

Entrepreneurial orientation and firm performance: the mediating role of functional performances

Jafar Rezaei and Roland Ort

*Faculty of Technology, Policy and Management, Delft University of Technology,
Delft, The Netherlands*

Abstract

Purpose – Earlier studies have generally shown a positive relationship between entrepreneurial orientation (EO) and the overall performance of the firm. The purpose of this paper is to understand in more detail how EO influences firm performance. It adds to the literature by distinguishing performances of different functions in a firm and by exploring how the dimensions of EO influence these functional performances and, in turn, overall firm performance.

Design/methodology/approach – This study examined the relationship between three dimensions of EO (innovativeness, proactiveness, risk-taking), three types of functional performances of firms (R&D performance, production performance, marketing and sales performance) and the overall performance of firms. The data are collected from 279 high-tech small-to-medium-sized enterprises (SMEs) using a postal survey. The proposed hypotheses are tested using structural equation modeling (SEM).

Findings – The results indicate that the dimensions of (EO) are related in different ways to the performance of functions in a firm. A positive relationship is observed between innovativeness and R&D performance and between proactiveness and marketing and sales performance. A negative relationship exists between risk-taking and production performance. The results also show a sequential positive relationship from R&D via production and marketing and sales to overall performance of firms. Therefore, it is concluded that the R&D, production and marketing and sales functions reinforce each other in a logic order and are complementary in their effect on overall firm performance.

Practical implications – The results imply that the three functions, R&D, production and marketing and sales, in a firm play different roles, both in the firm's EO and in their contribution to overall performance. Managers can use the findings to monitor and influence the performance of different functions in a firm to increase overall firm performance.

Originality/value – The first contribution of this study is that it unravels (i) which dimensions of EO have an effect on the performance of separate functions in a firm, indicating that functions contribute in different ways to entrepreneurial orientation of the firm. A second contribution is assessing how the performance of these functions influence the firm's overall performance. This paper fills a gap in the literature by exploring internal firm variables mediating the relationship between EO and overall firm performance and contributes to the discussion on the contradictory results regarding the relationship between risk-taking and firm performance.

Keywords SMEs, entrepreneurial orientation, SEM, Marketing performance, Entrepreneurship and small business management, R&D performance, Overall performance, Production performance

Paper type Research paper



1. Introduction

One of the most widely used constructs to assess firm entrepreneurship is entrepreneurial orientation (EO) (Miller, 1983). A firm is considered to be entrepreneurial if it is innovative, proactive and risk-taking. The concept of EO emerged in the 1970s (Edmond and Wiklund, 2010) and has since then evoked a large number of studies (Wales, 2016). EO is found to closely reflect actual entrepreneurial firm behavior (Stambaugh *et al.*, 2017) and is generally found to be positively related to firm performance (Wang, 2008).

As pointed out by Wang (2008), an important message from the findings in the literature on the EO-performance relationship is that simply investigating the direct effect of EO on firm performance does not provide a complete picture. To unravel the mechanism by which EO improves firm performance, many different mediating and moderating variables have been studied (Rauch *et al.*, 2009). A scientific gap in this line of research is the limited amount of studies on internal organizational moderators that further clarify the relationship between EO and firm performance (Gimenez and Ventura, 2005; Wales *et al.*, 2013). Our study will address this gap by exploring how EO influences the performance of different functions in a firm and how these functions, in turn, influence overall firm performance. For managers, it is highly relevant to assess the degree in which their firm is entrepreneurial and to understand how that is related to internal firm aspects, because knowledge of these aspects allows managers to make their firm more entrepreneurial.

A few studies have focused on specific internal firm aspects that play a role in the relationship between EO and firm performance. These studies focus on internal aspects such as market orientation (Buli, 2017), leadership behavior (Engelen *et al.*, 2015), knowledge sharing (De Clercq *et al.*, 2015), absorptive capacity (Engelen *et al.*, 2014) and cross-functional behavior within firms (Schneider and Engelen, 2015). Although these studies indicate the relevance of internal firm aspects in the relationship between EO and firm performance, they focus on different types of firm aspects. Hence, the results of these studies can neither be compared nor be combined to increase the body of knowledge on the relationship between EO and firm performance.

We contribute to this stream of work by studying how the performance of separate business functions serve as mediators between EO and overall firm performance.

A firm is usually involved in several business functions. (e.g. R&D, production, marketing and sales). These business functions contribute to the overall firm performance. We contribute to the existing literature by measuring the performance of separate business functions in a firm and by studying the mediating effect of the performance of these business functions in linking EO with overall performance. The aim of our study is to fill a serious gap, that is, knowing how different business functions in the firm relate to entrepreneurship, and to resolve the ongoing discussion on the contradictory relationship between one of the EO dimensions, especially risk-taking, and firm's overall performance. We consider a disaggregated conception of EO (Lumpkin and Dess, 1996) by distinguishing between three EO dimensions (innovativeness, proactiveness, risk-taking) and relate them to the performance of separate functions within the firm, that is, R&D, production and marketing and sales. Furthermore, we show how the performance of these functions in turn influences overall firm performance. This approach helps firms understand:

- which dimension of EO has a significant effect on which function's performance and;
- which function's performance has a significant effect on firm's overall performance.

This understanding contributes to more effective orientation of firms toward entrepreneurship. It also contributes to understanding how the firm's functions can be more effectively combined to increase overall firm performance.

To investigate these relationships, we formulate a set of hypotheses which are tested using a structural equation modeling (SEM). The results are based on a survey among 279 high-tech small-to-medium-sized enterprises (SMEs) in The Netherlands. We choose to focus on SMEs because these companies generally suffer from resource constraints (Woschke *et al.*, 2017) and as a result need to closely integrate their internal functions to act entrepreneurial and to perform well (Buli, 2017). We choose to focus on SMEs in high-tech industries because the EO-performance relationship is generally stronger in these industries (Rauch *et al.*, 2009).

In Section 2, we start by reviewing existing literature on the effect of EO on firm performance and show that there are different mediating and moderating variables in the EO-firm performance relationship. We proceed by reviewing existing literature on the effect of separate dimensions of EO on firm performance. In Section 3, we identify different company functions and hypothesize how these functions influence overall firm performance. We then hypothesize how the dimensions of EO affect company functions and, in turn, overall firm performance. The method, analysis and results are presented in Section 4. Practical implications, future research and the conclusion are presented in Section 5.

2. Theoretical framework

In this section, we first provide some definitions of EO and its dimensions. We then review existing literature on EO and firm performance.

2.1 EO and its effect on firm performance

Entrepreneurial orientation was initially defined by Miller (1983) as follows: “an entrepreneurial firm is one that engages in product-market innovation, undertakes somewhat risky ventures, and is first to come up with ‘proactive’ innovations, beating competitors to the punch”. He suggested three dimensions to characterize and test entrepreneurship: “innovativeness”, “proactiveness”, and “risk-taking”.

“Innovativeness reflects a firm’s tendency to engage in and support new ideas, novelty, experimentation, and creative processes that may result in new products, services, or technological processes” (Lumpkin and Dess, 1996). Risk-taking is defined as “the degree to which managers are willing to make large and risky resource commitments i.e. those which have a reasonable chance of costly failures” (Miller and Friesen, 1978), while proactiveness is defined as “seeking new opportunities which may or may not be related to the present line of operations, introduction of new products and brands ahead of competition, strategically eliminating operations which are in the mature or declining stages of the life cycle” (Venkatraman, 1989).

It has been found in many different studies that EO has a positive effect on firm performance. Many of these studies see EO as a singular construct. They indicate that EO has a similar effect on firm performance in widely different contexts: in different countries, different markets and for different types of firms. The effect of EO on performance is seen in diverse markets, such as the hotel market (Jantunen *et al.*, 2005) and manufacturing industries (Jantunen *et al.*, 2005), and the effect is found in different types of firms such as service organizations and manufacturing organizations (Jantunen *et al.*, 2005), small firms (Wiklund and Shepherd, 2005; Hughes *et al.*, 2007) and new or established firms (Su *et al.*, 2011). In a meta-analysis, Rauch *et al.* (2009) and Rosenbusch *et al.* (2013) found that EO has a moderate positive effect on firm performance.

2.2 Mediating or moderating variables in the EO firm performance relationship

To examine how the effect of EO on firm performance is realized, several authors have looked at variables that, in combination with EO, have this effect. In their meta-analysis,

Rosenbusch *et al.* (2013) identified several moderating and mediating variables, such as business size and industry. We found several articles that describe moderating and mediating variables and divided these variables into different categories:

2.2.1 Learning and knowledge related variables. Knowledge, learning capabilities and learning orientation on the one hand, and EO on the other, are generally found to be positively related and are found to strengthen each other's effect on firm performance, as a mediator, moderator or as independent variables (Wiklund and Shepherd, 2003; Wang, 2008; Li *et al.*, 2009; Zhao *et al.*, 2011; Alegre and Chiva, 2013; Real *et al.*, 2014). Li *et al.* (2009), for example, found that EO has a positive effect on knowledge creation processes, which in turn have a positive effect on firm performance. This implies that knowledge creation processes serve as a mediating variable between EO and firm performance.

2.2.2 Network resources, network capabilities and network orientation. Network orientation and relationships are generally found to strengthen the relationship between EO and firm performance (Walter *et al.*, 2006; Stam and Elfring, 2008; Zhang and Zhang, 2012). Walter *et al.* (2006), for example, show how a firm's network capability, that is, its ability to develop and use inter-organizational relationships, strengthens the relationship between EO and the performance of spin-off companies. In other words, in a company that is able to develop network relationships, EO will have a stronger effect on firm performance.

2.2.3 Exploitative and explorative activities. EO appears to be positively related both to the exploitative and more explorative capabilities of a firm. Both capabilities, in turn, positively influence overall firm performance (Lisboa *et al.*, 2011; Chen *et al.*, 2012).

The empirical results of these studies underline the important role of internal firm aspects in the relationship between EO and overall firm performance. However, these studies have adopted different perspectives on internal firm aspects and that has two serious consequences. First, most studies focus on a limited set of internal firm aspects and hence do not compare the effect of different types of firm aspects on the EO-firm performance relationship. Second, the studies adopted different categorizations of firm aspects; as a result, the internal firm aspects from different studies cannot easily be combined to create an overview. The division of internal firm aspects in exploitative and explorative activities, for example, cannot easily be combined or contrasted with firm aspects related to network resources, network capabilities and network orientation. The resulting problems in comparing and combining results from separate studies severely hampers the creation of a body of knowledge about how EO influences overall firm performance. This represents a scientific gap. The lack of overview of how internal firm aspects influence the relationship between EO and overall firm performance also hampers the formulation of management actions and strategies to increase overall firm performance. That represents a practical, managerial gap.

To fill this scientific and practical gap we decide to look at several business functions and explore their role in the relationship between EO and firm performance. Such an approach is adopted before but was limited to single business functions, such as marketing and R&D. Previous studies show that marketing competencies and orientation, and EO, are generally positively related with each other and with firm performance (Bhuian *et al.*, 2005; Keh *et al.*, 2007; Smart and Conant, 2011; Merlo and Auh, 2009). The relationship of EO with R&D is also examined separately, while the relationship between EO and production has never been examined at all. We will discuss the performance of functions and their relationship with EO in Section 3.

2.3 EO dimensions and firm performance

To understand how EO, together with other variables, influences firm performance, we first look at the separate dimensions of EO. In the first category of articles, for example, we

described how [Li et al. \(2009\)](#) found that EO has a positive effect on knowledge creation processes, which in turn positively influence firm performance. We think that the separate dimensions of EO – innovativeness, proactiveness and risk-taking – may play different roles in these relationships. We therefore think that studying the effects of the separate EO dimensions is important to understand how EO influences firm performance.

As becomes clear from literature, and as has also been pointed out by [Hughes and Morgan \(2007\)](#), recent research into EO has often merged the EO dimensions (innovativeness, proactiveness and risk-taking) into a single construct, analyzing their combined effect on firm performance.

[Lumpkin and Dess \(1996\)](#) show the usefulness of viewing the firm's EO as a multi-dimensional construct. They show that all the EO dimensions may be present when a firm is entering a new market (the essential act of entrepreneurship), but that a successful new entry does not require all these EO dimensions in equal measure, and that some of these dimensions may play a more prominent role during a new market entry. Similarly [Dai et al. \(2014\)](#) show that the dimensions in EO have differential roles in entering new international markets. Furthermore, the ability of a firm's EO dimensions to predict its success depends on several contingencies, for example, external variables such as cultural and industry characteristics and internal variables such as organizational structure ([Lomberg et al., 2016](#); [Saeed et al., 2014](#); [Shirokova et al., 2016](#)).

As pointed out by [Lumpkin and Dess \(1996\)](#), the multidimensionality of EO may result in different relationships between these EO dimensions and firm performance. This means that to fully understand the nature of EO-performance relationships, and to avoid misleading descriptive and normative theory building, we should consider the individual relationships between the different dimensions of EO and firm performance.

We looked for studies that have examined the separate effect of EO dimensions, and found that they can be divided into two groups. The first group looks at the separate EO dimensions, all of which are found to have a positive effect on overall firm performance ([Wang and Yen, 2012](#); [Kollmann and Stöckmann, 2014](#)). This would suggest that the dimensions can be combined in analyses. In contrast, in the second and largest group of articles that assesses the effect of separate EO dimensions, different types of effects are found for these dimensions ([Hughes and Morgan, 2007](#); [Kraus et al., 2012](#); [Lechner and Gudmundsson, 2014](#)). The results from these studies consistently indicate that risk-taking has a negative effect on firm performance, in contrast with the positive effect of innovativeness and proactiveness. These results confirm the idea that the different dimensions of EO should be considered separately, which is what we do in the next sections. In addition, we add to the existing literature by distinguishing between the performances of different functions of a firm.

3. Model formation and hypotheses

In this section, we first hypothesize on the relationship between the performance of different functional areas of the firm and overall performance, after which we hypothesize on the relationship between different dimensions of EO and different functional performances. In fact, we begin by describing the second part of our model, as we think it will make the first part easier to understand.

3.1 Functional performances and overall performance hypotheses

In the previous section, we discussed several studies that focus on the EO-performance relationship, some of which imply that there are different dimensions within EO. On closer inspection, some of these studies also imply that there are different types of performance: International performance ([Jantunen et al., 2005](#)); Market performance and response

performance (Hughes *et al.*, 2007); Perceptual and objective performance (Tang *et al.*, 2008); Innovation performance and overall performance (Alegre and Chiva, 2013). In line with these studies, we also distinguish different types of performance, in particular the performance of different functional areas within a firm: R&D performance, production performance and marketing and sales performance. We understand that a firm is active in some other business functional areas, such as finance and human resource management. Following Porter's idea of primary and secondary functions in a company's value chain (Porter, 2001) we focus on R&D, production and marketing and sales, which are the main primary functional areas in many high-tech SMEs.

Most studies discussed in the previous section look at the firm as a single entity and do not take the interaction between departments within a firm into account. That is to say, existing literature mainly focuses on the relationship between independent variables at firm level, such as different decisions, policies or orientations in a firm and the dependent variable of overall firm performance (Gimenez and Ventura, 2005). "Value chain disaggregates a firm into its strategically relevant activities [...]. A firm gains competitive advantage by performing these strategically important activities more cheaply or better than its competitors" (Porter, 2001). So, instead of considering a firm as a single entity, in this study, we consider a firm as a collection of three main functional areas (R&D, production and marketing and sales). This approach helps managers understand in which functional areas their firm performs better than competitors, and in which it does not. When it comes to different functional areas, their performances and their relationships, the most promising concept to explain these relationships is the "value chain" proposed by Porter (2001). According to Porter (2001), the value chain is "a systematic way of examining all activities a firm performs and how they interact". It is clear that, the overall performance of the firm, is the final output of this value chain.

Some studies explore the effect of the performance of some individual functional areas of a company on overall firm performance. Furrer *et al.* (2007), for example, explore the effect of marketing approaches on overall firm performance, while Ittner and Larcker (1997) examine the relationship between new product development practices (as part of R&D function) and overall performance. These studies look at the effect of individual functions on firm performance and fail to explore the relationships between these functions in the context of a value chain. A tentative explanation for this gap is that different scientific domains explore the effect of separate company functions on firm performance. Marketing scholars focus on the effect of the marketing and sales function on overall firm performance, for example, and the same applies to R&D scholars. However, as the "value chain" concept suggests, the performance of a particular functional area is affected by its predecessor functional area and it also affects the performance of its successor functional area. Porter (2001) considers a firm as "a collection of activities that are performed to design, produce, market, deliver, and support its product". Integrated performance measurement systems "strive to align the organization's processes (i.e. R&D, production, marketing and other traditional functional areas) with corporate strategy using both performance drivers and outcome measures" (Bremser and Barsky, 2004). In this study, we consider three main functional areas of a firm (R&D, production, marketing and sales), each of which adds value to the products in a sequence.

The main objective of the R&D function is to develop new products (Drongelen and Bilderbeek, 1999) and improve existing production processes. R&D has two different contributions to the performance of production: it develops new products that can be produced and it develops new ways to produce (existing and new) products. Because of such close connections, the performance of production can be affected by the performance of the R&D function. Sterlacchini (1989) in an empirical study found that the decline in the production performance of British manufacturers between 1973 and 1979 was significantly associated

with a decline in the performance of R&D activities. A good performing R&D function can increase the production quality and decrease production costs (Hall *et al.*, 2010). The production function is responsible for the production of the developed products, which are then marketed and sold by the marketing and sales function. This sequential relationship implies that the performance of production could influence the performance of marketing and sales. Successful marketing significantly depends on the production capacity (Ruyter and Wetzels, 2000), and sales growth heavily depends on production quality (Tsui, 1992). These three functions are closely related, and we postulate that they form a kind of internal firm value chain that determines firm performance. Figure 1 reflects the sequence of the three functions.

Based on the discussion, we propose the following hypotheses to test the relationship between different functional area performances and overall performance.

- H1.* A firm's R&D performance has a positive effect on its production performance.
- H2.* A firm's production performance has a positive effect on its marketing and sales performance.
- H3.* A firm's marketing and sales performance has a positive effect on its overall performance.

Each of these hypotheses separately seems difficult to reject, because it is logical to hypothesize that the performance of the three functions (R&D, production and marketing and sales) are positively related to each other and to overall firm performance. However, the combined set of the hypotheses indicates a particular relationship between the performance of the three business functions and overall firm performance that can be rejected and is not as obvious as it seems. The combined hypotheses indicate that the effect of R&D on overall firm performance is mediated by two variables: the effect of production and the effect of marketing and sales.

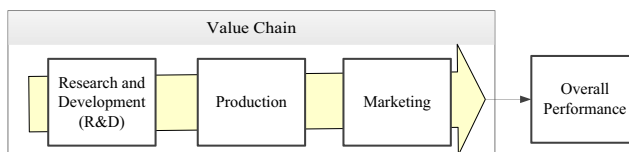
The combined hypotheses also indicate that the effect of production on overall firm performance is mediated by the effect of marketing and sales. Together, *H1*, *H2* and *H3* therefore posit that there is a sequential relationship between the performances of the separate organizational functions, from R&D to production to marketing and sales and finally to overall firm performance. Alternative hypotheses can now easily be envisioned: the performance of production can be hypothesized to be more important for overall firm performance than the performance of marketing and sales, for example.

3.2 EO-functional performances hypotheses

After developing our hypotheses about how the performance of different functions in combination influence overall firm performance, we can now extend the model by including different dimensions of EO.

It is important to first specify in more detail how the three dimensions of EO influence functional performances. Innovativeness and proactiveness are consistently found to have a positive effect on firm performance (Section 2.3), and we also hypothesize that these

Figure 1.
The relationship
between R&D,
production,
marketing and sales
performance and
overall performance



dimensions have a positive effect on functional performances, although the significance of the effect will depend on the type of functional performance. Different results were found with regard to risk-taking (Section 2.3), and we follow the majority of the articles that report a negative effect of risk-taking on firm performance, and hypothesize that risk-taking will have a negative effect on functional performances, although the significance of the effect depends on the type of functional performance.

Innovativeness is defined as “a firm’s tendency to engage in and support new ideas, novelty, experimentation, and creative processes that may result in new products, services, or technological processes” (Lumpkin and Dess, 1996), which shows that innovativeness will first and foremost influence the performance of the R&D function (Prajogo and Hong, 2008). Li *et al.* (2009) found that EO has a positive effect on knowledge creation processes, while Lisboa *et al.* (2011), and Chen *et al.* (2012) found that EO is positively related to explorative capabilities. R&D performance is measured by the number of patents, number of ideas, percentage of sales by new products, among others (Drongelen and Bilderbeek, 1999). A firm with a tendency to support these elements should be expected to have an R&D function with high performance levels. We therefore hypothesize a positive relationship between innovativeness and R&D performance (*H4*).

Risk-taking is defined as “the degree to which managers are willing to make large and risky resource commitments i.e. those which have a reasonable chance of costly failures” (Miller and Friesen, 1978). “A strong tendency for high-risk projects” (Covin and Slevin, 1989) which shows the risk-taking behavior of a firm is in contrast with a conservative approach which is needed to reduce the production cost, or to reduce the number of production defects which are the measures of production performance (Gunasekaran *et al.*, 2004). We expect that risk-taking, in particular, has a negative effect on production performance (*H5b*). As far as R&D performance and marketing and sales performance are concerned, the relationship with risk-taking is less obvious. R&D involves investing in the development of new technologies and products, which requires a long-term commitment with highly uncertain results. Similarly, marketing and sales performance may involve entering new markets, which in turn also requires a long-term and highly uncertain commitment. Following earlier studies investigating the combined relationship of all EO-dimensions with either marketing and sales (Bhuian *et al.*, 2005; Keh *et al.*, 2007; Smart and Conant, 2011) or exploration and R&D (Lisboa *et al.*, 2011; Chen *et al.*, 2012), we hypothesize that there is a positive relationship between risk-taking and R&D-performance (*H5a*) and between risk-taking and marketing and sales performance (*H5c*).

Proactiveness is defined as:

Seeking new opportunities which may or may not be related to the present line of operations, introduction of new products and brands ahead of competition, strategically eliminating operations which are in the mature or declining stages of the life cycle (Venkatraman 1989).

Based on its definition, proactiveness is more related to finding market opportunities. According to Stalk (1988) reducing the time to develop an idea, which is more related to proactiveness of a firm, increases its sales volume and turnover. Proactiveness could make first-mover advantages, and enables the firm to dominate the distribution channels and to establish brand recognition (Zahra and Covin, 1995; McGrath, 2001; Wiklund and Shepherd, 2003). We expect that proactiveness in particular has a positive effect on marketing and sales performance (*H6*). Below are the proposed hypotheses to test the relationship between the different dimensions of EO and the different types of functional performance.

H4. Innovativeness has a positive impact on a firm’s R&D performance.

H5a. Risk-taking has a positive effect on a firm’s R&D performance.

- H5b. Risk-taking has a negative effect on a firm's production performance.
- H5c. Risk-taking has a positive effect on a firm's marketing and sales performance.
- H6. Proactiveness has positive effect on a firm's marketing and sales performance.

Figure 2 shows how we see the relationships between the three dimensions of EO, the three functional performances and overall firm performance.

4. Method

4.1 Sample and data collection

The sample and data collection for this study came from a larger study of Dutch SMEs in high-tech industries. The sample was drawn from the “Kompas” database. We choose this database because it is a comprehensive database of companies, including data on the companies’ industry, size and turnover, which were required to select a sample from the population of high-tech SMEs in The Netherlands. Using the Medcof (1999) classifications criteria, we started selecting high-tech industries. In these industries, SMEs were found by selecting companies with at most 250 employees and maximum annual income of €43 million (the inclusion criteria for SMEs, according to the European Commission). A questionnaire was devised that included measures of EO, R&D performance, production performance, marketing and sales performance and overall performance. For this purpose, we used standard items that were tested in previous studies. The questionnaire was translated into Dutch by a professional editor and reviewed by one of the authors of this paper to correct potential translation errors. The questionnaire, along with a covering letter (both in Dutch) and a pre-addressed stamped envelope, were sent to chief executive officers (CEO) of 6,000 randomly selected high-tech SMEs. To ensure that the selection from the Kompas database was correct, we asked the CEOs to provide the number of employees and annual turnover of their company. In total, 304 questionnaires were returned. From these questionnaires, 25 were excluded (in six cases, the number of employees and/or turnover exceeded those of a standard SME, and in 19 cases, more than 10 per cent of the data were missing). As a result, the net sample contained 279 high-tech SMEs. In Table I, some descriptive statistics of the sample are provided.

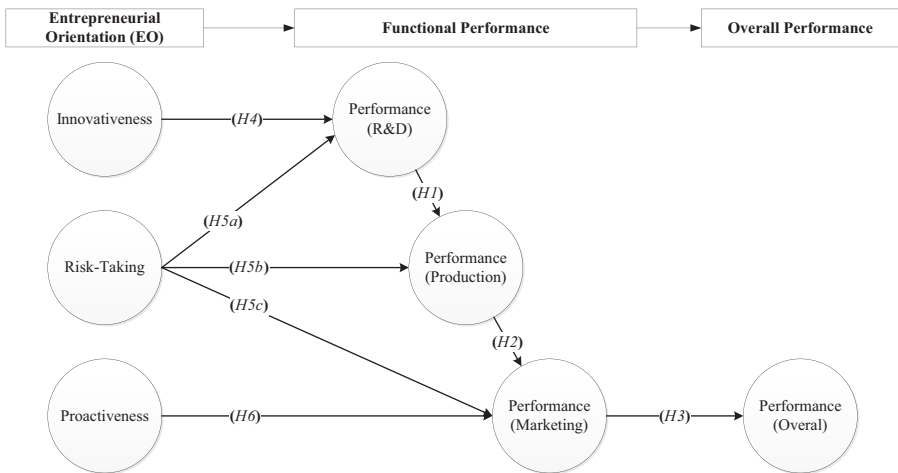


Figure 2.
Three dimensions of EO, different functional performances and overall firm performance

To address the issue of non-response bias, we tested for significant differences between early and late responses. The hypothesis is that late respondents are similar to non-respondents. To this end, the sample (279 SMEs) was divided into three groups of 93 observations. We then considered the first and the last 93 responses and performed *t*-tests on the means of the demographics of these two groups. The results show no significant differences between the early and late respondents (number of employee: $t = -0.839$, $p = 0.403$; annual turnover/euro (last year), $t = 0.221$, $p = 0.826$), which suggests that non-response bias is not a real concern in this study.

As a second test, we checked for common method bias using *Harmon's single-factor test* (Podsakoff and Organ, 1986). As a result, six factors (with eigenvalues greater than one) were extracted from all the measurement items (EO measures, R&D, production, marketing and sales and overall performance). These factors account for 65.6 per cent of the total variance, while the first factor accounts for 33.6 per cent of the variance. As can be seen, there is more than one factor, and the first factor does not account for the majority of the total variance. Together, these two observations from the factor analysis suggest that common method bias does not play a substantial role in this particular study.

4.2 Variables and measures

- *Entrepreneurial orientation*: EO was measured using the nine-item, seven-point scale developed by Covin and Slevin (1989) (Appendix 1), which is widely accepted and validated in literature. In a meta-analysis, Rauch *et al.* (2009) and Rosenbusch *et al.* (2013) found that EO has a moderate positive effect on firm performance. In most studies, a single score of the firm's EO is used, aggregating the nine items into a single measure by taking the average of the nine items (Messersmith and Wales, 2013; Van Doorn *et al.*, 2013; Sciascia *et al.*, 2014). However, it has been shown that the three dimensions of EO (innovativeness, risk-taking and proactiveness) have independent variances, which is why, in some empirical studies, they are considered separately (Kreiser *et al.*, 2013; Dai *et al.*, 2014). In this study, to capture the possible differences between the effects of EO dimensions on functional firm's performance, we consider the three dimensions separately (see the Appendix 1 for a full list of items).
- *Performance*: To measure the R&D performance of a firm, we used the performance scale suggested by Drongelen and Bilderbeek (1999), which is one of the most cited scales and has been validated by Drongelen and Bilderbeek (1999) as well. The scale makes it possible to measure the performance of R&D activities at different levels (team, individual, department and company). In this study, we used the scale to measure the performance of all R&D activities at firm level. To measure marketing and sales performance, we use the standard instruments developed by Green *et al.* (2008), and for production performance, we use the instrument developed by Gunasekaran *et al.* (2004). Overall performance was measured using the variables profitability and employment growth which have been extensively used in literature to measure the

Characteristics of the firms	Minimum	Maximum	Mean	SD
No. employees	1	250	44.32	43.456
Annual turnover (€1,000)	100	50,000	10,763	12,675
Firm age (year)	2	161	43.03	26.52

Table I. Some characteristics of the sample and the respondents

4.3 Analysis and results

4.3.1 *Confirmatory factor analysis.* A confirmatory factor analysis (CFA) model was specified and estimated using LISREL 8.80 (Joreskog and Sorbom, 2007). For this CFA model, we used three factors for EO and four factors for performance, so seven factors in all: innovativeness, risk-taking, proactiveness, performance-R&D, performance-production, performance-marketing and sales and performance-overall. As mentioned in the previous section, we use standard items to measure these factors. The number of items that are specified to load on their respective factors are as follows: three items to measure innovativeness, three items to measure risk-taking, three items to measure proactiveness, seventeen items to measure performance-R&D, five items to measure performance-production, three items to measure performance-marketing and sales and two items to measure performance-overall. A full list of the variables (items) is presented in Appendix 1.

To estimate the parameters, we use maximum likelihood. The factors are allowed to correlate, as is the error of some items of performance-R&D (e.g. between the first and the third items of performance-R&D), and no cross factor loading is specified. We used the LISREL 8.80 program (Joreskog and Sorbom, 2007) to estimate the parameters. Two important output measures of CFA are factor loading and goodness of fit, which are explained subsequently.

In Table II, a list of goodness of fit indices is presented. χ^2 is a statistical test of the difference between the estimated covariance matrix and the actual observed covariance matrix. The maximum likelihood method minimizes this difference, and it is desirable to have a smaller difference, hence an insignificant χ^2 value. However, for large sample sizes ($N > 250$) with a large number of observed variables ($m \geq 30$), the power of test increases and a significant χ^2 value is expected (Hair *et al.*, 2006). For our model, χ^2 value (1083.30) is large relatively to degree of freedom (488) which resulted in a significant χ^2 value as expected (recall that our $N = 279$ and $m = 33$). Root Mean Square Error of Approximation (RMSEA) (Steiger, 1990) is a test that is used to correct the tendency of χ^2 value to reject models with large N or m . Desirable values for RMSEA (which is in fact a badness of fit: the lower, the better) for $N > 250$, and $m \geq 30$ are the values below 0.07. For our model, RMSEA is 0.066, with p -value = 0.00 (Hair *et al.*, 2006). Standardized Residual Mean Square Residual (SRMR) is another badness of fit measure, which shows the standardized average of the residuals between individual observed and estimated covariance terms. For $N > 250$, and $m \geq 30$ values below 0.08 are desirable. In our model SRMR = 0.093. And, finally, Non-Normed Fit Index (NNFI), and Comparative Fit Index (CFI) (Bentler and Bonett, 1980;

Table II. Fit indices for the firm's EO and performances scales confirmatory factor analysis model

Model fit indices	Values
χ^2	1,083.30
Degrees of freedom	488
Root Mean Square Error of Approximation (RMSEA)	0.066
p -value for test of close fit (RMSEA < 0.05)	0.00
Standardized Residual Mean Square Residual (SRMR)	0.093
Non-Normed Fit Index (NNFI)	0.96
Comparative Fit Index (CFI)	0.96

Bentler, 1990) are among the most widely used goodness of fit measures, values greater than 0.90 are desirable. In our model, both are 0.96. On the basis of a wide range of measures, it is clear that the model is an appropriate description of the sample data, and the specified model is supported.

The factor loadings are presented in Table III. All factor loadings are positive and statistically significant, and they are all greater than 0.5 (the items with loading less than 0.5 are excluded from the model: PR-item3 from Proactiveness factor, Number of patents from Performance-R&D factor and Profitability from Performance-Overall). As an indicator of convergent validity, construct reliability (CR) is calculated (Hair *et al.*, 2006) (Table III), all of which are high. The high CRs mean that the measures of all the seven factors consistently represent the same corresponding latent construct. We have also calculated the Cronbach's Alpha for the factors (Table III), all of which are greater than 60 per cent, which shows an acceptable reliability of the constructs. The factor correlations are reported in Table IV, all of which are statistically significant, except the correlations between Performance-production and Innovativeness, Performance-production and Proactiveness and Performance-production and Risk-taking.

4.3.2 Model specification and estimation. The model presented in Figure 2 is formulated as an SEM. We used LISREL 8.80 (Joreskog and Sorbom, 2007) to specify and estimate the parameters of the SEM, for which we used data from 279 SMEs. To estimate the SEM parameters, we applied maximum likelihood method. Based on the thirty-three items (Appendix 1 and Table III), there are seven latent variables. The specified SEM model fits the data very well. The goodness (badness) of fit measures are presented in Table V. The χ^2 value (1139.90) is large relatively to degrees of freedom (500). RMSEA is 0.068, with p -value = 0.00, SRMR = 0.097, NNFI = 0.96, and CFI = 0.96, which together show a high level of fitness between the specified model and the data.

The standardized estimations of the parameters are presented in Figure 3. As can be seen in Figure 2, we formulated eight paths (corresponding with eight hypotheses), six of which are highly significant ($p < 0.05$), which means that six hypotheses are confirmed and two are rejected. In Figure 3, the coefficients and their corresponding t -values are reported. We also presented the reduced form of equations at the bottom of this figure, with their associated R -square (R^2) values.

4.3.3 Discussion. Here, we follow the steps in our literature description involving EO. First, the relationship between EO and overall firm performance is discussed. Second, the mediating effect of separate EO-dimensions is considered, followed by the effect of these dimensions on the performance of the R&D, marketing and sales and production functions. Finally, we discuss the relationship between the performances of the functions and their effect on overall performance.

In literature, EO is consistently found to have a positive overall effect on firm performance (Wang, 2008; Rauch *et al.*, 2009; Rosenbusch *et al.*, 2013). Furthermore, Rauch *et al.* (2009) found that the EO-performance relationship is generally stronger in high-tech industries. Because we looked at high-tech SMEs, we expected a positive EO-(overall) performance relationship. Our findings also indicate that EO has a significant and positive relationship with overall firm performance (0.42, $p < 0.01$) if the effect of all other variables is not taken into account.

Lumpkin and Dess (1996) indicated that it is important to consider the effects of the separate EO-dimensions on performance. Our findings (Table IV) indicate that the three dimensions of EO all have a significant and positive relationship with overall firm performance. The correlations of overall firm performance with innovativeness (0.29), proactiveness (0.41) and risk-taking (0.34) are positive and significant ($p < 0.01$) (Table IV).

Variable	Items*	Loadings (<i>t</i> -values)
Innovativeness (CR = 0.78; α = 79%) **	IN-item1	0.74 (13.50)
	IN-item2	0.73 (13.36)
	IN-item3	0.73 (13.12)
Proactiveness (CR = 0.77; α = 75%)	PR-item1	0.68 (11.75)
	PR-item2	0.89 (15.80)
Risk-taking (CR = 0.78; α = 78%)	RI-item1	0.72 (12.67)
	RI-item2	0.74 (13.14)
	RI-item3	0.76 (13.42)
Performance – R&D (CR = 0.95; α = 96%)	Customer satisfaction/market response	0.69 (12.65)
	% of products succeeding in the market	0.70 (12.97)
	Professional esteem to customers	0.67 (12.31)
	Agreed milestone/objectives met	0.67 (12.21)
	Number of products/projects completed	0.61 (10.94)
	Speed	0.55 (9.65)
	Efficiency/keeping within budget	0.54 (9.37)
	Quality of output/work	0.63 (11.18)
	Behavior of people involved in R&D activities	0.73 (13.80)
	No. ideas/findings	0.71 (13.25)
	Creativity/innovation level	0.79 (15.45)
	Network-building activities of the firm	0.62 (11.03)
	Expected or realized IRR/ROI	0.74 (14.01)
	% of sales by new products	0.76 (14.58)
Performance – Production (CR = 0.77; α = 78%)	Profit because of R&D	0.74 (14.38)
	Market share gained because of R&D	0.68 (13.35)
	Percentage of defects	0.58 (9.42)
Performance – M&S (CR = 0.70; α = 89%)	Cost per operation hour	0.68 (11.39)
	Capacity utilization	0.76 (13.09)
	Range of products and services	0.53 (8.60)
	Utilization of economic order quantity	0.58 (9.44)
Performance – Overall (CR = 0.68; α = 68%)	Average sales volume (units) growth	0.89 (17.35)
	Average turnover growth	0.90 (17.55)
Notes: *All the loading are highly significant ($p < 0.01$); **CR = Construct Reliability; α = Cronbach's Alpha	Employment growth	0.74 (12.09)
	Market share	0.70 (11.51)

Table III.
Standardized factor
loading for the firm's
EO and
performances scales

However, when the three EO dimensions and their relationships with overall firm performance are estimated in one model (rather than using three separate correlation measures) the model ($\chi^2 = 97.98$, degree of freedom = 29, RMSEA = 0.092 with p -value = 0.00, SRMR = 0.065, NNFI = 0.92 and CFI = 0.95) shows all the three relationships are insignificant (standardized coefficients: Innovativeness to overall performance: -0.08 ($t = -0.51$); Risk-taking to overall performance: 0.29 ($t = 1.83$); Proactiveness to overall performance: 0.23 ($t = 1.46$)).

To study these relationships further, we decided to look at the performance of the separate functions and included R&D, production and marketing and sales performance in our analysis.

Our model (Figure 3) includes the performance of R&D, production and marketing and sales to further clarify the relationship between EO and overall firm performance. While in the base model where the separate EO dimensions are directly related to overall firm performance, we found no significant relationship, our model in Figure 3 indicates that the

	Mean	SD	Innovativeness	Proactiveness	Risk-taking	Performance – R&D	Performance – Production	Performance – M&S	Performance – Overall
Innovativeness (N = 279)	4.11	1.35	1						
Proactiveness (N = 279)	4.61	1.24	0.75*	1					
Risk-taking (N = 279)	4.11	1.09	0.70*	0.69*	1				
Performance – R&D (N = 277)	4.32	1.07	0.66*	0.52*	0.50*	1			
Performance – Production (N = 278)	4.45	1.02	-0.04	0.06	0.10	0.40*	1		
Performance – M&S (N = 277)	4.40	0.97	0.33*	0.38*	0.34*	0.39*	0.17*	1	
Performance – Overall (N = 279)	4.40	0.97	0.29*	0.41*	0.34*	0.37*	0.24*	0.77*	1

Note: *Correlations are statistically significant ($p < 0.01$)

Table IV. Mean, standard deviation (SD) and correlation of the latent variables

effects of EO dimensions on performance are fully captured by the performance of the separate functions. When these functions are taken into account, EO-dimensions only have an indirect effect on overall firm performance, which is also indicated by [Li et al. \(2009\)](#), who found that EO has a positive effect on knowledge creation processes which, in turn, have a positive effect on (overall) firm performance. We add to these findings by showing that similar indirect effects are also found when the dimensions of EO are investigated separately and when the performances of several functions are considered. [Figure 3](#) also shows how the EO-dimensions play different roles in of R&D, production and marketing and sales performance. Innovativeness has a strong and positive relationship with R&D performance (confirming *H4*), while proactiveness has a strong and positive relationship with marketing and sales performance (confirming *H6*). In contrast, risk-taking has a significant negative relationship with production performance (confirming *H5b*). [Figure 3](#) also shows that the hypothesized relationship between risk-taking and R&D and marketing and sales performance (*H5a* and *H5c*) cannot be confirmed. It is interesting to relate these findings to earlier findings reported in literature. Several articles report a positive effect of risk-taking ([Wang and Yen, 2012](#); [Kollmann and Stöckmann, 2014](#)), while other articles ([Hughes and Morgan, 2007](#); [Kraus et al., 2012](#); [Lechner and Gudmundsson, 2014](#)) indicate that risk-taking has a negative effect on firm performance. As mentioned earlier, our

Table V.
Fit indices of the model

Model fit indices	Values
χ^2	1139.90
Degrees of freedom	500
Root Mean Square Error of Approximation (RMSEA)	0.068
<i>p</i> -value	0.00
Standardized RMR	0.097
Non-Normed Fit Index (NNFI)	0.96
Comparative Fit Index (CFI)	0.96

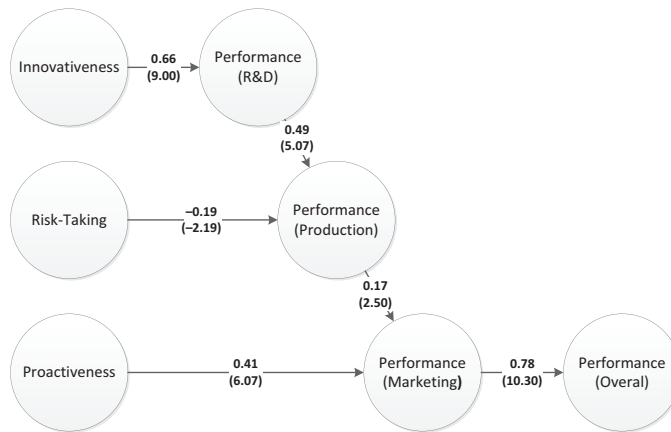


Figure 3.
Specification and parameter estimates of the model

Reduced Form Equations

$$\begin{aligned}
 \text{Performance(R\&D)} &= 0.66 * \text{Innovativeness. } R^2 = 0.44 \\
 \text{Performance(Production)} &= 0.33 * \text{Innovativeness} - 0.19 * \text{Risk-Taking. } R^2 = 0.05 \\
 \text{Performance(Marketing)} &= 0.056 * \text{Innovativeness} - 0.032 * \text{Risk-Taking} + 0.41 * \text{Proactiveness. } R^2 = 0.18 \\
 \text{Performance(Overall)} &= 0.044 * \text{Innovativeness} - 0.025 * \text{Risk-Taking} + 0.32 * \text{Proactiveness. } R^2 = 0.11
 \end{aligned}$$

findings indicate that risk-taking has a positive correlation with overall firm performance (Table IV) if the effects of other variables are not taken into account. However, if the effect of risk-taking on performance is studied in more detail, by looking at the performance of different functions, risk-taking appears to be negatively related to production performance rather than marketing and sales, and R&D.

On the basis of these findings, a tentative explanation for the earlier inconsistent findings regarding the effect of risk-taking on firm performance is possible. Although risk-taking can be seen as an important component of EO, it can have both positive and negative effects on performance. An interesting avenue for further research may be to explore how the level of risk is related to performance. It may be possible to find an inverse U-shaped relationship between risk and performance. That would mean that risk-taking up to a point has a positive effect on performance, after which it starts to have a negative impact. Similar curvilinear relationships were already found by [Bhuian et al. \(2005\)](#).

Furthermore, our results indicate that risk-taking has a different effect on performance, depending on the function involved. If production is a relatively important function in a company, it is possible that risk-taking has an overall negative effect on firm performance, as was reported by [Wang and Yen \(2012\)](#), and [Kollmann and Stöckmann \(2014\)](#). In contrast, if production plays a more modest role in firm performance, risk-taking may have a positive effect on firm performance, as was suggested by [Hughes and Morgan \(2007\)](#), [Kraus et al. \(2012\)](#) and [Lechner and Gudmundsson \(2014\)](#). Finally, Figure 3 shows that the functions appear to form a kind of internal value chain, from R&D to production to marketing and sales, which shows the integrity of the functions and suggests firms should focus on all functional areas in order to maximize their overall performance.

5. Practical implications, future research and conclusion

5.1 Practical implications and scientific discussion

We contribute to the scientific literature on the EO-performance relationship in several ways. First, our study fits well in the call for exploring internal firm variables that mediate or moderate the EO-performance relationship ([Wales et al., 2013](#)). In addition to contemporary studies that explored quite specific internal firm aspects as mediating or moderating EO-performance ([Buli, 2017](#); [Engelen et al., 2015](#); [De Clercq et al., 2015](#); [Engelen et al., 2014](#)) we decided to adopt an approach that includes the performance of the major functions in a firm as mediators between EO and firm performance. Second, by including all the primary functions of a firm, we could show how the separate dimensions of EO, innovativeness, proactiveness and risk-taking, have a differential relationship with these functions in the firm. These findings are a contribution to the notion in the literature that the EO-dimensions have different roles ([Dai et al., 2014](#); [Lomberg et al., 2016](#); [Wales, 2016](#)).

Our results suggest that the three functions form a kind of internal value chain. R&D performance directly influences production performance, which in turn directly influences marketing and sales performance. Marketing and sales performance directly influences overall firm performance. The existence of a linear chain, from R&D to production to marketing and sales to firm performance, has important managerial implications. First, the model indicates that a combination of the functions determines overall firm performance. Second, the model indicates which relationships between functions should be emphasized to optimize overall performance. Third, the model shows that functions have different roles in the so-called internal value chain of the firm.

We distinguished three dimensions of EO and explored how they influence the performance of individual company functions. Our results indicate that these dimensions have different

effects on the performance of company functions. Innovativeness primarily influences the performance of the R&D function. Innovativeness and the performance of other functions are related positively when these relationships are considered separately. However, the effect of innovativeness on the production and marketing and sales functions is fully mediated by the performance of the R&D function. Hence, no direct relationships between innovativeness and the performance of the production and marketing and sales functions are found. Proactiveness primarily influences the performance of the marketing and sales function in a company. Innovativeness and proactiveness have a positive effect on performance. In contrast, risk-taking is found to have a negative effect on the performance of the production function in a company. Our results regarding risk-taking add to the scientific debate whether risk-taking has a positive or negative effect on performance. We show that risk-taking indirectly affects firm performance, via the performance of the production function. Overall, our results imply that different aspects or dimensions in the EO affect the functions of a company in different ways. This potential difference has a significant impact on strategic decisions of firms. For instance, if knowledge creations has priority for a firm, it may focus on innovativeness dimension of EO.

5.2 Future research

Now we found that the different dimensions of EO have a different effect on functions within a firm and on firm performance, it is interesting to see whether these findings also hold for a more general population of firms, and whether there are other dimensions of EO and other functions within the firm that can be distinguished.

- Currently, the model has been tested for high-tech SMEs in the Netherlands. Future research could expand the population of firms and, for example, include larger firms and firms in other countries.
- The study focuses on three dimensions of EO, while some articles suggest there are five dimensions. In addition to proactiveness, innovativeness and risk-taking, “degree of autonomy” and “aggressiveness” are added (Lumpkin and Dess, 1996). Now we have established that the dimensions of EO have different effects, it would be interesting to see whether these dimensions have a separate, different or additional effect.
- The study focuses on three company functions, R&D, production and marketing and sales. It would be interesting to include facilitating functions, such as human resource management, and examine their role.
- Finally, the effect of risk-taking on firm performance and on the performance of separate functions deserves further research. Are the relationships curvilinear? Does the relationship between risk-taking and overall firm performance depend on the relative importance of the functions in the company? This research would explain some of the inconsistent findings reported in literature.

5.3 Conclusion

Managing the effect of EO on firm success requires insight into the role of entrepreneurship in separate company functions and their combined effect on firm performance. Existing literature shows that there are serious gaps with regard to the effect of entrepreneurship on different company functions (effects on production appear to be missing almost completely) and, in addition, the effects on R&D and marketing and sales are explored separately. Our article contributes by investigating how the dimensions of EO have different effects on the firm functions and how these functions, in turn, form a kind of internal value chain that determines the overall firm performance.

References

- Alegre, J. and Chiva, R. (2013), "Linking entrepreneurial orientation and firm performance: the role of organizational learning capability and innovation performance", *Journal of Small Business Management*, Vol. 51 No. 4, pp. 491-507.
- Bentler, P.M. (1990), "Comparative fit indexes in structural models", *Psychological Bulletin*, Vol. 107 No. 2, p. 238.
- Bentler, P.M. and Bonett, D.G. (1980), "Significance tests and goodness of fit in the analysis of covariance structures", *Psychological Bulletin*, Vol. 88 No. 3, p. 588.
- Bhuiyan, S.N., Menguc, B. and Bell, S.J. (2005), "Just entrepreneurial enough: the moderating effect of entrepreneurship on the relationship between market orientation and performance", *Journal of Business Research*, Vol. 58 No. 1, pp. 9-17.
- Bremser, W.G. and Barsky, N.P. (2004), "Utilizing the balanced scorecard for R&D performance measurement", *R&D Management*, Vol. 34 No. 3, pp. 229-238.
- Buli, B.M. (2017), "Entrepreneurial orientation, market orientation and performance of SMEs in the manufacturing industry: evidence from Ethiopian enterprises", *Management Research Review*, Vol. 40 No. 3, pp. 292-309.
- Chen, Y.C., Li, P.C. and Evans, K.R. (2012), "Effects of interaction and entrepreneurial orientation on organizational performance: insights into market driven and market driving", *Industrial Marketing Management*, Vol. 41 No. 6, pp. 1019-1034.
- Covin, J.G. and Slevin, D.P. (1989), "Strategic management of small firms in hostile and benign environments", *Strategic Management Journal*, Vol. 10 No. 1, pp. 75-87.
- Dai, L., Maksimov, V., Gilbert, B.A. and Fernhaber, S.A. (2014), "Entrepreneurial orientation and international scope: the differential roles of innovativeness, proactiveness, and risk-taking", *Journal of Business Venturing*, Vol. 29 No. 4, pp. 511-524.
- De Clercq, D., Dimov, D. and Thongpapanl, N. (2015), "Structural and relational interdependence and entrepreneurial orientation in small and medium-sized enterprises: the mediating role of internal knowledge-sharing", *International Small Business Journal*, Vol. 33 No. 5, pp. 514-536.
- Drongelen, I.C.K.V. and Bilderbeek, J. (1999), "R&D performance measurement: more than choosing a set of metrics", *R&D Management*, Vol. 29 No. 1, pp. 35-46.
- Edmond, V. and Wiklund, J. (2010), "The historic roots of entrepreneurial orientation research", in Landstrom, H. and Lohrke, F. (Eds), *The Historical Foundations of Entrepreneurship Research*, Edward Elgar Publishers, Cheltenham, pp. 142-160.
- Engelen, A., Gupta, V., Strenger, L. and Brettel, M. (2015), "Entrepreneurial orientation, firm performance, and the moderating role of transformational leadership behaviors", *Journal of Management*, Vol. 41 No. 4, pp. 1069-1097.
- Engelen, A., Kube, H., Schmidt, S. and Flatten, T.C. (2014), "Entrepreneurial orientation in turbulent environments: the moderating role of absorptive capacity", *Research Policy*, Vol. 43 No. 8, pp. 1353-1369.
- Furrer, O., Alexandre, M.T. and Sudharshan, D. (2007), "The impact of resource-strategy correspondence on marketing performance-financial performance tradeoffs", *Journal of Strategic Marketing*, Vol. 15 No. 2, pp. 161-183.
- Gimenez, C. and Ventura, E. (2005), "Logistics-production, logistics-marketing and external integration: their impact on performance", *International Journal of Operations & Production Management*, Vol. 25 No. 1, pp. 20-38.
- Green, K.W., Jr, Whitten, D. and Inman, R.A. (2008), "The impact of logistics performance on organizational performance in a supply chain context", *Supply Chain Management: An International Journal*, Vol. 13 No. 4, pp. 317-327.
- Gunasekaran, A., Patel, C. and McGaughey, R.E. (2004), "A framework for supply chain performance measurement", *International Journal of Production Economics*, Vol. 87 No. 3, pp. 333-347.

- Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E. and Tatham, R.L. (2006), *Multivariate Data Analysis*, Pearson Prentice, Hall Upper Saddle River, NJ.
- Hall, B.H., Mairesse, J. and Mohnen, P. (2010), "Measuring the Returns to R&D", *Handbook of the Economics of Innovation*, University of North Carolina, Greensboro, Vol. 2, pp. 1033-1082.
- Hughes, M. and Morgan, R.E. (2007), "Deconstructing the relationship between entrepreneurial orientation and business performance at the embryonic stage of firm growth", *Industrial Marketing Management*, Vol. 36 No. 5, pp. 651-661.
- Hughes, M., Hughes, P. and Morgan, R.E. (2007), "Exploitative learning and entrepreneurial orientation alignment in emerging young firms: implications for market and response performance", *British Journal of Management*, Vol. 18 No. 4, pp. 359-375.
- Ittner, C.D. and Larcker, D.F. (1997), "Product development cycle time and organizational performance", *Journal of Marketing Research*, Vol. 34 No. 1, pp. 13-23.
- Jantunen, A., Puumalainen, K., Saarenketo, S. and Kyläheiko, K. (2005), "Entrepreneurial orientation, dynamic capabilities and international performance", *Journal of International Entrepreneurship*, Vol. 3 No. 3, pp. 223-243.
- Joreskog, K. and Sorbom, D. (2007), *LISREL (Version 8.8)*, Scientific Software International, Chicago, IL.
- Keh, H.T., Nguyen, T.T.M. and Ng, H.P. (2007), "The effects of entrepreneurial orientation and marketing information on the performance of SMEs", *Journal of Business Venturing*, Vol. 22 No. 4, pp. 592-611.
- Kollmann, T. and Stöckmann, C. (2014), "Filling the entrepreneurial orientation–performance gap: the mediating effects of exploratory and exploitative innovations", *Entrepreneurship Theory and Practice*, Vol. 38 No. 5, pp. 1001-1026.
- Kraus, S., Rigtering, J.C., Hughes, M. and Hosman, V. (2012), "Entrepreneurial orientation and the business performance of SMEs: a quantitative study from The Netherlands", *Review of Managerial Science*, Vol. 6 No. 2, pp. 161-182.
- Kreiser, P.M., Marino, L.D., Kuratko, D.F. and Weaver, K.M. (2013), "Disaggregating entrepreneurial orientation: the non-linear impact of innovativeness, proactiveness and risk-taking on SME performance", *Small Business Economics*, Vol. 40 No. 2, pp. 273-291.
- Lechner, C. and Gudmundsson, S.V. (2014), "Entrepreneurial orientation, firm strategy and small firm performance", *International Small Business Journal*, Vol. 32 No. 1, pp. 36-60.
- Li, Y.H., Huang, J.W. and Tsai, M.T. (2009), "Entrepreneurial orientation and firm performance: the role of knowledge creation process", *Industrial Marketing Management*, Vol. 38 No. 4, pp. 440-449.
- Lisboa, A., Skarmeas, D. and Lages, C. (2011), "Entrepreneurial orientation, exploitative and explorative capabilities, and performance outcomes in export markets: a resource-based approach", *Industrial Marketing Management*, Vol. 40 No. 8, pp. 1274-1284.
- Lomborg, C., Urbig, D., Stöckmann, C., Marino, L.D. and Dickson, P.H. (2016), "Entrepreneurial orientation: the dimensions' shared effects in explaining firm performance", *Entrepreneurship Theory and Practice*, Vol. 41 No. 6.
- Lumpkin, G.T. and Dess, G.G. (1996), "Clarifying the entrepreneurial orientation construct and linking it to performance", *Academy of Management Review*, Vol. 21 No. 1, pp. 135-172.
- McGrath, R.G. (2001), "Exploratory learning, innovative capacity, and managerial oversight", *Academy of Management Journal*, Vol. 44 No. 1, pp. 118-131.
- Medcof, J.W. (1999), "Identifying 'super-technology' industries", *Research-Technology Management*, Vol. 42 No. 4, pp. 31-36.
- Merlo, O. and Auh, S. (2009), "The effects of entrepreneurial orientation, market orientation, and marketing subunit influence on firm performance", *Marketing Letters*, Vol. 20 No. 3, pp. 295-311.

-
- Messersmith, J.G. and Wales, W.J. (2013), "Entrepreneurial orientation and performance in young firms: the role of human resource management", *International Small Business Journal*, Vol. 31 No. 2, pp. 115-136.
- Miller, D. (1983), "The correlates of entrepreneurship in three types of firms", *Management Science*, Vol. 29 No. 7, pp. 770-791.
- Miller, D. and Friesen, P.H. (1978), "Archetypes of strategy formulation", *Management Science*, Vol. 24 No. 9, pp. 921-933.
- Norburn, D. and Birley, S. (1988), "The top management team and corporate performance", *Strategic Management Journal*, Vol. 9 No. 3, pp. 225-237.
- Podsakoff, P.M. and Organ, D.W. (1986), "Self-reports in organizational research: Problems and prospects", *Journal of Management*, Vol. 12 No. 4, pp. 531-544.
- Porter, M. (2001), "The value chain and competitive advantage", *Understanding Business: Processes*, Vol. 1, pp. 50-66.
- Prajogo, D.I. and Hong, S.W. (2008), "The effect of TQM on performance in R&D environments: a perspective from South Korean firms", *Technovation*, Vol. 28 No. 12, pp. 855-863.
- Rauch, A., Wiklund, J., Lumpkin, G.T. and Frese, M. (2009), "Entrepreneurial orientation and business performance: an assessment of past research and suggestions for the future", *Entrepreneurship Theory and Practice*, Vol. 33 No. 3, pp. 761-787.
- Real, J.C., Roldán, J.L. and Leal, A. (2014), "From entrepreneurial orientation and learning orientation to business performance: analysing the mediating role of organizational learning and the moderating effects of organizational size", *British Journal of Management*, Vol. 25 No. 2, pp. 186-208.
- Rosenbusch, N., Rauch, A. and Bausch, A. (2013), "The mediating role of entrepreneurial orientation in the task environment–performance relationship: a meta-analysis", *Journal of Management*, Vol. 39 No. 3, pp. 633-659.
- Ruyter, K.D. and Wetzels, M. (2000), "Determinants of a relational exchange orientation in the marketing-manufacturing interface: an empirical investigation", *Journal of Management Studies*, Vol. 37 No. 2, pp. 257-276.
- Saeed, S., Yousafzai, S.Y. and Engelen, A. (2014), "On cultural and macroeconomic contingencies of the entrepreneurial orientation–performance relationship", *Entrepreneurship Theory and Practice*, Vol. 38 No. 2, pp. 255-290.
- Schneider, M. and Engelen, A. (2015), "Enemy or friend? The cultural impact of cross-functional behavior on the EO–performance link", *Journal of World Business*, Vol. 50 No. 3, pp. 439-453.
- Sciascia, S., D'Oria, L., Bruni, M. and Larraneta, B. (2014), "Entrepreneurial orientation in low- and medium-tech industries: the need for absorptive capacity to increase performance", *European Management Journal*, Vol. 32 No. 5, pp. 761-769.
- Shirokova, G., Bogatyreva, K., Beliaeva, T. and Puffer, S. (2016), "Entrepreneurial orientation and firm performance in different environmental settings: contingency and configurational approaches", *Journal of Small Business and Enterprise Development*, Vol. 23 No. 3, pp. 703-727.
- Smart, D.T. and Conant, J.S. (2011), "Entrepreneurial orientation, distinctive marketing competencies and organizational performance", *Journal of Applied Business Research (Jabr)*, Vol. 10 No. 3, pp. 28-38.
- Stalk, G. Jr (1988), "Time—the next source of competitive advantage", *Harvard Business Review*, Vol. 41.
- Stam, W. and Elfring, T. (2008), "Entrepreneurial orientation and new venture performance: the moderating role of intra- and extraindustry social Capital", *Academy of Management Journal*, Vol. 51 No. 1, pp. 97-111.
- Stambaugh, J.E., Martinez, J., Lumpkin, G.T. and Kataria, N. (2017), "How well do EO measures and entrepreneurial behavior match?", *International Entrepreneurship and Management Journal*, Vol. 13 No. 3, pp. 717-737.

- Steiger, J.H. (1990), "Structural model evaluation and modification: an interval estimation approach", *Multivariate Behavioral Research*, Vol. 25 No. 2, pp. 173-180.
- Sterlacchini, A. (1989), "R&D, innovations, and total factor productivity growth in british manufacturing", *Applied Economics*, Vol. 21 No. 11, pp. 1549-1562.
- Su, Z., Xie, E. and Li, Y. (2011), "Entrepreneurial orientation and firm performance in new ventures and established firms", *Journal of Small Business Management*, Vol. 49 No. 4, pp. 558-577.
- Tang, J., Tang, Z., Marino, L.D., Zhang, Y. and Li, Q. (2008), "Exploring an inverted U-shape relationship between entrepreneurial orientation and performance in chinese ventures", *Entrepreneurship Theory and Practice*, Vol. 32 No. 1, pp. 219-239.
- Tsui, K.-L. (1992), "An overview of Taguchi method and newly developed statistical methods for robust design", *IIE Transactions*, Vol. 24 No. 5, pp. 44-57.
- Van Doorn, S., Jansen, J.J., Van den Bosch, F.A. and Volberda, H.W. (2013), "Entrepreneurial orientation and firm performance: drawing attention to the senior team", *Journal of Product Innovation Management*, Vol. 30 No. 5, pp. 821-836.
- Venkatraman, N. (1989), "Strategic orientation of business enterprises: the construct, dimensionality, and measurement", *Management Science*, Vol. 35 No. 8, pp. 942-962.
- Venkatraman, N. and Ramanujam, V. (1986), "Measurement of business performance in strategy research: a comparison of approaches", *The Academy of Management Review*, Vol. 11 No. 4, pp. 801-814.
- Wales, W.J., Gupta, V.K. and Mousa, F.T. (2013), "Empirical research on entrepreneurial orientation: an assessment and suggestions for future research", *International Small Business Journal*, Vol. 31 No. 4, pp. 357-383.
- Wales, W.J. (2016), "Entrepreneurial orientation: a review and synthesis of promising research directions", *International Small Business Journal*, Vol. 34 No. 1, pp. 3-15.
- Walter, A., Auer, M. and Ritter, T. (2006), "The impact of network capabilities and entrepreneurial orientation on university spin-off performance", *Journal of Business Venturing*, Vol. 21 No. 4, pp. 541-567.
- Wang, C.L. (2008), "Entrepreneurial orientation, learning orientation, and firm performance", *Entrepreneurship Theory and Practice*, Vol. 32 No. 4, pp. 635-657.
- Wang, H.K. and Yen, Y.F. (2012), "An empirical exploration of corporate entrepreneurial orientation and performance in taiwanese SMEs: a perspective of multidimensional construct", *Total Quality Management & Business Excellence*, Vol. 23 Nos 9/10, pp. 1035-1044.
- Wiklund, J. and Shepherd, D. (2003), "Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium-sized businesses", *Strategic Management Journal*, Vol. 24 No. 13, pp. 1307-1314.
- Wiklund, J. and Shepherd, D. (2005), "Entrepreneurial orientation and small business performance: a configurational approach", *Journal of Business Venturing*, Vol. 20 No. 1, pp. 71-91.
- Woschke, T., Haase, H. and Kratzer, J. (2017), "Resource scarcity in SMEs: effects on incremental and radical innovations", *Management Research Review*, Vol. 40 No. 2, pp. 195-217.
- Zahra, S.A. and Covin, J.G. (1995), "Contextual influences on the corporate entrepreneurship-performance relationship: a longitudinal analysis", *Journal of Business Venturing*, Vol. 10 No. 1, pp. 43-58.
- Zhang, Y. and Zhang, X.E. (2012), "The effect of entrepreneurial orientation on business performance: a role of network capabilities in China", *Journal of Chinese Entrepreneurship*, Vol. 4 No. 2, pp. 132-142.
- Zhao, Y., Li, Y., Lee, S.H. and Chen, L.B. (2011), "Entrepreneurial orientation, organizational learning, and performance: evidence from China", *Entrepreneurship Theory and Practice*, Vol. 35 No. 2, pp. 293-317.

Entrepreneurial Orientation (EO) items

The first three items used to measure "innovativeness", the second three ones to measure 'proactiveness', and the last three ones to measure "risk-taking" (source: (Covin and Slevin 1989))

In general my firm favors...		
A strong emphasis on the marketing of tried and proven products or services	1 2 3 4 5 6 7	A strong emphasis on R&D, technological leadership, and innovation in the past 5 years?
How many new lines of products or services has your firm marketed	1 2 3 4 5 6 7	Many new lines of products or services
No new lines of products or services	1 2 3 4 5 6 7	Changes in product or service lines have usually been quite dramatic
Changes in product or service lines have been mostly of a minor nature	1 2 3 4 5 6 7	
In dealing with competitors, my firm ...		
Typically responds to the actions of our competitors	1 2 3 4 5 6 7	Typically initiates actions to which competitors then respond
Is very seldom the first to introduce new products/services, administrative techniques, operating technologies, etc.	1 2 3 4 5 6 7	Is very often the first firm to introduce new products/services, administrative techniques, operating technologies, etc.
Typically seeks to avoid competitive clashes, preferring a 'live-and-let-live' approach	1 2 3 4 5 6 7	Typically adopts a very competitive, 'beat-the-competitors' approach
In general my firm has ...		
A strong tendency for low-risk projects (with normal and certain rates of return)	1 2 3 4 5 6 7	A strong tendency for high-risk projects (with chances of very high returns)
In general, my firm believes that ...		
Owing to the nature of the environment, it is best to explore gradually via continuous, incremental behavior	1 2 3 4 5 6 7	Owing to the nature of the environment, bold, wide-ranging acts are necessary to achieve the firm objectives
When confronted with decision-making situations involving uncertainty, my firm ...		
Typically adopts a cautious, 'wait and see' approach in order to minimize the probability of making costly decisions	1 2 3 4 5 6 7	Typically adopts a bold, aggressive approach in order to maximize the probability of exploiting potential opportunities

Performance items

Overall performance

How does your firm compare to competitors with regard to the following aspects?	1	2	3	4	5	6	7
Profitability							
Employment growth							

Marketing and sales performance

How does your firm compare to competitors with regard to the following aspects of marketing and sales?	1	2	3	4	5	6	7
Average market share growth							
Average sales volume (units) growth							
Average turnover growth							

Production performance

How does your firm compare to competitors with regard to the following aspects of production?	1	2	3	4	5	6	7
Percentage of defects							
Cost per operation hour							
Capacity utilization							
Range of products and services							
Utilization of economic order quantity							

R&D performance

How does your firm compare to competitors regarding the following aspects of R&D?	1	2	3	4	5	6	7
Customer satisfaction/market response							
% of products succeeding in the market							
Professional esteem to customers							
Agreed milestone/objectives met							
Number of products/projects completed							
Speed							
Efficiency/keeping within budget							
Quality of output/work							
Behavior of people involved in R&D activities							
No. patents							
No. ideas/findings							
Creativity/innovation level							
Network building activities of the firm							
Expected or realized IRR/ROI							
% of sales by new products							
Profit due to R&D							
Market share gained due to R&D							

About the authors

Jafar Rezaei is an Associate Professor of Operations and Supply Chain Management at the Delft University of Technology, the Netherlands, where he also obtained his PhD. His main research interests are in the area of supply chain partnership. He has published in various academic journals, including *International Journal of Production Economics*, *International Journal of Production Research*, *European Journal of Operational Research*, *Omega*, *IEEE Transactions on Engineering Management* and *Industrial Marketing Management*. Jafar Rezaei is the corresponding author and can be contacted at: j.rezaei@tudelft.nl

Roland Ortt is an Associate Professor of Technology and Innovation Management the Delft University of Technology, the Netherlands. His research interest focuses on the different paths of development and diffusion of high-tech products. He is the author of various articles in journals like the *Journal of Product Innovation Management*, the *Market Research Society* and the *Industrial Marketing Management*.