BUFFERING THE FAILURE OF NEW PRODUCT DEVELOPMENT PROJECTS: A MULTI-LEVEL APPROACH

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ABSTRACT

We develop a multi-level model of the impact of new product development (NPD) failures on firm valuation based on organizational, managerial, and product-level characteristics of high technology firms. Drawing on signalling theory we argue that the impact of failure increases with the product’s development stage, and that this effect is contingent on the resources of the firm. Using data on 234 NPD failures of biopharmaceutical firms listed on the NASDAQ Biotechnology index, the findings largely support our model and demonstrate that organizational and managerial characteristics are important factors that mitigate the impact of NPD failures in new technology firms. We discuss implications for the product development literature.

INTRODUCTION

In the product development and supply chain management literatures, the impact of new product development events on financial value has been widely investigated. For example, scholars have analyzed the consequences of ISO certification (Corbett et al., 2005), the effect of new product introductions (Chaney et al., 1991) and the financial consequences of delays in new product introductions (Hendricks and Singhal, 1997) for NPD projects. Fewer studies (Sarkar and de Jong, 2006; Girotra et al., 2007) have focused on how NPD is linked to firm valuation and stock market response. Specifically, although NPD processes are typically associated with high failure rates, empirical studies that investigate these failures are rare. For example, in the biotechnology sector more than 80% of all new products fail, and an average drug needs approximately $US 897 million before it can be introduced to market (DiMasi et al., 2003), suggesting a severe impact of NPD failures on the firm’s market value. How can firms mitigate the negative impact of a product failure on valuation?

Existing studies on NPD failures (Sharma and Lacey, 2004; Brixa et al., 2007) have primarily focused on why failures occur. Drawing on signaling theory which suggests that organizational characteristics signal the future performance of a firm, in this article we develop a multi-level model investigating how firm-specific resources buffer negative effects of NPD failures on firm valuation. We acknowledge that products can fail at different development stages and that organizational and managerial resources will contribute to buffer the impact of failures contingent on the product’s development stage. We test our model with data on 234 biopharmaceutical NPD failures of publicly traded biotechnology firms during the period 1994 to 2008. Using an event study technique we show that later stage NPD failures have a stronger negative impact on firm valuation than early stage failures. Moreover, we find that this effect is stronger for firms with fewer employees, higher R&D expenses, and higher revenues. We do not find moderating effects of managerial team variables, although firms with younger management teams decline less in valuation after NPD failures than firms with older management teams.
We make the following contributions to literature. First, our multi-level contingency approach goes beyond existing studies that investigate market responses to new product developments based on linear and single-level effect models (Sarkar and de Jong, 2006). Second, although existing entrepreneurship literature has recognized that the external environment can negatively impact new venture performance (Nicholls-Nixon and Cooper, 2000), little is known about factors specific to the organization that can buffer this impact. Finally, our work has implications for managers of high-tech companies since our results allow them to better anticipate the consequences of NPD failures and act appropriately to preserve stakeholder value when such failures occur.

THEORY AND HYPOTHESES

In dynamic and uncertain environments NPD processes are characterized by high failure risks. This is particularly true for young firms that typically suffer from constraints in resources and effective internal routines (Stinchcombe, 1965). However, the visibility of NPD processes and their outcomes have a large impact on stakeholders’ perceptions and evaluations of a firm (Sharma and Lacey, 2004; Bixia et al., 2007). Thus, NPD failures can be characterized as events that deteriorate the perceived value creating capacity of a firm. Moreover, these failures do not only increase stakeholders’ uncertainty about future firm performance, but also lead to an increase in information asymmetry surrounding the venture. Furthermore, NPD failures reduce the firm’s intangible resources that are typically valuable, rare and difficult to duplicate (Wernerfelt, 1984). Thus, NPD failures lead to a negative signal to firm’s stakeholders since they reflect losses in expected future cash flows and performance. Recent studies have shown that product failures, especially those in NPD processes, typically lead to sharp drops in firm valuations (Guedj and Scharfstein, 2004; Sharma and Lacey, 2004).

Research in cognitive psychology has shown that negative information is more likely to focus shareholders’ attention than positive information (Mizerski, 1982) suggesting that NPD failures send a strong signal to the capital markets. However, there is heterogeneity in the effects of product failures on firm valuation, specifically in the case of young high technology firms. In this case, shareholders may use more information than just that fact that an NPD failure occurs when evaluating the firms’ market value. We will now investigate how available information on (i) the development stage of the failed product, (ii) organizational factors and (iii) managerial factors influence the impact of NPD failures. Our particular attention is on effects across levels since we propose that organizational and managerial level factors will determine, partly, the extent to which the development stage of the failed product impacts firm valuation.

Product development stage and NPD failures

New product development is often associated with long development times (Bixia et al., 2007), and in some industries such as drug development these processes are regulated and proceed along a series of different, well-defined stages. These stages differ significantly in their needs in resources, and depending on the progress of the new product will send different signals towards firms’ shareholders. In the biopharmaceutical industry, the development process of a new drug is particularly well defined. It usually starts with basic research in the lab, followed by pre-clinical studies where the drug candidate that emerged from the laboratory studies is tested in animals. Subsequently, this product candidate is tested in three stages of clinical trials in human subjects, and if it succeeds, it enters the NDA review process before the Food and Drug Administration (FDA) classifies the drug as “approvable” (Sarkar and de Jong, 2006). Based on scientific and financial information, a biopharmaceutical company has to decide at each development stage whether to continue with the next, even more expensive phase, or stop development in case the
trial’s desired end points were not met or competitors have in parallel developed a more promising
drug candidate for the same disease (Guedj and Scharfstein, 2004).

The later the development stage, the more resources firms need to start the next clinical trial. For example, a typical phase I clinical trial demands about $32 million, whereas costs for a phase III trial on average amount to $220 million (DiMasi et al., 2003). Because of that increase in resources demands failures in later development stages will provide a more negative signal to shareholders than failures in early development stages where few resources have been invested into the failed product. Further, the closer the new product to market, the more likely it will create revenues for the firm and value for the firm’s shareholder. For example, Girotra (2007) reported that a typical drug in the biopharmaceutical industry undergoing phase III trails has an average success probability of about 80%, suggesting that most investors would think that future returns from a phase III drug candidate are relatively certain. However, if the phase III candidate fails, the firm loses this potential future cash flow, and Girotra (2007) claimed that in this case investors likely lose confidence in the firm’s future potential as a whole and may penalize the firm and its management for much more than just the lost product candidate. Thus,

\[ H1: \text{The more advanced a young technology firm’s new product candidate, the larger the decrease in firm value after failure of that candidate.} \]

Organizational-level factors and the buffering of NPD failures

In our study we focus on organizational-level factors that have been shown to influence organizational outcomes and may affect shareholder response to NPD failures of high technology firms: firm size, R&D expenses, and revenues.

First, size is an important characteristic of a firm since it signals legitimacy and opportunities to access and control resources (Haveman, 1993). This increased resource availabilities may buffer the impact of NPD failures because they allow the firm to quickly recover from such events. For example, larger firms can compensate for failures more easily than small firms because they can often draw on a substantial network of contacts to other organizations to find, acquire, or in-license new product candidates and re-fill their pipeline. Further, in case such an agreement is reached, the negotiation power of large firms allows them to appropriate a substantial part of the licensed product’s ownership. Consistent with these arguments, Womack (1996) found that firm size mitigates market reaction after recommendations by brokerage analysts.

It appears that this buffering effect of firm size is particularly important for failures of late stage products. In contrast to early stage product candidates, late stage candidates reflect substantial investments in the past and near future earnings. Size can signal to investors that (i) the firm has not invested all (or a too high part) of its resources in the failed product so that future development efforts are threatened, and (ii) the firm has enough networks, legitimacy, and other resources to acquire a substitute product candidate at the same development stage that will generate earnings in the new future. For failures in early development stages, size may not be a similarly important buffering signal because (i) the resources that have already been invested in the project are not as substantial even for a small firm, and (ii) improvement of basic technologies that may underlie the early stage failure may also be feasible for small firms with little legitimacy and fewer network contacts. Thus,

\[ H2a: \text{The larger a young technology firm, the smaller the decrease in firm value after NPD failure.} \]
H2b: The relationship between the development stage of a young technology firm’s new product candidate and the value of the firm after NPD failure is more negative when the firm is small than when it is large.

Second, R&D expenditures reflect intangible assets of a firm and signal uncertain future benefits. Girotra et al. (2007) found that R&D expenses positively impact firm valuation given that the firm allocates these investments in a way that the product pipeline optimally balances long development cycles and low success rates. High R&D expenditures signal to investors that the firm invests much of its resources to develop new products, suggesting that investors will have high expectations for those products reaching market launch and generating revenues for the firm. In case such a product fails during development, shareholders may interpret high R&D expenditures as an inefficient allocation of resources. In contrast, NPD failure of firms with low R&D expenditures will have less impact on firm valuation because in this case investors’ a priori expectations of products entering the market will be lower.

High R&D expenditures will be particularly daunting for the firm’s value when the failing product has already reached a mature development stage. This is because the misallocation of resources appears particularly apparent to investors and their expectations of the failed product entering the market. This is consistent with previous studies (Ely et al., 2003; Bixia et al., 2007) demonstrating that R&D expenses in drugs at later development stages are more value-relevant than R&D investments in early development stages. Thus,

H3a: The higher the R&D expenses of a young technology firm, the larger the decrease in firm value after NPD failure.

H3b: The relationship between the development stage of a young technology firm’s new product candidate and the value of the firm after NPD failure is more negative when the firm has higher R&D expenses than when it has lower R&D expenses.

Finally, existing literature (Medoff and Abraham, 1980) has shown that higher firm performance is associated with substantially higher revenues of the firm, which is consistent with Chandra and Ro’s (2008) recent observation that firms that generate more revenues achieve higher stock market valuations than firms with less or even no revenues. High revenues signal to investors that the firm is able to capture much of their products’ value. For products under development, shareholder will thus expect that firms that are currently generating high revenues will be able to generate high revenues in the future based on their product development pipeline. That is, if a product under development fails, shareholders will discount the value of a firm more if they assume that this firm could have generated high revenues from that product than when they assume that the firm would have generated only moderate or low revenues.

The signalling effect of high revenues, however, will vary with the development stage of the product. When products in early stage development stages fail, higher revenues are seen more positive by investors, because they allow firms to compensate failed compounds by their own earnings (Ertrimur et al., 2003). In contrast, Guedj and Scharfstein (2004) have claimed that when failures during later stages occur, firms with higher revenues will loose more market value since investors’ expectation that substantial revenues from the sale of the failed product will finally materialize have been higher. Thus,

H4a: The higher the revenues of a young technology firm, the larger the decrease in firm value after NPD failure.
**H4b:** The relationship between the development stage of a young technology firm’s new product candidate and the value of the firm after NPD failure is more negative when the firm has high revenues than when it has low revenues.

**Top management teams and the buffering of NPD failures**

The upper echelon perspective (Hambrick and Mason, 1984) claims that the Top Management Team (TMT) is authorized to take any firm decisions necessary to adapt the firm to environmental demands. For example, Jensen and Zajac (2004) found empirical support that variables that measure visible and heterogeneous characteristics of TMTs matter to organizational outcomes. Especially for young high technology ventures that operate in uncertain environments, the composition of the TMT is crucial for firm performance and stakeholder interpretations of event severity are influenced by TMT characteristics. In our analysis we explicitly focus on those TMT characteristics that are known to influence shareholder interpretation of NPD failures (DeCarolis and Deeds, 1999; Bixia et al., 2007): the size of the TMT and the average age of its members.

First, TMT size (measured by the number of team members) is an important aspect of TMT research (Carpenter et al., 2004). Larger teams have been found yield better firm performance and faster firm growth (Eisenhardt and Schoonhoven, 1990). Furthermore, the size of a TMT has been shown to positively influence the valuation of the firm at IPO (Finkle, 1998). Large TMT are believed to have more cognitive resources than small teams which facilitates them dealing with complex decision tasks (Haleblian and Finkelstein, 1993). Moreover, larger teams tend to have more social capital in terms of valuable contacts to other individuals working in the same or related industries. These advantages over small teams suggest that investors will see large teams as superior to small teams regarding their resources to deal with a complex situation such as an NPD failure and to work out a viable strategy to recover from that failure. Consequently, the decrease of firm value after NPD failures will be more severe for small than for large teams.

This positive effect of TMT size on buffering of NPD failures appears particularly important in later development stages of new products. Whereas a failure of an early stage product represents a relatively frequent situation for the firm due to the high failure rates at those stages, late stage failures are less frequent and represent a newer and perhaps unprecedented situation for the firm, requiring high levels of managerial resources. Second, when products have already reached late development stages, a substantial part of the firm’s assets have developed in a way that is specific for the product (e.g. large scale manufacturing or marketing capabilities). A failure at a late stage will thus represent a challenging situation for the firm and may be accompanied by a major reorganization of the assets developed leading to strategic reorientation. These situations require high levels of managerial talent and competence, suggesting that investors will place particular value on having the firm run by a large team when late stage failures occur. Thus,

**H5a:** The larger the top management team of a young technology firm, the smaller the decrease in firm value after NPD failure.

**H5b:** The relationship between the development stage of a young technology firm’s new product candidate and the value of the firm after NPD failure is more negative when the firm’s top management team is small than when it is large.

Second, with respect to TMT age, previous studies (Hambrick and Mason, 1984; Wiersema and Bantel, 1992) have shown that older TMTs have a reduced willingness to change the firm’s status quo. Moreover, they are less open to new ideas and for them security increases in
importance. Furthermore, Wiersema and Bantel (1992) demonstrated a negative relationship between average TMT age and change in corporate strategy. As visible demographic characteristic, high TMT age may signal to shareholders little ability and willingness to change the firm’s strategic direction as response to an NPD failure. That is, the impact of NPD failure on firm valuation will be more substantial for older than for younger teams.

Further, the benefits of young TMT age in terms of signalling recovery potential to investors appear to be more substantial when the failed product has already reached a late development stage. As argued earlier, in this case the firm’s assets are likely more specific to the developed product, and the TMT will be less familiar with the situation faced than when early products fail. Therefore high ability and willingness to change the firm’s strategy – signalled by a young TMT – will be more highly valued by investors when NPD failures occur at later development stages than at earlier development stages. Thus,

\[ H6a: \text{The higher the average age of a young technology firm’s top management team, the larger the decrease in firm value after NPD failure.} \]

\[ H6b: \text{The relationship between the development stage of a young technology firm's new product candidate and the value of the firm after NPD failure is more negative when the age of the firm’ top management team is high than when it is low.} \]

**RESEARCH METHOD**

**Data and Sample**

To test our hypothesis we chose the biotechnology industry as a research setting. This sector is well suited for our analysis because it is a relatively young, knowledge and invention intensive industry where highly risky NPD is critical for success. Our sample consists of publicly traded biotechnology firms that were listed in the Nasdaq Biotechnology Index during the period 1994 to 2008. To ensure homogeneity of our sample with respect to technology and NPD activities we exclusively included firms commercializing drugs for the treatment of human diseases. Moreover, to ensure comparability of NPD failures we focused on those failures that occurred during the clinical development stages of new drugs. Clinical trial data we collected from Recombinant Capital Database (ReCap) whereas financial data were gathered from The Wall Street Journal, Market Watch database, Lexis Nexis database and the companies’ web pages.

From our initial sample of 92 biotechnology firms that experienced 593 NPD failures at clinical trial stage, we had to drop 276 failures because full information and the exact failure date were not available. Moreover, we had to exclude additional 83 failures because firm’s financial data were not fully available. Our final data set covers 234 NPD failures that match our criteria and for which we have all data to test our hypotheses.

**Variables**

_Cumulative abnormal return (CAR),_ the dependent variable in our study, captures the financial impact of a clinical NPD failure on firm valuation. We build on previous research on event study methodology (Brown and Warner, 1985) and control for potentially confounding events by taking care for the identification of the exact event date and the optimal length of the event window. In order to ensure that we capture the exact event date, we double-checked each observation identified in the ReCap database drawing on news reports provided by the Lexis Nexis database.
By doing so, we identified the specific date of the earliest news release for every observation of our sample. Second, we focused on a narrow 3-day event window (Mc Williams and Siegel, 1997) that included the day prior to, the day of, and the day following the announcement of the failure, following research on event study methodology that supports short event windows. We calculated the CAR by utilizing stock market data from The Wall Street Journal and the Market Watch database. Finally, in order to control for confounding, industry-wide events we used the Nasdaq Biotechnology Index as benchmark. We measured the CAR as the relative difference between the price of the Nasdaq Biotechnology Index and the firms’ share price during the 3-day event window around the failure date. If the event day was not a trading day our CAR represented the trading days immediately before and after the event date.

Our independent variables were split into three categories depending on the levels they represent. First, the product level is represented by the development stage of the product candidate. When we calculated the average CAR for all four product development phases that constitute the drug development process we found changes in firm valuation of -4% for clinical phase I failures, -7% for clinical phase II failures, -19% for clinical phase III failures, and -19% for failures in the NDA filing phase. Thus, we observe a clear split between phases I and II on the one hand and phases III and NDA filed on the other hand. We therefore consider phase I and II as “early development stage” and phases III and NDA filed as “late development stage”. Development stage therefore is a contrast coded variable with a value of 0.5 when the failure occurred in early stage, and -0.5 otherwise.

Second, variables representing organizational level characteristics were taken from the 10-K SEC fillings and the firms’ annual reports in the period before the failure occurred. We measured firm size as the number of Employees. We included further a size corrected measurement of Revenues by dividing revenues by employees. Similarly, we measured R&D expenses by dividing firms’ R&D expenses by employees. All these data we validated by cross checking with the firms’ consolidated balance sheets.

Third, TMT variables were based on the firms’ 14-A SEC fillings. In line with previous studies (Haleblian and Finkelstein, 1993; Carpenter et al., 2004) we operationalized the sum of top managers that were listed one period before the failure occurs as TMT_size. TMT_age was measured by the average age of all TMT members.

Control variables were included in our analysis because they are known or expected to influence the firm’s CAR. First, we controlled for firm age since older firms are likely to have more products in development and on the market than younger firms (Deeds and Hill, 1996). Furthermore, younger firms are considered to have higher failure risks due to their lack of environmental legitimacy and organizational constraints (Zheng et al., 2009). We measured firm age by the days from a firm’s inception to its product failure. Second, we controlled for effects that product development with a partner may have on firm valuation. We coded Alliances by a dummy variable with the value 1 if the firm developed the failed drug within an alliance and 0 otherwise. Alliances may buffer the negative effect of product failures on stock markets valuation since a firm’s engagement in alliances is viewed as facilitating its R&D process, post-approval production, and risk sharing (Baum et al., 2000). Third, we controlled for the firm’s product pipeline using the dummy variable Products. This variable indicates whether the firm had only one drug candidate (Products = 0) or several products (Products = 1) within its development pipeline. Recent studies support that declines in firm value after NPD failures are mitigated by the presence of parallel development strategies and backup projects (Girotra et al., 2007) whereas single product firms may loose significantly more value because their managers are less willing to
drop unpromising drug candidates (Guedj and Scharfstein, 2004). Fourth, we controlled for the firms’ cash positions and operationalized Cash as the amount of firm cash divided by employees. Finally, the tenure of the TMT may influence its strategic decision. Longer tenured TMTs are found to have greater commitment to the status quo of the firm (Wiersema and Bantel, 1992) and have negative effects on organizational outcomes (Boeker, 1997). Tenure denoted average tenure of all those executives that constitute the TMT.

RESULTS

To test our hypothesis we run OLS regression analyses while controlling for within-firm error correlation. Further, to account for potential heteroskedasticity that is often observed in event studies, we estimated our models with robust standard errors. Since the correlation coefficients indicated some correlation between independent variables (e.g. between revenues and employees) we tested for multicollinearity by calculating variance inflation factors (VIFs). Multicollinearity was not a problem in our data as indicated by, the maximum VIF of 2.64, which is below the acceptable threshold for multivariate analysis (Hair et al., 2005).

Table 1 shows the results of the analysis. We first entered the control variables (Model 1). This base line model is statistically significant (R² = 0.12, p = 0.018). In the next step, we added the independent variables, resulting in a statistically significant model (Model 2) with an increase in explained variance as compared to the base line model (R² = 0.35, ∆R² = 0.23, p< 0.001). Finally, we entered the interaction terms (Model 3) yielding a considerable increase in explained variance as compared to the base line and main-effect only models (R² = 0.44, ∆R² = 0.09, p < 0.001).

Regarding main-effects hypotheses (Model 2), our results reveal that later stage NPD failures have a stronger impact on firm valuation than early stage failures, supporting Hypothesis 1. Regarding organizational factors and their buffering impact after NPD failures we find the expected effects stated in Hypothesis 2a and 3a. With respect to managerial resources we find that the higher the average age of a firm’s TMT, the larger the decrease in firm value after NPD failure, supporting Hypothesis 6a.

Moreover, we find statistically significant interactions between development stage and (i) number of employees, (ii) R&D expenses, and (iii) revenues (Model 3). Since we do not find significant interactions between development stage and (iv) team size and development stage and (ii) team age, Hypotheses 5b and 6b are not supported. In order to better understand the significant interactions we plot them on a x-axis of project development stages and on a y-axis of CAR and plots representing low and high levels of organizational-level firm characteristics (one standard deviation above and below the mean, Figure 1).

Figure 1A shows that the relationship between development stage of the failed product and CAR is less negative when the firm has more employees than when the firm has fewer employees. The nature of this significant interaction supports Hypothesis 2b. Figure 1B shows that the negative relationship between development stage of the failed product and CAR is more negative when the firm has higher levels of R&D expenses than when the firm has lower levels of R&D investments. The nature of this significant interaction supports Hypothesis 3b. Finally, Figure 1C shows that the relationship between development stage of the failed product and CAR is less negative when the firm has high revenues than when the firm has low revenues. The nature of this significant interaction provides particular support for Hypothesis 4b. For this latter case, it is interesting to note that the two lines representing high and low revenues cross. That is, while for
late stage failures, firms with higher revenues suffer more, for early stage failures the impact on firm valuation is stronger for firms with lower revenues. We will discuss this finding below.

**DISCUSSION**

In this study, we build on the product development literature to shed new light on the role of firm specific characteristics in explaining heterogeneity of event severity across firms. We focus on NPD failures, which are frequent in many technology-based industries. We study how the development phases of product candidates and the firms’ organizational and managerial-level characteristics mitigate the negative impact of NPD failure on firm valuation. We acknowledge that interactions between product-level and organizational-level variables and between product-level and managerial-level variables may occur and explain some variance in shareholder reaction to NPD failures. Our empirical analysis supports wide parts of our model.

The literature on new product development is relatively silent on the effect of project failure at different development stages. Much of the existing literature has focused only on the firm specific factors that can mitigate the valuation effect of an NPD failure (Sharma and Lacey, 2004; Sarkar and de Jong, 2006; Bixia et al., 2007), but these studies have neglected the effects of different product development stages on firm valuation. Indeed, to the best of our knowledge only two studies have been published that explicitly took into account the development stages of products. Girotra et al. (2007) conducted an event study on product failures of phase III clinical trials and explained heterogeneity in project valuation based on interactions with the development stages of other product candidates in the firm’s pipeline. Guedj and Scharfstein (2004) pointed out that phase II drug candidates of young firms are less likely to advance to phase III because of agency problems between managers and stakeholders. Therefore young firms typically bring less promising (less valued) product candidates to phase II trails than established firms. We add to this literature by investigating how failures of early and late development stage product candidates can be mitigated by organizational and managerial level properties.

An interesting empirical finding of our study is that while in early development stages firms with less revenues suffer more from NPD failures than firms with high revenues, this effect is reverse for NPD failures at late development stages (see the crossing lines in Figure 1C). Shareholders appear to interpret the role of revenues differently in the case of early and late stage failures. This result can be interpreted in line with Guedj and Scharfstein (2004) who suggest that late stage failures are viewed by investors as losses of expected average sales of the product. The higher the firm’s revenues, the higher are the shareholders’ expectations of sales, and the more severe the drop in firm valuation will be when those expectations are not met because of an NPD failure. For early stage failures, in contrast, shareholders may see high revenues as a source for finance that allows the firm to quickly develop new, early stage projects that compensate for the failed candidate. Future research can test this explanation.

Our results are consistent with the resource-based view of the firm (Wernerfeldt, 1984) which suggests that firms are idiosyncratic bundles of resources that are crucial determinants of organizational performance and firm valuation. A late stage product candidate represents a more valuable resource for a firm than an early stage candidate since more finance has been invested in a late candidate and the late stage candidate is closer to market. Consequently, the negative impact of product failure on firm valuation is more severe in later stages of the development process. Importantly, however, our results demonstrate that other organizational resources can buffer this negative effect contingent on the product’s development stage. In the case of NPD failures investors appear to value a firm not only based on the resource destroyed (the failed product) but
also based on how that resource is expected to contribute to firm performance given the firm’s idiosyncratic characteristics. This is in line with recent research showing that the composition of a firm’s product development portfolio explains, partly, the impact of NPD failures on firm valuation (Girotra et al., 2007).

Moreover, our study adds to upper echelon research (Hambrick and Mason, 1984) by investigating the role of the management team in the case of NPD failures. While much upper echelon research has focused on how TMTs impact financial performance over an extended time frame or a yearly basis (e.g. Boeker, 1997; Jensen and Zajac, 2004), much less is know about their role in the case of adverse events. For example, Wiersema and Bantel (1992) found that TMTs propensity to change corporate strategy is linked to its demographic characteristics and much higher when TMT age is lower and TMT tenure is shorter. We present one of the first empirical studies on how TMT characteristics can mitigate the negative effect of NPD failure on firm valuation. We show that firms with older management teams decline more in valuation than firms with younger management teams, independently of the failed product’s development phases. These findings complement previous studies (Haleblian and Finkelstein, 1993; Wiersema and Bantel, 1992) that have shown that older TMTs display a reduced willingness to change the firm’s status quo. As visible demographic characteristic, TMT age seems to act as signal towards shareholders to demonstrate the TMT’s ability to change the firm’s strategic direction in difficult situations such as after NPD failures.

Our findings have implications for practice, especially for managers of high technology firms since they allow them to better anticipate and understand the consequences of NPD failures. Specifically, our result highlight the influence that shareholders perceptions of the organizational and managerial characteristics of the firm have on value destruction after NPD failures, and that this influence is dependent on the product development stage of the failed product. Managers who develop a portfolio of product candidates at different development stages should align those stages with their organization’s characteristics in terms of firm size, R&D expenses, revenues, and age of the management team. For example, for small firms it appears more beneficial than for large firms to sell or out-license product candidates before they reach later development stages (even if the firm has sufficient financial resources to finalize their development) because in case the product fails in late development the effect on firm valuation is particularly daunting for small firms. Aligning the product development portfolio with organizational characteristics can preserve shareholder value in case of NPD failures.

As all studies, this one has limitations which in turn provide opportunities for future research. One issue concerns the focus on biotechnology companies, and thus on a single high technology industry. While this sampling technique rules out methodological threats (Zheng et al., 2009), it raises the question of generalizability to a larger population. Caution must be exercised when transferring results from a single industry to others. We hope that future research will verify our findings in settings other than the biotech industry. Further, since we exclusively focus on companies listed in the Nasdaq Biotechnology index to better operationalize the relative difference between the benchmark and the firm’s share after NPD failure, our measure of CAR is incomplete to the extent that focal firms’ losses in share price influence the performance of the index itself (that is, the firm that experiences a focal NPD failure itself contributes to the composition of the index). Although our approach is in line with Michaely et al. (1995) who argue that measurement of the CAR by using a fitting index is beneficial to avoid confounding events that are industry-specific, more work is needed to investigate alternative measures of the CAR.
In conclusion, this study shows that product, organizational, and managerial-level factors explain variance in the impact of NPD failures on the valuation of young technology firms. Our results demonstrate that these factors interact in mitigating this impact such that the effect of the development stage of the failed project product is contingent on firm size, R&D expenses, and revenues. These results advance our understanding of shareholders’ perspectives of product failures and emphasize that cross-level effects should be considered by future research seeking to explain variance in investor behaviour and firm valuation.

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REFERENCES


Table 1: Results of OLS regression

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<tr>
<th>Variables</th>
<th>Cumulative Abnormal Return (CAR)</th>
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<tbody>
<tr>
<td></td>
<td>Model 1</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
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<tr>
<td><strong>Control variables</strong></td>
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<td>Alliances</td>
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</tr>
<tr>
<td>Products</td>
<td>0.200 (0.054)***</td>
</tr>
<tr>
<td>Cash</td>
<td>0.005 (0.011)</td>
</tr>
<tr>
<td>TMT-tenure</td>
<td>0.001 (0.015)</td>
</tr>
<tr>
<td><strong>Direct effects</strong></td>
<td></td>
</tr>
<tr>
<td>Development stage</td>
<td>0.060 (0.015)***</td>
</tr>
<tr>
<td>Employees</td>
<td>0.040 (0.011)***</td>
</tr>
<tr>
<td>Revenues</td>
<td>-0.022 (0.015)</td>
</tr>
<tr>
<td>R&amp;D expenses</td>
<td>-0.053 (0.015)***</td>
</tr>
<tr>
<td>TMT-size</td>
<td>-0.012 (0.014)</td>
</tr>
<tr>
<td>TMT-age</td>
<td>-0.034 (0.016)**</td>
</tr>
<tr>
<td><strong>Cross-level effects</strong></td>
<td></td>
</tr>
<tr>
<td>Development stage x Employees</td>
<td>-0.031 (0.011)***</td>
</tr>
<tr>
<td>Development stage x Revenues</td>
<td>0.027 (0.010)***</td>
</tr>
<tr>
<td>Development stage x R&amp;D expenses</td>
<td>0.054 (0.010)***</td>
</tr>
<tr>
<td>Development stage x TMT-size</td>
<td>0.014 (0.015)</td>
</tr>
<tr>
<td>Development stage x TMT-age</td>
<td>0.023 (0.015)</td>
</tr>
<tr>
<td>Observations</td>
<td>234</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.12</td>
</tr>
<tr>
<td>Change in R-squared</td>
<td>0.23***</td>
</tr>
<tr>
<td>F-test(df)</td>
<td>2.94 (5)</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Figure 1: Interaction effects between different project development stage of product failures and (A) the firm size, (B) the level of R&D expenses, and (C) the level of revenues.