions include the company's value proposition, the market segments in which the company operates, the structure of its value chain, its revenue generation mechanism(s), its position within its value network, and the competitive strategy by which the company gains or holds an advantage over rivals. Amit and Zott (2012, para. 6) define a business model as 'a system of interconnected and interdependent activities that determines the way the company "does business" with its customers, partners and vendors.' For Osterwalder and Pigneur (2010, p. 14), 'a business model describes the rationale of how an organization creates, delivers and captures value.' In their work, a business model is based on nine building blocks, including: (1) the *customer segments* a company serves; (2) a company's *value proposition(s)*; (3) the *channels* a company uses to deliver its value proposition(s); (4) the *customer relationships* a company establishes; (5) a company's *revenue streams*; (6) the *key resources* a company uses; (7) the *key activities* a company performs; (8) the *key partnerships* the company establishes; and (9) the *cost structure* adopted. The authors bring these blocks together in a business model

canvas that companies can use to develop and improve their business model.

Innovating a company's business model means more than just introducing a new product, service, or process. Business model innovation affects multiple activities of a firm at once (in the Amit and Zott definition of business models) or changes multiple building blocks at once in the business model canvas (in the Osterwalder definition of business models). Thus, business model innovation causes far-reaching and system-wide change in how a firm conducts its business or, in the case of start-ups with unconventional business models, displays a fundamentally different way of doing business, as compared to incumbents. Therefore, innovative business models may offer formidable protection against competitors (Amit and Zott 2012). In line with this, Chesbrough (2010, p. 354) states that 'a mediocre technology pursued within a great business model may be more valuable than a great technology exploited via a mediocre business model.'

In recent years, we have seen many incumbent industries disrupted by innovative business models, such as Airbnb, Uber, and Tesla. Tesla innovated on the value proposition it offers to customers, the way it delivers such value, and the channel it uses to reach customers. The value proposition of Tesla's Roadster was that it was the first not to compromise between performance and fuel efficiency. Tesla chose to integrate the charging infrastructure with its superchargers, which no car manufacturer had done. Tesla also did not adopt an independent dealership network as was common in

the automotive industry (and in the US, even required by law), but operated its own stores, Apple-like, and allowed customers to order and pay online for their new Tesla. In this way, Tesla avoided a potential conflict of interest at dealerships that would have an interest in promoting the combustion engine (higher maintenance revenues) at the expense of the electric car.

Similarly, established companies are also looking for new ways to innovate their business models and gain a competitive advantage. Nespresso, a subsidiary of Nestlé, revolutionized the way the coffee business worked. Already in 1976 Eric Favre, a Nestlé employee, invented and patented the original machine (Mulier 2011). In 1986, Nestlé established Nespresso SA, a fully owned subsidiary that introduced the first version of the system to the Swiss market. By 1988, Nespresso sold coffee capsules directly to high-income households by mail, shifting its original focus from offices (Osterwalder and Pigneur 2010). However, sales struggled, until Nestlé innovated its Nespresso business model.

First, Nespresso hired a top designer to upgrade its machines to look more trendy. Second, it started to use uncommon channels to promote its brand and to sell its machines and capsules. As such, Nespresso demonstrated its products in premium events, such as golf tournaments and fashion shows, and partnered with airlines to offer its coffee to business class passengers (by 2000, 20 airlines served Nespresso in business class in more than 1,000 planes (Slywotzky 2011)). Nespresso also vertically integrated into a retailer and started its own chain of Nespresso stores in well-targeted, highly visible

locations. By operating its own stores, Nespresso moved from a transactional business model selling coffee through other retailers to one with recurring revenues by selling coffee capsules using direct channels (Osterwalder 2013). This choice also enabled Nespresso to adopt more of a service model. Third, Nespresso's pricing model is tailored towards seducing customers into buying a Nespresso machine at a relatively low cost, after which the consumer is locked into Nespresso capsules at very high prices. Nespresso has aggressively protected its captive markets through a wide patent portfolio and innovation in its brewing technology, continuously providing it protection from "capsule entry" in its captive market.

2.3.5 Innovation Types According to Risk and Time Horizon

Product, service, business model and process innovations may vary in the risk they entail as well as in the time horizon within which the firm can expect to reap its benefits. Scholars have used different categorizations that practically trace back to such varying risk rates and time horizons. Most well-known are: (1) incremental versus radical innovations, (2) sustaining versus disruptive innovations, and (3) core versus adjacent versus transformational innovations. We discuss each in turn.

Chandy and Tellis (1998, p. 476) possibly provide the best definitions to distinguish incremental innovations from radical innovations. They define incremental innovations as innovations that 'involve relatively minor changes in technology and provide relatively low incremental customer benefits per dollar' and radical

innovations as innovations that 'involve substantially new technology and provide substantially greater customer benefits per dollar, relative to existing products.' An innovation may be incremental on the product level, but radical on the business model level, or vice versa. For instance, the iPhone is considered to be an incremental product innovation because it did not include substantially new technology (with the possible exception of the multi-touch function), but at the same time it represented a radically new business model. Similar variations in the extent to which an innovation is radical or incremental may exist across product, service, business model, and process innovation.

Radical innovation is an engine of economic growth capable of changing market structures and even creating entirely new markets (Chandy and Tellis 2000). Wuyts et al. (2004) find that radical innovations are more profitable than incremental ones. The authors also identify alliance portfolios as a driver of radical and incremental innovation success. Furthermore, a meta-analysis by Rubera and Kirca (2012) shows that radical innovations consistently generate more positive outcomes than do incremental innovations.

It is therefore not surprising that many scholars (e.g., Golder et al. 2009; Montaguti et al. 2002; Sood and Tellis 2005; Sorescu et al. 2003) study and advocate radical innovation. One of the interesting topics is why some firms are more likely than others to introduce (radical) innovations. The literature has firmly established the following determinants of radical innovation: firm size (e.g., Cohen 2010), national differences such as culture (e.g., Song and

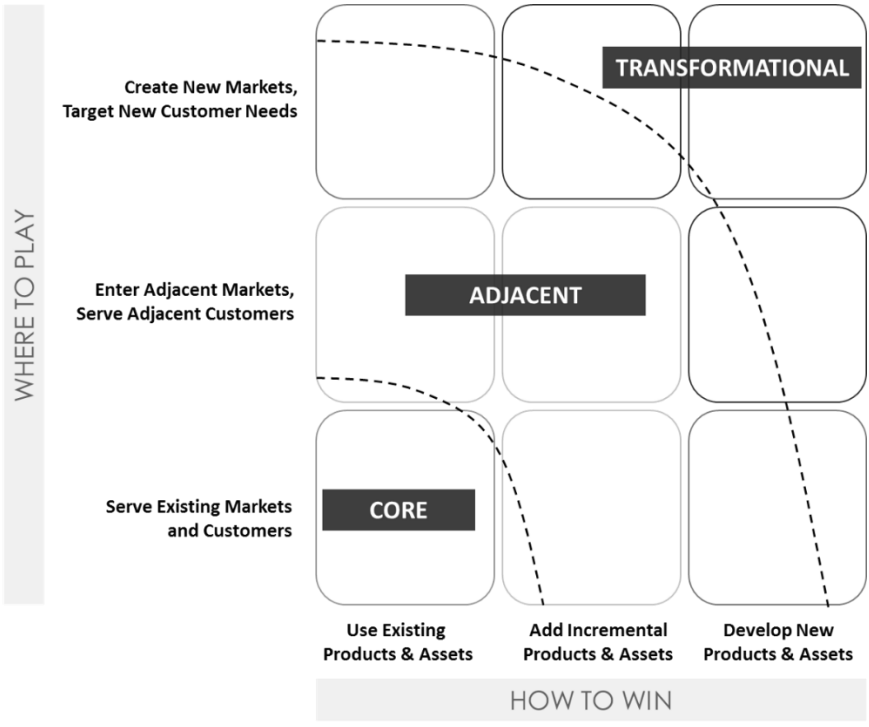
Parry 1997; Tellis et al. 2009) and organizational differences such as structure and culture (e.g., Chandy and Tellis 1998; Damanpour 1991; Olson et al. 1995).

Christensen (2000, p. 72) introduced the distinction between sustaining and disruptive innovations. Sustaining innovations 'make a product or service perform better in ways that customers in the mainstream market already value'. Disruptive innovations 'create an entirely new market through the introduction of a new kind of product or service, one that's actually worse, initially, as judged by the performance metrics that mainstream customers value.' Christensen (1997) theorized that companies that focus on sustaining innovations targeting the top market segments will achieve the greatest profitability in the short term. However, by doing so these companies enable disruptive innovators to target the bottom of the market. Such a disruptive innovation provides consumers at the lower end of the market access to products that were previously only accessible to a select group of consumers. From this lower end of the market, disruptive innovations may destroy the fortune of former market leaders in the long term.

Nagji and Tuff (2012) adapt the risk matrix of Day (2007) to manage risk and reward in innovation portfolios. This adaptation results in the innovation ambition matrix (see Figure 2.2), which maps innovations on the extent to which they develop new products and assets and the extent to which innovations create new markets and target new customer needs. Nagji and Tuff (2012, p. 68-69) distinguish between three innovation initiatives: core, adjacent, and

transformational innovations. Core innovations 'are efforts to make incremental changes to existing products and incremental inroads into new markets'. Adjacent innovations 'leverage something the company does well into a new space'. Transformational innovations 'are new offers – if not whole new businesses – to serve new markets and customer needs.' The authors find that firms that outperform their competitors dedicate 70% of their investments to core innovations, 20% to riskier adjacent innovations, and only 10% to transformational innovation 'gambles.' Interestingly, the authors find that these transformational innovations are most profitable.

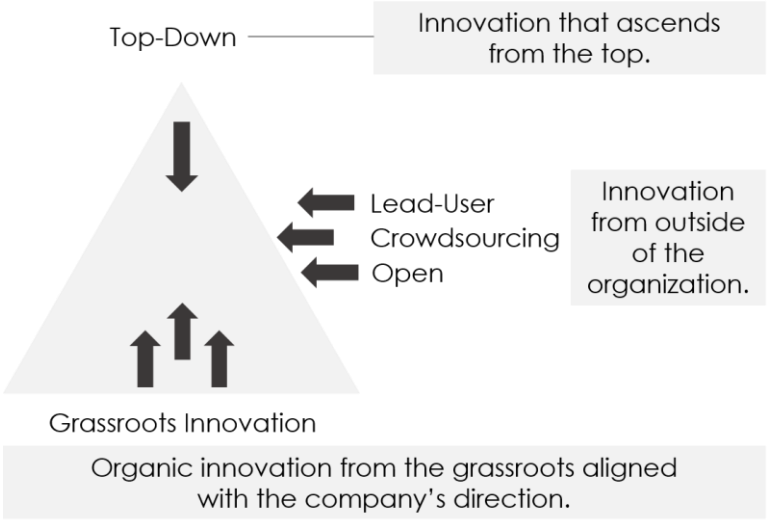
Fig. 2.2 Innovation Ambition Matrix (Adapted from Nagji & Tuff 2012)



2.4 Who of Innovation: Innovation Sources

While the traditional top-down innovation approach is still present in many companies, different innovation methods that involve other innovative demographics often complement it. A first demographic is firms' own employee base in its broadest sense, leading to grassroots innovation efforts. A second demographic are select customers, so-called lead users, of a firm that experience a need for an innovation before the mainstream market. By extension, a company can crowdsource its innovations from a very large demographic of customers or the general public at large, which may include technical experts from other fields. Last, we review open innovation logic, which advocates direct co-operation of firms with external experts or other firms rather than sending out a call for ideas to a large audience, like grassroots or crowdsourcing approaches advocate (see Figure 2.3 for an overview of sources of innovation).

Fig. 2.3 Sources of Innovation



2.4.1 Top-Down Innovation

The more traditional of the innovation methodologies is top-down innovation, where innovation is conceived at the top or by a 'lab elite' and pushed down the organization. Although lower-level employees in top-down organizations carry through most innovation initiatives, higher management is responsible for setting goals, deploying resources, and overseeing innovation development. Several companies are well-known notorious for using this management style. Think of Apple in the days of Steve Jobs as CEO and the lab-elite model used by Alcatel-Lucent's Bell Labs. This model can be especially successful when those at the top in charge of innovation have a sharp vision of where they want the company to go, think long term, and develop innovations that customers may not know they want or need.

Concentration of power at the top can also be important in times of crisis or great opportunities, when power can be used to instill radical change (Huy and Mintzberg 2003). In the early 1990s, with increasing oil prices, a growing middle class, and the US government's focus on fuel-efficiency, Toyota's top management charged a team with developing a more fuel-efficient vehicle (Tellis 2013). The top-down directive, aimed at capturing the market for efficient vehicles and changing Toyota's image as an unimaginative copycat, led to the introduction of the Toyota Prius in 1997.

A strong top-down vision from entrepreneurs has also yielded many powerful new firms. Richard Branson's dream to explore space began when he was just a teenager and saw the first

moon landing in 1969. While he was building an empire through Virgin Records and Virgin Atlantic, his ambition to democratize space travel never vanished. In the early 1980s, without any concrete plans, Branson trademarked the name Virgin Galactic. He was even given the chance to become the first tourist in space in 1988 when Russia's President Mikhail Gorbachev offered Branson the chance to become a cosmonaut. There was only one problem: it would cost Branson $50 million (Higginbotham 2013). Branson declined and continued to look for alternatives. In 2004, Virgin Galactic was born with the goal of becoming the world's first 'spaceline.' By 2015, with investments in the company reaching $500 million and with more than 700 people who paid up to $250,000 to travel with Virgin Galactic, Branson's dream is yet to become reality (Langewiesche 2015). While development has been left to experts, it took Branson's vision from the top to start the revolutionary project.

While top-down innovation has led to celebrated products such as Apple's iPod or the Toyota Prius and to the search for new frontiers, such as Virgin Galactic, it has also led companies to failure. Founded in 1925, Bell Labs was an innovation powerhouse for much of the 20th century, so much so that seven researchers at Bell Labs received Noble prizes for their work at the company. With mounting competition for its parent company (AT&T, later Lucent Technologies) and decreasing funding, Bell Labs was no longer able to sustain itself. The 'lab elite' model of Bell Labs created major problems for the company (Coupland 2014). The lab elite focused too much on long-term fundamental research, which made it difficult

to create short-term projects that would bring in the revenue to keep the company going. Moreover, the lab elite was not close enough to the customers to develop products that would serve their needs.

The lack of connection with customers also accounts for a major failure within the Tata Group. The development of the Tata Nano followed Ratan Tata's vision to build a safe and affordable car to compete with scooters that often transported multiple passengers at great risk. While many innovations at Tata were employee led and evidence based, the Nano came as a directive from its Chairman. Ratan Tata set a price tag of 1 lakh (approx. $2,000) for the car. Introduced in 2009 as 'the people's car,' the Tata Nano failed to appeal to customers. By this time, Tata had already spent $400 million developing the car and hundreds of millions had been invested in a factory that could produce 15,000 to 20,000 Nanos monthly. Sales reached their peak in April 2012 with 10,000 cars sold, but soon declined to less than 2,000 cars per month in early 2013. Tata had failed to understand that while India's growing middle class citizens wanted cheap cars, they did not want the image of driving a cheap-looking car (McLain 2013).

2.4.2 Grassroots Innovation

Grassroots innovation refers to the process where all employees within a company, regardless of their rank, can ideate and develop innovations (Betz et al. 2014). Companies that embrace this innovation methodology make innovation the job of everyone and foster an entrepreneurial environment (Hamel 1998; Hamel and

Breen 2007). Birkinshaw et al. (2011, p. 49) explain that the reason behind pushing responsibility down to the entire organization is simple and stems from the idea that 'top executives are not close enough to the action to be able to come up with or implement new ideas.' Fostering ideas from employees can be a major source of value creation for companies and allows them to be more adaptive. This type of innovation, which stands at the core of companies such as Google, 3M, and W.L. Gore, is commonly referred to as bottom-up innovation. While top-down innovation may lead to dramatic changes in companies, grassroots innovation allows for organic and sustainable change (Huy and Minzberg 2003). While many companies adopt grassroots principles, some companies have established a structured process to harness their employees' creativity and innovativeness.

In 2009, Merck KGaA introduced a grassroots initiative named Innospire (Betz et al. 2014) to complement its traditional top-down process. The name 'Innospire' came to be through the combination of innovation and inspiration. Innospire had several goals. One was to promote cross-divisional cooperation, especially between the chemical and pharmaceutical divisions. Moreover, it aimed to foster an entrepreneurial spirit within the company and to motivate employees to develop new business ideas. Importantly, Merck was looking to innovate by using the knowledge and expertise of its large employee base. The initiative received an unprecedented response from employees, with 462 ideas submitted from 32 countries in its first edition.

By 2015, two new products have been launched, seven projects are being developed and over 30 patents have been submitted as a result of these grassroots initiatives. Merck estimates that €200-500 million in revenues from new business resulted from Innospire. Innovations coming from Innospire and the initiative itself have also received much external acclaim. In 2012, one of the Innospire projects, Lisprova, won the CphI Pharma Silver Award for Best Innovation. The award recognizes innovations in the Pharmaceutical industry that help drive the industry forward. In the same year, Merck received a best-practice award for the capacity of Innospire to mobilize the innovation potential of its employees. In 2015, Merck won the Innovationspreis der Deutschen Wirtschaft (the Innovation Award of the German Economy), the oldest innovation award in the world that recognizes the most significant scientific, technical, managerial, and intellectual innovations in Germany.

Similar to Merck, Michelin leverages its full employee base to drive new business growth. In 2012, Michelin developed a grassroots initiative called InnovationWorks to encourage grassroots innovation within and outside Michelin's core business. To reach a global scale and involve employees from all ranks, Michelin scaled InnovationWorks in three phases. The first phase included a deployment in the US, after which Michelin deployed InnovationWorks in China and Europe. So far, Michelin employees have submitted over 5,000 ideas in the InnovationWorks process. By 2016, the initiative has produced more than 10 new activities on

three continents, several of which are showing strong and profitable growth only two years after the start of InnovationWorks.

Another well-known initiative is Dell's EmployeeStorm (start in 2007), an internal social media platform where employees could suggest, discuss, and vote on ideas. This initiative started four months after introducing IdeaStorm, a crowdsourcing platform to listen to the ideas of Dell's customers. Ideas submitted in the EmployeeStorm platform could be about almost anything, including ideas for customers, new products, and for employees and company facilities. Through this initiative, Dell wanted to harness the power of its more than 80,000 employees. Through EmployeeStorm, Dell showed employees that their voices are important and fostered a culture where information flows more easily throughout the company (Bennett 2009).

2.4.3 Lead-User Innovation

Traditional marketing research tends to gather input from representative consumers, those at the center of the market whose thinking is confined by their current experience and environment (Eliashberg et al. 1997; Lilien et al. 2002). In order to forecast future customer needs, companies have turned to "lead users." Introduced in 1986 by Eric von Hippel, the concept of lead users refers to 'users whose present strong needs will become general in a marketplace months or years in the future' (von Hippel 1986, p. 791). Lead users do not only serve as a need-identification tool. As they attempt to fill their needs, lead users can help companies with designing and

developing products (Lilien et al. 2002; Urban and von Hippel 1988; von Hippel 1986). Early prototypes or improvised versions of products made by lead-users to serve their own needs have become highly successful innovations (Morrison et al. 2000; von Hippel 2005).

In a natural experiment conducted at 3M, Lilien and colleagues (2002) found that lead-user idea-generation projects perform substantially better than contemporaneous traditional projects. They find that, on average, annual sales from a lead-user-led project was more than eight times larger than the 5-year cumulative revenues from other products within the company that did not use the lead-user methodology during development. The authors describe 3M's methodology as 'identifying and learning from lead users both within the target market and in "advanced analog" markets that have needs in a more extreme form' (Lilien et al. 2002, p. 1043). An example of such an advanced analog market facing an extreme situation is a car manufacturer needing efficiency gains through the reduced weight of lighter, stronger materials and looking to the aerospace industry for inspiration (Lilien et al. 2002).

Lead users have shaped innovation in a variety of contexts. They have been beneficial for developing new industrial products (Herstatt and von Hippel 1992; Urban and von Hippel 1998), medical equipment (Lilien et al. 2002), software innovation (von Hippel 2001), and innovation in sports equipment (Franke and Shah 2003; von Hippel 2005). Furthermore, empowering users and involving them in the design and development of products can have

positive effects on demand (Fuchs et al. 2010; Fuchs and Schreier 2011; Schreier et al. 2012).

An important user-led innovation comes from John Heysham Gibbon, the doctor who invented the first heart-lung machine. In the early 20th century, medical equipment companies could not assess its market potential and therefore did not invest in its development (Mangelsdorf 2011). However, Gibbon, faced with the death of many young patients, saw the need for a heart-lung bypass machine. Following a successful use of a prototype on animals in 1935, he then used a heart-lung machine (i.e., pump oxygenator) on a human patient in 1953 and performed the first open-heart bypass surgery. Following his original idea and prototype, IBM engineers joined Gibbon's project and helped develop fully functional models.

2.4.4 Crowdsourcing Innovation

The term 'crowdsourcing' was first coined by Jeff Howe in 2006 and he defined it as 'the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call' (Howe 2010). While new internet-based technologies have spurred the growth of crowdsourcing by facilitating its application, the idea is not a new one. As early as 1714, the British government offered a cash prize, named the Longitude prize, to anyone who could propose a simple and reliable way to determine a ship's position at sea (The Economist 2008). Isaac Newton, who advised the Longitude board, strongly believed that there could only be an

astronomical solution. However, the winner was the carpenter and clockmaker John Harrison, who based his solution on the inner workings of clocks (Jeppesen and Lakhani 2010). In their work, Jeppesen and Lakhani (2010) find that being further away from the problem - i.e., having expertise in a different field than the one for which you are trying to find a solution - can be advantageous because it can bring forth a different perspective.

To explain the rise of crowdsourcing, Howe provides several examples of how crowdsourcing communities are changing industries and how large, more traditional organizations are adopting its principles. iStockphoto, a photo-sharing website where anyone from a large community of photographers can share their images, was founded in 2000. These images were sold at a fraction of the price of professional photographs, disrupting the traditional agency-based model. Following rapid growth, Getty Images purchased iStockphoto in 2006 for $50 million (Howe 2006).

Through similar principles, Wikipedia managed to create an impressive and free online encyclopedia by depending on a large community of contributors. In an attempt to solve an 800-year-old mystery about the location of Genghis Khan's tomb, National Geographic has been asking the wider community to go through and tag satellite images of Mongolia (Boudreau and Lakhani 2013). Their efforts started in 2010 and by 2015 more than 200,000 'explorers' have processed more than 1 million images.

Other groups and companies have quickly followed suit in adopting crowdsourcing. Dell introduced IdeaStorm (Bayus 2013),

Cisco introduced the I-Prize competition (Jouret 2009), Netflix launched the Netflix prize in a search for a better recommendation algorithm (Afuah and Tucci 2012), and Eli Lilly funded InnoCentive, a platform that connects companies with the crowd and which has been used by companies such as Boeing, DuPont, and Procter & Gamble (Howe 2006).

Companies are also relying on their customers to generate and develop new ideas because customers best understand their own needs (Bayus 2013). In 2008, Starbucks introduced My Starbucks Idea, a community website that collects suggestions and ideas from its customers. Users can share their ideas, vote on each other's ideas, discuss ideas, and offer further suggestions to give guidance to the company on what to implement. Customers are also able to view 'ideas in action' where Starbucks reports on changes made in response to community feedback. The initiative was a great success and in the first year alone, users generated more than 70,000 ideas. On the fifth birthday of My Starbucks Idea in 2013, Starbucks had implemented more than 250 ideas from customers. These included free Wi-Fi in all of its stores, free drinks to customers after purchasing a certain number of drinks, and several new coffee flavors.

2.4.5 Open Innovation

Open innovation entails the use of internal and external ideas as well as internal and external paths to market because firms aim to advance their technologies (Chesbrough 2003). Open innovation is 'the use

of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively' (Gassmann et al. 2010, p. 1). While crowdsourcing can fall within the general open innovation paradigm, open innovation, as explained by researchers such as Chesbrough (2003), Huston and Sakkab (2006) and Guinan et al. (2013), is about companies working with external experts or partnering with other companies as opposed to sending out a call for ideas to the general public. The open innovation concept explains how companies can go beyond their internal boundaries by using external knowledge rather than relying merely on their internal R&D operations.

Going back to the failure of Bell Labs, Henry Chesbrough (2003) explains how Bell Labs' lack of openness led it to losing the battle against Cisco Systems. Through Bell Labs, Lucent Technologies devoted substantial resources to internally develop new products and services. Cisco Systems, lacking the internal R&D capabilities of Bell Labs, acquired the technology it needed externally by partnering or investing in promising startups. Through this strategy and without conducting much research of its own, Cisco was able to become a formidable competitor to Lucent's R&D powerhouse.

Procter & Gamble (P&G) has a long history of collaboration and open innovation. It was founded in 1837 through the collaboration between William Procter and James Gamble. Procter was a candle maker while Gamble was a soap maker. The two founders realized that because they were using the same materials,

they could negotiate better prices by joining forces, and so they created P&G. Some of P&G's biggest products, such as Tide detergent, Crest toothpaste, and Bounce fabric softener, came from the acquisition of external technologies. In 2000, P&G initiated an open innovation program called Connect & Develop. At that time, P&G's CEO A.G. Lafley had set the goal to acquire 50% of innovations from outside the company (Huston and Sakkab 2006). By 2006, more than 35% of the company's innovations came from open innovation, bringing in billions of dollars in revenues for the company. The idea behind Connect & Develop was not to replace staff with external resources, but to have a constant flow of ideas and to harness the firm's own internal R&D capabilities. P&G realized that, while they had 7,500 people in the company, there were 1.5 million people outside that could potentially contribute to innovation (Huston and Sakkab 2006).

Under Lou Gerstner, the first outsider appointed as CEO (in 1993), IBM, known for its strong internal R&D, began a radical transformation. It began to open its doors to collaborations and to form strategic alliances with other companies (Chesbrough 2003; 2007). IBM has introduced several programs to gain value from open innovation. For example, for its First-of-a-Kind (FOAK) program, IBM cooperates with customers to solve the problems they face. They staff each initiative with an average of four to five IBM researchers for one year. The customer benefits from the solutions that arise, while IBM owns the intellectual property (IP) created by its staff. By 2008, on average 70% of completed FOAK projects

were transferred to an IBM Business Unit for commercialization. From 2002 to 2007, FOAK projects brought more than $400 million in direct revenues from sales related to the reuse of FOAK assets and more than $4 billion from revenue generated by adapting FOAK concepts to new businesses (Frost & Sullivan 2009).

2.4.6 Combining Innovation Methodologies

The methodologies proposed above are by no means mutually exclusive. Dell, for example, uses a combination of crowdsourcing, lead-user, open innovation, grassroots innovation, and top-down directives to develop and accelerate innovation. The InnovationWorks initiative at Michelin infuses top-down directives with employee-led innovation. Top management is in charge of setting goals for the initiatives and for helping teams develop their ideas to ensure full alignment between the employees and the company. Furthermore, in bringing their ideas to the market, employee teams need to continuously gather customer input and work with external partners where needed. Combining multiple innovation methodologies allows companies to make use of both their internal capabilities and external knowledge and resources.

2.5 How of Innovation: Innovation Processes

In this section, we discuss how firms generate and develop innovations. We review more traditional approaches such as the stage-gate and spiral innovation processes, as well as more recent approaches such as lean innovation, design thinking, and systematic inventive thinking.

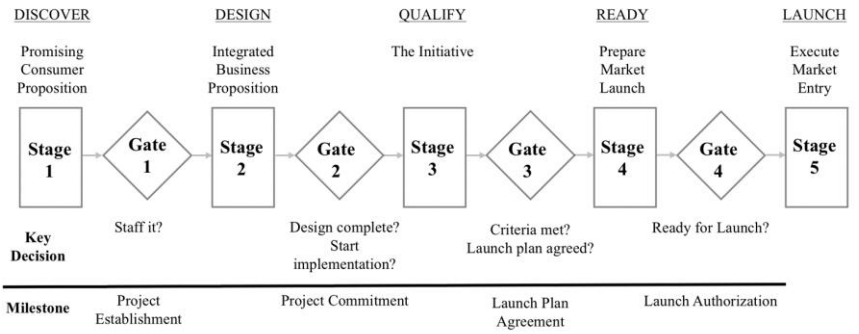
2.5.1 Stage-Gate Innovation Process

Cooper (1994, p. 4) defines the stage-gate innovation process as 'a roadmap from idea to launch consisting of discrete stages, each stage preceded by a Go/Kill decision point or gate.' The stage-gate methodology stems from NASA's 'phased project planning' and gained popularity in the 1980s and early 1990s (Cooper 1994; 2008). In 1997, Griffin found that approximately 60% of US firms were using the stage-gate methodology. More recently, Ettlie and Elsenbach (2007) find that 48.6% of the companies in the automotive industry are using a traditional stage-gate process.

The stage-gate process varies with each company, but it typically consists of between four to eight stages and gates (O'Connor 1994). To illustrate, let us consider the stage-gate process of P&G (see Figure 2.4), also known internally as the Successful Initiative Management and Product Launch model (SIMPL). SIMPL consists of five stages (including ideation) and four gates that guide projects from the ideation to the post-launch stage. Consistent with the stage-gate philosophy, P&G's SIMPL methodology consists of clearly defined activities and expectations, evaluated

against specific criteria. Cooper and Mills (2005) identify the following drivers behind the success of P&G's stage-gate process: (1) instead of focusing on progressing (all) projects through the various stages of the process, P&G focuses its efforts on projects that can win in the marketplace; (2) P&G has clearly defined success criteria that it uses to evaluate the projects; (3) a strong customer focus combined with rigorous planning and decision making mitigates the risks of projects.

Fig. 2.4 Stage-Gate Process P&G (based on Cooper and Mills 2005)



The stage-gate process uses multifunctional teams that work on several activities at the same time (Cooper 2008). This approach makes it considerably more efficient than phased project planning, which reportedly doubles the development time of projects (Cooper 1994). A firm increases resource investment as the project passes through successive stages and uncertainty decreases. The stage-gate methodology incorporates a go-or-kill decision after each stage. This decision is based on the progress of the project as evaluated against a predetermined set of criteria (Cooper 2008).

Several scholars have inventoried the main disadvantages of the stage-gate method. O'Connor (1994) concludes that implementing the stage-gate process is neither easy nor quick. Cooper (1994) concludes that the stage-gate process: (1) may delay the progress of a project because each stage has to be completed before the next can start; (2) may be too heavy for small, low-risk projects; and (3) does not prioritize projects and, thus, does not focus resources on projects with the highest priority. Sethi and Iqbal (2008) find that rigorously applying strict review criteria to all projects decreases the flexibility of projects. Such lower flexibility may lead to lesser exploitation of learning over the course of a project, increasing the risk of market failure of new products. Oorschot et al. (2010) find that strictly applying the stage-gate methodology may lead to abandoning viable projects. Overestimating team size (i.e., a team may need more time to finish) or underestimating workload (i.e., a team may need more resources to finish a stage in time) may result in projects being abandoned.

Companies have typically customized stage-gate processes to fit their own context. Ettlie and Elsenbach (2007) find that approximately one-third of the companies in the automotive industry are using a modified stage-gate process. Modified stage-gate processes typically focus on increasing the speed without compromising the thoroughness of the process. Cooper (1994; 2008) differentiates between the traditional and the modified stage-gate processes: the latter is typically more adaptable (e.g., it is tailored to accommodate different risk levels), less strict (e.g., conditional

instead of final go-kill decisions), and more focused (e.g., direct resources only to the most promising projects) than the former.

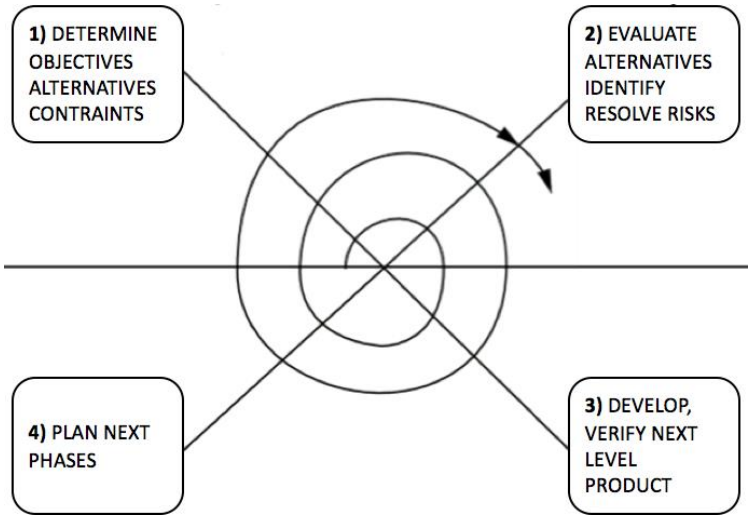
2.5.2 Spiral Innovation Process

Boehm (1988) first introduced the spiral process of innovation as a model for software development and enhancement. We can see the foundations of the spiral model in various models for software development such as the waterfall model (Boehm 1988), which is essentially a step-by-step approach to software development related to the stage-gate methodology. Boehm (2000, p. vii) defines the spiral development process as 'a family of software development processes characterized by repeatedly iterating a set of elemental development processes and managing risk so it is actively being reduced.' Essentially, the spiral model consists of numerous rapid iterations of the stages from ideation to testing a prototype among customers. Each successive spiral proceeds at greater speed and lower costs (Hauser et al. 2006). The number of iterations depends on the risks and the project's state of development (Mizell and Malone 2007).

Figure 2.5 depicts a spiral process. The spiral development process starts at the center of the spiral, which represents the inception of the project idea. The spiral process is divided into four main parts (Boehm 1988): 1) Finding out the goal of the project and identifying technical, legal, and feasibility constraints. 2) Risk identification, which is crucial to the process. Ideally, the biggest risk is resolved first, followed by the next biggest risk and so forth. If a

risk cannot be resolved, the project may be cancelled. 3) Verifying the concept by requesting customers' feedback on a prototype. 4) The customer feedback determines whether a project is cancelled, put through to another iteration of the spiral process or is ready for market launch.

Fig. 2.5 Spiral Process (Based on Boehm 1988 & Boehm et al. 1998)



Numerous case studies (e.g., Boehm et al. 1998) illustrate the popularity and effectiveness of the spiral process for software development. The spiral process emphasizes risk management and is very flexible. These characteristics make the methodology particularly suitable for large-scale high-risk projects. According to Mizell and Malone (2007), the spiral process results in high quality customer-centric products.

2.5.3 Lean Innovation Process

The lean innovation process is based on speed of execution and on deploying minimum viable products that can receive continuous customer feedback (Blank 2013). The process places emphasis on experimentation, learning and customer development (Ries 2011); it follows from the idea of lean thinking that characterized Toyota's lean manufacturing philosophy. The ideas of waste reduction, immediate feedback, and customer satisfaction form the foundation of this process (Womack and Jones, 1996).

Dropbox, a file sharing tool, attributes its growth to the lean methodology. The founders of Dropbox, Drew Houston and Arash Ferdowsi, created it as a solution to their own frustrations. They created a minimum viable product and called upon end users to quickly learn and improve it (Ries 2011). In September 2008, the team publicly launched beta versions of the program to test whether others would also see the value in this solution and would be willing to pay for it. These beta testers were enthusiastic users who signaled their interest in using Dropbox as well as in helping to improve the program and to spread the word about it. The team continued launching fast, early, and often. Word of mouth became their main customer acquisition vehicle and they adapted their business model accordingly. In order to stimulate referrals, users would gain more free space in their Dropbox for every referral. This was the best way to create demand for a product that not all customers realized they needed. Three years after its launch, Dropbox went from 100,000 to over 50 million registered users worldwide. By 2015, Dropbox's

valuation has reached $10 billion, with more than 400 million registered users.

Similar to Dropbox, LinkedIn has grown to more than 380 million users in 2015 by starting out lean. The LinkedIn site was officially launched in 2003 and through multiple iterations based on customer feedback, it launched public profiles in 2006. In line with the lean philosophy, LinkedIn's co-founder Reid Hoffman famously stated, 'If you are not embarrassed by the first version of your product, you've launched too late'.

While it was initially only start-ups that created and deployed lean innovation, its principles are increasingly making their way to large companies (Blank 2013; Ries 2011). With growing competition and rapidly changing customer needs, large companies can no longer risk spending years and millions of dollars on products that the customer may not want. One company that embraced the lean startup approach is General Electric (GE). Through a new initiative called FastWorks, GE attempts to increase the speed by which its products are tested and works closely with customers to incorporate their feedback into the products. By late 2014, the company had already trained 40,000 employees on the new initiative and started more than 300 FastWorks-based projects (Clough 2014). By encouraging employees to fail fast and small, GE aims to bring products to market faster and at lower costs than ever before. Qualcomm and Intuit have joined GE by adopting similar principles (Blank 2013).

2.5.4 Design Thinking Innovation Process

Herbert Simon first introduced the idea of incorporating design in decision making in his 1969 book, 'The Sciences of the Artificial.' Peter Rowe introduced the term 'design thinking' in 1987 in a book with the same name and which describes the architectural and urban planning design process. IDEO, a global design and innovation-consulting firm, later applied the design thinking principles to the process of innovation generation and development. Design thinking as an innovation process was then popularized by IDEO's CEO and president Tim Brown, together with one of IDEO's co-founders David Kelley, who in 2003 first labelled IDEO's approach as 'design thinking' (Brown 2008).

Design thinking takes a human-centered approach to innovation. It is driven by understanding people's wants and needs through direct observation and learning what they like and dislike about products (Brown 2008). Using a designer's method, this methodology aims to create innovation at the intersection of customer needs, technological feasibility, and a viable business strategy (Kelley and Kelley 2012). To do so, a design process goes through the three stages of inspiration, ideation and implementation (Brown 2008). Innovators are encouraged to 'leave the building' to observe people, to rapidly create a prototype, and to gather continuous customer feedback.

An example of design thinking is the innovation led by Doug Dietz, a GE employee (Kelley and Kelley 2012). At the unveiling of a new MRI-scan, Dietz observed the anxiety of a young girl and her

parents as she was waiting to get an MRI-scan. Dietz later discovered that up to 80 percent of pediatric patients had to be sedated because they could not lie still long enough for the scan to take place. Without any funding to redesign the machine, Dietz and his team focused on making the experience more enjoyable. They came up with the new 'Adventure Series' scanners, which were colorful, fun, and resembled a pirate ship or a space ship. MRI technicians even had scripts that guide the patients through the adventure. These new machines significantly reduced the number of pediatric patients needing sedation, diminished the need for anesthesiologists, and increased the number of patients scanned on a given day.

2.5.5 Systematic Inventive Thinking

While customers can be a great resource for innovation, they may not always know what they need or lack the imagination to help develop innovations (Goldenberg et al. 2003). As opposed to many other processes, systematic inventive thinking is characterized by 'inside the box' thinking and listening to the voice of the product rather than solely to that of the consumer. This process is inspired by the research of the Russian engineer, Genrich Altshuller, whose work aimed to place some structure on the creative process.

By studying patents and other inventions, Altshuller realized that there are certain patterns to how people solve problems and develop innovations (Goldenberg et al. 2003). In a series of papers, Goldenberg et al. (1999a; 1999b; 1999c) explain that structure is needed for creativity to flourish. They describe how the lack of

structure leads to the failure of commonly used idea-generating methods such as brainstorming and lateral thinking (Goldenberg et al. 1999a). Furthermore, they find that even in one of the most creative industries, advertising, award-winning ads show a clear pattern and up to 89% can be captured by only six creativity templates (Goldenberg et al.1999b). In innovation in general, a set of different patterns emerge, which not only help in categorizing ideas but also in generating them (Goldenberg et al. 2003).

In practice, the process of systematic inventive thinking starts by listing the physical components and attributes of existing products, understanding the products' direct environment, and then, seeking paths for improvement (Goldenberg et al. 2003). Innovation can then follow one or more of five identified patterns.

The first pattern, subtraction, entails removing undesirable components from the product in question. An example is the Sony Walkman, a portable cassette player that did not have the ability to record (Boyd and Goldenberg 2013).

The second pattern, multiplication, involves creating copies of certain product components and then changing those copied parts to develop an innovation. This is what Gillette did to its razor when it added a second blade at a different angle to the first, allowing the first blade to raise the whiskers and the second to achieve a clean shave (Goldenberg et al. 2003).

The third pattern, division, entails separating the components physically or functionally and then rearranging them differently. For instance, the first air conditioners came as a single unit. With the

division technique, later models separated the motor and fan from the cooling unit, which minimized noise, heat, and space requirements (Boyd and Goldenberg 2013).

The fourth pattern, task unification, emerges when innovators add a new unrelated function to an existing component. A clear example is printing assembly instructions on the packaging of a product, such as a cabinet or cupboard (Boyd and Goldenberg 2013). This eliminates the need for a separate sheet that customers often lose, saves costs on printing the paper, and simplifies the packaging process of the manufacturer.

The fifth pattern, attribute dependency, entails innovation arising from beneficial connections between a product and its environment. For example, eyeglasses with lenses that change color when it is sunny or dark eliminate the need to buy multiple pairs of eyeglasses (Boyd and Goldenberg 2013). Innovators can make use of one or a combination of several of these five patterns simultaneously to develop new products or services.

2.6 Conclusions

Building an innovation agenda is becoming increasingly important but at the same time challenging for managers. To help managers along the way, we aimed to provide a review of the options available to them, including leading literature and leading cases. This review could therefore serve as a basic compass to guide managers through innovation terminology and different innovation processes. Undoubtedly, many more innovation processes and hybrid models for innovation generation have emerged and will emerge. In this respect, academic researchers will continue to play an important role in understanding better the innovation generation process. Ultimately, companies must choose which process fits them best given their industry, their employee base, and management style. What is clear is that ignoring new ways to innovate can lead to the failure of even the most established companies. Thus, companies need to continue to innovate how they innovate.

Chapter 3[2]
Innovation from the Grassroots: Determinants of Success

3.1 Abstract

Grassroots innovation is decentralized innovation in which participation is voluntary and not bounded by seniority or level of expertise. An increasing number of firms are experimenting with grassroots innovation. The authors examine the determinants of grassroots innovation success. They propose a model that extends self-determination theory to the context of a corporate hierarchy with controlling mechanisms and test their theory using two large-scale surveys among managers: (1) a cross national survey among 2,139 managers in 14 countries (1,387 of which had already engaged in grassroots innovation) and (2) a longitudinal survey among 689 managers in the US (350 of which had already engaged in grassroots innovation). The authors find that grassroots innovation helps firms achieve higher innovation performance and that participants' intrinsic motivation is a stronger driver of grassroots innovation performance than extrinsic motivation (e.g., career benefits, visibility to senior management or monetary rewards). Yet, they also show that a high depth of control is key to the success of grassroots innovation. These findings help companies implement or improve on their grassroots innovation initiatives.

[2] This chapter is co-authored by Nuno Camacho, Isabel Verniers and Stefan Stremersch and is an invited resubmission to the Journal of Marketing.

3.2 Introduction

In a quest to promote innovation, many firms are experimenting with grassroots innovation, i.e., decentralized innovation in which participation is voluntary and not bounded by seniority or level of expertise (own definition, see below). One can contrast grassroots innovation to top-down innovation, in which a firm's senior management delegates innovation efforts to a "lab elite" and subsequently pushes it down through the organization. Therefore, practitioners sometimes refer to grassroots innovation as bottom-up innovation. One can find well-known grassroots innovation initiatives in the banking industry (e.g., UBS' "Idea Exchange"), pharmaceuticals (e.g., Merck's "Innospire"), telecommunications equipment (e.g., Alcatel-Lucent's "Entrepreneurial Bootcamps") and retail (e.g., Best Buy's "Resilience Initiative"), to name just a few. Grassroots innovation is increasingly seen as strategic for firms, because it harnesses the creative potential of employees across all ranks within the firm.

Companies deploying grassroots innovation have varying success rates. For instance, Birkinshaw, Bouquet, and Barsoux (2011) mention three initiatives – Best Buy's Resilience Initiative, GlaxoSmithKline's Spark and UBS's Idea Exchange – that "didn't have the impact that their proponents would have liked" (p. 49). Thus, it is important to answer two crucial questions: (1) does grassroots innovation, on average, increase firms' innovation performance?; and, if yes, (2) what are the determinants of grassroots innovation success? Unfortunately, there is no empirical study to

date that offers guidance to managers seeking answers to these questions as they aim to deploy or improve grassroots innovation initiatives at their firms.

We propose a theoretical framework to explain the determinants of grassroots innovation success and the impact of grassroots innovation on firms' innovation performance. We test this theory across two studies: (1) a large cross-national sample with 2,139 managers in 14 countries, 1,387 of which (64.8%) indicated that their firm had already engaged in grassroots innovation, and (2) a longitudinal survey among 689 innovation managers in the US, 350 of which (50.8%) working in firms that had already engaged in grassroots innovation (and, of these 350, 151 answered a second wave survey). Across these two studies, we document (1) the effects of grassroots innovation on firms' innovation performance, (2) the effects of intrinsic motivation and extrinsic motivation on grassroots innovation performance, and (3) the effects of controlling mechanisms (depth and type of control) on grassroots innovation performance. We also replicate the effects of self-determination principles (autonomy, competence and relatedness) on employees' intrinsic motivation.

Our theory development and large-scale empirical testing yields the following insights that are new to the literature. First, we document that, on average, grassroots innovation helps firms achieve a higher innovation performance, i.e. a higher return on investment, sales growth and profitability from their innovation efforts, relative to their major competitors. We also show that the better a firm's

grassroots innovation performance, the greater the effect of grassroots innovation on overall innovation performance. Thus, grassroots innovation is a promising ingredient in a firm's overall innovation strategy.

Second, we show that employees' intrinsic motivation (i.e., enjoyment of the task itself) is a stronger driver of grassroots innovation performance than extrinsic motivation (i.e., seeking career benefits, visibility or monetary rewards). Thus, firms should ensure that employees who participate in grassroots innovation derive their motivation mostly from the innovation activity itself, rather than from extrinsic incentives. We also show that firms can boost the intrinsic motivation of employees participating in grassroots innovation by increasing their autonomy, competence and relatedness.

Third, we show that the controlling mechanisms that a firm puts in place to monitor project teams participating in grassroots innovation are an important driver of grassroots innovation performance. Specifically, we find that a high depth of control helps firms ensure the success of their grassroots innovation initiatives. For instance, firms can ask grassroots project teams to regularly report on their progress using pre-agreed key performance indicators (a coercive control mechanism). Firms may also ensure that grassroots project teams interact frequently with senior managers who offer them feedback on their projects (an enabling control mechanism).

These findings are robust across two studies using different data sources, and across model specifications, such as the inclusion of a latent methods factor directly in our model to control for potential common method variance, and a Heckman two-step procedure to control for potential selection bias. These findings yield several important insights for managerial practice. First, even though grassroots innovation, on average, increases firms' innovation performance, many firms are not yet deploying grassroots innovation (35.2% in Study 1 and 49.2% in Study 2). Our findings can help managers in such firms to make a case to their superior executive layers in favor of grassroots innovation to be deployed in their firm.

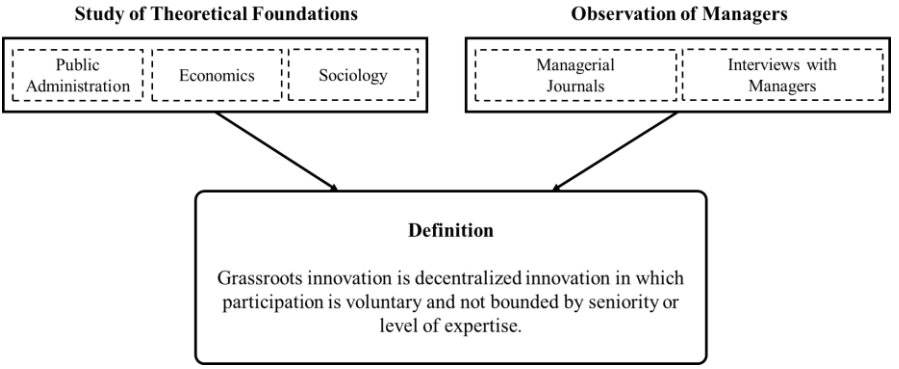
Second, from the firms that are already experimenting with grassroots innovation (64.8% in Study 1 and 50.8% in Study 2), many struggle with its effective implementation. For such firms, our findings offer specific guidance on how to improve their grassroots innovation processes. For instance, our results indicate that firms need to consistently evoke the intrinsic motivation of employees who participate in their grassroots innovation initiatives. To do so, we show that firms should ensure that project teams feel that the grassroots innovation initiative offers them a high level of autonomy (e.g., allowing employees to self-assemble their own teams), competence (e.g., offering workshops and coaching) and relatedness (e.g., making it easier for employees to connect with like-minded colleagues). On the other hand, our results point to the importance of a high depth of control. A low depth of control may trigger

misalignment between employees' innovation efforts and firm-wide goals and make grassroots innovation inefficient. Thus, despite the decentralized and voluntary nature of grassroots innovation, firms should frequently monitor the progress of project teams.

3.3 Grassroots Innovation

The innovation, marketing and management literatures do not contain a universally accepted definition of grassroots innovation. Given its central role in the present paper, this section aims to provide such definition as follows. We inventory the foundations of the grassroots concept in the public administration, economics and sociology literatures. Next, we immerse ourselves in the practice of grassroots innovation to ensure that our definition captures grassroots innovation as a real and significant managerial phenomenon. We study the managerial literature to understand how managers use the term and what they see as defining characteristics of grassroots innovation and we interview managers about their innovation practices in general, and grassroots innovation, in particular. Based on (1) the theoretical foundations of grassroots and (2) its application to innovation as observed from managers, we formally define grassroots innovation (see Figure 3.1).

Fig. 3.1 Defining Grassroots Innovation



3.3.1 Grassroots: Theoretical Foundations

The term grassroots dates back to the Tennessee Valley Authority (TVA). The United States Congress established this federal agency in 1933 to find novel solutions to power and water management challenges in the Tennessee Valley, a region badly hit by the Great Depression (Selznik 1949). The key tenet of the TVA was a decentralized system of governance, in which ordinary citizens could voluntarily propose solutions for the valley's problems. Over the years, the TVA became a much-praised example of the "grassroots" approach to public administration (Neuse 1983). Its influence in public administration persists until this day. For instance, Seyfang and Smith (2007) have applied this grassroots idea to the field of sustainability and see it as a promising source for novel bottom-up solutions for sustainable development. However, solid foundations exist in other fields as well, most notably in economics and sociology.

In economics, its foundations lie in the legal and social institutions that support economic activity, more in particular in the contrast between the "top-down" and the "bottom-up" view (Easterly 2008). The "top-down" view argues that institutions are governed by rules and laws written by (political) leaders, whereas the "bottom-up" view sees institutions as emerging naturally from ordinary individuals (Easterly 2008). Several liberal economists have shown themselves to be strong proponents of the bottom-up view. For instance, in Friedrich von Hayek's "bottom-up, grassroots theory, the modern market economy, in the process of creating new products, whether goods or methods, draws on the freedom of individuals in that system to exercise their originality" (Phelps 2013, p. 128).

In sociology, scholars study grassroots as decentralized movements that originate from voluntary actions among the general public and subsequently progress up to create social disruption (for instance, Goode and Ben-Yehuda 1994). They contrast grassroots, among others, to elite-engineered disruption; a model that sees social disruption as centralized in a small and powerful elite deliberately and consciously undertaking a campaign to trigger and sustain disruption (Goode and Ben-Yehuda 1994). In a study on non-governmental organizations in China, Spires (2011) identifies voluntary action and decentralization (i.e., the fact that such organizations have no government ties and are run by local Chinese citizens) as the defining characteristics of grassroots movements.

3.3.2 Grassroots Innovation: Immersion in Practice

In the managerial literature, the term "grassroots innovation" is used to refer to innovation initiatives that are decentralized and leverage on the voluntary actions of employees with different levels of expertise and seniority. For example, Birkinshaw, Bouquet and Barsoux (2011) stress decentralization when they equate grassroots innovation to "pushing responsibility for innovation down into the organization" (p. 49). Other authors stress the voluntary nature of grassroots innovation. For example, Huy and Mintzberg (2003) refer to grassroots innovation as organic change, which they define as voluntary innovation that "tends to arise from the ranks" (p.80). Along similar lines, Pascale (1999) recounts the legacy of Steve Miller who, in the late 1990s, introduced the grassroots philosophy at Royal Dutch Shell, which involved "cutting through the organization's layers and barriers" (p.88). Decentralization and voluntary action were the defining characteristics of Shell's grassroots initiatives. In fact, Miller wanted to tap into "the insight and the initiative of our [Shell's] front-line troops" and he believed that "many, if not most, of the ideas come from the lower ranks of our company who are in direct contact with the customer" (Pascale 1999, p. 90).

Next, we conducted exploratory interviews with innovation managers at three multinational companies, namely Alcatel-Lucent Bell Labs (Murray Hill, New Jersey), Michelin North America (Greenville, South Carolina) and AirFrance-KLM (Paris, France). Responses to the interviews supported the usage of the term in

managerial literature, stressing the importance of decentralization and voluntary action as the most important and distinctive characteristics of grassroots innovation initiatives.

According to managers we interviewed, decentralization refers to the notion that, in grassroots innovation, ideas do not originate only from employees whose function is directly related to innovation. Voluntary action, in turn, means that any employee, irrespective of her function and seniority, can freely contribute to innovation. In the grassroots initiatives of these firms, employees from all corners of the organization were encouraged to submit ideas, mature their ideas into innovation projects and, if selected for incubation, be on the implementation team. Alcatel-Lucent Bell Labs focused on its entire employee base and ran its initiative, called "Entrepreneurial Bootcamps" at the country-level. Michelin involved all white-collar employees in its "InnovationWorks" process, which was originally launched in the US. Later on, when it expanded to Europe, it involved all employees, including employees of several manufacturing plants. AirFrance-KLM opened up its "Bluecamp" to all employees, except flying personnel. If certain employee groups were excluded, the reasons the companies cited for this exclusion were practical considerations such as work regulations and not (lack of) seniority or expertise. For instance, for an airline it is very complex to allot flying personnel to innovation workshops, as it has a major impact on their work schedules, routing, compensation days, etc.

3.3.3 Construct Definition

Based on the theoretical foundations and the observation of managers, we define *grassroots innovation* as *decentralized innovation in which participation is voluntary and not bounded by seniority or level of expertise*.

3.4 Hypotheses Development

As it becomes clear from our construct definition (see Figure 3.1), *voluntary participation* and *decentralization* are two essential ingredients of grassroots innovation. These ingredients create two main challenges for firms. The first challenge is to guarantee that employees who volunteer to participate in grassroots innovation initiatives *persist* in their innovation efforts. The voluntary nature of grassroots innovation implies that grassroots innovation initiatives typically attract the most participative employees in an organization, i.e. those who tend to volunteer to participate in tasks that are not necessarily their job. Highly participative employees, however, often fall prey to the "paradox of persistence and participation," which predicts a negative correlation between participation and persistence (Cress, McPherson and Rotolo 1997). Specifically, when they volunteer to participate in a certain task, highly participative employees need to sacrifice other activities that compete for their time (ranging from other voluntary tasks, both at work and outside work, to time with their family). This competition for their time leads highly participative employees to, paradoxically, be less likely to persist in any given task. Consequently, to succeed in grassroots

innovation, firms need to be able to motivate participating employees so they persist in the development of their ideas, i.e. in developing an idea into a business case, and then a business case into a new commercial proposition for customers. The theoretical lens we use to study employee motivation and persistence is self-determination theory (Deci and Ryan 2011; Ryan and Deci 2000).

The second challenge is to avoid *inefficiency* stemming from the decentralized nature of grassroots innovation. In a decentralized process, participants may have a tendency to drift away from firm-wide goals. This happens either because employees who are distant from senior management may not know the firm-wide goals, or because they may have a tendency to engage in opportunistic innovation efforts that they may find rewarding, but that may have a tenuous fit with the firm's goals (Mundy 2010; Simons 1995). For instance, opportunistic employees may exploit the decentralized nature of grassroots innovation to develop innovative ideas that enhance their personal well-being or that address communities or causes (e.g., global warming) they favorably relate to instead of innovative ideas that enhance firm profitability. We study controlling mechanisms that firms may use to channel grassroots innovation efforts towards firm-wide goals, thereby avoiding inefficiency (Adler and Borys 1996; Adler and Chen 2011).

In sum, our conceptual framework highlights that we expect both employee motivation and controlling mechanisms to drive grassroots innovation performance which, in turn, affects a firm's innovation performance (see Figure 3.2).

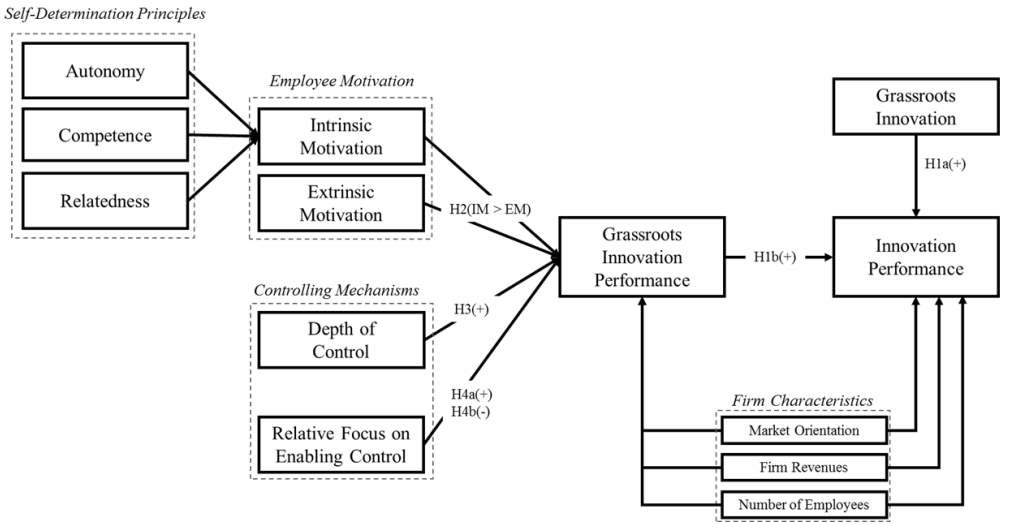
3.4.1 The Impact of Grassroots Innovation on Firms' Innovation Performance

To justify investing scarce resources in grassroots innovation initiatives, firms need proof that grassroots innovation contributes to their innovation performance, i.e. to the return on investment, sales growth and profitability resulting from the firm's overall innovation efforts. We theorize that grassroots innovation contributes positively to firms' innovation performance because the decentralized and voluntary nature of grassroots innovation offer two key benefits.

First, the decentralized nature of grassroots innovation means that project teams in grassroots innovation initiatives are typically more diverse, in terms of functions and seniority, than project teams in top-down innovation initiatives. Such diversity means that grassroots innovation project teams are less likely to anchor on their prior knowledge and experiences than project teams in top-down innovation initiatives (Fern, Cardinal and O'Neill 2012).

For instance, different team members may voice their unique knowledge and viewpoints which, in turn, may stimulate other members to consider new options (Simonton 2003), thereby facilitating the scanning of the search space for novel solutions that befit customer needs.

Fig. 3.2 Conceptual Framework and Overview of Studies



OVERVIEW OF STUDIES

Study 1

- 2,139 managers in 14 countries ("full sample")
- Of these, 1,387 (64.8%) adopted grassroots innovation ("grassroots sample")

Study 2

- 689 managers in the US ("full sample")
- Of these, 350 (50.8%) adopted grassroots innovation ("grassroots sample")
- Of these, 151 answered a second wave survey ("longitudinal sample")

Tests of H1a: OLS regressions estimated on the "full sample" of study 1 and study 2.

Tests of H1b-H4b: Bayesian SEM models estimated on the "grassroots sample" of study 1 and study 2 and on the "longitudinal sample" of study 2.

Second, given its voluntary nature, grassroots innovation may lead employees to feel empowered, i.e. to feel that the firm is giving them a voice and an opportunity to change the firm's offerings. Feelings of empowerment may induce a sense of psychological ownership towards the firm and its offerings (see e.g., Fuchs, Prandelli and Schreier 2010). Increasing employees' psychological ownership, in turn, leads employees to feel they have a moral responsibility to make decisions that contribute to the long-term success of the firm (Avey et al. 2009), thereby boosting their willingness to scan the search space for profitable solutions for customer needs (Schepers et al. 2012). Hence, we hypothesize:

> **H1a**: Firms that adopt grassroots innovation achieve, on average, higher innovation performance than firms that do not adopt grassroots innovation.

And

> **H1b:** Firms with higher levels of grassroots innovation performance have higher innovation performance than firms with lower levels of grassroots innovation performance.

In sum, we expect to find that, on average, firms that adopt grassroots innovation outperform firms that do not adopt grassroots innovation, and that as firms get better at grassroots innovation they also have higher overall innovation performance.

3.4.2 Employee Motivation and Grassroots Innovation Performance

By definition, employees participate voluntarily in grassroots innovation and voluntary action of employees has been connected with low persistence (Cress et al. 1997). Persistence in a given task is a key driver of employee performance in such a task (Grant et al. 2007). If employees in grassroots innovation initiatives do not persist, grassroots innovation is bound to fail. We theorize that the extent to which employees are intrinsically or extrinsically motivated in grassroots innovation affects their persistence in such innovation efforts and, thereby, the success of grassroots innovation.

Intrinsic motivation occurs when people derive their motivation to perform an activity from intrinsic rewards, i.e., directly from the activity itself, while *extrinsic motivation* occurs when people derive their motivation not from the activity itself, but from separable rewards to which the activity leads (Deci and Ryan 2011; Osterloh & Frey 2000). In the context of grassroots innovation, such intrinsic rewards may be the opportunity to attain a higher level of stimulation at work (e.g., by working in new tasks, on one's own idea, or with new colleagues) or the opportunity to learn and achieve personal growth. Extrinsic rewards, in turn, include career progression, visibility to senior management, enriching one's curriculum or monetary rewards (e.g., bonuses or other financial incentives).

There are two important differences between intrinsic and extrinsic motivation by which they may affect persistence in

grassroots innovation differentially: (1) differences in self-regulation (internal versus external) and (2) differences in goal proximity (task-focused versus outcome-focused). First, intrinsic motivation triggers self-regulatory processes with an internal locus of causality, whereas extrinsic motivation triggers self-regulatory processes with an external locus of causality (Turban et al. 2007). Intrinsically motivated employees will, thus, feel that their effort emanates from their own volition and is based on their own enjoyment of the task at hand (Grant 2008). Such feelings of volition and personal enjoyment, in turn, lead intrinsically motivated employees to experience low levels of effort, even when, objectively, the task is hard and difficult (Kehr 2004). In contrast, for extrinsically motivated employees, effort is the result of conscious self-regulation targeted at achieving an external goal, such as reaping a reward (Cadwallader et al. 2010), which absorbs cognitive resources (Kehr 2004). Such absorption of cognitive resources, in turn, means that extrinsically motivated employees tend to experience a task as more effortful, and, thus, give up more easily, than intrinsically motivated employees.

Second, intrinsic motivation triggers employees to focus on a proximal goal - the task itself - whereas extrinsic motivation triggers them to see the task as instrumental to the achievement of a distal goal - the outcomes of the task (Botti and McGill 2011). Focusing on the task itself, rather than on its outcome, leads intrinsically motivated employees to adopt a “playful” mindset which is characterized by an arousal-seeking predisposition

(Legrand and Thatcher 2011). Employees with an arousal-seeking predisposition, in turn, tend to accept negative feedback and the need for frequent changes in their idea as an integral part of the task itself, which they find pleasant. In contrast, extrinsically motivated employees focus on the outcomes of the task and its associated rewards, which triggers a "serious" and arousal-avoidant mindset (Legrand and Thatcher 2011). Employees with an arousal-avoidant mindset tend to find that negative feedback and the need for constant changes interfere with goal achievement, which they find unpleasant. This means that extrinsically motivated employees are less likely to persist working on their ideas than intrinsically motivated employees. Thus, we hypothesize:

> **H2:** The intrinsic motivation of employees in a grassroots innovation process has a stronger effect on grassroots innovation performance than their extrinsic motivation.

3.4.3 Controlling Mechanisms and Grassroots Innovation Performance

There is a widely held belief that controlling mechanisms stemming from a central authority are incongruent with the decentralized and voluntary nature of grassroots innovation. For instance, Neuse (1983) argues that, in its first fifty years of existence, the TVA sometimes struggled to garner sufficient support among the Tennessee Valley's interest groups precisely because it tried to institute a "system of governance at the same time democratic and bureaucratic" (p. 496). However, several other grassroots theorists

recognize that, without appropriate controlling mechanisms to coordinate actions among the general public, grassroots efforts become inefficient and result in scattered individual efforts with a loose contribution to higher-level societal goals (Goode and Ben-Yehuda 1994). We expect controlling mechanisms to be particularly important in the context of grassroots innovation, where employees' efforts need to fit a corporate hierarchy with its own governance. Without appropriate controlling mechanisms, participants in grassroots innovation initiatives may have a tendency to drift away from firm-wide goals due to two mechanisms: *lack of transparency of firm-wide goals* and *employee opportunism*.

First, the successful development of an idea into a commercial proposition for customers requires such idea to be "picked up and then prioritized by top management" (Birkinshaw, Bouquet, and Barsoux 2011, p. 49). In order to be prioritized by top management, employee ideas need to contribute to firm-wide goals. Thus, it is important to ensure that firm-wide goals are transparent to employees, i.e., that employees understand the upstream and downstream implications of their work to the firm and its goals (Adler and Chen 2011; Wouters and Wilderom 2008). Unfortunately, the decentralized nature of grassroots innovation poses a risk to the transparency of firm-wide goals. Specifically, as many participants in grassroots innovation initiatives are, by definition, distant from top management, it is harder for them to understand how their efforts fit in the broader context and strategy of the firm. Consequently, project teams in grassroots innovation

initiatives may be unsure about how they can contribute to firm-wide goals, increasing the likelihood that they drift away from firm-wide goals.

Second, the voluntary nature of grassroots innovation may promote opportunistic behaviors among employees. Prior literature argues that, in the context of innovation, employees have a tendency to engage in "opportunistic innovation efforts" that can be rewarding to them but have a tenuous fit with the strategic goals of the firm (Simons 1995). These "opportunistic innovation efforts" can be self-serving (e.g., working on an innovation project that the employee finds personally enjoyable but knows that it will not contribute to firm-wide goals), or they can be altruistic (e.g., working on an innovation project that the employee believes can be beneficial for communities or causes she favorably relates to, but knows that it will not contribute to firm-wide goals). The voluntary nature of grassroots innovation may exacerbate these opportunistic tendencies. Specifically, the voluntary nature of grassroots innovation triggers a sense of psychological empowerment that, despite its many benefits, may also lead people to become more egocentric and neglect other people's goals and advice (Tost et al. 2012). As a result, project teams in grassroots innovation may have a tendency to ignore the firm's goals and engage in "opportunistic innovation efforts".

Controlling theory posits that adequately designed controlling mechanisms may help firms overcome both the lack of transparency of firm-wide goals (Adler and Chen 2011) and

employee opportunism (Mundy 2010). Controlling mechanisms vary along two dimensions: (1) the depth of control (e.g., Sethi and Iqbal 2008), and (2) the degree to which such control is exerted in a relatively more coercive or enabling manner (e.g., Adler and Borys 1996).

Depth of control. In grassroots innovation initiatives with a high depth of control, firms ask project teams to frequently report on their progress, while in grassroots innovation initiatives with a low depth of control, project teams report on their progress only infrequently. We expect that a high depth of control leads to a more successful deployment of grassroots innovation initiatives, because employees are less likely to drift away from firm-wide goals. Specifically, frequently interacting with project teams allows managers to clarify firm-wide goals to employees (Wouters and Wilderom 2008) and may activate a sociocentric (in this case, firm-centric), rather than egocentric, self (Gardner, Gabriel and Lee 1999). When compared with people with an activated egocentric self, people with an activated sociocentric self are more likely to contribute to the group to which they belong (in this case, the firm). Hence, a high depth of control may make firm-wide goals more transparent and reduce employees' tendency to engage in egocentric opportunism that does not align with the firm-wide goals. We hypothesize:

> **H3**: The greater the depth of control in a grassroots innovation initiative, the greater the grassroots innovation performance.

Relative focus on enabling (vs. coercive) control. The second dimension in which controlling mechanisms vary is the *relative focus on enabling (vs. coercive) control*, i.e., the extent to which firms adopt, in their grassroots innovation initiatives, controlling mechanisms that are relatively more enabling, or relatively more coercive, regardless of the depth of such control (e.g., Adler and Borys 1996). *Enabling control* occurs when senior managers support project teams' efforts through informal interaction and feedback. Examples of enabling control mechanisms, include meetings where senior managers offer guidance and support to employees. *Coercive control* occurs when firms demand project teams to use formal rules and procedures to periodically report on the progress of their projects. "Stage-gate" processes are a prime example of coercive control mechanisms (Cooper 1994; Sethi and Iqbal 2008). Two contrasting logics suggest that firms should rely either on relatively more enabling, or on relatively more coercive, control mechanisms in grassroots innovation. These two logics hold different underlying assumptions about employee behavior.

The first logic assumes that most employees feel accountable for their work and, thus, want to contribute to firm-wide goals and, thus, deviations from firm-wide goals stem mostly from the lack of transparency in such goals. According to this logic firms should thus strive to increase goal transparency by adopting relatively more enabling control mechanisms. Enabling control mechanisms work precisely because they "can make transparent the organization's goals and progress towards these goals" (Adler and Chen 2011, p.

75). Informal feedback between senior management and project teams, for example, helps increase the visibility of the firm's context and goals, thereby clarifying how employees can contribute to firm-wide goals (Sprinkle 2003). In contrast, according to this logic, coercive control mechanisms may fail to address the lack of transparency in firm-wide goals. For instance, coercive control mechanisms may limit project teams' capacity to learn (Sethi and Iqbal 2008). Such incapacity to learn, in turn, may make it harder for project teams to understand and internalize firm-wide goals. Thus, we hypothesize:

> **H4a**: The greater the relative focus on enabling (vs. coercive) control in a grassroots innovation process, the greater the grassroots innovation performance.

The second logic assumes that individuals are opportunistic and seek self-interest with guile (see e.g., Williamson 1996). Self-interested employees may have a tendency to put their own interests ahead of those of the firm and engage in "opportunistic innovation efforts" that can be rewarding to them but have a tenuous fit with firm-wide goals (Simons 1995). Prior research in controlling suggests that coercive control mechanisms are better able than enabling control mechanisms in reducing such opportunistic behaviors for the following two reasons.

First, coercive control mechanisms require project teams to periodically report on their projects using formal rules and procedures. Such requirements create uniformity and consistency in

the performance metrics reported by different project teams (Wouters and Wilderom 2008). Such uniformity and consistency in performance metrics, in turn, reduce the information asymmetry between employees and management, creating a disincentive for employees to engage in opportunistic behaviors. Enabling control mechanisms are, by definition, less formalized and, thus, do not create such uniformity and consistency in performance metrics.

Second, coercive control mechanisms may punish employees who deviate from firm-wide goals. Such a punitive focus on deviations from firm-wide goals is likely to discourage opportunistic tendencies through feelings of guilt and anxiety (Adler and Chen 2011). Enabling control mechanisms, by definition, are not punitive and are, thus, less likely to trigger such feelings of guilt and anxiety. Therefore, coercive control mechanisms are more effective than enabling control mechanisms in aligning employees' efforts with firm-wide goals, thereby stimulating grassroots innovation performance. Thus, we hypothesize:

> **H4b**: The greater the relative focus on enabling (vs. coercive) control in a grassroots innovation process, the lower the grassroots innovation performance.

The extent to which the logic behind H4a or the one behind H4b is stronger is an empirical question, which we formally test in this study.

3.4.4 Other Variables

Given its pivotal role in determining the success of grassroots innovation initiatives, it is also insightful to examine the antecedents of intrinsic motivation in grassroots innovation. Based on self-determination theory (Deci and Ryan 2011), we expect the extent to which a firm's grassroots innovation initiatives satisfy three fundamental human needs (autonomy, competence and relatedness) to positively affect employee's intrinsic motivation. *Autonomy* is the extent to which employees in grassroots innovation initiatives have decision-making authority over their innovation projects. For instance, firms can empower employees by allowing them to work on a project of their own choosing or composing their own team. *Competence* is the extent to which employees in grassroots innovation initiatives feel competent to execute their innovation projects. For instance, firms can offer training or coaching to employees in fields relevant to the grassroots innovation project they are working on. *Relatedness* is the extent to which employees in grassroots innovation initiatives feel connected to the people surrounding them. For instance, firms can organize events or deploy IT platforms to connect people in the organization with similar interests.

In addition, we include two control variables in our model to account for alternative determinants of grassroots innovation performance and innovation performance. The first control variable is market orientation, which leads firms to place a high priority on the profitable creation of superior value to customers (Jaworski and

Kohli 1993). Consequently, project teams in firms with high levels of market orientation may be better equipped to understand customer needs and propose new solutions for such needs, as compared with project teams in firms with low levels of market orientation. The second control variable is firm size. Prior research has found mixed results regarding the effect of firm size on innovation performance (Chandy and Tellis 1998; Cohen and Levin 1989). Existing studies typically measure firm size using financial metrics such as firm revenues. Given the decentralized nature of grassroots innovation, we also control for the number of employees, a proxy for the pool of ideas available for development.

3.5 Method

We tested our hypotheses in two survey studies to assess reliability and replicability. The first was a large-scale international survey among 2,139 innovation managers in firms with at least 500 employees in 14 countries. Out of these 2,139 respondents, 1,387 (64.8%) indicated that their firm had already engaged in grassroots innovation. The second was a longitudinal survey among 689 innovation managers in the US, 350 of which (50.8%) indicated that their firm had already engaged in grassroots innovation. Out of these initial 350 managers, 151 responded our second-wave survey. This approach avoids the weaknesses of single-method approaches and protects against common method variance, a well-known weakness of survey research (Podsakoff et al. 2003; Rindfleisch et al. 2008).

3.6 Study 1 – Large-Scale International Survey

3.6.1 Data Collection

First, we piloted our survey in English in a small (40 respondents) convenience sample of innovation managers, through our own network. Second, we redesigned the survey based on the feedback of this convenience sample and formally pretested the full survey in English among 486 subjects in Germany, UK and US. We contracted uSamp, a global market research company headquartered in Los Angeles, to run the fieldwork of this pilot as well as the full survey later in their online panels. uSamp's screening methodologies allowed us to effectively screen and target the right panelists (innovation managers). Furthermore, uSamp constantly evaluates its rewarding and data cleaning procedures to guarantee data integrity and respondent's attention and motivation. Third, once we designed the final survey instrument based on the feedback of our pilot, we employed a back-translation procedure (Brislin 1970) to translate the survey to the local languages in our full sample (for full information on our pre-testing and translation procedures, see Appendix 3A; both pilot versions of the survey are available from the authors upon simple request).

uSamp executed the full, Internet-based, survey in local languages among innovation managers in firms with at least 500 employees in 14 countries: Belgium, Brazil, China, Germany, India, Indonesia, Italy, Mexico, the Netherlands, Philippines, South Korea, Spain, the United Kingdom and the United States. This sample ensured a sufficient coverage of developed and emerging economies,

given budget constraints. In total, uSamp solicited 12,481 innovation managers among its panel members. We considered respondents eligible, if they had been working at their current company for at least four years and if they were sufficiently knowledgeable about innovation in their firm (i.e. if they had a score of six or higher on knowledge of innovation: see Homburg et al. 2012 for how these factors increase accuracy). Of the 12,481 solicited responses, 3,964 were eligible (32%). Even though uSamp continuously monitors the quality of its panels, we conducted additional data integrity checks to remove careless, inattentive or fraudulent respondents from the 3,964 eligible respondents (for procedure see Appendix 3B). This further reduced the sample to 2,139 respondents, which we took as our final sample.

3.6.2 Questionnaire Composition

In the first part of the questionnaire, we explained the context of our study and provided respondents with clear and simple definitions of our key terms, such as grassroots innovation. We also offered respondents the possibility to receive a customized benchmarking report. In the second part, we inventoried general information such as respondents' job description, functional domain of expertise and general measures of firms' innovation success, namely firms' innovation performance (i.e., return on investment, sales growth and profitability from innovation). In the third part, we measured whether or not a respondent's firm had ever engaged in grassroots innovation. For respondents who had already engaged in grassroots

innovation, we then measured grassroots innovation performance, the intrinsic and extrinsic motivation of employees participating in grassroots innovation, self-determination principles (i.e. autonomy, competence and relatedness) and the controlling mechanisms the firm put in place in its grassroots innovation initiatives. The last part inventoried general company characteristics and control variables, namely market orientation, number of employees and firm revenues.

3.6.3 Survey Measures

We now discuss our measures (see Appendix 3C for all survey items). Unless otherwise noted, we used seven-point Likert scales for our measures.

Grassroots innovation performance ($\alpha = .86$). We measured grassroots innovation performance using a new scale of five items capturing the extent to which grassroots innovation teams develop innovations that address the needs of their target customers and are generally considered a success at the firm.

Innovation performance ($\alpha = .87$). We used three items adapted from Li and Calantone (1998) to measure the extent to which innovation helps the firm achieve higher *return on investment*, *sales growth* and *profitability* relative to major competitors.

Intrinsic and extrinsic motivation. We used three items to measure intrinsic motivation ($\alpha = .87$) and two items to measure extrinsic motivation ($\rho = .76$), adapted from the *Motivation at Work* scale (Gagné et al. 2010; Wu and Parker 2017).

Depth of control and relative focus on enabling control. We developed a new scale to measure both enabling control (3 items; α = .85) and coercive control (4 items; α = .85) mechanisms, domain-sampled from Adler and Borys (1996) and Adler and Chen (2011). In line with our theorizing, we specified *depth of control* as the sum of the latent constructs for enabling control and coercive control and *relative focus on enabling control* as the difference between the enabling control latent construct and the coercive control latent construct.

Self-determination principles (autonomy, competence and relatedness). We adapted the 21-item *Intrinsic Need Satisfaction* scale (Deci et al. 2001) to a 13-item scale to measure autonomy (4 items; α = .87), competence (4 items; α = .88) and relatedness (5 items; α = .90) in the context of grassroots innovation.

Market orientation (α = .91). To measure market orientation, we used the 8-item scale developed by Deshpandé and Farley (1997), to put less burden on respondents than the full 32-item scale proposed by Jaworski and Kohli (1993), while still achieving very high reliability (α = .91). Verhoef and Leeflang (2009) showed this scale to correlate highly with the full scale.

Firm size. We measured the number of employees and total revenues according to 12 (number of employees) and 14 (revenues) ordered categories.

3.6.4 Measurement Validation

We validated our measures using confirmatory factor analysis. The fit of our measurement model was acceptable. The root mean square error of approximation (RMSEA = .042), the comparative fit index (CFI = .95) and the Tucker-Lewis Index (TLI = .95), were both below (in the case of RMSEA) and above (in the case of CFI and TLI) the commonly recommended cutoff values, indicating an acceptable fit.

Following Anderson and Gerbing (1988), we also checked our measurement scales for unidimensionality, reliability, convergent and divergent validity. First, to assess unidimensionality, we conducted factor analyses on all constructs taking one scale at a time. Using the common cut-off of an eigenvalue of 1.0, we found that only a single factor was extracted for each of the constructs. These single factor models all had an acceptable fit. Given that the fit of the measurement model reported above was also acceptable, we conclude that all our measures showed satisfactory unidimensionality.

Second, all scales in our model showed satisfactory reliability. All scales have a Cronbach's α of at least .80 (with the exception of extrinsic motivation, which has two items with a correlation of $\rho = .76$), indicating high reliability. The composite reliability of all our scales is also above .85 for all scales, indicating acceptable fit (Bagozzi and Yi 1988). We also assessed the average variance extracted, which is a more conservative measure of

reliability. The average variance extracted is greater than .50 for all scales (Fornell and Larcker 1981).

Third, we assessed convergent validity through the path coefficients from the latent construct to their corresponding indicators. All loadings were significant at the $p<0.1$ and all parameter estimates were at least ten times as large as the standard errors (Anderson and Gerbing 1988). Thus, our measures showed high convergent validity.

Fourth, all pairs of constructs passed Fornell and Larcker's (1981) discriminant validity test. Specifically, we examined all pairs of constructs and confirmed that the average variance extracted per construct was, in all cases, higher than the shared variance between the standardized constructs. Thus, we conclude that our measures also show high divergent validity.

3.6.5 Model Formulation and Estimation

We tested our hypothesis H1a using ordinary least squares (OLS) regression estimated on our full sample (N = 2,139). We regressed *innovation performance* on a dummy variable indicating whether or not firm *i* had adopted grassroots innovation, controlling for number of employees, revenues and market orientation. For *innovation performance* and *market orientation*, we averaged respondents' answers to the items in each of these scales to produce summated scales. In doing so, we follow the standard argument in psychometrics (Nunnally and Bernstein 1994) and in marketing

research textbooks (Iacobucci and Churchill 2010) that it is both safe and useful to treat summated Likert scales as interval scales.

We used a Bayesian structural equation model (SEM) estimated on the subsample of firms that have adopted grassroots innovation (N = 1,387) to test our remaining hypotheses. Table 3.1 depicts the descriptive statistics and bivariate correlations among all constructs in our model in this subsample of firms that have adopted grassroots innovation. To compute these correlations, we again averaged respondents' answers to the items in each of the scales to produce summated scales for each construct. In the robustness section, we used a two-step Heckman correction to demonstrate that our results in the subset of firms that have adopted grassroots innovation are not threatened by selection bias.

We used a Bayesian SEM for several reasons. First, given that we gathered multiple indicators to measure each latent construct, a SEM framework allows us to explicitly account and control for measurement error. Second, a SEM framework allows us to flexibly control for the potential threat of common method variance by including a latent methods factor directly in our model (Podsakoff et al. 2003). Third, we modeled the effect of depth of control (which is the sum of two latent constructs – enabling and coercive control) and the effect of relative focus on enabling control (which is the difference between these two latent constructs).

Table 3.1 Descriptive Statistics (Study 1; "Grassroots Sample"; N = 1,387)

Construct	1	2	3	4	5	6	7	8	9	10	11	12
1. Grassroots Innovation Performance	1											
2. Innovation Performance	.54	1										
3. Autonomy	.63	.46	1									
4. Competence	.69	.48	.78	1								
5. Relatedness	.71	.47	.70	.79	1							
6. Intrinsic Motivation	.63	.48	.66	.64	.65	1						
7. Extrinsic Motivation	.43	.37	.43	.42	.38	.43	1					
8. Depth of Control*	.68	.52	.65	.71	.70	.62	.48	1				
9. Relative Focus on Enabling Contr.*	.00	.00	-.02	-.03	.00	-.02	-.04	.12	1			
10. Market Orientation	.66	.52	.52	.59	.65	.57	.34	.64	-.01	1		
11. Number of Employees	.04	.06	.04	.02	.05	.03	-.05	.04	-.03	.06	1	
12. Revenues	.07	.15	.08	.07	.09	.09	.10	.08	-.02	.09	.33	1
M	5.56	5.27	5.52	5.67	5.70	5.71	5.58	11.11	.07	5.83	7.23	8.53
SD	.82	1.06	.89	.84	.84	.96	1.34	1.84	.69	.84	2.35	3.67
Reliability	.86	.87	.87	.88	.90	.87	.76	.85*		.91		
Average Variance Extracted	.56	.70	.62	.64	.63	.69	.76	.64*		.55		

* For depth of control (enabling + coercive control) and relative focus on enabling control (enabling - coercive control), we report the average reliability and variance extracted across the two scales of enabling control (α = .85; AVE = .70) and coercive control (α = .85; AVE = .58).

The Bayesian SEM approach uses data augmentation, which allows sampling the latent constructs alongside the model parameters (Tanner and Wong 1987). This means that latent constructs are available for transformation and for usage in estimation, a key advantage of the Bayesian approach (Lee 2007). For these and other reasons, Bayesian estimation is increasingly recognized as a more flexible approach to the estimation of theory-driven structural equation models than maximum likelihood (Muthén and Asparouhov 2012).

We specified the posterior distribution of the parameters of interest across all respondents and estimate our model simultaneously across all countries. We sampled the model parameters from their posterior distributions using the Gibbs sampler (Casella and George 1992) with data augmentation (Tanner and Wong 1987). At each iteration of our Gibbs sampler, we first drew the latent constructs according to our measurement model and then included, in our structural model, the sum of the latent constructs of enabling and coercive control to test the effect of depth of control and the difference between enabling and coercive control to test the effect of relative focus on enabling control on grassroots innovation performance.

We used standard diffuse priors for our parameters (normal distributions for measurement intercepts, loadings and structural parameters and inverse-Wishart distributions for variance–covariance matrices). We used standard Markov chain Monte Carlo procedures with two concurrent chains for estimation. We let both

chains converge by running our model for 35,000 draws. We then discard the first 10,000 iterations as burn-in values. We used the next 5,000 thinned draws (2,500 in each of the two chains, as we used every 10th draw to reduce autocorrelation) for posterior inference. For technical details about the econometric specification of our model, please see Appendix 3D.

3.6.6 Model Fit and Diagnostics

Model fit. To assess model fit, we compared several models and, for each of these models, we calculated the deviance information criterion (DIC), for which lower values indicate a better fit (Spiegelhalter et al. 2002). Model 1 is a baseline model with only market orientation and firm size as predictors of grassroots innovation performance and innovation performance (DIC_{M1} = 125,960). In Model 2, we add the effects of intrinsic motivation and the self-determination principles, which improves model fit (DIC_{M2} = 123,992). Model 3 introduces extrinsic motivation, which again leads to an improvement of the DIC when compared with Model 1 but not when compared with Model 2 (DIC_{M3} = 125,635). Model 4 introduces depth of control and relative focus on enabling control, which also leads to an improvement in the DIC (DIC_{M4} = 123,908). Thus, the optimal model, based on minimum DIC, is Model 4.

Individual DIC values are hard to interpret in absolute terms and the Bayesian literature recommends comparing the *differences in DIC* between models (Burnham and Anderson 2004). Following Burnham and Anderson (2004), we compare the difference between

each model and the model with minimum DIC ($\Delta_i = DIC_i - DIC_{min}$), and consider models with $\Delta_i > 10$ as having essentially no support, as compared with the best-fitting model. This analysis shows that Model 1 ($\Delta_1 = 2{,}052$), Model 2 ($\Delta_2 = 84$) and Model 3 ($\Delta_3 = 1{,}727$) have essentially no support, when compared with Model 4. The optimal model, based on differences in DIC, is again Model 4.

For robustness, we also estimate several ordinary least squares (OLS) regressions, which confirm that our path model with mediators offers a good fit to the data, following Baron and Kenny's (1986) approach. Our models explain 50.9% of the variance in intrinsic motivation, 59.3% of the variance in grassroots innovation performance and 34.5% of the variance in innovation performance.

Common method variance. Common method variance (CMV) – systematic error variance shared among variables measured with a single method and source – is a common concern in cross-sectional survey research (Podsakoff et al. 2003; Rindfleisch et al. 2008). We guaranteed respondents full anonymity in the self-administered online questionnaire, which, according to Podsakoff et al. (2003), should reduce respondents' tendency to respond in an acquiescent manner, thereby reducing the threat of CMV. We also conducted Harman's one-factor test, which requires loading all variables into an exploratory factor analysis and examining the unrotated factor solution to determine whether a single factor emerges. The assumption behind this single-factor hypothesis is that, in the presence of severe CMV, one general factor should account for most of the variation across constructs. In our

case, the single-factor hypothesis was rejected. In addition, we also tested the robustness of our findings to the inclusion of a latent common method factor in our model, which is a more stringent test of CMV than Harman's one-factor test (Podsakoff et al. 2003). Following Podsakoff et al. (2003), we control for the effect of an unmeasured latent common method factor by letting all items load on their theoretical constructs as well as on the latent common method factor, and examining whether the estimates for the structural parameters in our model change. Our results remain unchanged. Study 2, below, offers additional evidence that CMV does not threaten our results.

Multicollinearity. To assess whether multicollinearity is a concern, we used several steps. First, we inspected the correlation matrix of the predictor variables (see Table 3.1). Only two out of the 66 bivariate correlations were high correlations (i.e., $\rho > .75$), reducing concerns with multicollinearity (Grewal, Cote and Baumgartner 2004). Second, we used the condition index method of Belsley, Kuh, and Welsch (1980) in the OLS regressions. The condition index crosses the threshold of 30 in only one occasion, in the regression of intrinsic motivation on the self-determination principles of autonomy, competence and relatedness (Cond. Index = 31.4). Note that multicollinearity is unlikely when Fornell and Larcker's (1981) discriminant validity criterion is satisfied as in this study (Grewal, Cote, and Baumgartner 2004). Moreover, multicollinearity does not create bias in estimates, it merely inflates standard errors, therefore increasing the likelihood for Type II errors,

while not affecting Type I errors (Grewal, Cote, and Baumgartner 2004). Thus, in theory-testing research it is seen as merely leading to more conservative inference. Belsley et al. (1980) suggest that variables with high condition indexes and variance decomposition portions greater than .50 are the ones most likely affected by multicollinearity. This was the case only for relatedness, an effect that is significant in our model, thereby reducing concerns with Type II errors in this variable. Third, analysis of variance inflation factor indicates that there is no significant standard error inflation due to multicollinearity problems (all VIFs are below 10), indicating that multicollinearity is not a severe issue in our data.

3.6.7 Results

The impact of grassroots innovation on innovation performance. From our OLS regression of innovation performance on the grassroots innovation dummy and control variables (as introduced above; N = 2,139; R^2 = .31), we find, in support of H_{1a}, that firms that adopt grassroots innovation have a significantly higher innovation performance than firms that do not adopt grassroots innovation (β = .13; p <.001). We also find that market orientation (β = .61; p <.001) and revenues (β = .08; p <.001) have a positive and significant effect on firms' innovation performance. However, the number of employees does not (β = -.02; p = .25).

The impact of grassroots innovation performance on innovation performance. Table 3.2 presents the estimation results of our Bayesian SEM, with the results of Study 1 depicted in the third

column. In support of H_{1b}, we find that grassroots innovation performance has a positive effect on firms' innovation performance (β.=.55; 95% CI = [.44,.65]).

Employee motivation and grassroots innovation performance. In line with $H_{2,}$ we find that the effect of intrinsic motivation on grassroots innovation performance (β.=.23; 95% CI = [.17,.29]) is stronger than the effect of extrinsic motivation on grassroots innovation performance (β.=.05; 95% CI = [.02,.08]), with no overlap between their 95% credible intervals.

Controlling mechanisms and grassroots innovation performance. In line with $H_{3,}$ we find that depth of control has a positive effect on grassroots innovation performance (β.=.17; 95% CI = [.13,.21]). We also find a negative effect of relative focus on enabling control on grassroots innovation performance (β = -.19; 95% CI = [-.33, -.06]), in line with H_{4b} but contrary to H_{4a}.

Table 3.2 Bayesian SEM Model Results (Estimates are the Posterior Means of the MCMC Chains)

	Hypothesis	Study 1 (N = 1,387)	Study 2 Wave 1 Analysis (N = 350)	Study 2 Longitudinal Analysis (N = 151)
Financial Impact of Grassroots Innovation				
Grassroots Innovation Performance → Innovation Performance	H_{1b} (+)	**.55** ***	**.54** ***	**.61** ***
Employee Motivation and Grassroots Innovation Performance				
Intrinsic Motivation → Grassroots Innovation Performance	H_2 (IM > EM)	**.23** ***	**.19** ***	**.56** ***
Extrinsic Motivation → Grassroots Innovation Performance		**.05** ***	-.06	**.25** **
Controlling Mechanisms and Grassroots Innovation Performance				
Depth of Control → Grassroots Innovation Performance	H_3 (+)	**.17** ***	**.33** ***	**.41** ***
Relative Focus on Enabling Control → Grassroots Innovation Performance	H_{4a} (+) / H_{4b} (-)	**-.19** ***	.07	.03
Other Variables				
Autonomy → Intrinsic Motivation		**.50** ***	.23	.22
Competence → Intrinsic Motivation		-.04	**.54** ***	**.48** **
Relatedness → Intrinsic Motivation		**.50** ***	**.23** *	.33
Market Orientation → Grassroots Innovation Performance		**.27** ***	**.21** *	**.65** ***
Nr. Employees → Grassroots Innovation Performance		.01	.03	**.12** ***
Revenues → Grassroots Innovation Performance		-.02	-.07	**.14** ***
Market Orientation → Innovation Performance		**.28** ***	**.32** ***	**.27** ***
Nr. Employees → Innovation Performance		-.01	.03	**.11** ***
Revenues → Innovation Performance		**.11** ***	.03	**.15** ***

Note: We let all models converge and run each of our Bayesian SEM models for 35,000 draws. We then discarded the first 10,000 draws for burn-in and used the remaining thinned draws for posterior inference (we used every 10th draw to reduce autocorrelation). We use '***' to indicate that the 99% Credible Interval of a parameter does not contain zero, '**' to indicate that the 95% Credible Interval does not contain zero, and '*' to indicate that the 90% Credible Interval does not contain zero. In our longitudinal analysis, the sample is much smaller (N = 151). Therefore, to ensure sufficient statistical power, we run five separate models: (1) a model for the effect of grassroots innovation performance on innovation performance, (2) a model for the effects of the self-determination principles on intrinsic motivation only, (3) a model for the effects of extrinsic and intrinsic motivation on grassroots innovation performance only, (4) a model for the effects of the controlling mechanisms (depth of control and relative focus on enabling control) on grassroots innovation performance and (5) a model for the effects of the control variables on grassroots innovation performance and innovation performance. The parameter estimates in column 5 depict the results of these five separate models.

Other variables. Confirming self-determination theory principles, we find that autonomy (β.=.50; 95% CI = [.34,.66]) and relatedness (β.=.50; 95% CI = [.34,.67]) have a positive effect on intrinsic motivation. We do not find a significant effect of competence on intrinsic motivation (β.=-.04; 95% CI = [-.30,.22]). We find that firms with higher levels of market orientation have both higher levels of grassroots innovation performance (*β.*=.27; 95% CI = [.21,.33]) and higher innovation performance (*β.*=.28; 95% CI = [.18,.37]). We do not find an effect of neither number of employees (*β.*=.01; 95% CI = [-.02,.04]) nor revenues (*β.*=-.02; 95% CI = [-.05,.01]) on grassroots innovation performance. We also do not find an effect of number of employees on firms' innovation performance (*β.*=-.01; 95% CI = [-.06,.04]). Yet, we do find a positive and significant effect of revenues on firms' innovation performance (*β.*= .11; 95% CI = [.06,.16]).

3.7 Study 2 – Longitudinal Survey

3.7.1 Data Collection

In Study 2, we collaborated with Research Now – a leading online sampling and data collection company headquartered in Plano, Texas – to replicate our findings among innovation managers in the US from a completely different panel. We applied the same data quality protocol described above for the uSamp sample, which resulted in a first wave sample of 689 innovation managers, out of which 350 (50.8%) indicated that their firm had already engaged in grassroots innovation. In order to further address concerns with

common method variance, we gathered outcome measures in a second wave among the 350 managers whose firms had already conducted grassroots innovation in our sample, five months after collecting the data from the first wave (this window was set based on experiences with longitudinal surveys of Research Now). 151 (43%) of these managers filled out the second survey.

3.7.2 Survey Measures

In wave 1 of Study 2, we employed the same measures as in Study 1 to measure grassroots innovation performance, innovation performance, intrinsic motivation, extrinsic motivation, coercive control and enabling control. We also employed the same measures for autonomy, competence, relatedness, market orientation and firm size. In the second questionnaire (wave 2), we again employed the same items from Study 1 (and wave 1 of Study 2) to measure grassroots innovation performance, innovation performance and intrinsic motivation. We followed the same measurement validation, model formulation, estimation and model fit and diagnostics procedures as in study 1. The results of these procedures, which are available in Appendix 3E, show that the fit of our model is acceptable, that our measures are unidimensional, reliable and exhibit divergent and convergent validity and that multicollinearity is also not a threat in this study.

3.7.3 Results from Cross-Sectional Analysis (First Wave)

The impact of grassroots innovation on innovation performance. In support of H1a, we again find that firms that adopt grassroots innovation have a significantly higher innovation performance than firms that do not adopt grassroots innovation (β = .21; p <.001). Market orientation also drive firms' innovation performance (β = .55; p <.001) but revenues (β = .01; p = .46) and number of employees do not (β = -.01; p = .77).

The impact of grassroots innovation performance on innovation performance. The fourth column of Table 3.2 presents the results of our Bayesian SEM model estimated on the first wave of Study 2. In line with H_{1b}, we also again find that grassroots innovation performance has a positive effect on a firm's innovation performance (β=.54; 95% CI = [.38,.70]).

Employee motivation and grassroots innovation performance. We find that intrinsic motivation has a positive and significant effect on grassroots innovation performance (β=.19; 95% CI = [.05,.33]) but that extrinsic motivation has no significant effect on grassroots innovation performance (β=-.06; 95% CI = [-.14,.03]). Thus, we find intrinsic motivation to be a stronger driver of grassroots innovation performance than extrinsic motivation, in line with H_2.

Controlling mechanisms and grassroots innovation performance. With respect to the controlling mechanisms, we find that depth of control has a positive effect on grassroots innovation performance (β=.33; 95% CI = [.21,.46]), in line with H_3. We do not

find an effect of relative focus on enabling control on grassroots innovation performance (β = .07; 95% CI = [-.25,.39]). Hence, in this second study we do not find support neither for H_{4a} nor for H_{4b}.

Other variables. The self-determination principles remain key drivers of intrinsic motivation, even though with some differences in significance. Specifically, while we do not find a significant effect of autonomy on intrinsic motivation (β=.23; 95% CI = [-.08,.54]), we find that competence (β=.54; 95% CI = [.19,.91]) and relatedness (β=.23; 90% CI = [.01,.44]) both have a positive effect on intrinsic motivation. Comparable to Study 1, we find that market orientation has a positive effect on both grassroots innovation performance (β=.21; 90% CI = [.02,.40]) and on innovation performance (β=.32; 95% CI = [.10,.55]). We find no effect of number of employees on either grassroots innovation performance (β=.03; 95% CI = [-.06,.12]) or on innovation performance (β=.03; 95% CI = [-.08,.15]). Similarly, we find no effect of revenues on grassroots innovation performance (β=-.07; 95% CI = [-.16,.02]). The only difference with respect to Study 1, is that we do not find a significant effect of revenues on innovation performance (β=.03; 95% CI = [-.09,.14]).

3.7.4 Results from Longitudinal Analysis

The fifth column of Table 3.2 depicts the results of our longitudinal analysis. Our results remain robust if we re-estimate our model using the outcome measures from our second wave and predictors from the first wave of responses, further reducing concerns with CMV and

generalizability of our findings (Richardson et al. 2009). There are two caveats. First, we find that extrinsic motivation has a positive effect on grassroots innovation performance (β=.25; 95% CI = [.04,.49]) and that its 95% Credible Interval overlaps with that of the effect of intrinsic motivation on grassroots innovation performance (β=.56; 95% CI = [.27,.87]). It is possible that the much lower sample size in this longitudinal analysis (N=151 vs. N=350 in the cross-sectional analysis and N=1,387 in Study 1) makes it harder to distinguish the strength of these two effects. Second, the effect of relatedness on intrinsic motivation remained positive (β = .33) but non-significant, even though the 80% Credible Interval does not contain zero (80% CI = [.06,.60]), suggesting this may again be due to a much smaller sample size.

The results of Study 2 suggest that our findings are largely reproducible using a completely different data source and using a longitudinal survey. The fact that we replicate our results in a different and much smaller sample offers robust evidence that the effects we uncover are robust and generalizable and not a mere consequence of common method variance.

3.8 Robustness to Selection Bias

Some firms may have better capabilities and resources for innovation and, hence, be more likely to adopt grassroots innovation, exactly because they expect to achieve better results from grassroots innovation. To test the sensitivity of our results to this potential endogeneity problem, we re-ran our analyses using a Heckman two-

step procedure. We augmented our SEM models with an estimate of the omitted drivers of self-selection (i.e. the drivers of the decision to engage or not in grassroots innovation) to solve the selection issue (Heckman 1979).

We depict the results of this two-stage Heckman procedure in Appendix 3F. To specify the selection model, we assume that a firm's decision to engage in grassroots innovation initiatives depends on its expectations about the success of such initiatives. Such expectations, in turn, may depend on its innovation capabilities and resources available for grassroots innovation. To instrument for firm's innovation capabilities, we include three markers of firms' prior innovation success vis-à-vis competitors in our selection equations (see e.g. Chandy and Tellis 1998; De Luca and Atuahene-Gima 2007): (i) number of radical innovations introduced in the market in last two years, (ii) number of incremental innovations introduced in the market in last two years and (iii) time from ideation until market launch. To instrument for resource availability, we also include number of employees and revenues in our selection equation, which may account for economies of scale (Cohen and Levin 1989) and access to a larger pool of ideas (Surowiecki 2005).

Following Heckman (1979), we then corrected for potential self-selection bias by including the Lee's lambda (or Inverse Mill's Ratio) as an additional control variable in our SEM models (Study 1 and first wave of Study 2). We let the models converge by running them for 35,000 draws, we then discarded the first 10,000 draws for burn-in and used the remaining 2,500 thinned draws (we used every

10^{th} to reduce autocorrelation) for posterior inference. All our substantive conclusions remained unchanged (see Appendix 3F).

3.9 Discussion

Based on a first survey study among 2,139 innovation managers in 14 countries and a second replication longitudinal survey study among 350 US innovation managers (for first wave; 151/350 innovation managers participated in the second wave) we demonstrate the following findings that are new to the literature.

First, firms that adopt grassroots innovation perform significantly better than firms that do not adopt grassroots innovation (confirming H1a). As firms get better at grassroots innovation, they also reap more financial benefits from innovation overall (confirming H1b).

Second, intrinsic motivation has a stronger effect on grassroots innovation performance than extrinsic motivation (H2). We also show that firms may boost the intrinsic motivation of employees participating in grassroots innovation by satisfying their innate human needs for autonomy, competence and relatedness. While these findings did not perfectly replicate across studies, the general pattern of results supports self-determination theory as a guiding principle for designing effective grassroots innovation processes.

Third, depth of control in a grassroots innovation initiative has a significant and positive effect on grassroots innovation performance, a finding that is robust across our studies (H3). We

found mixed results with respect to the relative focus on enabling (vs. coercive) control. In Study 1, we found that coercive control is more effective than enabling control (in line with H4b). In Study 2, we found this effect to be insignificant, possibly caused by the considerably smaller sample size in study 2, compared to study 1. Overall, on the basis of both studies, their sample sizes and the intrinsic uncertainty involved in statistical tests, it seems prudent to conclude that coercive control is more likely to lead to grassroots innovation success than enabling control, but that further studies are needed to replicate such effect, preferably in large samples, comparable in size to our first study. At the very least, our studies challenge the validity in a grassroots innovation context of the prevailing wisdom that coercive control negatively influences employees' innovation performance (e.g. see Adler and Chen 2011).

3.10 Managerial Implications

Our results yield several important insights for managerial practice. The majority of respondents in our surveys indicated that their firms were already experimenting with grassroots innovation (64.8% in Study 1 and 50.8% in Study 2). Still, many firms are not doing so (35.2% in Study 1 and 49.2% in Study 2). Our study empirically demonstrates that grassroots innovation, on average, helps firms enhance their innovation performance. Thus, our findings, can help managers in firms that did not implement grassroots innovation yet to make a case to their superior executive layers in favor of grassroots innovation to be deployed in their firm.

In firms that struggle with the effective implementation of grassroots innovation, our findings should support project managers in their continued efforts to make grassroots innovation successful in their firms. In our studies, for firms which had implemented grassroots innovation, we asked, on a 7-point Likert scale, the extent to which respondents agreed with the statement, "grassroots innovation initiatives are generally considered a success at my firm". The labels were: (1) strongly disagree; (2) disagree; (3) somewhat disagree; (4) neither agree nor disagree; (5) somewhat agree; (6) agree; (7) strongly agree. 83.3% of respondents in Study 1 and 82.6% of respondents in Study 2 score a 5, 6 or 7. Using a more stringent criterion for success, 52.7% of respondents in Study 1 and 48.0% of respondents in Study 2 score a 6 or 7. Thus, it seems fair to conclude that firms that struggle with the effective implementation of grassroots innovation are a substantial proportion of the firms we examined.

For such firms, our findings offer specific guidance on how to improve on their grassroots innovation processes. First, firms need to consistently evoke participants' intrinsic motivation. To do so, we show that firms should ensure that project teams feel that the grassroots innovation initiative offers them a high level of autonomy, competence and relatedness. From the field interviews we conducted, we learnt this can be done as follows. For example, a firm can stimulate perceived autonomy by ensuring that grassroots innovation is seen as a unique opportunity for employees to work on "their own baby" (i.e., their own idea). They can also allow

employees to self-assemble their own teams. Firms can also satisfy participants' innate need for competence by delivering workshops and best-practice sharing that help project teams in the development of their innovation projects. Finally, firms can satisfy employees' innate need for relatedness, by maximizing the chances for employees to connect with like-minded colleagues. For instance, several of the firms we interviewed organize marketplace events where selected employees can promote their ideas and recruit colleagues to join their innovation team.

Second, our results point to the importance of a high depth of control. A low depth of control may trigger misalignment between employees' innovation efforts and firm-wide goals and lead to inefficiencies in innovation efforts. Thus, firms should frequently monitor the progress of project teams. In some of the firms we interviewed, they do so by installing a high-level steering committee to which the teams regularly report (e.g. quarterly). They typically also deploy performance metrics to follow the maturation of the innovation project over time and define clear stage gates for grassroots innovation projects. In the pharmaceutical firm we examined in our interviews, such stage-gating process for grassroots innovation projects is different from the stage-gate process they use for their typical R&D process. Sometimes, in-between reporting meetings they organize acceleration clinics, where grassroots teams are again brought together to see, for instance, if they can accelerate their time to market.

3.11 Limitations and Future Research

This study suffers from several limitations that offer opportunities for future research. First, we rely on self-reported data to test our hypotheses. Future research using experimental data could lead to greater levels of internal validity, but is obviously difficult to execute in this context. Secondary data is equally difficult to execute, given the absence of historical, objective data, on grassroots innovation program deployments, across many firms. Yet, over time such data may become available. For example, firms increasingly use online platforms to manage their grassroots innovation initiatives. The usage of data such platforms generate may be a promising avenue for future research.

Second, we relied on single key informant responses to test our hypotheses. Even though we followed several steps to ensure key informant accuracy (Homburg 2012), and used triangulation to avoid the weaknesses of a single-source and single-method approach, future research could consider multi-respondent surveys. In such multi-respondent survey studies, researchers could include employees participating in grassroots innovation processes, in addition to innovation managers, as well as managers from other functional areas.

Appendix 3A Pre-Testing and Translating Survey Measures

Pre-Testing the Survey Instrument. We pretested our measures in a panel provided by Survey Sampling International in Germany (103 subjects), the UK (217 subjects) and the US (166 subjects). The relationship between the constructs was nomologically valid in this pretest, which increased our confidence in the validity of our measures. We discarded these data from further usage. This pretest was run in English and confirmed the clarity and feasibility of our survey in terms of respondent burden.

Translating Measures. Before rolling out the survey across 14 countries, we employed a back translation approach to ensure meaning equivalence for all items across the countries in our sample (Brislin 1970). Specifically, we asked native speakers to translate the original survey to each of the target languages. A second native speaker (the back-translator) translated the survey from his native target language back to English. The translators and back-translators were academics, graduate and undergraduate students in social sciences, fluent in English and native speakers of each target language. We compared the back-translated survey in English with the original survey and discussed the two versions with both translators and back-translators, iteratively, until we were sure that the final survey retained exactly the same meaning in all languages (Brislin 1970).

Appendix 3B Data Cleaning Protocol (Study 1)

Even though uSamp continuously monitors the quality of its panels, we conducted additional data integrity checks to remove careless, inattentive or fraudulent respondents. First, we flagged 697 respondents as *straight liners* by identifying respondents who chose the same response scale option in more than 2/3 of the questions (Meade and Craig 2012). We also identified 445 *persistent respondents* by flagging respondents who exhibited "long string" behavior, i.e. respondents who chose the same response scale option as in the question right before the focal question in more than 2/3 of the questions (Huang et al. 2012).

Second, we collaborated with uSamp to detect and remove *fraudulent responses*. We followed a procedure similar to the one used by Cacioppo and colleagues (2013), who also used a uSamp panel. This procedure involved checking the integrity of respondents' identities and reported functions, checking whether their IP addresses match their reported country of residence, using digital fingerprints, identification of respondents who answer the survey more than once, etc. Through this post-hoc detection of fraudulent responses, we removed 187 additional respondents across all countries. We also flagged 345 additional respondents as fraudulent, because they, despite passing the screen-out questions, stated a position that was clearly below management level or provided false information regarding their company.

Third, we used Mahalanobis D^2 to detect multivariate outliers, removing an additional 154 respondents. Prior studies show

that this procedure is effective in identifying inattentive respondents by identifying nomologically invalid response patterns (Meade and Craig 2012). We computed two Mahalanobis D^2 measures using two sets of constructs: (1) self-determination theory constructs (autonomy, competence and relatedness, all of which are nomologically related; Deci and Ryan 2011) and (2) innovation performance metrics (including firms' innovation performance, but also radical and incremental innovation performance, which are also nomologically related; Chandy and Tellis 1998; De Luca and Atuahene-Gima 2007). We do not use the items on coercive and control mechanisms because firms may have high or low levels of both types of control, making it hard to define what a multivariate outlier is. The same applies to intrinsic and extrinsic motivation. We removed respondents identified as multivariate outlier, i.e. those with a very unusual D^2 ($p< 0.001$), according to any of the two D^2 measures. Our data integrity checks and data cleaning procedures left us with a final sample of 2,139 respondents.

Appendix 3C Survey Measures*

Construct and Items*	**Cronbach`s α** S1	S2 Wave 1	S2 Wave 2
Grassroots Innovation Performance [New scale] Please indicate your agreement or disagreement with each of the following statements. a. Grassroots innovation at my firm is successful in developing new businesses (increase revenues). b. Project teams in our grassroots innovation initiatives succeed in developing innovations that are driven primarily by the expected satisfaction of their target customers. c. Project teams in our grassroots innovation initiatives succeed in developing innovations that serve their target customers' needs well. d. Project teams in our grassroots innovation initiatives succeed in developing innovations which are well focused on their target customers. e. Grassroots innovation initiatives are generally considered a success at my firm.	.86	.88	.91
Innovation Performance [Adapted from *Li and Calantone (1998)*] Please indicate you agreement or disagreement with each of the following statements: All outcomes of innovation at my firm have helped us achieve… a. …higher return on investment than our main competitors. b. …higher sales growth than our main competitors. c. …higher profits than our main competitors.	.87	.88	.88
Intrinsic Motivation [Adapted from *Gagné et al. (2010)* and *Wu and Parker (2017)*] In my opinion, most employees at my firm participate in grassroots innovation initiatives because… a. …they enjoy it very much. b. …they have fun while doing it. c. …they like participating in such initiatives.	.87	.85	.85
Extrinsic Motivation [Adapted from *Gagné et al. (2010)* and *Wu and Parker (2017)*] In my opinion, most employees at my firm participate in grassroots innovation initiatives because… a. …they may get some form of financial compensation for developing innovations for our firm. b. ...they may get a bonus or financial reward for developing innovations for our firm.	ρ=.76	ρ=.73	
Autonomy [*Adapted from Deci et al. (2001)*] Grassroots innovation initiatives at my company enable participating employees to… a. …make their own decision regarding their innovation projects. b. …use their judgment when solving problems related to their innovation projects. c. …take on responsibilities related to their innovation projects. d. …execute tasks related to their innovation projects in their own way.	.87	.87	
Competence [*Adapted from Deci et al. (2001)*] Grassroots innovation initiatives at my company enable participating employees to… a. …successfully overcome challenges related to their innovation projects. b. …be competent when executing tasks related to their innovation projects. c. …solve problems that arise in their innovation projects. d. …successfully complete the tasks required by their innovation projects.	.88	.87	
Relatedness [*Adapted from Deci et al. (2001)*] Grassroots innovation initiatives at my company enable participating employees to… a. …develop a good mutual understanding with colleagues that help them to develop an innovation. b. …get along with colleagues that help them to develop an innovation. c. …develop a sense of trust in the colleagues that help them to develop an innovation. d. …establish mutually beneficial relationships with colleagues that can help them to develop an innovation. e. …network with colleagues who can bring expertise and energy that can help them to develop an innovation.	.90	.90	

* All variables, unless otherwise stated, are measured on a 7-point Likert scale with (1) Strongly disagree, (2) Disagree; (3) Somewhat Disagree; (4) Neither agree nor disagree, (5) Somewhat agree; (6) Agree; (7) Strongly agree.

Appendix 3C Survey Measures*

Construct and Items*	**Cronbach`s α**	
	S1	**S2**
		Wave 1 Wave 2
Enabling Control [*New scale*]	.85	.86
Please indicate your agreement or disagreement with each of the following statements about the role of senior managers in your firm's grassroots innovation initiatives:		
a. Senior managers frequently provide innovation project teams feedback about their projects.		
b. Senior managers frequently communicate their level of confidence in innovation project teams.		
c. Senior managers pay close attention to each innovation project team's progress and needs.		
Coercive Control [*New scale*]	.85	.85
Please indicate your agreement or disagreement with each of the following statements:		
At my firm…		
a. …there is clear communication of responsibility regarding grassroots innovation.		
b. …there are clear KPI`s (key performance indicators) on the outcomes of grassroots innovation.		
c. …grassroots innovation project teams need to regularly communicate their progress to a specific team which oversees grassroots innovation (e.g. a venturing team).		
d. …grassroots innovation project teams need to communicate their progress through a formal reporting structure.		
Market Orientation [*Deshpandé and Farley (1997)*]	.91	.89
Please indicate for each of the following statements the extent to which it provides a good description of your firm.		
a. Our business objectives are driven primarily by customer satisfaction.		
b. We constantly monitor our level of commitment and orientation to serving customers' needs.		
c. We freely communicate information about our successful and unsuccessful customer experiences through all business functions.		
d. We freely communicate information about our successful and unsuccessful customer experiences through all business functions.		
e. We measure customer satisfaction systematically and frequently.		
f. We have routine or regular measures for customer service.		
g. We are more customer focused than our competitors.		
h. I believe this business exists primarily to serve customers.		
Firm Size		
Firm Revenues		
What were approximately your firm`s sales revenues in <<the last fiscal year>>?** (a) Less than $100K; (b) At least $100K but less than $1M; (c) At least $1M but less than $ 2.5M; (d) At least $2.5M but less than $5M; (e) At least $5M but less than $10M; (f) At least $10M but less than $20M; (g) At least $20M but less than $50M; (h) At least $50M but less than $100M; (i) At least $100M but less than $500M; (j) At least $500M but less than $1B; (m) At least $1B but less than $2.5B; (n) At least $2.5B but less than $5B; (o) Greater than or equal to $ 5B.		
Number of Employees		
How many employees did your firm have in <<the last fiscal year>>? (a) Less than 20; (b) 20 to 99; (c) 100 to 249; (d) 250 to 499; (e) 500 to 999; (f) 1,000 to 2,499; (g) 2,500 to 4,999; (h) 5,000 to 9,999 (i) 10,000 to 24,999; (j) 25,000 to 49,999; (m) 50,000 to 99,999 (n) 100,000 or more.		

* All variables, unless otherwise stated, are measured on a 7-point Likert scale with (1) Strongly disagree, (2) Disagree; (3) Somewhat Disagree; (4) Neither agree nor disagree, (5) Somewhat agree; (6) Agree; (7) Strongly agree.

** We adapted this question to the local currency of each country.

Appendix 3D Bayesian SEM: Model Specification

In this appendix we discuss the econometric specification of our Bayesian SEM model. In the equations below, *i* indexes respondents (i=1,…,N; N=1,387), *p* indexes the response items measuring latent constructs (p=1,…,P; P=41), *q* indexes latent endogenous constructs (q=1,..,Q; Q=4), and *r* indexes latent exogenous constructs (r=1,…,R; R=6). We collect two additional items for single-item constructs (our firm size control variables, i.e., revenues and number of employees). For these single-item constructs, we first standardize the respondents' answers and then include the standardized scores directly in the structural model below.

We specify our measurement equations relating the latent endogenous constructs –grassroots innovation performance (GIP), innovation performance (IP), intrinsic motivation (IM) and extrinsic motivation (EM) – to the observed responses:

(1) $$y_{ip} = \tau_p + \lambda_p \cdot \eta_{q,i} + \varepsilon_{ip}, \text{ for } 1 \leq p \leq 13,$$

where $\eta_{q,i}$ denotes an endogenous latent variable. τ_p are item-specific intercepts, capturing the average response, across respondents, to each of the items we measure. We define the latent exogenous constructs – autonomy (AU), competence (COMP), relatedness (REL), enabling control (EC), coercive control (CC) and market orientation (MKOR) - as follows:

(2) $$y_{ip} = \tau_p + \lambda_p \cdot \xi_{r,i} + \varepsilon_{ip}, \text{ for } p \geq 14,$$

where $\xi_{r,i}$ denotes an exogenous latent variable. We collect the error terms in Equation 1 and Equation 2 in a single (P×1) random

vector of residuals, $\boldsymbol{\varepsilon_i}$, which we assume to be normally distributed as N($\mathbf{0}$,$\boldsymbol{\Psi}$), where $\boldsymbol{\Psi}$ is a ($P\times P$) diagonal covariance matrix. The error terms are orthogonal to the latent factors.

Our structural model is defined as:

(3) $$IM_i = \beta_{AU\rightarrow IM}\cdot AU_i + \beta_{COMP\rightarrow IM}\cdot COMP_i + \beta_{REL\rightarrow IM}\cdot REL_i + \delta_{1,i}$$

(4) $$EM_i = \tau_{EM} + \delta_{2,i}$$

(5) $$GIP_i = \beta_{IM\rightarrow GIP}\cdot IM_i + \beta_{EM\rightarrow GIP}\cdot EM_i + \beta_{DEPTHC\rightarrow GIP}\cdot(EC_i+CC_i) + \beta_{RELFENC\rightarrow GIP}\cdot(EC_i-CC_i) + \beta_{MKOR\rightarrow GIP}\cdot MKOR_i + \boldsymbol{\Gamma_1}'\mathbf{Xi}^* + \delta_{3,i}$$

(6) $$IP_i = \beta_{GIP\rightarrow IP}\cdot GIP_i + \beta_{MKOR\rightarrow IP}\cdot MKOR_i + \boldsymbol{\Gamma_2}'\mathbf{Xi}^* + \delta_{4,i,}$$

where the β parameters capture the structural paths of interest, to be estimated. This structure clarifies that our endogenous latent variables are: intrinsic motivation (IM_i), extrinsic motivation (EM_i), grassroots innovation performance (GIP_i) and innovation performance (IP_i), while our exogenous latent variables are autonomy (AU_i), competence ($COMP_i$), relatedness (REL_i), depth of control ($DEPTHC_i = EC_i + CC_i$), relative focus on enabling control ($RELFENC_i = EC_i - CC_i$) and market orientation ($MKOR_i$). In addition, we collect our two observed exogenous covariates (revenues and number of employees, which are standardized) in the two-dimensional vector $\mathbf{X_i}^*$. Consequently, $\boldsymbol{\Gamma_1}$ and $\boldsymbol{\Gamma_2}$ contain the structural paths corresponding to the effects of revenues and number of employees on grassroots innovation performance and innovation performance, respectively.

This structure leads to a natural distinction between exogenous variables, both latent (ξ's) and observed ($\mathbf{X_i}^*$), and endogenous latent variables (η's). The former (ξ's and $\mathbf{X_i}^*$) capture choices firms make when designing grassroots innovation initiatives (autonomy, competence, relatedness, depth of control and relative focus on enabling control) and firm characteristics (market orientation, revenues and number of employees), whereas the latter (η's) capture the behavior of participating employees (intrinsic and extrinsic motivation) and managerial outcomes of interest (grassroots innovation performance and innovation performance).

We collect all exogenous latent variables in a ($R\times1$) vector $\boldsymbol{\xi_i}$ distributed according to N($\mathbf{0}$,$\mathbf{\Phi}$), where $\mathbf{\Phi}$ is a (R×R) full covariance matrix and we assume the residuals, $\delta_{q,i}$, are independent of the latent variables and distributed according to N(0, $\psi_{\delta,q}$), for q=1-4. Given that all endogenous latent constructs in our SEM have mean zero by definition, we set the intercept of extrinsic motivation in Equation 4 (τ_{EM}) to zero. Yet, we also run a model where we estimate this intercept and our results remain unchanged.

Appendix 3E Study 2: Measurement Validation, Model Formulation, Fit and Diagnostics

Measurement Validation

We follow the same procedures as in Study 1 to validate our measures. The fit of our measurement model was acceptable. The root mean square error of approximation (RMSEA = .05), the comparative fit index (CFI = .94) and the Tucker-Lewis Index (TLI = .93), indicate an acceptable fit.

We again checked our measurement scales for unidimensionality, reliability, convergent and divergent validity. First, using the common cut-off of an eigenvalue of 1.0, we found that only a single factor was extracted for each of the constructs, indicating satisfactory unidimensionality (Anderson and Gerbing 1988). Second, all scales in our model showed satisfactory reliability (with a Cronbach's α of at least .80). The composite reliability of all our scales is also acceptable (Bagozzi and Yi 1988), and the average variance extracted was greater than .50 for all scales (Fornell and Larcker 1981). Third, all loadings were significant at the $p<0.1$ and all parameter estimates were at least ten times as large as the standard errors, showing high convergent validity (Anderson and Gerbing 1988). Fourth, all pairs of constructs passed Fornell and Larcker's (1981) discriminant validity test with the exception of one of our control variables (market orientation). Even in the case of market orientation, the shared variance between market orientation and all other constructs was below the average variance extracted of all such

constructs, thereby showing that our measures have high divergent validity.

Model Formulation and Estimation

To test our hypothesis H1a we used the same OLS regression as in Study 1, estimated in the full *Research Now* sample (N = 689). To test our hypotheses H1b to H4b, we then re-estimated our Bayesian SEM on the subsample of firms that have adopted grassroots innovation in the first wave of the *Research Now* sample (N=350). Afterwards, we re-run our Bayesian SEM model in the sample of 151 managers who answered both our first and second wave questionnaires (N=151), using the *innovation performance*, *grassroots innovation performance* and *intrinsic motivation* measures collected in the second wave survey, and the predictors collected in the first wave survey.

Model Fit and Diagnostics

Model Fit. To assess model fit, we again calculated the deviance information criterion (DIC) for the same models we estimated in Study 1. According to the DIC, the optimal model is Model 4 (DIC_{M4} = 32,210). Model 1 (DIC_{M1} = 32,335; Δ_1 = 125), Model 2 (DIC_{M2} = 32,226; Δ_2 = 16) and Model 3 (DIC_{M3} = 32,229; Δ_3 = 18) have essentially no support. We use Model 4 to test our hypotheses. We also estimate several ordinary least squares (OLS) models and compute the R^2s associated with each of these regressions, which confirm that our path model offers a good fit to the data. Specifically,

our models explain 56% of the variance in intrinsic motivation, 51% of the variance in grassroots innovation performance and 31% of the variance in innovation performance.

Multicollinearity. To assess whether multicollinearity is a concern, we again used the condition index method of Belsley, Kuh, and Welsch (1980) in the OLS regressions. The condition index does not cross the threshold of 30 (Belsley et al. 1980) in any of our models. Moreover, analysis of variance inflation factor indicates that there is no significant standard error inflation due to multicollinearity problems (all VIFs are below 10). These results indicate that multicollinearity is not an issue in our data.

Appendix 3F Robustness Checks for Selection Bias – Heckman's Two Step Procedure

	Hypothesis	Study 1 (N = 1,387)	Study 2 Wave 1 (N = 350)
Financial Impact of Grassroots Innovation			
Grassroots Innovation Performance → Innovation Performance	H_{1b} (+)	**.48** ***	**.35** ***
Employee Motivation and Grassroots Innovation Performance			
Intrinsic Motivation → Grassroots Innovation Performance	H_2 (IM > EM)	**.24** ***	**.16** **
Extrinsic Motivation → Grassroots Innovation Performance		**.05** ***	**-.07** *
Controlling Mechanisms and Grassroots Innovation Performance			
Depth of Control → Grassroots Innovation Performance	H_3 (+)	**.18** ***	**.31** ***
Relative Focus on Enabling Control → Grassroots Innovation Performance	H_{4a} (+) / H_{4b} (-)	**-.19** ***	.08
Other Variables			
Autonomy → Intrinsic Motivation		**.50** ***	.22
Competence → Intrinsic Motivation		-.05	**.54** ***
Relatedness → Intrinsic Motivation		**.51** ***	**.22** *
Market Orientation → Grassroots Innovation Performance		**.27** ***	**.21** *
Nr. Employees → Grassroots Innovation Performance		.01	**.16** **
Revenues → Grassroots Innovation Performance		-.01	-.03
Lambda (Inverse Mill's Ratio) → Grassroots Innovation Performance		.13	-.01
Market Orientation → Innovation Performance		**.25** ***	**.23** **
Nr. Employees → Innovation Performance		.01	**.29** ***
Revenues → Innovation Performance		.06 ***	**.19** **
Lambda (Inverse Mill's Ratio) → Innovation Performance		**-.95** ***	.03

Note: We let all models converge and run each of our Bayesian SEM models for 35,000 draws. We then discarded the first 10,000 draws for burn-in and used the remaining 2,500 thinned draws for posterior inference (we used every 10th draw to reduce autocorrelation). We use '***' to indicate that the 99% Credible Interval of a parameter does not contain zero, '**' to indicate that the 95% Credible Interval does not contain zero, and '*' to indicate that the 90% Credible Interval does not contain zero. Given the much smaller sample size of our longitudinal analysis, and the fact that it is, in itself, a robustness check (for CMV), we do not run a two-step Heckman procedure for the longitudinal analysis.

Chapter 4[3]

A Look on the Bright Side of Resistance to Change: Effects on Innovation Performance

4.1 Abstract

Innovation, which is essential to sustain or gain competitive advantage, by its very nature, requires change. Given that employees have a natural tendency to devalue and avoid change, firms often fear that resistance to change may hurt innovation performance. Such belief echoes common wisdom among scholars, who have shown the detrimental effects of resistance to change for firms. Against this backdrop, more recently the benefits of resistance to change have emerged. Such benefits include promoting diversity in opinions and a healthy debate. Despite the high relevance of these mechanisms for innovation, no empirical study has documented the effect of resistance to change on innovation performance. In this paper, we develop a conceptual framework that reconciles conflicting views on the effect of resistance to change. Using a cross-sectional survey among managers in 321 firms in the US, we show that resistance to change has a nonlinear effect on innovation performance. In firms with low or high levels of resistance to change, employees either loyally execute change (low) or openly voice their concerns (high), thereby improving innovation performance. However, in firms with moderate levels of resistance to change,

[3] This chapter is co-authored by Nuno Camacho and Stefan Stremersch and has not been offered for publication yet to any journal.

employees tend to disengage, which hurts innovation performance. Our findings suggest that managers need to reconsider their commonly held beliefs regarding resistance to change. We discuss how firms can embrace - rather than trying to squash – resistance to change. We also offer mechanisms that firms can use to prevent employee disengagement and improve innovation efforts.

4.2 Introduction

Increasingly firms consider innovation to be essential in sustaining or gaining competitive advantage. Without bringing new products or services to market, firms risk losing sales, profitability and market share as competitors outperform them (Chandy and Tellis 2000; Hauser, Tellis and Griffin 2006). Given its critical role in business performance, innovation is a top priority among CEOs (Griffin et al. 2013), and a key driver of firm value and stock returns (Sood and Tellis 2009; Srinivasan et al. 2009). Still, many firms end up disappointed and find that their innovation efforts did not yield an improved competitive position.

When one talks to innovation managers, a routinely heard reason for failure is the resistance they face within their company. By nature, innovation is a departure from the status quo. It is very well known that humans have a preference for the status quo that biases them against change (Kahneman, Knetsch and Thaler 1991). Hence, innovation naturally meets resistance. For instance, in the last couple of years Lufthansa, under its Eurowings brand, has been desperately trying to innovate its business model as a response to low-cost

challengers such as Ryanair and Easyjet. 15 strikes later, and hundreds of millions of euros in lost profits (Sheahan 2016), very little progress seems to be made to make Lufthansa a more competitive airline.

Such cases and anecdotes vividly remind us of the destructive influence of employees' resistance to change on innovation outcomes. However, more recently, organizational scholars have started to express divergent and more optimistic views on resistance to change (e.g., Ford and Ford 2009, Ford, Ford and D'Amelio 2008; Piderit 2000). According to this, largely conceptual, stream of literature, resistance to change may lead to a better and more open dialogue, to the elimination of counterproductive elements of change and to the promotion of diversity in opinions. As such, resistance to change is increasingly being praised as a prime learning mechanism.

Interestingly, there is no empirical proof on the link between resistance to change and innovation performance. Thus, despite the anecdotes of innovation managers and infamous cases, we really do not understand this relationship all that well. Moreover, the conflicting views on the effects of resistance to change suggest that this relationship is more sophisticated than one would originally believe. The objective of the present paper is to enlighten this complex relationship. It postulates that the relationship between resistance to change and innovation performance is a nonlinear one. Specifically, we theorize that while both low and high resistance to change may yield positive outcomes, moderate resistance to change leads to the poorest innovation outcomes.

Moreover, the present paper is the first to empirically tie these expectations to three underlying mediating processes. Drawing upon Hirschman's (1970) framework, we propose that the reaction of employees to change can be of three types. First, employees may *voice* concerns they may have with the change and openly discuss any problems they foresee. Second, employees may be *loyal*, thereby ignoring any problems they foresee and actively execute the change. Third, employees may *disengage* and passively let execution continue without challenge even if they have concerns with the change.

As we will derive below, a low resistance to change leads to a loyal execution of change. In addition, under low resistance to change, employees who may have concerns with the change feel safe to voice such concerns. Taken together, this allows firms to achieve their desired innovation outcomes. A high resistance to change leads employees to voice important considerations and risk factors they foresee, which allows the firm to successfully avoid pitfalls and exploit opportunities, and thus again achieve the desired innovation outcomes. A moderate resistance to change, however, leads employees to disengage, creating hesitation in the execution that remains unchallenged. Consequently, a moderate resistance to change hampers firms from achieving their desired innovation outcomes.

We demonstrate the empirical validity of these expectations in a large sample of innovation managers working in 321 firms in the US. This research yields several novel insights that are meaningful to

managers. First, our study shows that resistance to change can be an important catalyst for innovation. Hence, managers facing high resistance should not simply try to squash that resistance. Instead, they should use resistance to their own benefit by creating open dialogues with employees on the challenges they foresee.

Second, this study allows managers to more realistically assess the outcomes they may expect from their innovation efforts, in view of the typical resistance new initiatives face in their firm. In firms with low resistance to change, employees tend to be loyal and actively support innovation efforts. In firms that are highly resistant to change, employees tend to voice their concerns, helping improve innovation efforts. In such firms, managers may expect innovation outcomes to materialize more easily than in firms where employees do not embrace change easily (i.e., with moderate resistance to change) and do not voice their concerns with the change.

Third, this study shows the destructive influence of employee disengagement on innovation performance. We find that employee disengagement is the key reason why resistance to change may lower innovation performance. Managers should thus employ disengagement breaking practices in their innovation efforts. For instance, managers should try to find who, among the firm's employee base, embraces the change and rely on such employees to convince their peers to actively engage with the innovation efforts. In addition, managers should carefully craft internal communication efforts and frame the need for change in order to persuade skeptical employees.

4.3 Background

In this paper, we build upon two literature streams. First, we focus on *innovation performance*, which we define as the extent to which all outcomes of innovation help firms achieve higher return on investment, sales growth, profits, and market share than their main competitors. This is in line with prior work in marketing and innovation such as Li and Calantone (1998) and Zhou (2006). Prior research has found several drivers of innovation performance. For example, the positive effect of market orientation on innovation performance is well documented (Atuahene-Gima 1996, 2005; Han, Kim and Srivastava 1998, Li and Calantone 1998). Other positive drivers of innovation performance include a greater entrepreneurial orientation (Van Doorn et al. 2013), cross-functional collaboration (De Luca and Atuahene-Gima 2007) and new product launch (Sood and Tellis 2009; Srinivasan et al. 2009; Bayus, Erickson and Jacobson 2003).

Despite the large body of work on the drivers of innovation performance, resistance to change remains a neglected driver. Therefore, second, we focus on *resistance to change*, which we define as the tendency of a firm's employees to find change aversive, to avoid or to devalue change (Oreg 2003). Traditionally, resistance to change is seen as detrimental. Resistance to change can delay implementation, lead to frustration and disengagement among employees, thereby increasing the costs of implementing change (Courpasson, Dany, and Clegg 2011; Guth and MacMillan 1986; Waddell and Sohal 1998). Resistance may occur due to numerous

factors. First, employees may resist change due to a natural tendency to maintain the status quo rather than embrace the risks inherent in change (Kotter 1995). Second, employees may resist change because they believe that the proposed change will be detrimental to them (Waddel and Sohal 1998), to others, or to the firm. Third, they may also be reluctant to put in the effort needed to learn new competencies that come with change (Hon, Bloom and Crant 2014). Employees' unwillingness to embrace change has been linked to several negative consequences, ranging from employee disengagement, to attempts to block change, to reducing the quality of change, or even completely sabotaging change (Guth and MacMillan 1986).

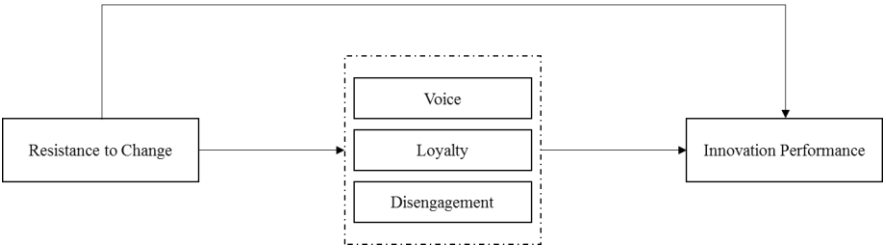
More recently, the benefits of resistance have emerged. In this new stream of literature, resistance to change is seen as a valuable resource to successfully implement change (Ford and Ford 2009, Ford, Ford and D'Amelio 2008; Piderit 2000). First, resistance to change triggers an open dialogue which, in turn, promotes a better understanding of the change and improved implementation (Ford, Ford and D'Amelio 2008). Such open dialogue also leads to increased engagement by employees, an important driver of firm performance (Harter, Schmidt and Hayes 2002). Second, resistance to change leads to the elimination of unnecessary, impractical or counterproductive elements of change (Ford, Ford and D'Amelio 2008). Employees build counterarguments and a stronger rationale for change, which can play an important role in fostering innovation (Dyer and Song 1998; Xie, Song and Stringfellow 1998). Third, and

importantly, resistance to change leads to sharing of diverse opinions, which are essential for effective change (Piderit 2000). Ensuring diversity in opinions matters more than the ability of particular individuals within the firm (Page 2007).

4.4 Theory Development

Figure 4.1 presents our conceptual framework. We theorize that resistance to change influences innovation performance in a nonlinear way. This occurs as two opposing logics underlie the effect of resistance to change on innovation performance. On the one hand, prior research suggests that resistance to change may hamper innovation. Resistance to change manifests itself in an aversion towards altering the status quo (Oreg 2003). Hence, in firms with high levels of resistance, employees tend to avoid or devalue innovation, which revolves around change by its very nature. In such firms, many employees may believe that they will regret embracing change as it will ultimately hurt them, leading them to feel anxious about or even fear change (Anderson 2003; Loewenstein et al. 2001). At such firms, for many employees, the disadvantages associated with change will loom larger than its advantages, leading to disengagement and inertia. Thus, resistance to change may reduce innovation performance through a *disengagement effect*.

Fig. 4.1 Conceptual Model



There are several negative consequences of employee inertia on innovation performance. First, innovation managers may find it hard to rally employees around innovation efforts. Second, managers may find it more difficult to continuously encourage innovation teams to persist in the face of uncertainty. Third, innovation teams will work in a context that is very discouraging as their colleagues will questions why the status quo needs changing. As a consequence, innovation teams' energy levels will more quickly deplete, the learning of the organization will be more and more handicapped, and the risk of innovation teams doing the wrong things, doing things too slowly or simply not proceed, increases.

On the other hand, more recent research suggests that resistance to change can increase innovation performance. As firms face high resistance to change, employees will more readily challenge why innovation is needed and whether the innovation that the firm is undertaking is in the right one. Courpasson, Dany and Clegg (2011), for instance, argue that employees often resist change in an attempt to get senior management to pay attention to their claims and steer change in a direction that is more beneficial to them

and to the organization. Such open challenge promotes diversity of opinions. It is well known that opinion diversity improves problem solving and decision-making in innovation (e.g., Hong and Page 2004). Specifically, resistance to change helps firms learn faster what type of innovations it can execute on, and how it can outperform its competition. In sum, according to this logic, resistance to change leads to more effective and efficient innovation efforts. Thus, resistance to change may enhance innovation performance through a *voice effect*.

While it seems at first that these two opposing logics directly conflict with one another and cannot co-exist, both logics are actually complementary to one another. To reconcile these opposing logics, we draw upon Hirschman's (1970) theory on voice, loyalty and exit. According to this theory, employees concerned with change may *voice* their concerns and openly discuss any problems they foresee, may be *loyal* and ignore any problems they foresee and actively execute the change, or they can voluntarily terminate their employment and *exit* the firm. In the context of employees' response to innovation efforts, exit (i.e., leaving the company) is a very extreme and rare response. A more natural response, which we add to our model, is for employees to *disengage* and passively let execution continue without challenge, even if they have concerns with the change.

In this paper, we argue that at different levels of resistance to change, employees concerned with change respond differently to such change. Specifically, we posit that at low levels of resistance to

change, the most common employee response is to loyally execute the proposed change or voice any concerns they may have. Low resistance to change is especially prevalent when employees trust their leaders and are committed to the organization (Ford, Ford and D'Amelio 2008; Herold et al. 2008). At such low levels of resistance, employees will either have very few concerns with the proposed change, and thus loyally execute it, or openly discuss any concerns they may have without feeling emotional stress. Thus, we expect firms with low levels of resistance to change to perform better in innovation than firms with moderate levels of resistance to change.

At moderate levels of resistance to change, we expect the inertia effect to dominate the diversity effect, which leads employees to disengage from the firm's innovation efforts. At moderate levels of resistance, anxiety and anticipated regret kick in, and the most natural response is to avoid action (Anderson 2003). Thus, while at low levels of resistance employees comply and actively execute change, moderate levels of resistance may trigger a 'mere compliance' attitude, whereby employees disengage and passively execute (Meyer 2007). Disengaged employees are less likely to openly share their concerns and, at the same time, execute without commitment, passion or persistence.

In contrast, at high levels of resistance to change, we expect the diversity effect to dominate the inertia effect. In firms with high resistance to change, employees disagree so strongly with the proposed change that it is more likely for them to openly voice their concerns. This happens because employees believe that through such

'productive resistance' they can help the firm strengthen the change (Courpasson, Dany and Clegg 2012). This triggers a process of divergence and constructive conflict that helps improve the innovation efforts (De Dreu and West 2001). Therefore, after this possibly painful process of divergence, the firm is better prepared to more powerfully execute its innovation efforts, as compared to firms with moderate levels of resistance to change. Consequently, we also expect firms with high levels of resistance to change to perform better in innovation than firms with moderate levels of resistance to change. Therefore, we hypothesize that:

H_1: Resistance to change has a U-shaped effect on innovation performance.

4.5 Data

4.5.1 Data Collection

To test our hypothesis we conducted a large scale survey in the US with managers from 321 firms. The sample was drawn from the business panel of the online survey provider ResearchNow. The sample was limited to managers with at least 4 years of experience within their company and with a high knowledge of innovation practices. Knowledge and tenure increase key informant accuracy (Homburg et al. 2012). We further restricted the sample to companies with more than 250 employees, to ensure the companies had a sufficient employee base to test our hypothesis.

On top of the quality checks ensured by ResearchNow, we conducted a number of checks to remove any careless or inattentive

respondents. We identified 27 respondents as "straight liners" which are respondents who use the same response scale option in more than 2/3 of the questions (Meade and Craig 2012). We also identified 19 "persistent respondents" which are respondents who use the same response scale option as in the previous item in more than 2/3 of the questions (Huang et al. 2012). Our quality checks left us with 321 respondents from the original 367. These 367 respondents were collected from a total of 689 solicited respondents, for a response rate of 53%.

4.5.2 Measurement and Construct Validation

Resistance to Change. We use a 16-item resistance to change scale based on Oreg (2003). Oreg's (2003) original scale considers four dimensions that capture people's tendency to find change aversive, to avoid or devalue change. In his paper, Oreg (2003) uses the four dimensions to establish a single scale for resistance to change. These four dimensions are routine seeking, emotional reaction, short-term thinking and cognitive rigidity. We adapted the scale items to capture resistance to change among a firm's employees (see Appendix 4A). Respondents scored each item using a seven-point, Likert scale. We create a summated scale by averaging all items and treating it as the measure of a firm's resistance to change. The scale is reliable (Cronbach's $\alpha = .97$) and all items load in a single dimension (using the common cut-off of an eigenvalue of 1.0) with factor loadings above .70 for all items.

Voice, Loyalty and Disengagement. To measure the prototypical employee's reaction to change at each of our respondent's firms, we first offered clear and simple definitions of our key terms, in line with Hirschman's framework (see Appendix 4A). We then asked respondents to think about the reaction of employees at their firm towards an important change. Subsequently, we asked respondents to distribute 100 points amongst the three types of employee reaction just discussed, with a higher score indicating that such type of reaction is more frequent at their firm.

Innovation Performance. To measure innovation performance, we used four items adapted from prior work in marketing and innovation (Li and Calantone 1998; Van Doorn et al. 2013; Zhou 2006) to measure the extent to which innovation outcomes help the respondent's firm achieve (i) higher return on investment, (ii) higher sales growth, (iii) higher profitability and (iv) higher market share relative to major competitors. We used a 7-point Likert scale. The four-item scale is reliable (Cronbach's $\alpha = .90$) and all items load in a single dimension (using the common cut-off of an eigenvalue of 1.0) with factor loadings above .85 for all items. We again use a summated scale as our measure of a firm's innovation performance.

Control Variables. To control for firm size, we asked respondents to indicate their firm's number of employees and revenues in the previous year (Chandy and Tellis 2000). Firm size can be an important determinant of innovation performance as large firms have access to more resources and knowledge (Chandy and

Tellis 2000). We gathered the measure of number of employees on 12-point scale, and the measure of revenues on a 14-point scale.

4.6 Results

4.6.1 Descriptive Statistics and Model-Free Evidence

Table 4.1 depicts the descriptive statistics and bivariate correlations among all constructs in our model. The pattern of correlations suggests that multicollinearity is not a concern in our data. We also examined variance inflation factors (VIFs) for each of our models. The maximum VIF we found was 34.85 when the squared resistance to change term was included. This VIF is above the common threshold of 10. Note that multicollinearity is unavoidable in models with a linear and a squared term, because the same information is shared by both terms. However, when removing squared terms, all VIFs fall clearly below 10, with the maximum VIF being 1.67. Note also that multicollinearity does not create bias in estimates, it merely inflates standard errors, therefore increasing the likelihood for Type II errors, while not affecting Type I errors (Grewal, Cote, and Baumgartner 2004). Thus, the only coefficient that is potentially affected in its significance (by Type II errors) is the squared term of resistance to change.

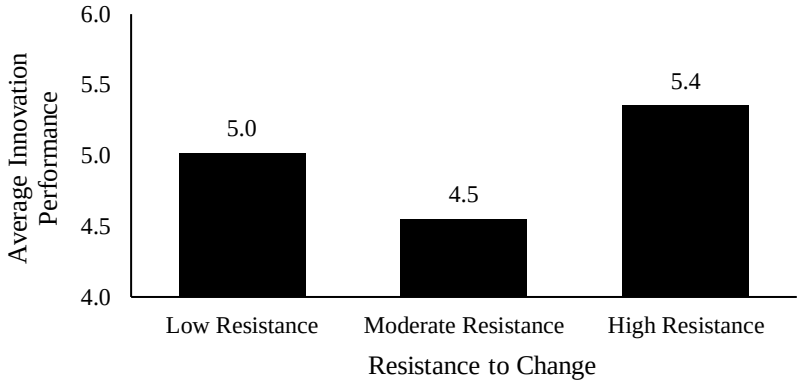
Table 4.1 Descriptive Statistics: Correlations, Mean, Standard Deviation & Reliability

Construct	1	2	3	4	5	6	7
Innovation Performance	1						
Resistance to Change	.05	1					
Voice	*.12*	*.12*	1				
Loyalty	.14	-.31	-.63	1			
Disengagement	-.31	.23	-.39	-.47	1		
Number of Employees	.01	-.05	.03	-02	-.01	1	
Firm Revenues	.11	*-.13*	-.10	.15	-.07	.54	1
M	4.98	4.63	32.89	42.16	24.95	6.20	8.89
SD	1.05	1.25	21.25	22.22	18.69	2.36	3.17
Reliability	.90	.97	-	-	-	-	-

Note: Bolded correlations are significant at the .01 level (two-tailed). Italicized correlations are significant at the .05 level (two-tailed).

Before presenting model estimation and results, we discuss model-free evidence that is consistent with our hypothesis. We first split our sample in three groups based on the level of resistance to change. We considered firms with resistance to change below the 33^{th} percentile to have 'low resistance', firms between the 33^{th} and the 66^{th} percentile to have 'moderate resistance' and firms above the 66^{th} percentile to have 'high resistance'. Figure 4.2 shows that innovation performance is lowest in firms with moderate resistance to change ($\mu = 4.5$; SD = .81), and higher in both firms with low resistance to change ($\mu = 5.0$; SD = 1.08) and high resistance to change ($\mu = 5.4$; SD = 1.10).

Fig. 4.2 Model Free Evidence: Average Innovation Performance at Low, Medium and High Resistance to Change



Note: Low (N=106), moderate (N=106) and high (N=109) levels of resistance to change are measured by calculating the lower $^1/_3$, middle $^1/_3$ and upper $^1/_3$ percentiles.

4.6.2 Model Estimation and Goodness-of-Fit

We test our hypotheses using ordinary least squares (OLS) regression and carry out formal tests of mediation following Baron and Kenny (1986). We treat the summated scales for our focal constructs as interval scales. In doing so, we follow standard argument in psychometrics (Nunnally and Bernstein 1994) and in marketing research textbooks (Iacobucci and Churchill 2010) that show it is both safe and useful to treat summated Likert scales as interval scales.

Table 4.2 presents the results of our main model. A baseline model with just an intercept, number of employees and revenues explains only .2% of the variance in innovation performance (R^2=.02; Adj. R^2=.01). Including a linear effect of resistance to

change in the model does not result in an improvement in goodness-of-fit with respect to the baseline model (R^2=.02; Adj. R^2=.01; $F_{1,317}$=1.29; p = .26). Our model, which includes both the linear and the squared resistance to change term, results in a significant improvement in model fit (R^2=.19; Adj. R^2=.18; $F_{1,316}$=67.18; p < .001). Goodness-of-fit, in absolute terms, is also satisfactory and comparable to those in recent cross-sectional studies on innovation performance. For example, the R^2 for the radical innovation model in Tellis, Prahbu, and Chandy (2009) is .29 (Adj. R^2=.23), and the (adjusted) R^2's for the innovation performance models in Song and Parry (1997) range from .20 to .49, depending on the innovation performance measure used as dependent variable.

Table 4.2 U-Shaped Effect of Resistance to Change on Innovation Performance

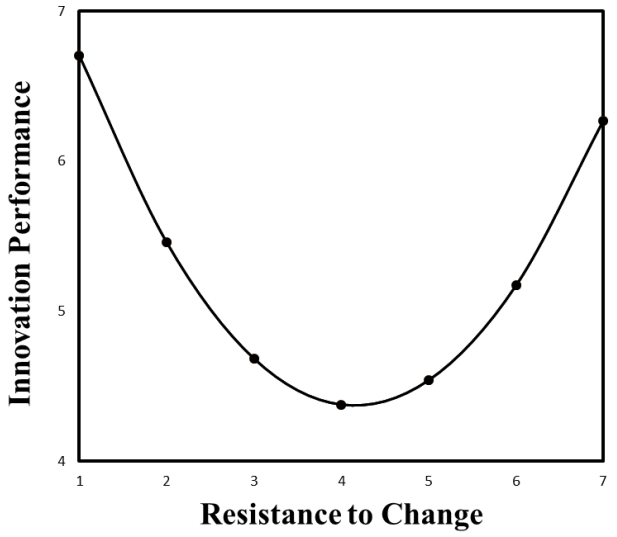
Variable	Coefficient	SE
Constant	8.41 ***	.56
Main Effects		
Resistance to Change	-1.95 ***	.25
Resistance to Change^2	.23 ***	.03
Control Variables		
Number of Employees	-.03	.03
Firm Revenues	.04 *	.02
R^2 (Adj. R^2)	.191 (.180)	
N	321	

* p < .10 (two-sided tests)
** p < .05 (two-sided tests)
*** p < .01 (two-sided tests)

4.6.3 Hypothesis Testing

In support of H_1, we find that resistance to change has a nonlinear effect on innovation performance. As the parameter estimates in Table 4.2 show, we find a negative and significant linear effect of resistance to change on innovation performance ($\beta = -1.95$, $p < .01$) and a positive and significant quadratic effect of resistance to change on innovation performance ($\beta = .23$, $p < .01$). Figure 4.3 depicts this relationship graphically. We used the estimated parameters to calculate the expected level of innovation performance at different levels of resistance to change. This Figure shows that a moderate level of resistance to change hampers innovation performance, as compared to both low and high levels of resistance to change.

Fig. 4.3 U-Shaped Effect of Resistance to Change on Innovation Performance



4.6.4 Mediation Analysis

We now discuss the mechanism through which resistance to change influences innovation performance in a nonlinear manner. We follow the logic proposed by Baron and Kenny (1986) to show that the influence of resistance to change on innovation performance is mediated by the three types of employee reactions discussed above: voice, loyalty and disengagement.

Having shown that resistance to change has a significant nonlinear effect on innovation performance, we first discuss the effect of our proposed mediators on innovation performance. According to Baron and Kenny (1986), the proposed mediators should be significantly related to the dependent variable, when considered separately. Thus, we first regressed innovation performance, separately, on voice, loyalty and disengagement, controlling for firm size. We find that voice ($\beta = .01$, $p < .05$) and loyalty ($\beta = .01$, $p < .05$) have both a positive and significant effect on innovation performance. In contrast, disengagement has a negative and significant effect on innovation performance ($\beta = -.02$, $p < .01$).

Next, to compare the impact of each of the mediators compared to one another, we regressed innovation performance on the mediators taken together. Recall, however, that we asked respondents to distribute 100 points between voice, loyalty and disengagement, which means the three mediators are mutually exclusive. Hence, we first treat disengagement as our reference

category (Model 1 in Table 4.3) and, subsequently, we treat loyalty as our reference category (Model 2 in Table 4.3). We find that voice ($\beta = .02$, $p < .01$, Model 1) and loyalty ($\beta = .02$, $p < .01$, Model 1) have a more positive effect on innovation performance than disengagement, and that their impact is not statistically significantly different from each other ($\beta = .00$, $p = .73$, Model 2).

Table 4.3 Effect of Voice, Loyalty and Disengagement on Innovation Performance

Variable	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
Constant	3.51 ***	.29	5.16 ***	.25
Main Effects				
Voice	.02 ***	.00	.00	.00
Loyalty	.02 ***	.00		
Disengagement			-.02 ***	.00
Control Variables				
Number of Employees	-.03	.03	-.03	.03
Firm Revenues	.04 *	.02	.04 *	.02
R^2 (Adj. R^2)	.104 (.092)		.104 (.092)	
N	321		321	

* $p < .10$ (two-sided tests)
** $p < .05$ (two-sided tests)
*** $p < .01$ (two-sided tests)

Subsequently, we regressed each of our proposed mediators on resistance to change (linear and quadratic terms), controlling for firm size (see Table 4.4). We discuss the results of these models, each in turn. First, we find that voice has a quadratic ($\beta = 1.23$, $p <$

.05), but not a linear (β = -8.77, p = .11) effect on innovation performance. This suggests, in line with our theory, that employees in firms with a high level of resistance to change are more likely to openly voice their concerns, as compared to employees in firms with lower levels of resistance.

Table 4.4 Effect of Resistance to Change on Voice, Loyalty and Disengagement

Variable	Model 1 Voice		Model 2 Loyalty		Model 3 Disengagement	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Constant	47.93 ***	12.22	68.45 ***	12.25	-16.37	10.53
Main Effects						
Resistance to Change	-8.77	5.43	-8.22	5.44	16.99 ***	4.68
Resistance to Change^2	1.23 **	.63	.36	.63	-1.59 ***	.54
Control Variables						
Number of Employees	1.08 *	.59	-1.23 **	.59	.15	.51
Firm Revenues	-1.06 **	.44	1.26 ***	.44	-.20	.38
R^2 (Adj. R^2)	.043 (.030)		.120 (.109)		.081 (.070)	
N	321		321		321	

* p < .10 (two-sided tests)
** p < .05 (two-sided tests)
*** p < .01 (two-sided tests)

Second, when regressing loyalty on both a linear and a quadratic effect of resistance to change, we do find significant effects in either the linear (β = -8.22, p = .13) or the quadratic (β = .36, p < .57) term. Yet, when we regress loyalty on only a linear effect of resistance to change, we find a significant and negative effect (β = -5.16, p < .01). This shows that, as theorized, at low levels of

resistance to change, employees tend to loyally and actively execute change.

Third, we find both a positive linear ($\beta = 16.99$, $p < .01$) and a negative quadratic effect ($\beta = -1.59$, $p < .01$) of resistance to change on disengagement. We find an inverted-U relationship between resistance to change and disengagement. In line with our theory, this shows that in firms with moderate levels of resistance to change, employees are more likely to disengage and, therefore, passively let execution continue.

We plot the results of Table 4.3 in Figure 4.4, which graphically confirms the results just discussed. First, it confirms that in firms with high levels of resistance to change, the most common response of employees is to voice their concerns (Figure 4.4a). Second, it shows that in firms with low levels of resistance to change, loyalty is the most common employee response (Figure 4.4b). Third, it also shows that the risk of employee disengagement is highest in firms with moderate levels of resistance to change (Figure 4.4c).

Fig. 4.4 Effect of Resistance to Change on Voice, Loyalty and Disengagement

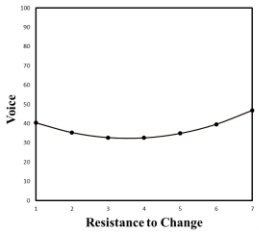


Fig. 4.4a Effect of Resistance to Change on Voice

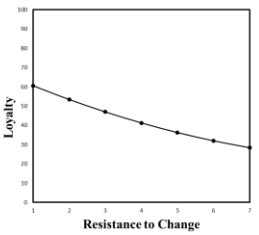


Fig. 4.4b Effect of Resistance to Change on Loyalty

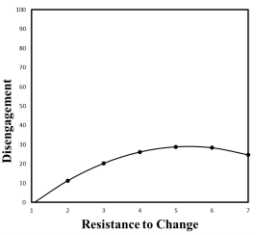


Fig. 4.4c Effect of Resistance to Change on Disengagement

Finally, we regress innovation performance on both the mediators (voice, loyalty and disengagement) and on resistance to change (linear and quadratic terms). According to Baron and Kenny (1986), the relationship between the exogenous variable and the dependent variable should be nonsignificant (for full mediation) or weaker (for partial mediation) when the mediators are included in the model. We find that the inclusion of our mediators leads to a slight decrease in the effect sizes of both the linear (from -1.95 to -1.68) and the quadratic terms (from .23 to .21) of resistance to change, but they remain significant, suggesting partial mediation.

4.7 Discussion

We show that resistance to change has a nonlinear effect on innovation performance, which possibly explains the existence of contradictory views in prior literature. Our findings offer several

substantive implications to managers. On the basis of our findings, we can advise managers in firms with high resistance to change to embrace rather than trying to prevent such resistance. Rather than seeing employee resistance as a nuisance that should be avoided or even squashed, managers should see resistance as an opportunity to learn and strengthen their innovation efforts. As such, firms can create channels through which criticism and even dissent are welcome and used to drive innovation. For instance, Pixar credits much of its creative success to its Braintrust, a group of directors, writers, and heads of story, who meet every few months to openly discuss and criticize the latest movie the studio is making. In the Braintrust, employees are encouraged to openly share their views with one another especially if they are divergent and critical. Such culture of open dialogue, ensures that the person whose views are being challenged or criticized (e.g., a movie's writer or director) does not feel personally attacked, but understands that this divergence is an integral part of the innovation process.

Another way to embrace resistance to change and promote divergent thinking is to bring new views from outside of the firm. For example, hiring people with divergent views, or collaborating with outside experts can trigger debate. A good example of such an approach comes from the strategy followed by BMW's CEO Norbert Reithofer to push the "megacity vehicle" initiative in the mid-2000s, which would later materialize in electric i-series line in 2013. As one would expect, Reithofer's initial proposal faced strong resistance from within the company ranks. At the time, BMW was doing

exceptionally well with its "high horsepower" strategy of building beautiful and powerful cars. In order to spur diversity, Reithofer hired two controversial external people: former U.S. Secretary of State Madeleine Albright and former German foreign minister and Green Party member Joschka Fischer. Reithofer tasked Albright and Fischer to win support internally for the "megacity vehicle" initiative. Albright and Fischer delivered provocative speeches to hundreds of executives and engineers at BMW. Such speeches triggered a much needed debate which culminated in massive support and enthusiasm for electric vehicles within the company.

4.7.1 Limitations and Future Research

This study offers a first step into understanding the complex relationship between resistance to change and innovation performance. Yet, as all studies, it is not without limitations, some of which offer pertinent opportunities for future research.

First, we used a cross-sectional survey to test our theory. Even though it is non-trivial to find secondary data on this topic, such data would allow us to generalize the findings from our research and better quantify its market impact. By the same token, conducting lab, or even better field experiments on this topic would help us gain a deeper understanding of the causal mechanisms linking resistance to change to innovation performance.

Second, while we find that voice, loyalty and disengagement partially mediate the effect of resistance to change on innovation performance, there may exist other mechanisms that drive this

relationship. Future research could thus extend our model with further theoretical mechanisms to strengthen our understanding of this phenomenon.

Third, future research could examine the antecedents of resistance to change. For example, it could be that companies' mechanisms to promote extrinsic motivation (e.g., compensation policies) or intrinsic motivation (e.g., employee empowerment) drive the level of resistance to change.

Fourth, future research could also examine firm-level contingency factors that moderate the effect of resistance to change, or voice, loyalty and disengagement, on innovation performance. As an example, firms with higher levels of market orientation may be better able to benefit from divergence in opinions and, therefore, to use resistance to change to develop innovations with higher chances of market success.

All in all, we offer a new view and empirical documentation of the relationship between resistance to change and innovation performance. While several important research questions remain, we hope our study convinces innovation managers that there is great potential in exploiting the positive effects of employees' resistance to change to succeed in innovation.

Appendix 4A Survey Measures*

	Std. Factor Loadings	Cronbach`s Alpha
Dependent Variable		
Innovation Performance (vis-à-vis competitors) [Based on Li and Calantone (1998), Van Doorn et al. (2013) and Zhou (2006)]		.90
Please indicate you agreement or disagreement with each of the following statements: All outcomes of innovation at my firm have helped us achieve…		
a. …higher return on investment than our main competitors.	.87	
b. …higher sales growth than our main competitors.	.90	
c. …higher profits than our main competitors.	.89	
d. …higher market share than our main competitors.	.87	
Independent Variable		
Resistance to Change [Based on Oreg (2003)]		.97
Please indicate your agreement or disagreement with each of the following statements: Employees at my firm...		
a. …generally consider change to be a negative thing.	.83	
b. …would prefer a routine day over a day full of unexpected events.	.81	
c. …like to do the same old things rather than try new and different ones.	.85	
d. …would rather be bored than surprised.	.81	
e. …typically feel stressed when they are informed that there is going to be a significant change regarding the way things are done.	.85	
f. …tense up a bit, whenever they are informed of changes in plans.	.85	
g. …stress out when things don't go according to plan.	.82	
h. …would probably feel uncomfortable if their manager changed the evaluation criteria, even if they thought they would do just as well even without having to do any extra work.	.82	
i. …find changing plans a real hassle.	.87	
j. …often feel a bit uncomfortable, even about changes that may potentially improve their work.	.86	
k. …when pressured to change something, tend to resist it even if they think the change may ultimately benefit them.	.87	
l. …sometimes avoid changes that they know will be good for them.	.83	
m. …do not often change their mind.	.78	
n. …once they come to a conclusion, are not likely to change their mind.	.82	
o. …don't change their mind easily.	.80	
p. …have very consistent views over time.	.74	

* All variables, unless otherwise stated, are measured on a 7-point Likert scale with (1) Strongly disagree, (2) Disagree; (3) Somewhat Disagree; (4) Neither agree nor disagree, (5) Somewhat agree; (6) Agree; (7) Strongly agree.

Appendix 4A Survey Measures* (continued)

Mediators

*Voice, Loyalty and Disengagement***
[New]

When your firm makes an important change, how frequently do you observe each type of reaction? Please indicate, for every 100 employees at your firm, how many are of each of the three types:

Type 1: Vocal	0/100
Type 2: Loyal	0/100
Type 3: Disengaged	0/100
Total	100

Firm Size

Revenues
What were approximately your firm`s sales revenues in 2015?

(a) Less than $100K; (b) At least $100K but less than $1M; (c) At least $1M but less than $ 2.5M; (d) At least $2.5M but less than $5M; (e) At least $5M but less than $10M; (f) At least $10M but less than $20M; (g) At least $20M but less than $50M; (h) At least $50M but less than $100M; (i) At least $100M but less than $500M; (j) At least $500M but less than $1B; (m) At least $1B but less than $2.5B; (n) At least $2.5B but less than $5B; (o) Equal or more than $ 5B.

Number of Employees
How many employees did your firm have in 2015?
(a) Less than 20; (b) 20 to 99; (c) 100 to 249; (d) 250 to 499; (e) 500 to 999; (f) 1,000 to 2,499; (g) 2,500 to 4,999; (h) 5,000 to 9,999 (i) 10,000 to 24,999; (j) 25,000 to 49,999; (m) 50,000 to 99,999 (n) 100,000 or more.

* All variables, unless otherwise stated, are measured on a 7-point Likert scale with (1) Strongly disagree, (2) Disagree; (3) Somewhat Disagree; (4) Neither agree nor disagree, (5) Somewhat agree; (6) Agree; (7) Strongly agree.

** To define vocal, loyal and disengaged, we provided the following definition to respondents:

"When firms make an important change, employees who have concerns with that change can be classified in three types, depending on their reaction to that change:

Type 1: Vocal
- *Employees of 'type 1' voice their concerns with the change, meaning that they tend to openly discuss the problems they foresee with the change.*

Type 2: Loyal
- *Employees of 'type 2' are loyal, meaning that they tend to ignore the problems they foresee and actively execute the change.*

Type 3: Disengaged
- *Employees of 'type 3' disengage, meaning that they tend to passively let execution continue."*

Chapter 5
Summary

5.1 Summary in English

This dissertation aims to enhance our understanding of how incumbent firms organize innovation in response to the challenges and opportunities they face. The first paper focuses on understanding all components of the complex innovation ecosystem. In this chapter we synthesize the literature on innovation and provide a critical review of the field. The second paper centers on how firms can succeed in grassroots innovation, thereby harnessing the knowledge and skills of their entire employee base. In this chapter we take an in-depth look at grassroots innovation and its success determinants. The third paper looks at how the inevitable resistance to change affects innovation performance, and how resistance can be turned into a strength. We further explain the relationship between resistance to change and innovation performance by studying the mediating effect of the reaction of concerned employees.

5.2 Nederlandse Samenvatting (Summary in Dutch)

Dit proefschrift heeft als doel om ons het begrip inzicht van te vergroten over hoe bedrijven innovatie organiseren in reactie op de uitdagingen en opportuniteiten mogelijkheden die zij zien die ze tegenkomen. Het eerste artikel richt zich op het begrip van alle onderdelen in het complexe innovatie ecosysteem. In dit hoofdstuk synthetiseren we de literatuur over innovatie en geven wij een kritische evaluatie van het veld. In het tweede artikel ligt de nadruk op grassroots innovatie, een stroom waarbij bedrijven succes behalen mede door de kennis en vaardigheden van alle medewerkers in te zetten. In dit hoofdstuk word grondig gekeken naar grassroots innovatie, en de bepalende factoren voor succes. Het derde artikel onderzoekt hoe de onvermijdelijke weerstand tegen verandering invloed heeft op innovatie prestaties, en hoe deze weerstand kan worden omgezet in een kracht. Hier verklaren we nader de relatie tussen weerstand tegen verandering en innovatie succes door het bestuderen van het effect van de reactie van de betrokken medewerkers als mediator.

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Chapter 3

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About the Author

Elio was born in Tirana (Albania) on December 4th 1988. He obtained his bachelor degree in International Business and Business Economics at Erasmus School of Economics, Erasmus University Rotterdam. He then completed his Master's degree in Economics and Business, majoring in Marketing, also at the Erasmus School of Economics, Erasmus University Rotterdam and continued with his Ph.D. at the marketing department of Erasmus School of Economics. During his Ph.D. Elio taught Marketing Strategy at the Master's level for four years, published several case studies with IESE Business School Publishing and a book chapter in the 'Handbook of Research on New Product Development (edited by Peter Golder and Debanjan Mitra), Edward Elgar, 2017'. In March 2017, Elio joined MTI^2 (The Marketing, Technology and Innovation Institute), a consulting firm specializing in innovation and marketing, as an Associate.

Portfolio

PUBLICATIONS

"The What, Who and How of Innovation Generation", (with Stefan Stremersch and Gert Jan Prevo), *in Handbook of Research on New Product Development* (edited by Peter Golder and Debanjan Mitra), Edward Elgar, 2017 (Forthcoming)

"Babcock: An Innovative Business Model in the Mining and Construction Industry," (with Stefan Stremersch), *IESE Business School*, 2015, 1329-E.

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WORK IN PROGRESS

"Innovation from the Grassroots: Determinants of Success," (with Stefan Stremersch, Nuno Camacho and Isabel Verniers)

"A Look at the Bright Side of Resistance to Change: Effects on Innovation Performance," (with Stefan Stremersch and Nuno Camacho)

TEACHING CREDENTIALS

Lecturer, Seminar Strategic Marketing
Masters Marketing, Erasmus School of Economics, Erasmus University
2012, 2013, 2014, 2015, 2016

Guest Lecturer, PhD Seminar
IESE Business School, University of Navara
2016, 2017

DOCTORAL COURSES

- Panel Data Econometrics: Theory and Practice
- Mediation, Moderation, and Conditional Process Modeling
- Forecasting in Marketing
- Data Analysis with R
- Applied Econometrics
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This dissertation aims to enhance our understanding of how incumbent firms organize innovation in response to the challenges and opportunities they face. The first paper focuses on understanding all components of the complex innovation ecosystem. In this chapter we synthesize the literature on innovation and provide a critical review of the field. The second paper centers on how firms can succeed in grassroots innovation, thereby harnessing the knowledge and skills of their entire employee base. In this chapter we take an in-depth look at grassroots innovation and its success determinants. The third paper looks at how the inevitable resistance to change affects innovation performance, and how resistance can be turned into a strength. We further explain the relationship between resistance to change and innovation performance by studying the mediating effect of the reaction of concerned employees.

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T +31 10 408 1182
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